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

Regulations 2021
Curriculum and Syllabi
(Updated upto December 2023, as per 21st Academic Council)

B.Tech.
(Aeronautical Engineering)

REGULATIONS 2021

CURRICULUM AND SYLLABI

(Updated upto December 2023, as per 21st Academic Council)

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 ENGINEERING)

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 - 2021
B.TECH. DEGREE PROGRAMMES
(Under Choice Based Credit System)

(Amendments Approved by the 19th Academic Council – September 2022)

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 / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,

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

v) **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **"Dean of the School"** means the Dean of the School of the department concerned.

x) **"Head of the Department"** means the Head of the Department concerned.

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) The student shall have studied at least any three of the following courses: Physics, Mathematics, Chemistry, Computer Science, Electronics, Information Technology, Biology, Informatics Practices, Biotechnology, Technical Vocational Subjects, Agriculture, Engineering Graphics, Business Studies, Entrepreneurship at 10+2 level. In case if the student has not studied any or all the courses viz., mathematics, physics and chemistry, he / she shall undergo bridge course(s) in the concerned course(s) at 10+2 level knowledge.

2.2 Notwithstanding the qualifying examination, the candidate might have passed at 10+2, 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 the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.

2.3 Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.4 The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.

2.5 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities 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.

1. Aeronautical Engineering
2. Artificial Intelligence and Data Science
3. Automobile Engineering
4. Biotechnology
5. Civil Engineering
6. Computer Science and Engineering
7. Computer Science and Engineering (Cyber Security)
8. Computer Science and Engineering (Internet of Things)
9. Electrical and Electronics Engineering
10. Electronics and Communication Engineering
11. Electronics and Instrumentation Engineering
12. Information Technology
13. Mechanical Engineering
14. Polymer Engineering

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 Science Courses - BSC
ii) Humanities and Social Sciences including Management Courses - HSC
iii) Engineering Science Courses - ESC
iv) Professional Core Courses - PCC
v) Professional Elective Courses - PEC
vi) Open Elective Courses - OEC
vii) Laboratory Courses – LC
viii) Laboratory Integrated Theory Courses – LITC
ix) Mandatory Courses- MC
x) Project - PROJ (Project work, seminar and internship in industry or at appropriate workplace)

4.1.1 Mandatory Induction Programme for First year Students

The first year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization with departments / schools and centres, etc.,

4.1.2 Personality and Character Development

All students shall enroll, on admission, in any of the following personality and character development programmes:

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO)
- Youth Red Cross (YRC)
- Rotaract
- Crescent Indian Society Training Development (ISTD – C)
- Crescent Creative Strokes
- Crescent Technocrats club

The training activities / events / camp shall normally be organized during the weekends / vacation period.

4.1.3 Online Courses for Credit Transfer

Students are permitted to undergo department approved online courses under SWAYAM up to 40% 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.

4.1.4 Value Added Courses

The students are permitted to pursue department approved online courses (excluding courses registered for credit transfer) or courses offered / approved by the department as value added courses.

The details of the value added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Dean (Academic Affairs) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course.

These value added courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and above the curriculum during the period of study.

4.1.5 Industry Internship

The students shall undergo training for a period as specified in the curriculum during the summer vacation in any industry relevant to the field study.

The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period prescribed in the curriculum during the summer vacation, in lieu of Industrial training.

In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.

4.1.6 Industrial Visit

The student shall undergo at least one industrial visit every year from the second year of the programme. The Heads of Departments / Deans of Schools shall ensure the same.

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 per week
- 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.

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 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 students).

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

5.3 The maximum duration for completion of the programme as mentioned in clause 5.1 shall also include period of break of study vide clause 7.1 so that the student may be eligible for the award of the degree.

6.0 REGISTRATION AND ENROLLMENT

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

6.2 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.

6.3 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.

7.0 BREAK OF STUDY FROM PROGRAMME

7.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

7.1.1 Medical or other valid grounds

7.1.2 Award of ‘I’ grade in all the courses in a semester due to lack of attendance

7.1.3 Debarred due to any act of indiscipline

7.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1).

7.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

7.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the ‘I’ grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 Class Advisor

A faculty member shall be nominated by the Head of the Department 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.

8.2 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.

9.0 COURSE COMMITTEE

9.1 Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the course faculty teaching the common course with one of them nominated as a course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending on whether all the course faculty teaching the common course belong to a single department or from several departments. The course committee shall ensure preparation of a common question paper and scheme of evaluation for the tests and semester end examination.

10.0 CLASS COMMITTEE

A class committee is constituted branch wise and semester wise by the Head of the Department / Dean of the School shall normally comprise of faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman.

10.1 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

10.2 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) All the faculty members handling 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

10.3 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 components 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.

10.4 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.

10.5 The third meeting of the class committee, excluding the student members, shall meet after the semester end examinations to analyse 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 course faculty concerned.

11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

11.1 A student can enroll for a maximum of 32 credits during a semester including Redo / Predo courses.

11.2 The minimum credits earned by the student to move to 7th semester shall not be less than 60 credits (40 credits for lateral entry students).

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 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%

12.2 Theory Course

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

12.3 Laboratory Course

Every practical course shall have 60% weightage for continuous assessments and 40% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory Courses

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 components 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 components shall be through continuous assessment.

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

12.6 Industry Internship

In the case of industry internship, 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 / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the 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.

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

12.9 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 become invalid.

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 components.

13.0 SUBSTITUTE EXAMINATIONS

13.1 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 the School for that purpose. There is no substitute examination for semester end examinations.

13.2 A student shall apply for a substitute exam in the prescribed form to the Head of the Department / Dean of the School within a week from the date of assessment test. However, the substitute examination will be conducted only after the last instructional day of the semester.

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% 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.

14.2 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 the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

14.3 If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.

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

14.5 The student awarded "I" grade, shall enroll and repeat the course when it is offered next. In case of "I" 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 the Head of the Department / Dean of the School.

14.6 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 when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains "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.

14.7 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.

15.0 REDO COURSES

15.1 A student can register for a maximum of three redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the concerned department, based on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

15.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is no provision for any substitute examination and withdrawal from a redo course.

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis. The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. 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	-
I	-

"W" - denotes withdrawal from the course

“I” - denotes inadequate attendance in the course and prevention from appearance of semester end examination

“U” - denotes unsuccessful performance in the course.

16.2 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.

16.3 Upon awarding grades, the results shall be endorsed by the chairman of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 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 the Controller of Examinations. Subsequently, the Head of the Department / Dean of the 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 faculty member having expertise in that course as members. 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.

16.5 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 the first semester onwards.

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

If C_i, is the number of credits assigned for the i^{th} course and GP_i 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” 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

16.6 After successful completion of the programme, the degree shall be awarded to the students 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 semesters for all students (except lateral entry students) and 6 semesters for lateral entry students
First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters for lateral entry students
Second Class	Others

16.6.1 Eligibility for First Class with Distinction

- A student should not have obtained 'U' or 'I' grade in any course during his/her study
- A student should have completed the UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 Eligibility for First Class

- A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 7.1.1)

16.6.3 The students who do not satisfy clause 16.6.1 and clause 16.6.2 shall be classified as second class.

16.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out students 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 in VI semester 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 the even semester.

18.0 DISCIPLINE

18.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

18.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the Head of the Department / Dean of the School concerned shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action. This committee shall also address the grievances related to the conduct of online classes.

19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

i) Successfully earned the required number of total credits as specified in the curriculum of the programme of study within a maximum period of 14 semesters (12 semesters for lateral entry) from the date of admission, including break of study.

ii) Successfully completed the requirements of the enrolled professional development activity.

iii) No dues to the Institution, Library, Hostel, etc.

iv) No disciplinary action pending against him/her.

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

20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

20.1 The students admitted in the following B.Tech. programmes 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)

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

<table>
<tr><th>Sl. No.</th><th>Minor Degree</th><th>Eligible Major Degree Programmes
(from other Departments)</th></tr>
<tr><td>1.</td><td>Artificial Intelligence and Machine Learning</td><td rowspan="5">Mechanical Engineering
Aeronautical Engineering
Polymer Engineering
Automobile Engineering
Civil Engineering
Biotechnology
Electrical and Electronics Engineering
Electronics and Instrumentation Engineering</td></tr>
<tr><td>2.</td><td>Block Chain</td></tr>
<tr><td>3.</td><td>Cyber Security</td></tr>
<tr><td>4.</td><td>Data Science</td></tr>
<tr><td>5.</td><td>Internet of Things (IoT)</td></tr>
<tr><td>6.</td><td>Virtual and Augmented Reality</td><td>Mechanical Engineering
Aeronautical Engineering
Polymer Engineering</td></tr>
</table>

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

9.	3D Printing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electronics and Communication Engineering
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering

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

		Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering

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

20.4 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.

21.0 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 AND TECHNOLOGY
B.TECH. AERONAUTICAL ENGINEERING
CURRICULUM FRAME WORK, REGULATIONS 2021

(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHD 1181	Applied Physics *	3	0	2	4
2.	BSC	CHD 1181	Engineering Materials and Applications *	3	0	2	4
3.	BSC	MAD 1181	Algebra and Differential Calculus	3	1	0	4
4.	ESC	GED 1101	Engineering Graphics *	2	0	2	3
5.	ESC	GED 1102	Engineering Design	2	0	0	2
6.	ESC	GED 1103	Manufacturing Practices Laboratory	0	0	2	1
7.	ESC	GED 1104	Programming for Problem Solving **	1	0	2	2
			Credits				**20#**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	END 1281	English for Engineers	3	0	0	3
2.	BSC		Physics Elective	2	0	0	2
3.	BSC		Chemistry Elective	2	0	0	2
4.	BSC	MAD 1283	Partial Differential Equations and Transforms	3	1	0	4
5.	ESC	GED 1202	Basic Electrical and Electronics Engineering *	3	0	2	4
6.	ESC	GED 1201	Engineering Mechanics	3	1	0	4
7.	PCC	AED 1211	Basics of Aeronautical Engineering *	2	0	2	3
8.	MC	GED 1206	Environmental Sciences	2	0	0	2
			Credits				**24**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective I	3	0	0	3
2.	BSC		Mathematics Elective	3	1	0	4
3.	PCC	AED 2101	Solid Mechanics	3	0	0	3
4.	PCC	AED 2102	Engineering Thermodynamics*	3	0	2	4
5.	PCC	AED 2103	Fluid Mechanics *	3	0	2	4
6.	PCC	AED 2104	Aircraft Materials and Manufacturing Processes	3	0	0	3
7.	PCC	AED 2105	Aircraft Component and Assembly Drawing Laboratory	0	0	2	1
8.	HSC	GED 2101	Essential Skills and Aptitude for Engineers	0	0	2	1
			Credits				**23**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	AED 2211	Low Speed Aerodynamics	3	0	0	3
2.	PCC	AED 2212	Aircraft Structural Mechanics	3	0	0	3
3.	PCC	AED 2213	Propulsion I	3	0	0	3
4.	PCC	AED 2214	Aircraft Systems and Instruments *	3	0	2	4
5.	PCC	AED 2215	Experimental Aerodynamics *	3	0	2	4
6.	PCC	AED 2216	Solid Mechanics Laboratory	0	0	2	1
7.	PEC		Professional Elective Courses	3	0	0	3
8.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers	0	0	2	1
9.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0
			Credits				**22**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3181	Fundamentals of Entrepreneurship	3	0	0	3
2.	PCC	AED 3101	Propulsion II	3	0	0	3
3.	PCC	AED 3102	Aircraft Structural Design and Analysis	3	0	0	3
4.	PCC	AED 3103	High Speed Aerodynamics	3	0	0	3
5.	PCC	AED 3104	Control Engineering *	2	0	2	3
6.	PCC	AED 3105	Propulsion Laboratory	0	0	2	1
7.	PEC		Professional Elective Courses				6
8.	HSC	GED 3101	Communication Skills for Career Success	0	0	2	1
9.	PROJ	AED 3106	Internship I ##	0	0	0	1
			Credits				**24**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective II	2	0	0	2
2.	OEC		Open Elective I	3	0	0	3
3.	PCC	AED 3211	Avionics *	3	0	2	4
4.	PCC	AED 3212	Flight Dynamics	3	0	0	3
5.	PCC	AED 3213	Aircraft Design Project	0	0	2	1
6.	PCC	AED 3214	Aircraft Structures Laboratory	0	0	2	1
7.	PEC		Professional Elective Courses				6
8.	HSC	GED 3201	Reasoning and Aptitude for Engineers	0	0	2	1
			Credits				**21**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective II				3
2.	OEC		Open Elective III				3
3.	PCC	AED 4101	Computational Fluid Dynamics	3	0	0	3
4.	PCC	AED 4102	Aircraft Design and Modeling Laboratory	0	0	4	2
5.	PCC	AED 4103	Computation Mechanics Lab	0	0	2	1
6.	PEC		Professional Elective Courses				9
7.	PROJ	AED 4104	Internship II ###				1
8.	HSC	GED 4101	Employability Skills $	0	0	2	1
			Credits				**22**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	AED 4201	Project Work	0	0	18	9
			Credits				**9**

Overall Total Credits – 165

* Laboratory Integrated Theory course

** Laboratory Course

Three Week Orientation Programme – Mandatory Non-Credit Course

15 days of Industrial training during the summer vacation of second year. The credit will be awarded in the 5th Semester.

15 days of Industrial training during the summer vacation of third year. The credit will be awarded in the 7th Semester.

$ Not a Mandatory Course - The student will take up this course during the Summer Holidays of III year as a comprehension of Soft Skills courses offered from semester III to VI. Upon successful completion, the course will be mentioned in grade sheet of VII semester.

LIST OF PROFESSIONAL ELECTIVE COURSES

SPECIALIZATION I: AERODYNAMICS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Semester
1.	PEC	AEDX 01	Industrial Aerodynamics	3	0	0	3	IV
2.	PEC	AEDX 02	Helicopter Aerodynamics	3	0	0	3	V
3.	PEC	AEDX 03	Wind Tunnel Model Design	1	0	0	1	V
4.	PEC	AEDX 04	Viscous Flows	3	0	0	3	VI
5.	PEC	AEDX 05	Hypersonic Aerodynamics	3	0	0	3	VI
6.	PEC	AEDX 06	Optical Flow Diagnostics	1	0	0	1	VII
7.	PEC	AEDX 07	Introduction to Multi-Phase Flow	2	0	0	2	VII

SPECIALIZATION II: PROPULSION

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Semester
1.	PEC	AEDX 08	Space Mechanics	3	0	0	3	IV
2.	PEC	AEDX 09	Heat Transfer	3	0	0	3	V
3.	PEC	AEDX 10	Micro Gas Turbine	1	0	0	1	V
4.	PEC	AEDX 11	Combustion	3	0	0	3	VI
5.	PEC	AEDX 12	Cryogenics	1	0	0	1	VI
6.	PEC	AEDX 13	Rocket Propulsion	3	0	0	3	VI
7.	PEC	AEDX 14	Rockets and Missiles	3	0	0	3	VII
8.	PEC	AEDX 15	Advanced Propulsion Systems	3	0	0	3	VII

SPECIALIZATION III: AIRCRAFT STRUCTURES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Semester
1.	PEC	AEDX 16	Machine Design	3	0	0	3	IV
2.	PEC	AEDX 17	Theory of Elasticity	3	0	0	3	V
3.	PEC	AEDX 18	Aircraft Structural Testing and Qualification	1	0	0	1	V
4.	PEC	AEDX 19	Vibration and Aero Elasticity	3	0	0	3	VI
5.	PEC	AEDX 20	Smart Structures	1	0	0	1	VI
6.	PEC	AEDX 21	Experimental Techniques for Aircraft Structures	3	0	0	3	VI
7.	PEC	AEDX 22	Structural Analysis Tools	2	0	0	2	VII
8.	PEC	AEDX 23	Analysis of Composite Structures	3	0	0	3	VII
9.	PEC	AEDX 24	Finite Element method	3	0	0	3	VII

SPECIALIZATION IV: AIRCRAFT MATERIALS AND MAINTENANCE

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Semester
1.	PEC	AEDX 25	Aviation Rules and Regulation	3	0	0	3	IV
2.	PEC	AEDX 26	Airframe Repair and Maintenance	3	0	0	3	V
3.	PEC	AEDX 27	Advanced Manufacturing Technologies	2	0	0	2	V
4.	PEC	AEDX 28	Measurement Systems	3	0	0	3	VI
5.	PEC	AEDX 29	Aircraft General Engg and Maintenance Practice	3	0	0	3	VI

6.	PEC	AEDX 30	Air Traffic Control and Design	3	0	0	3	VII
7.	PEC	AEDX 31	Behavior of Materials at High Temperatures	3	0	0	3	VII
8.	PEC	AEDX 32	Product Development and 3D Printing Technologies	2	0	0	2	VII

SPECIALIZATION IV: AVIONICS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Semester
1.	PEC	AEDX 33	Microprocessor and Microcontroller for Aircraft Systems	2	0	0	2	IV
2.	PEC	AEDX 34	Mathematical Modelling and Simulation	2	0	0	2	V
3.	PEC	AEDX 35	MEMS Devices and Fabrication	1	0	0	1	V
4.	PEC	AEDX 36	Satellite Technology	3	0	0	3	VI
5.	PEC	AEDX 37	Space Debris Management	1	0	0	1	VI
6.	PEC	AEDX 38	Aircraft Navigation and Guidance Systems	3	0	0	3	VII
7.	PEC	AEDX 39	UAV and MAV systems	2	0	0	2	VII

PHYSICS ELECTIVES – II SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	PHDX 01	Non Destructive Testing of Materials	2	0	0	2
2	PHDX 02	Materials Science for Engineering	2	0	0	2
3	PHDX 03	Biomaterials	2	0	0	2
4	PHDX 04	Optical Fibre Communication	2	0	0	2
5	PHDX 05	Semiconductor Physics for Information Technology	2	0	0	2

6	PHDX 06	Sensors and Actuators	2	0	0	2
7	PHDX 07	Fundamentals of Nanotechnology and its Applications	2	0	0	2

CHEMISTRY ELECTIVES – II SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	CHDX 01	Chemistry of Construction Materials	2	0	0	2
2	CHDX 02	Chemistry of Materials and Electrochemical Devices	2	0	0	2
3	CHDX 03	Chemistry and Instrumentation for Electrical and Electronic Applications	2	0	0	2
4	CHDX 04	Functional Materials and Applications	2	0	0	2
5	CHDX 05	Chemistry of Fuels, Combustion and Lubricants	2	0	0	2
6	CHDX 06	Instrumental Methods of Polymer Analysis	2	0	0	2
7	CHDX 07	Medicinal Chemistry	2	0	0	2

MATHEMATICS ELECTIVES – III SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	MADX 01	Transforms and Partial Differential Equations	3	1	0	4
2	MADX 02	Discrete Mathematics	3	1	0	4
3	MADX 03	Probablity and Statistics	3	1	0	4
4	MADX 04	Random Processes	3	1	0	4
5	MADX 05	Numerical Methods	3	1	0	4

HUMANITIES ELECTIVES – III SEMESTER

1	SSDX 01	Engineering Economics and Management	3	0	0	3

2	SSDX 02	Sociology of Science and Technology	3	0	0	3
3	SSDX 03	Industrial Economics and Management	3	0	0	3
4	SSDX 04	Dynamics of Indian Social Structure	3	0	0	3

HUMANITIES ELECTIVES – VI SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	SSDX 11	Economics of Sustainable Development	2	0	0	2
2	SSDX 12	Sociology of Industrial Relations.	2	0	0	2
3	SSDX 13	Professional Ethics and Human Values	2	0	0	2
4	SSDX 14	Gender, Technology and Development	2	0	0	2

OPEN ELECTIVE COURSES FOR
B.TECH. PROGRAMMES R 2021 - VI SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX201	Application of Fluid Mechanics in Everyday Life	3	0	0	3	Aero
2	GEDX 202	Basics of Management and Organizational Behaviour	3	0	0	3	CSB
3	GEDX 203	Big Data Analytics	3	0	0	3	CA
4	GEDX 204	Biology for Engineers	3	0	0	3	SLS
5	GEDX 205	Consumer Electronics	3	0	0	3	ECE
6	GEDX 206	Creative Writing	2	1	0	3	English
7	GEDX 207	Cyber Forensics	3	0	0	3	CSE
8	GEDX 208	Cyber Security	3	0	0	3	IT
9	GEDX 209	Disaster Management	3	0	0	3	Civil
10	GEDX 210	English for Competitive Examination	2	1	0	3	English
11	GEDX 211	Enterprise Risk Management	3	0	0	3	CSB
12	GEDX 212	Fundamentals of Project Management	3	0	0	3	CSB
13	GEDX 213	Industrial Robotics	2	0	2	3	Mech.

14	GEDX 214	Internet of Things and its Applications	3	0	0	3	ECE
15	GEDX 215	Introduction to Health Care Analytics	3	0	0	3	CA
16	GEDX 216	IPR and Patent Laws	3	0	0	3	CSB
17	GEDX 217	Logistics and Supply Chain Management	3	0	0	3	CSB
18	GEDX 218	Nano Materials and Technology	2	0	2	3	Physics / Chemistry
19	GEDX 219	Numerical Computational Tools for Engineers	2	0	2	3	EIE
20	GEDX 220	Optimization Techniques	3	0	0	3	EEE
21	GEDX 221	Polymers for Different Transportations	3	0	0	3	Polymer
22	GEDX 222	Programming Language Principles	3	0	0	3	CSE
23	GEDX 223	Public Speaking and Rhetoric	2	1	0	3	English
24	GEDX 224	Python Programming	2	0	2	3	IT
25	GEDX 225	R Programming	3	0	0	3	CA
26	GEDX 226	Smart Sensors for Healthcare Applications	3	0	0	3	EIE
27	GEDX 227	Total Quality Management	3	0	0	3	Mech.
28	GEDX 228	Value Education	3	0	0	3	Commerce
29	GEDX 229	Waste Water Management	3	0	0	3	Civil
30	GEDX 230	Web Application Development	3	0	0	3	CA

OPEN ELECTIVE COURSES FOR
B.TECH. PROGRAMMES R 2021 - VII SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 101	Advanced Entrepreneurship	3	0	0	3	CSB
2	GEDX 102	Artificial Intelligence and Machine Learning Applications	3	0	0	3	CSE
3	GEDX 103	Automotive Technology	3	0	0	3	Automobile
4	GEDX 104	Behavioural Psychology	3	0	0	3	SSSH
5	GEDX 105	Building Repair Solutions	3	0	0	3	Civil

6	GEDX 106	Cloud Services and Management	3	0	0	3	CA
7	GEDX 107	Cost Management for Engineers	3	0	0	3	Commerce
8	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
9	GEDX 109	Data Analytics and Visualization	3	0	0	3	CA
10	GEDX 110	Deep Learning Essentials	3	0	0	3	CSE
11	GEDX 111	Drone Technologies	2	0	2	3	Aero
12	GEDX 112	Electric Vehicle	3	0	0	3	EEE
13	GEDX 113	Emerging Technologies in Mobile Networks	3	0	0	3	ECE
14	GEDX 114	Fundamentals of Data Science and Machine Learning	3	0	0	3	IT
15	GEDX 115	Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
17	GEDX 117	Image Processing and its Applications	3	0	0	3	ECE
18	GEDX 118	Industrial Automation and Control	3	0	0	3	EIE
19	GEDX 119	Industrial Safety	3	0	0	3	Mech.
20	GEDX 120	Industry 4.0	3	0	0	3	Mech.
21	GEDX 121	Introduction to Artificial Intelligence	3	0	0	3	IT
22	GEDX 122	Introduction to Artificial Intelligence and Evolutionary Computing	3	0	0	3	EEE
23	GEDX 123	Motor Vehicle Act and Loss Assessment	3	0	0	3	Automobile
24	GEDX 124	National Service Scheme	3	0	0	3	SSSH
25	GEDX 125	National Cadet Corps	3	0	0	3	SSSH
26	GEDX 126	Personal Finance and Investment	3	0	0	3	Commerce
27	GEDX 127	Soft Computing Techniques	3	0	0	3	CSE
28	GEDX 128	Value Analysis and Engineering	3	0	0	3	Mech.
29	GEDX 129	Vehicle Maintenance	3	0	0	3	Automobile

SEMESTER I

PHD 1181	APPLIED PHYSICS	L	T	P	C
		3	0	2	4

SDG: 4

COURSE OBJECTIVES:

COB1: To make the students in understanding the importance of mechanics and properties of matter.

COB2: To classify the different types of crystal structures and study their defects.

COB3: To correlate the quantum mechanics principles and its impact in its application.

COB4: To introduce the basics of oscillations, optics and lasers.

COB5: To analyze the acoustics of buildings and applications of ultrasonics

MODULE I MECHANICS AND PROPERTIES OF MATTER 9

Moment of inertia (M.I.) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - Elasticity – Stress-strain diagram – Factors affecting elasticity – Poisson's ratio - Twisting couple on a wire – Shaft – Torsion pendulum – Bending moment - Depression on a cantilever – Young's modulus by cantilever – Uniform and non-uniform bending.

MODULE II CRYSTAL PHYSICS 9

Miller Indices-Interplanar distance- Hexogonally closely packed crystal structures – Reciprocal Lattice -Defects in crystals: voids – Line defects - Edge and screw dislocations - Surface Defects - Crystal Growth Techniques - Bridgman method – Czochralski method (qualitative)-Polymorphism and allotropy in crystals.

MODULE III QUANTUM MECHANICS 9

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 wavelength - Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Quantum computing.

MODULE IV OPTICS AND LASERS 9

Interference -Anti-reflection coating -Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet-Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of

Laser: Nd:YAG laser –CO_2 laser and semiconductor laser - Applications : Laser Materials Processing - Holography.

MODULE V ACOUSTICS & ULTRASONICS 9

Basic requirement for the acoustically good halls - Factors affecting the architectural acoustics and their remedy-Sound absorbing materials - 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.

PRACTICALS

List of Experiments

1. Determination of rigidity modulus of the given wire using Torsional pendulum.
2. Determination of young's modulus of the beam by uniform / non-uniform bending method.
3. Determination of young's modulus of the beam by cantilever method.
4. Determination of coefficient of viscosity of low viscous liquid by Poiseuille's flow.
5. Determination of coefficient of viscosity of high viscous liquid by Stoke's method.
6. To determine the frequency of an electrically maintained tuning fork using a vibration generator. (Melde's experiment)
7. Determination of thickness of a thin wire / sheet using Air Wedge method.
8. Determination of wavelength of laser light using semiconductor laser diffraction.
9. Determination of angle of divergence of a laser beam using semiconductor diode laser and He-Ne laser.
10. Determination of particle size of lycopodium powder using semiconductor laser.
11. Determination of velocity of sound in solids using Kundt's tube method.
12. Determination of velocity of ultrasonic waves in the liquid using ultrasonic interferometer.

L – 45; P – 15 ; TOTAL HOURS –60

TEXT BOOKS:

1. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.
2. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.

REFERENCES:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. Brij Lal and N. Subramanyam, Properties of Matter, S.Chand& Co, 2003.
3. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.
4. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
5. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.
6. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.

COURSE OUTCOMES:

CO1:grasp the importance of mechanics and the principles of elastic behaviour of materials & apply them to analyze the various substances based on elasticity.

CO2: get acquainted with the topics concerning types, defects in crystal structures, methods of preparation and apply the same to categorize different crystal systems in real time.

CO3: comprehend the importance &principles of quantum mechanics and utilize ideas to understand working of modern devices and its variants.

CO4: know the basics of oscillations, optics and lasers and their applications.

CO5: assimilate the ideas of acoustical requirements of buildings, understand principles of ultrasonics and add values to their usefulness in acoustical design of halls and their applications.

Board of Studies (BoS) :	**Academic Council:**
13th BoS of Physics held on 14.09.2023	21st AC held on 20.12.2023

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHD 1181	ENGINEERING MATERIALS AND APPLICATIONS	L	T	P	C
		3	0	2	4

SDG: 9

COURSE OBJECTIVES: To make the students conversant with

COB1: preparation, properties and applications of various polymers and composites

COB2: synthesis, properties and applications of nanomaterials

COB3: the basic concepts and different types of catalysts involved in catalytic processes.

COB4: basic principles and its applications of certain spectroscopic techniques towards characterization of chemical compounds and concepts of photochemical processes involved in photochemical reactions.

COB5: different types of sensors and its applications.

MODULE I POLYMER AND COMPOSITES 9

Introduction – classification: source, heat, composition and structure- glass transition temperature – synthesis, properties and applications of polycarbonate, polyurethane, teflon, ABS, kevlar, bakelite, epoxy resin, acrylic polymers (PAN) - biopolymers : importance and applications of biodegradable polymers (PLA, PHBV).

Composites- Introduction - properties and applications: fibre-reinforced plastics (glass, carbon and aramid), ceramic matrix composites (CMC) –- bio-composites - Society of the Plastics Industry (SPI)' Code.

MODULE II NANOCHEMISTRY 9

Introduction – classification based on dimension with examples – properties of nanomaterials (surface to volume ratio and size quantisation effect) - synthesis of nanomaterials (Top-down and Bottom-up)– role of capping & reducing agents - CVD (CNT), laser ablation (Ag, Ag_2O), electrodeposition (semiconductor materials), precipitation (Ag, Au), thermolysis: solvothermal (CuO, CeO_2) and hydrothermal (TiO_2, ZnO, carbon dots), microwave method (metal oxide), bio-nanomaterials - biogenic method (synthesis of Ag, Au by plants extracts, bacteria, fungi)

MODULE III CATALYSIS 9

Types of catalysis – Criteria for catalysts - catalysis by transition metal ions and their complexes- solid catalyst - metal oxides and zeolites - shape selective catalysts- mechanism of catalytic action- CO oxidation, NOx and SOx reduction – Enzyme catalysis-Mechanism of enzyme action- electrocatalysis -green catalyst.

MODULE IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Laws of photochemistry – Quantum yield -– Jablonski diagram - photophysical processes - photosensitisation – Quenching– chemiluminescence – bioluminescence

Atomic and molecular spectrum – absorption and emission spectrum - Beer Lambert’s law – problems and applications – principles and applications: colorimetry, UV -vis spectroscopy (Chromophore- auxochrome, red and blue shift), atomic absorption spectroscopy, IR spectroscopy (finger print region, functional group interpretation)

MODULE V SENSORS 9

Sensors – types: bio and toxic chemicals sensors- principle, working and applications of Electrochemical sensors: MEMS and NEMS, - Biosensors- construction, working and classification, Advantages - Biochips - touch sensor (oxi and gluco meter) - Advanced sensors: Smoke and gas sensors, humidity sensors, temperature sensor and alcohol sensor.

PRACTICALS

List of Experiments

1. Preparation of polymers – phenol-HCHO, urea-HCHO, polylactic acid, epoxy resin
2. Determination of molecular weight and degree of polymerization using Oswald’sviscometer.
3. Synthesis of nano-ZnO and CuO by precipitation
4. Demonstration of Laser ablation techniques for nanomaterials.
5. Electrochemical synthesis of graphene oxide
6. One-pot synthesis using green catalyst.
7. Green synthesis: Photocatalytic reactions, solvent - free organic reaction - Aldol; green oxidation, green reduction.
8. Diels - Alder reaction in eucalyptus oil (green process).
9. Spectrophotometer iron estimation.(Beer Lambert’s law) determination of Fe^{3+}
10. FT-IR spectral characterisation (functional group interpretation)

L – 45; P – 30; Total Hours – 75

TEXT BOOKS:

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2016.
2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge,2012.
3. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis: Principles and Applications, Narosa Publishing House, 2002.
4. Gadi Rothenberg, Catalysis: Concepts and Green Applications, WILEY-VCH
5. Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, Principles of molecular photochemistry: An introduction, University Science Books, Sausalito, CA, 2009.
6. John Vetelino, AravindReghu , Introduction to Sensors By · 2017.

REFERENCES:

1. Jhon S. Wilson, Sensor Technology Handbook, Elsevier 2005.

COURSE OUTCOMES:

The students will be able to

CO1: enumerate and compare the preparation, properties and applications of various types of polymers and composites.

CO2: synthesize different type of nanomaterials on a commercial scale based on its size and applications.

CO3: apply the concepts of spectroscopic techniques towards spectral interpretation for identification of compounds and explain various photochemical processes in photochemical reactions.

CO4: Impart types, characteristics and applications of different types of catalyst.

CO5: categorize the sensors and its applications to real time situation.

Board of Studies (BoS) :	**Academic Council:**
13th BoS of Chemistry held on 08.09.2023	21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	-	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-

Note : L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: To support scientific & technology development and innovation of materials and electronic devices

Introduction of basics on various materials and electronic devices towards innovation on new technology.

MAD 1181	**ALGEBRA AND DIFFERENTIAL CALCULUS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To introduce matrix algebra techniques for engineers to apply in practical problems

COB2: To find the roots of polynomial equations using different techniques

COB3: To demonstrate the concepts of limits, continuity and application of differential calculus.

COB4: To familiarize the students with the functions of several variables

COB5: To develop the use of differential equations necessary for engineering applications

MODULE I MATRICES 9+3

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 THEORY OF EQUATIONS 9+3

Introduction - Surds and irrational roots – simple problems – Equations whose roots are in A.P,G.P and in H.P – Relations between the roots and coefficients – symmetric functions – Formation of equations – Decreasing and Increasing the roots – transformation of equation – Reciprocal equations

MODULE III DIFFERENTIAL CALCULUS 9+3

Limits of functions - one sided limits – Continuity - Curvature – Cartesian and polar coordinates – center and radius of curvature – Circle of curvature – Involutes and evolutes – Envelopes

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Laws of limits –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 9+3

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

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2010.
2. Grewal B.S., "Higher Engineering Mathematics" 44th edition, Khanna Publishers, New Delhi, 2017.
3. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2011

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Jain, R.K. & Iyengar, S. R. K., "Advanced Engineering Mathematics", Narosa Publishers, 5th edition, 2016.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
5. James Stewart, "Calculus" 7th edition, Brooks/Cole Cengagelearning, UK

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: use the matrix algebra methods for finding eigenvalues, eigenvectors and diagonalization

CO2: solve equations using the relations between roots and coefficients

CO3: apply differential calculus in various engineering problems

CO4: able to use differential calculus on several variable functions

CO5: solve various types of differential equations that arise in many applications

Board of Studies (BoS) :	**Academic Council:**
12th BOS of Mathematics & AS held on 23.06.2021	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all

Learning of various mathematical techniques like matrices and calculus will lead to knowledge of applications in Engineering problems

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

SDG: 9

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of engineering drawing, andfamiliarize with conic sections, special curves and orthographic projection of points and straight lines

COB2: To get practical exposure on projection of planes and solids

COB3: To be familiar with sectioning of solids, and development of surfaces

COB4: To conversant with 3D isometric projection, and perspectiveprojection of simple solids

COB5: To introduce computerized drafting using CADD for drawing theorthographic views of simple solids

MODULE I BASICS, ENGINEERING CURVES AND ORTHOGRAPHIC PROJECTION OF POINTS AND STRAIGHT LINES L: 7 P: 7

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

Conic sections: ellipse, parabola, hyperbola. Special curves: cycloid, epicycloid, hypocycloid and involutes.

Orthographic projection – first angle, second angle, third angle and fourth angle projections. Orthographic projection of points in all quadrants. Projection of straight lines in first quadrant – true length and true inclinations –traces of straight line.

MODULE II PROJECTION OF PLANES AND SOLIDS L: 7 P: 7

Projection of plane lamina in first quadrant and its traces

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

MODULE III SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES L:5 P:5

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

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

MODULE IV THREE DIMENSIONAL PROJECTIONS L:4

P: 4

Isometric projection: Isometric scale – isometric axes- Isometric projection and view of prism, pyramid, cylinder, cone and frustums.
Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid by Visual ray method.

MODULE V ORTHOGRAPHIC PROJECTION USING CADD L:7

P:7

Introduction to CADD - Basic commands for sketching - Editing sketches - creating texts and tables - Basic dimensioning and editing dimensions - Sketching orthographic views of simple solids and machine parts as per first angle projection - Plotting drawings.

L – 30; P – 30; Total Hours – 60

TEXT BOOKS:

1. N.D. Bhatt, "Engineering Drawing",Charotar Publishing house, 53rdEdtion, 2014.
2. Venugopal. K, and V. Prabhu Raja, "Engineering Graphics", New Age International (P) Ltd., Publication, Chennai, Edition 15, 2017.

REFERENCES:

1. K.V. Natarajan, "A text book of Engineering Graphics", Dhanalakshmi publishers, Chennai, 31st Edition, 2018.
2. Agrawal B. & Agrawal C. M., "Engineering Graphics", TMH Publication, 2012.
3. Jeyapoovan, T., "Engineering Graphics using AutoCAD", Vikas Publishing House Pvt. Ltd., New Delhi, 2015.
4. AutoCAD Software Theory and User Manuals
5. Engineering graphics You tube Lecture videos link:

   https://www.youtube.com/user/BSAUNIV/videos

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: identify the specifications and standards of technical drawing and drawconic sections, special curves and orthographic projection of points andstraight lines

CO2: apply the concept of orthographic projection to draw the orthographic views of plane figures and simple solids
CO3: draw the sections of solids and development of solid surfaces

CO4: apply the concept of isometric and perspective projection to draw the 3-D views of simple solids
CO5: draw the orthographic views of simple objects using drafting software

Board of Studies (BoS):
18thBoS of MECH held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO2	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO3	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO4	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO5	M	L	L	-	M	-	-	-	-	L	-	-	-	-

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The various industrial standards of technical drawing and the application of orthographic projections to draw simple solids helps to innovate a new design for sustainable industrialization

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

SDG:9

COURSE OBJECTIVES:

COB1: To learn the basic concepts of design in engineering

COB2: To study the basic design thinking principles in problem solving

COB3: To encourage the students to develop a prototype using design concepts

COB4: To introduce the role of innovation in engineering

MODULE I INTRODUCTION TO DESIGN 08

Introduction to Engineering design – Design thinking – Problem identification - Design of Product, Process, System and Software – Case studies on Product, Process, Systems and Software design.

MODULE II DESIGN THINKING PROCESS 08

Empathy – Ideate - Need analysis - Voice of customers - product specification - concept generation - Bench marking - Quality function deployment - Concept evaluation - Case studies

MODULE III PROTOTYPE DESIGN 07

Product form and function – High level design – Design detailing - Sketch models – Prototypes - 3D printing - Case studies.

MODULE IV INNOVATION 07

Creativity and innovation – Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – Intellectual property rights - case studies on innovative products.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Clive L. Dym, Patrick Little, and Elizabeth J. Orwin, “Engineering Design: A Project Based Introduction”, 4th Edition, Wiley, 2014.
2. Eppinger, S. and Ulrich, K., “Product design and development”, McGraw-Hill Higher Education, 2015.

REFERENCES:

1. Nigel Cross, “Design Thinking”, Berg Publishers, 2011.

2. Tom Kelley, “The Art of Innovation”, Profile Books Ltd, London, 2016.
3. Tim Brown, “Change by Design”, HarperCollins e-books, 2009.
4. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: explain the basic concepts of design in engineering products / process / Service

CO2: analyse the problems and perform design thinking process

CO3: correlate the basic principles of design thinking to solve engineering problems and develop prototypes

CO4: apply innovative approaches to engineering problems and provide design solutions

Board of Studies (BoS):
18th BoS of MECH held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	-	H	-	M	-	-	-	-	L	-	L	-	-
CO4	-	-	M	-	-	-	-	-	-	L	-	L	-	-

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic understanding of basic knowledge in Engineering design and its process in the development of prototypes results in satisfying industrial challenges.

GED 1103	MANUFACTURING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

SDG: 9

COURSE OBJECTIVES:

COB1: To learn the basics of pipe connections used in household andindustrial systems

COB2: To educate the usage of welding equipment's and machiningmethods

COB3: To impart knowledge onsand mould preparation for simple components

COB4: To explorevarious tools, instruments and methods used in electrical wiring

COB5: To impart knowledge onDesign, assembly and testing ofelectronic circuits

PRACTICALS

List of Experiments:

CIVIL ENGINEERING PRACTICE:

1. Study of plumbing in general household and industrial systems: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
2. Making a small window frame with Lap and Mortise & Tenon Joints by sawing planing and cutting.
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints using Arc Welding - Gas cutting (Demo)
2. Machining of a component using simple turning and drilling practices.
3. Foundry operations such as sand mold preparation for simple component.
4. Plastic Component Manufacturing (Demo on Injection / Blow moulding)

ELECTRICAL ENGINEERING PRACTICE:

1. Comparison of incandescent, fluorescent, CFL and LED lamps.
2. Domestic, staircase and go down wiring.
3. Measurement of earth resistance.
4. Study of protection devices (small relay, fuse, MCB, HRC, MCCB, ECCB).

5. Familiarization of household electrical gadgets (Iron Box, Wet Grinder).
6. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE:

1. Identifications and symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Design and testing of electronic circuits using active and passive electronic components

P – 30; Total Hours – 30

TEXT BOOK:

1. S.Gowri and T.Jeyapoovan, "Engineering Practices Lab Manual – Civil, Mechanical, Electrical, Electronics included", Vikas Publishing, 5th Edition, 2019.

REFERENCES:

1. SubhransuSekhar Dash & K.Vijayakumar, "Electrical Engineering Practice Lab Manual", Vijay Nicole Imprints Private Ltd., First Edition, 2013.
2. Raghbir Singh Khandpur, "Printed Circuit Boards: Design, Fabrication, and Assembly", Tata McGraw-Hill Education, 2005.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: demonstrate Plumbing requirements of domestic buildings.

CO2: use welding equipment's to join the structures and to carry out machining operations

CO3: perform the task of making sand mould for simple components

CO4: execute simple electrical wiring and comprehend the construction and working of household appliances.

CO5: assemble and test simple electronic circuits used in day-to-day life

Board of Studies (BoS):	**Academic Council:**
18th BoS of MECH held on 21.06.2021	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	L	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic understanding of welding, moulding, machining, wiring andelectronic circuit increases the access of small-scale industrial and otherenterprises in developing countries.

		L	T	P	C
GED 1104	**PROGRAMMING FOR PROBLEM SOLVING**	**L**	**T**	**P**	**C**
SDG: 8		**1**	**0**	**2**	**2**

COURSE OBJECTIVES:

COB1: To explore the hardware and software components of thecomputer

COB2: To learn the structured and procedural programming concepts usingC.

COB3: To study the constructs of decision making in branching and iteration statements

COB4: To learn Functions for effective reusability and readability of the code.

COB5: To understand pointer and file operation concepts.

MODULE I INTRODUCTION TO C PROGRAMMING 05

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, system software, compilers, creating, compiling and executing a program, Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming - Structure of C - C Tokens – Data Types – Declaration of Variables and Storage class – Operators – Expressions - Type Conversion.

MODULE II DECISION MAKING AND ARRAY 05

Decision Making and Branching: Simple if Statements, The if..else statements, Nesting of if..else statements, else…if Ladder, switch Statements, goto Statements, Looping: while, do…while, for Statements, Array: One-Dimensional, Two-Dimensional and Multi-Dimensional operations.

MODULE III USER-DEFINED FUNCTIONS AND FILE OPERATIONS 05

Definition of Functions - Function Types – Nesting of Functions – Recursion – Structures and Unions – Pointers - File handing operations.

PRACTICALS

LIST OF PROGRAMS IN C:

1. Computer organization –Hardware in a typical computer Identification – Booting error messages and what it means
2. Structure of a basic program - Hello world program
3. Data types and Type conversions
4. Input / Output: Formatted functions – Unformatted functions – Library functions

5. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
6. Conditional Statements: If – if else- nested if else- goto- switch case – nested switch case
7. Iteration Statements: for loops – nested for loops – while loop – do-while loop – break and continue statement
8. I/O operations of one- and two-dimensional arrays
9. Bubble Sort and Linear Search using arrays.
10. Functions and its types, Recursion Function
11. Pointers File Operations

L – 15; P – 30 ; Total Hours – 45

TEXT BOOKS:

1. Richard L. Stegman, "Focus on Fundamentals of Programming with C", Ninth Edition, ISBN -170077395X, 9781700773951, 2019.
2. E.Balagurusamy, "Programming in ANSI C", McGraw Hill Education, Eighth Edition, ISBN-13: 978-93-5316-513-0, ISBN-10: 93-5316-513-X, 2019.

REFERENCES:

1. Brian W. Kernighan and Dennis M. Ritchie, " The C Programming Language", Prentice Hall, ISBN 0-13-110362-8, 2015.
2. Ashok N Kamthane, "Computer Programming", Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012.
3. Paul J. Deitel, Deitel & Associates, "C How to Program", Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: identify the hardware components and describe the software components of computer.

CO2: bring out the importance of structural and procedural programming

CO3: write C coding using conditional and iteration statements

CO4: develop programs using Functions, Pointers and Files

CO5: implement program to build a real time application.

Board of Studies (BoS) :	**Academic Council:**
18th BoS of CSE held on 26.07.2021	17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	M	L	H	-	L	-	-	M	-	-	-	-	-
CO2	H	M	M	-	-	H	M	-	M	-	-	-	-	-
CO3	H	M	H	-	-	H	-	-	H	-	-	-	-	-
CO4	H	H	H	H	M	H	-	-	H	-	-	-	-	-
CO5	H	H	H	H	H	H	H	H	H	L	H	H	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: The students can have productive employment and decent work by learning this computer fundamentals and programming course.

SEMESTER II

END 1281	**ENGLISH FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To train students to use appropriate vocabulary in academic and technical contexts

COB2: To facilitate students to speak effectively while exchanging ideas and making presentations

COB3: To develop students' listening skill for comprehending and analysing information

COB4: To develop their reading skill through sub skills like skimming, scanning and critical reading of a text

COB5: To sharpen their academic writing skills

COB6: To expose them to the correct usage of language and help them to apply that knowledge appropriately

MODULE I HUMAN RESOURCES 10

L: Listening to short texts – short formal & informal conversations.

S: Introducing one self – exchanging personal info.

R: Process of reading purposes, Reading comprehension, improving comprehension skills, Reading activities – short comprehension passages, practice in skimming & scanning.

W: Scientific & Technical Writing, Editing skills, Activities – completing sentences, developing hints - Paragraph Writing

Voc. development: Prefixes, Suffixes

Lang. development: Articles, Countable and Uncountable nouns, Present tense, Wh – Questions, Yes or No questions.

MODULE II TRANSPORT 10

L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

R: Comprehension passages with multiple choice questions / Wh–questions/ openended questions - Reading longer technical texts & completing exercises based on them.

W: Use of reference words & discourse markers on a text, jumbled sentences, describing a process – flow chart, use of sequence words.

Voc. development: Guessing meanings of words in context, vocabulary used in formal letters, e-mails & reports.

Lang. development: Preposition of Time, Place & Date, Past tense, Conjunctions, Impersonal passive voice, Question tags, Numerical Adjectives.

MODULE III ENERGY 9

L:Listening to talk on the topic & completing tasks.

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

W: Letter seeking permission for Industrial Visit / symposium – Letter of invitation

Voc. development: Sequence words, misspelt words.

Lang. development: Adverbs, Degrees of comparison, Future tense, Homophones

MODULE IV OUR LIVING ENVIRONMENT 8

L: Listening to scientific texts & making notes – Effective ways of making notes.

S: Speaking about one's friend.

R: Reading texts & magazines for detailed comprehension. (Students can be asked to read any book of their choice to encourage reading habit)

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

MODULE V TECHNOLOGY 8

L: Listening to talks (General & Scientific).

S: Short group conversations.

R: Reading and understanding technical articles, Short narratives & articles from Newspaper including conversations.

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

L - 45; Total Hours - 45

TEXT BOOKS:

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1) Perry, Carol Rosenblum (2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2) Dutt, P.K. Rajeevan G. andPrakash, C.L.N. (2007). A course in Communication Skills, Cambridge Univesity Press, India.
3) Sen, Leena (2004). Communication Skills, Prentice Hall, New Delhi.
4) Matt Firth, Chris Sowton et.al (2012). Academic English An Integrated Skills Course for EAP, Cambridge University Press, Cambridge.
5) Bailey,Stephen 2011. Academic Writing: A practical guide for students, New York, Rutledge.
6) Redston, Chris&Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi.
7) Dutt P. Kiranmai and RajeevanGeeta (2013). Basic Communication Skills, Foundation Books.

COURSE OUTCOMES:

CO1: Read articles of a general kind in magazines and newspapers

CO2: Participate effectively in conversations, introduce themselves and their friends and express opinions in English

CO3: Comprehend conversations and short talks delivered in English

CO4: Write short essays of a general kind and letters and emails in English

CO5: Express through speaking and writing using appropriate vocabulary and grammar

Board of Studies (BoS) :

13th BoS of Department of English held on 17.6.2021

Academic Council:

17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	-	-	-	-	-	-	H	-	-
CO3	-	-	-	-	-	-	-	-	-	M	-	-
CO4	-	-	-	-	-	-	-	-	-	H	-	-
CO5	-	-	-	-	-	-	-	-	-	M	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG No. 4 : Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

MAD 1283	**PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

SDG: 4

COURSE OBJECTIVES:

COB1: To formulate and solve partial differential equation of first, second and higher orders

COB2: To introduce basics and engineering applications of Fourier series

COB3: To develop Fourier transform techniques

COB4: To introduce techniques and engineering applications of Laplace Transforms

COB5: To acquaint with Z -Transform techniques for discrete time systems.

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 9+3

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 9+3

Fourier Series and Dirichlet's conditions - General Fourier series – Even and Odd functions - Half range Fourier series - Parseval's identity - Harmonic Analysis

MODULE III FOURIER TRANSFORMS 9+3

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

MODULE IV LAPLACE TRANSFORM 9+3

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 V Z – TRANSFORM 9+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, 2011.
2. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017.
3. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2010.

REFERENCES:

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

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form and solve the partial differential equations

CO2: derive a Fourier series of a given periodic function by evaluating Fourier coefficients

CO3: apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms

CO4: solve ordinary differential equations using Laplace transforms

CO5: solve difference equations using Z-transform

Board of Studies (BoS) :	**Academic Council:**
12th BOS of Mathematics & AS held on 23.06.2021	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various mathematical techniques like Partial differential equations and transform techniques will help to solve complicated engineering problems

GED 1202	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

SDG: 3, 5, 8, 12

COURSE OBJECTIVES:

COB1: To make the students understand the basic calculations and measurements in DC circuits.

COB2: To provide the basic knowledge on AC circuit calculations and measurements.

COB3: To familiarize with working and characteristics of different DC and AC machines.

COB4: To impart knowledge onbasic semiconductor devices and their applications.

COB5: To introduce the students to fundamentals of digital electronics.

MODULE I DC CIRCUITS & MEASUREMENTS 12

The concept of voltage and current-Electric circuit elements: R, L, C – Independent and dependent sources - Ohm's law- Kirchhoff's law- series and parallel resistive circuits – Voltage and current division – Star-delta transformation - Mesh and nodal analysis of resistive circuits – simple problems - Measurement ofvoltage, current and power in DC circuits.

MODULE II AC CIRCUITS & MEASUREMENTS 17

Sinusoidal voltage - RMS, average, peak value, peak factor and form factor - single phase RL, RC and RLC circuits –phasor representation - complex power – power factor - simple problems - Resonance in RLC circuits – 3 phase balanced circuit calculations– star and delta connections - Principles of measurement of AC voltage, current, power and energy - Measurement of three phase power.

MODULE III ELECTRICAL MACHINES 18

Construction, principle of operation, basic equations, characteristics and applications of DC generators, DC motors, single phase transformers and three phase induction motors. Working principle of BLDC Motor and its applications in home appliances.
(Qualitative treatment only).

MODULE IV SEMICONDUCTOR DEVICES AND APPLICATIONS 14

Introduction to semiconductors - Characteristics of PN Junction Diode – Zener Diode and its characteristics – SCR and its characteristics –– Bipolar Junction Transistorand its characteristics – JFET & MOSFET – their characteristics.
Applications: Half wave and full wave rectifiers - Voltage Regulation – Regulator ICs.

MODULE V INTRODUCTION TO DIGITAL CIRCUITS 14

Logic gates- Boolean algebra theorems– K Map-Introduction to combinational circuits– Flip-Flops – Registers– A/D and D/AConversion–Data acquisition systems

PRACTICALS

List of Experiments

1. Verification of KCL and KVL (ii) Measurement of voltage, current and power in DC circuits.
2. (i) Resonance of RLC series circuit

   (ii) Measurement of voltage, current, power and power factor in single phase & three phase AC circuits.
3. (i) Magnetization characteristics of DC generator

   (ii) Characteristics of DC shunt motor, single phase transformer and three phase induction motor.
4. Fabrication of a low voltage regulated power supply.
5. Implementation of half and full adders.

L – 45; P – 30; Total Hours – 75

REFERENCES:

1. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 12th Edition, 2016.
2. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Education, First Edition, 2017.
3. Cotton H, “Electrical Technology”, CBS Publishers, 7th Edition, 2007.

4. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.
5. Jacob Millman & Christos C. Halkias, Satyaprataba Jit “Electronic Devices and Circuits” McGraw Hill Education, 4th Edition, 2021.
6. Floyd, “Electronic Devices: Conventional Current Version” Pearson Education India, 7th Edition, 2008.
7. S. Salivahanan, N. Sureshkumar and A. Vallavaraj, “Electronic Devices and Circuits”, McGraw Hill Education (India) Pvt. Ltd., 2018.
8. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education Inc., New Delhi, 2008.

COURSE OUTCOMES:

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

CO1: perform the basic calculations in DC circuits and measure the various quantities associated with DC circuits.

CO2: measure and compute the rms current and voltage, power, power factor and energy in AC circuits.

CO3: choose appropriate motor for specific applications based on the motor characteristics.

CO4: fabricate a regulated power supply for low voltage applications and build static switches using BJT and SCR.

CO5: build simple digital circuits like half adder and full adder.

Board of Studies (BoS) :

15th meeting of BoS of EEE held on 25.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	-	H	L	M	-	M	-	L	L	M	L	-	-	-
CO2	H	-	H	L	M	-	M	-	L	L	M	L	-	-	-
CO3	H	-	H	L	-	-	M	-	L	L	M	L	-	-	-
CO4	H	-	H	L	-	-	M	-	L	L	M	L	-	-	-
CO5	H	-	H	L	-	-	M	-	L	L	M	L	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals of electrical and electronics systems can help in designing systems to promote good health and well being.

SDG 5: Gender equality

Statement: Acquiring the interdisciplinary knowledge help overcome the gender barriers in work place.

SDG 8: Descent work and economic

Statement: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 12: Responsible consumption and production.

Statement: Use of right and energy efficient electric and electronic components and devices results is reasonable consumption and production.

GED 1201	**ENGINEERING MECHANICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To impart knowledge about the basic laws of mechanics,resolution of forces, equilibrium of particles in 2D and 3D force systems.

COB2: To learn about supports, reactions and equilibrium of rigidbodies

COB3: To educate surface properties such as centroid and momentof inertia

COB4: To impart knowledge on friction and its applications

COB5: To study the laws of motion, impulse, momentum and elasticbodies

MODULE I VECTOR APPROACH AND EQUILIBRIUM OF PARTICLE **L: 11 T: 3**

Introduction - Vectors – Vectorial representation of forces and moments – Vector Algebra and its Physical relevance in Mechanics – Laws of Mechanics – Parallelogram and triangular Law of forces- Coplanar Forces Principle of transmissibility, Resolution and Composition of forces- Forces in plane and space - Lame's theorem - Equilibrium of a particle in 2D plane - Equilibrium of a particle in 3D space - Equivalent systems of forces – Single equivalent force

MODULE II EQUILIBRIUM OF RIGID BODY **L: 7 T: 3**

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 III PROPERTIES OF SURFACES **L:10 T:3**

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 using standard formula – second and product moments of plane area – Physical relevance - Standard sections: Rectangle, triangle, circle-composite sections, Hollow section using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia

MODULE IV FRICTION **L:9**
T:3

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

MODULE V LAWS OF MOTION **L:8**
T:3

Review of laws of motion – Newton's second law – D'Alembert's principle and its applications in plane motion; Work Energy Equation of particles– Impulse and Momentum – Impact of elastic bodies.

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers", McGraw Hill Education, 10th Edition, 2017.
2. R.K. Bansal., "A Text Book of Engineering Mechanics", Laxmi Publications, 6th Edition, 2015.

REFERENCES:

1. Russell C Hibbeler, "Engineering Mechanics: Statics & Dynamics", 14th Edition, Pearson, 2015.
2. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education India, 2005.
3. R.S. Khurmi., "A Text Book of Engineering Mechanics", S. Chand Publishing, 22nd Edition, 2018.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: resolve composite forces, apply concept of equilibrium to particles and solve problems

CO2: apply the concept of equilibrium to rigid bodies and solve problems

CO3: determine the properties of surfaces

CO4: analyse and evaluate the frictional forces between the bodies

CO5: apply the laws of motion in solving dynamics problems

Board of Studies (BoS):
18th BOS held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	M	-	-	-
CO3	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO4	-	M	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	L	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The understanding of force systems and its components leads to construction of robust engineeringsystems.

AED 1211	**BASICS OF AERONAUTICAL ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To study various components of aircraft & their functions and understand aerodynamic forces acting on airplane.

COB2: To introduce various aircraft performance parameters and differentiate between various types of air breathing engines.

COB3: To study different structural elements and materials used in aircraft.

COB4: To gain knowledge about instruments and systems required for the operation of airplanes.

MODULE I — HISTORY AND BASIC AERODYNAMICS — 8

History of Aviation, Airplane configurations, components of airplane, functions. Standard Atmosphere, Aerodynamic forces and Moments, Air speed, Mach Number, Reynold's Number, Airfoil Aerodynamics, Wing Aerodynamics and Drag Polar.

MODULE II — AIRCRAFT PERFORMANCE, STABILITY & CONTROL — 8

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

MODULE III — AIRCRAFT STRUCTURES AND MATERIALS — 7

Stress, strain, stress-strain diagram, Monocoque and semi-monocoque structures – Wing, fuselage, types of rivets and welding methods - Materials used in aircraft – Identification of materials used in Boeing series – Airbus series - metal alloys, composites, smart materials – properties of materials.

MODULE IV — AIRCRAFT ENGINES, INSTRUMENTS AND SYSTEMS — 7

Types of engines, Identification of engines used in Boeing series – Airbus series - Engine components, Engine performance parameters - Basic T instruments, Gyro instruments, Hydraulic and pneumatic systems, Fly-by-wire system, Power-by-wire - Auto-Pilot, CVR, Flight data recorder.

PRACTICALS

LIST OF EXPERIMENTS

1. Flow visualization study on streamlined bodies
2. Flow visualization study on bluff bodies
3. Identification and study of components of piston engine
4. Identification and study of components of jet engine
5. Fabrication of panel using TIG and MIG welding
6. Fabrication of panel using various riveting techniques
7. Study of Beechcraft Bonaza A35 and Gnat aircraft
8. Study of different hydraulic and pneumatic actuators

L – 30; P – 30; Total Hours – 60

TEXT BOOKS:

1. John Anderson, Introduction to Flight, McGraw-Hill, 8th Edition, 2016.
2. Richard S. Shevell, Fundamentals of Flight, 2nd Edition, Pearson Education, 2006.

REFERENCES:

1. Kermode, A. C., Flight without formulae, McGraw-Hill, 5thEdition,1997
2. B. W. McCormick, Aerodynamics, Aeronautics and Flight Mechanics, John Wiley & Sons, 1995.

COURSE OUTCOMES:

CO1: Identify various components of aircraft & their functions and estimate aerodynamic forces on airplanes and their effects on aircraft structures.

CO2: Calculate various aircraft performance parameters and differentiate between various types of air breathing engines.

CO3: Identify different structural elements and suggest materials used in aircraft.

CO4: Distinguish various instruments and systems required for the safe operation of airplanes.

Board of Studies (BoS):
14th BoS of Aero held on 19.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	L	M	L	L	-	-	-	-	-	-	-	-	M	M
CO2	M	H	L	L	L	-	-	-	-	-	-	-	M	M
CO3	-	M	L	L	-	L	L	-	-	-	-	-	M	M
CO4	-	M	L	L	-	L	-	-	-	-	-	-	M	M
CO5	L	M	L	L	-	-	-	-	-	-	-	-	M	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: an overview of and an introduction to the fundamentals of aeronautics, using the history of aviation as a story line

GED 1206	**ENVIRONMENTAL**	**L**	**T**	**P**	**C**
SDG: All	**SCIENCES (for Undergraduate B.Tech. Courses)**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

To make the student conversant with the

COB1: various natural resources, availability, utilisation and its current scenario.

COB2: diverse ecosystems and its function, importance of biodiversity, its values, threats and conservation.

COB3: types of pollutants and its impacts on the environment and the effects of natural disasters.

COB4: impacts of human population, human health, diseases and immunisation for a sustainable lifestyle.

MODULE I NATURAL RESOURCES 8

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems - (a) Land resources: Land degradation soil erosion and desertification - (b) Forest resources: Use and over-exploitation, deforestation (c) Water resources: Use and over-utilisation of surface and ground water, conflicts over water, dams: benefits and problems, effects on forest and tribal people - (d) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, mining (e) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture (f) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources.

MODULE II ECOSYSTEMS AND BIODIVERSITY 8

Concept of an ecosystem - Food chains, food webs, Energy flow in the ecosystem - ecological pyramids - Ecological succession - Characteristic features, structure and function of (a) Terrestrial Ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem (b) Aquatic fresh water ecosystems: Ponds and lakes, rivers and streams (c) Aquatic salt water ecosystems: oceans and estuaries

Biodiversity and its conservation - Types: genetic, species and ecosystem diversity - Values of biodiversity - India as a mega-diversity nation - Invasive, endangered, endemic and extinct species - Hot sports of biodiversity and Red Data book - Threats to biodiversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

MODULE III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8

Sources, 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 pollution (h) ill-effects of fireworks and upkeep of clean environment, types of fire and fire extinguishers- Solid waste Management: types, collection, processing and disposal of urban waste, industrial waste, e-waste and biomedical wastes - Disaster management: flood, drought, cyclone, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Human Population - Population growth, Population explosion, population pyramid among nations - Family Welfare Programme - Human Rights - Value Education - Environment and human health: air-borne, water borne, infectious diseases, contagious diseases and immunisation (all types of vaccines from birth), risks due to chemicals in food and water, endocrine disrupting chemicals, cancer and environment - Sustainable development - Resettlement and rehabilitation of people - Environment Legislative laws-Women and Child Welfare, Public awareness.

Case studies related to current situation.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Erach Bharucha, “Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education for University Grants Commission”, Orient Blackswan Pvt. Ltd., Hyderabad, India, 2013.
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, “Environmental Science and Engineering”, Sri Krishna Publications, Tamil Nadu, India, 2018.
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.
4. "Waste to Resources: A Waste Management Handbook", The Energy and Resources Institute, 2014.
5. https://www.teriin.org/article/e-waste-management-india-challenges-and-opportunities.
6. https://green.harvard.edu/tools-resources/how/6-ways-minimize-your-e-waste.
7. https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html.
8. https://tspcb.cgg.gov.in/Shared%20Documents/Guidelines%20for%20Management%20of%20Healthcare%20Waste%20Waste%20Management%20Rules,%202016%20by%20Health%20Care%20Facilities.pdf.

COURSE OUTCOMES:

The student will be able to

CO1: analyse the current scenario of various natural resources and their depletion and suggest remedies to curb the exploitation.

CO2: identify food chains and web and its function in the environment, assess the impacts on the biodiversity and propose solutions to conserve it.

CO3: analyse the types and impacts of pollutants in the environment and propose suitable methods to alleviate the pollutants and the natural disasters.

CO4: assess on the impact of human population and the health related issues and immunisation practices and sustainable developments for a healthy life.

Board of Studies (BoS) :
11th BoS of Chem held on 17.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	L	M	-	-	L	M	-	-	-	-	-	-	-
CO2	-	-	-	M	H	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	M	-	-	L	-	-	-
CO4	-	-	-	-	-	M	M	M	-	-	-	L	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG All: No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable & Clean Energy, Decent Work and Economic Growth, Industry, Innovation & Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships for the Goals.

Statement: This course discuss about the environment, all the natural resources available, sharing of resources, effective utilisation, effects of over utilisation, health and environmental issues pertained to that, global warming and related issues, climates, disasters, impact assessments, population, human rights, societal welfare, laws to conserve the environment and sustainability.

AED 2101	**SOLID MECHANICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Predict the behavior of bars under various loadings.

COB2: Calculate the bending and shear stress and the deflection of beams under various loadings.

COB3: Calculate the deflection of beams under various loadings.

COB4: 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

COB5: Predict the response of the structural elements subjected to combined loading and the load bearing capacity of pressure vessels.

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, principle of superposition.

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, Macaulay's methods, Moment Area Method, Conjugate Beam Method.

MODULE IV TORSION –SPRINGS – COLUMNS 12

Torsion of solid and hollow circular shaft - Shear Stress variation - Power transmissions in shaft - open and closed coil helical springs - Stresses in helical springs &Leaf Spring - Euler's Column curve, Columns with different end conditions.

MODULE V PRINCIPAL STRESSES BIAXIAL STRESSES 8

Principle Stress and Strains, Mohr's circle - Stresses in thin-walled pressure vessels - Thick-walled pressure vessel – combined bending, torsion and axial loading of circular shafts.

L – 45; 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.

COURSE OUTCOMES:

Students will be able to

CO1: predict the behavior of bars under various loadings.

CO2: calculate the bending and shear stress and the deflection of beams under various loadings.

CO3: calculate the deflection of beams under various loadings.

CO4: 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

CO5: predict the response of the structural elements subjected to combined loading and the load bearing capacity of pressure vessels.

Board of Studies (BoS) :

15th BoS of AERO held on 11.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	L	L						L		L	M	M
CO2	L	L	L	L								M	M	M
CO3	M	M	M	L								L	H	M
CO4	L	M	M	M								M	H	H
CO5	L	L	L	L								L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG No. 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Understand stresses, deformation of solid materials and structures under various loades.

AED 2102	ENGINEERING THERMODYNAMICS	L	T	P	C
SDG: 9		3	0	2	4

COURSE OBJECTIVES:

COB1: Use the first Law of Thermodynamics to evaluate the limitations on thermal-mechanical energy conversion

COB2: Can apply thermodynamics second law concepts and entropy principles on engineering applications

COB3: Carry out design and performance analysis on IC Engines.

COB4: Carry out performance analysisof refrigeration and air-conditioning systems

COB5: Estimate heat transfer rates in simple engineering situations

MODULE I BASICS & FIRST LAW OF THERMODYNAMICS 9

Macroscopic approach-thermodynamic systems-properties-state, path and process, quasi-static process-work and heat-zeroth law and first law of thermodynamics-internal energy-enthalpy-applications of first law of thermodynamics to closed and open system.

MODULE II SECOND LAW OF THERMODYNAMICS 9

Second law of thermodynamics, Heat engine, Carnot cycle, thermodynamic temperature scale, entropy, change of entropy for different processes, equivalence of Kelvin plank and Clausius statements, Clausius inequality.

MODULE III AIR STANDARD CYCLES 9

Air standard efficiency - Otto cycle - diesel cycle - dual cycle - Brayton cycle - components of IC (piston) engines -Two stroke and four stroke cycle engines - performance of IC engine. Case study: Future of automobiles (fitted with IC engines) Vs Electrical vehicles.

MODULE IV REFRIGERATION AND AIR-CONDITIONING 9

Principle of Refrigeration – Vapour compression & Vapour absorption types – Coefficient of performance, Properties of refrigerants, Psychrometrics – Relative Humidity – WBT/DBT - Principle of Air conditioning – Types – Introduction to reciprocating air compressor- multi stage. Case study: Aircraft cabin air-conditioning.

MODULE V FUNDAMENTALS OF HEAT TRANSFER 9

Introduction to different modes of Heat Transfer: Conduction, convection and radiation heat transfer - heat conduction through composite walls, Different types of heat exchangers - heat transfer coefficient for parallel, counter and cross flow type heat exchanger- radiation properties. Case study: Jet Engine cooling – Effective heat transfer methods/techniques.

PRACTICAL

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. Performance test on an air-conditioning test rig
8. Performance test on 2-stage reciprocating air-compressor test rig
9. Determination of thermal resistance of a composite wall.
10. Determination of emissivity of a black body.
11. Determination of effectiveness of a parallel flow & counter flow heat exchangers.

L - 45; P - 30; TOTAL HOURS - 75

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. Yunus A. Cengel, Afshin J. Ghajar, “Heat and Mass Transfer - Fundamentals and Applications’, 6th Edition, McGraw Hill, 2020

COURSE OUTCOMES:

Students will be able to

CO1: Explain the physical concepts and implications of the first law of TD in practical applications

CO2: Use entropy calculations as a tool for evaluating irreversibility in engineering processes

CO3: Estimate the thermodynamic efficiency and power production of an arbitrary ideal cycle

CO4: Carry out a thermodynamic analysis of a basic power consumption and assess performance of refrigerator and air conditioners.

CO5: Estimate heat transfer rates for different engineering applications

Board of Studies (BoS) :

15th BoS of AERO held on 11.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	L							L		L	M	M
CO2	L	L	L	L								M	M	M
CO3	M	M	M	L								L	H	M
CO4	L	M	M	M								M	H	H
CO5	L	L	L	L								L	H	M

Note: L - Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Quality Education and Build resilient Infrastructure promote inclusive and sustainable industrialization and foster innovation.

Statement: Understanding the fundamentals of thermodynamics will pave way for designing innovative engineering appliances leading to resilient infrastructure and sustainable industrialization.

AED 2103	**FLUID MECHANICS**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To understand the properties of fluids and working methods of digital measuring devices.

COB2: To provide basic knowledge of governing equations of fluid flows.

COB3: To introduce the concepts of dimensional analysis and its applications.

COB4: To introduce the concepts of boundary layer and its purposes.

COB5: To provide basic knowledge of the working principles of pumps and turbines.

MODULE I BASIC CONCEPTS, FLUID PROPERTIES 10

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 – Introduction to digital pressure measurement systems- digital gauges- sensors.

MODULE II FLUID STATICS 8

Fluid statics: concept of fluid static pressure, hydrostatic pressure distribution, hydrostatic forces on plane and curved surfaces, buoyancy and stability, pressure. Case studies: pressure distribution overimmersed bodies.

MODULE III KINEMATICS OF FLUIDS AND GOVERNING EQUATIONS OF FLOW & DIMENSIONAL ANALYSIS 11

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, Dimensional homogeneity, Dimensional analysis and Similarity, Buckingham Pi theorem. Case studies: behavioural study of different types of flows.

MODULE IV INTERNAL FLOWS & BOUNDARY LAYER CONCEPTS 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. Fundamental concepts, Boundary layer equations, Boundary layer over a flat plate, Momentum integral equation, Flow separation. Concept of thermal boundary layer. Case studies: losses occurred in internal flows.

MODULE V TURBOMACHINERY 6

Introduction and classification. Pumps: Performance curves, Dynamic pumps, Centrifugal pumps, Axial pumps. Pump scaling laws. Turbines: Positive-displacement turbines, Dynamic turbines, Impulse turbines, Reaction turbines, Turbine scaling laws.

PRACTICALS

1. Comparison of coefficients of discharge of given Orifice meter and Venturi meter.
2. Velocity measurement using Pitot Static tube.
3. Determination of major and minor losses in pipes.
4. Calibration of Roto meter.
5. Impact of jet on flat and curved vanes
6. Determination of friction factor for the given set of pipes.
7. Performance test on a jet pump.
8. Performance study of Centrifugal pump
9. Determination of maximum efficiency for the given Reciprocating pump.
10. Determination of the maximum power at constant speed / constant load for an Impulse turbine/ Reaction turbine.

L – 45 ; P – 30 ; TOTAL HOURS –75

TEXT BOOKS:

1. Cengel, Yunus A. Fluid mechanics. Tata McGraw-Hill Education, 2010.
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.
3. APS/DFD Gallery of Fluid Motion.

COURSE OUTCOMES:

Students will be able to

CO1: identify and relate to different kinds of fluids and flows.

CO2: derive and apply the governing equations of fluid flow to solve practical problems.

CO3: evaluate losses in pipe flow systems, and use the principles of dimensional analysis to design realistic and accurate experiments.

CO4: solve the basic problems involved in boundary layer concept.

CO5: apply the knowledge of pumps and turbines to solve basic problems of fluid machinery.

Board of Studies (BoS) :

15th BoS of AERO held on 11.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M					L				L		H	L
CO2	H	M									M		H	L
CO3	H	M	L	M	L		L				M		H	
CO4	H	M	L	L							H		H	
CO5	H	H	L	L						L	L	L	H	L

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Through understanding fluid properties, statics, dynamics, and boundary layer concepts, students learn to analyze and design systems crucial for sustainable infrastructure, such as water supply networks, transportation systems, and renewable energy technologies.

AED 2104 SDG:4,9	AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To identify & select suitable materials for different parts of aircraft based on their characteristics and properties

COB2: To gain knowledge about engineering behaviour of materials and study effects, protection against corrosion of aircraft materials.

COB3: To study various heat treatment processes of aircraft metals and alloys.

COB4: To acquire knowledge on basics of different ceramic and composite materials.

COB5: To gain better understanding about metal working processes and welding methods used in aerospace industries.

MODULE I SELECTION OF MATERIALS FOR AIRCRAFT 6

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.

MODULE II MECHANICAL BEHAVIOUR OF MATERIALS & CORROSION 10

Linear and nonlinear 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 10

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 9

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

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MODULE V METAL WORKING PROCESSES AND WELDING 10

Metal working processes used in the manufacture of aircraft materials or components - Hot-working - Cold-working – Rivet joints, methods of riveting, types - 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.

L - 45 ; 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.

COURSE OUTCOMES:

Students will be able to

- **CO1:**select and suggest suitable materials for different parts of aircraft based on their characteristics and properties.
- **CO2:**gain knowledge on engineering behaviour of materials and effects of corrosion on materials.
- **CO3**:identify the need for different alloying materials and heat treatment processes involved.
- **CO4**: acquire knowledge on types and applications of different ceramic and composite materials.
- **CO5**: employ different metal working processes and welding methods used in aerospace industries.

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	L								L	L	M	H
CO2	L	L	M	L								M	M	M
CO3	M	M	M	L							L	L	H	M
CO4	L	M	M	M								M	H	H
CO5	L	M	M	L							L	L	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4 & 9: Quality Education and Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The course provides an extensive understanding of the diverse materials employed in aircraft and their respective manufacturing techniques.

		L	T	P	C
AED 2105	**AIRCRAFT COMPONENT AND ASSEMBLY DRAWING LABORATORY**	**0**	**0**	**2**	**1**
SDG: 09					

COURSE OBJECTIVES:

COB1: To train the students to draft basic aircraft components using modelling packages

PRACTICALS

List of Experiments:

1. Sketches and Part modeling
2. Modeling of riveted joints (Lap joint).
3. Modeling of riveted joints (Butt joint with single and double straps).
4. Construction of airfoil.
5. Layout of typical wing structure.
6. Layout of typical fuselage structure.
7. Computer aided modeling of typical aircraft wing.
8. Computer aided modeling of typical fuselage structure.
9. Computer aided modeling of Aircraft control surfaces.
10. Three view diagrams of a typical aircraft
11. Exposure to different CAD modeling software.

P – 30; Total Hours - 30

REFERENCES:

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

COURSE OUTCOMES:

CO1: Gain hands-on experience in drafting aircraft components and structuresusing computer-aided modeling.

CO2: Gain knowledge and experience in drawing the layout of aircraft & controlsystems using computer-aided modeling.

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M										L	M
CO2	M	M	M										L	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: understand the modeling of aircraft components using various CAD softwares

GED 2101	**ESSENTIAL SKILLS AND APTITUDE FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 17		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1:To enable them to make effective business presentations

COB2:To train them to participate in group discussions

COB3: To enhance the problem-solving skills

COB4: To train students in solving analytical problems

MODULE I ORAL DISCOURSE 07

Importance of oral communication-verbal and non-verbal communication, Presentation Strategies- one minute presentation (using Audacity/vocaro) - Effective listening skills, listening for specific information

MODULE II VERBAL COMMUNICATION 08

Understanding negotiation, persuasion & marketing skills - Listening to short conversations & monologues - Group Discussion techniques - Role plays - Interview techniques

MODULE III BASIC NUMERACY 08

Simplification and Approximation – Competitive Examination Shortcut Techniques - Number Systems - Simple and Compound Interest-Progression

MODULE IV ANALYTICAL COMPETENCY 07

Blood Relations – Clocks and Calendars – Coding and Decoding – Analytical Reasoning(Linear Arrangement, Circular Arrangement, Cross Variable Relationship and Linear Relationship)– Directions .

P – 30; TOTAL HOURS - 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
2. Swan, Michael (2005). Practical English Usage, Oxford University Press
3. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi.

4. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
5. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
6. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
7. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
8. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
9. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Make effective business presentations

CO2: Speak English intelligibly, fluently and accurately in group discussions

CO3: To apply the various problem-solving techniques

CO4: Understand and solve aptitude problem

Board of Studies (BoS) :

13thBoS of the Department of English held on 17.6.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1										H					
CO2									M	H					
CO3					L	L									
CO4		M		L											
CO5															

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Statement: This course ensures capacity building and skills development requisite for implementing global partnership.

AED 2211	LOW SPEED AERODYNAMICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the governing equations and basic aerodynamic concepts like circulation, vorticity.

COB2: To learn the fundamental equations of inviscid incompressible flow.

COB3: To gain the theoriesinvolved for designing airfoil.

COB4: To introduce the concept of classical thin airfoil theory and Prandtl's lifting linetheory for wings.

COB5: Introduce the basics of viscous flow.

MODULE I FUNDAMENTAL EQUATIONS OF AERODYNAMICS 10

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. Case studies: application of governing equations.

MODULE II FUNDAMENTALS OF INVISCID INCOMPRESSIBLE FLOW 9

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 – KuttaJoukowski 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, 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 LAMINARAND TURBULENT BOUNDARY LAYER 7

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

L – 45 ; Total Hours - 45

TEXT BOOKS:

1. Anderson Jr, John David. Fundamentals of aerodynamics. Tata McGraw-Hill Education, 2010.
2. Schlichting, Herrmann, and Klaus Gersten. Boundary-layer theory. Springer Science & Business Media, 2003.
3. E. Rathakrishnan, Theoretical Aerodynamics, John Wily & Sons, 2013.

REFERENCES:

1. Houghton, Edward Lewis, and Peter William Carpenter. *Aerodynamics for engineering students*. Elsevier, 2003.
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

COURSE OUTCOMES:

Students shall be able to

CO1: Identify the importance and limitations of potential flow theory and formulate the mathematical express of fundamental equations of fluid flows.

CO2: Make the equation which is suitable for inviscid incompressible flow problems.

CO3: Perform simple calculations for the estimation of the lift characteristics of airfoils using circulation theory/ thin airfoil theory.

CO4: Estimate the induced drag characteristics and lift characteristics of finite wings.

CO5: Perform simple laminar and turbulent boundary layer calculations.

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	H	L					M	L			L	L	H	M
CO2	H	L					M	L			L	L	H	M
CO3	H	H	M					M					H	M
CO4	H	H	M					M					H	M
CO5	H	H		M				M		H			H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement : The holistic understanding of aerodynamics and its role of fluid flow problems leads to makes the better safety and performance for aircraft design industry

		L	T	P	C
AED 2212	**AIRCRAFT STRUCTURAL MECHANICS**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Understand the different loads experiencedduring aircraft flight and determine the loads on different structural member

COB2: Study the load estimation for indeterminate Structural members

COB3: Obtain the critical load relation for inelastic buckling

COB4: Study various energy methods and find loads for different structural members

COB5: Understand different failure mechanism of aircraft structural components for safe design.

MODULE I LOADS AND STATICALLY DETERMINATE STRUCTURES 12

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

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

MODULE II STATICALLY INDETERMINATE STRUCTURES 11

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

MODULE III COLUMN 7

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

MODULE IV ENERGY METHODS 8

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 V FAILURE THEORY 7

Maximum principle Stress theory, Maximum principle Strain theory, shear stress theory, distortion energy theory, octahedral shear stress theory, case study: failure theory for composite materials.

L - 45; TOTAL HOURS – 45

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.

COURSE OUTCOMES:

CO1: Identify and relate different kinds of load factors experienced in aircraft flight and Estimate the load bearing capability of different structural members used in the construction of aircraft.

CO2: Extend the concepts of solid mechanics to in-determinate structural problems.

CO3: Give a theoretical design ofcolumns subjected to various loads.

CO4: Obtain theoretical predictions of structural behavior using energy methods.

CO5: Acquire knowledge on failure theories and to predict the values of the stress at which the structure fails.

Board of Studies (BoS):	**Academic Council:**
15th BoS of AERO held on 11.12.2021	18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	M	-	M	-	-	-	L	-	L	H	M
CO2	H	H	H	M	-	M	-	-	-	L	-	H	H	M
CO3	H	H	H	M	-	M	-	-	-	M	-	H	H	M
CO4	L	L	H	M	-	M	-	-	-	1	-	H	L	M
CO5	L	L	H	H	-	M	--	-	--	M	-	H	L	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: understanding of various types of loads acting on an aircraft and obtain the solution for indeterminate structures & types of failure theory.

AED 2213	**PROPULSION I**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the fundamental of aero engines and the working principles of different types of aero engines.

COB2: To study and analyse about propeller aerodynamic theories and their applications.

COB3: To analyse the design aspects and flow features of subsonic intakes.

COB4: To study and analyze design aspects and performance characteristics of compressors.

COB5: To study and analyse the design parameters of exhaust nozzles and thrust vector control mechanism.

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 Turboshaft - Performance characteristics and analysis, Ideal and Real Brayton cycles - analysis, Methods of thrust Augmentation.

MODULE II PROPELLER THEORY 8

Propeller fundamentals, propeller aerodynamic theories – momentum, blade elemental and vortex theory. Introduction to helicopter, Drone and marine propellers.

MODULE III SUBSONICINTAKES 8

Inlets for transport Aircrafts and Military Aircrafts, Internal flow and Stall in subsonic intakes – Boundary layer separation – Major features of external flow near a subsonic intake -Relation between minimum area ratio and external deceleration ratio – Performance of subsonic intake and diffuser.

MODULE IV COMPRESSORS 12

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.

MODULE V COMBUSTION SYSTEMS 8

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

L – 45;TOTAL HOURS – 45

TEXT BOOKS:

1. Saravanamuttoo, H.I. H., Rogers, G.F.C., CohenH., PaulStraznicky, “GasTurbineTheory”,7th Edition, Pearson Education Canada,2018.
2. Hill Philip, Peterson Carl, “Mechanics and Thermodynamics of Propulsion”, 2nd Edition, Addison Wesly, 2009.

REFERENCES:

1. KroesMichaelJ,Wild ThomasW,“Aircraft Powerplants”,7th Edition, TataMc Graw Hill, 2010.
2. MattinglyJ.D.,“Elements of GasTurbine Propulsion”, TataMcGraw Hill,2005.
3. ElSayedAhmed, “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.

COURSE OUTCOMES:

At the end of the courseStudents will be able to

CO1: Get perspective of different types of jet engines used in aircraft.

CO2: Apply design concepts in propeller blade design.

CO3: Learn engineering features of subsonic intakes of jet engines.

CO4: Analyze axial type compressor and fan design aspects and performance characteristics.

CO5: Acquire basic knowledge on combustion systems used in jet engines.

Board of Studies (BoS) :

5th BoS of AERO held on 11.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	L	L	-	-	-	-	-	-	-	H	H
CO3	M	M	M	L	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	L	L	-	-	-	-	-	-	-	H	H
CO5	H	H	H	L	L	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course covers the fundamental knowledge of aero engines and design aspect of aero engine components results in satisfying aerospace industry challenges.

		L	T	P	C
AED 2214	**AIRCRAFT SYSTEMS AND INSTRUMENTS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To introduce the basic knowledge of flight control system and its types.

COB2: To impart knowledge of the hydraulic and pneumatic systems components and its operation.

COB3: To acquaint the students to basic engine components and their applications.

COB4: To introduce some knowledge about the cabin comfort system and its applications.

COB5: To gain the basic knowledge of navigational instruments to the students.

MODULE I AIRPLANE CONTROL SYSTEMS 9

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 II AIRCRAFT SYSTEMS 10

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 III ENGINE SYSTEMS 9

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 AIRCONDITIONING AND PRESSURIZING SYSTEM 8

Basic air cycle systems – vapour cycle systems, boot-strap air cycle system – evaporative vapour cycle systems – evaporation air cycle systems –Cabin Pressurisation control System- oxygen systems – fire protection systems, de-icing and anti-icing system.

MODULE V AIRCRAFT INSTRUMENTS 9

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

PRACTICALS

List of Experiments

1. Aircraft Jacking Up procedure
2. Aircraft Levelling 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. Functional Test to adjust operating pressure
8. Pressure Test procedure on fuel system components
9. Brake Torque Load Test on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.

L – 45; P – 30 ; TOTAL HOURS – 75

TEXT BOOKS:

Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.

Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co, 1993.

REFERENCES:

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

COURSE OUTCOMES:

Students will be able to

CO1: introduce the basic knowledge of flight control system and its types.

CO2: impart knowledge of the hydraulic and pneumatic systems components and its operation.

CO3: acquaint the students to basic engine components and their applications.

CO4: introduce some knowledge about the cabin comfort system and its applications.

CO5: gain the basic knowledge of navigational instruments to the students.

Board of Studies (BoS) :

15th BoS of AERO held on 11.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	L	L	-	-	-	-	-	-	-	H	H
CO3	M	M	M	L	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	L	L	-	-	-	-	-	-	-	H	H
CO5	H	H	H	L	L	-	-	-	-	-	-	-	H	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement : Understanding operating principles of various instruments used in the aircraft

AED 2215	**EXPERIMENTAL AERODYNAMICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To introduce the concept and working principle of low speed wind tunnel.

COB2: To introduce the concept and working principle of high speed wind tunnel.

COB3: To familiarize the various parameter measuring techniques.

COB4: To gain the knowledge behind the different flow visulazation methods applied in fluid flows.

COB5: To introduce the concept of hypersonic flow and its flow regimes.

MODULE I LOW-SPEED WIND TUNNEL 10

Introduction of Wind tunnel - Classification of wind tunnels- Applications of wind tunnels - Non-dimensional simulationparameters. Irregularities of flow in low-speed tunnels, Reduction of turbulence - Effect ofscreens on turbulence - Honeycombs - Wind tunnel contractions -The diffuser,Losses in wind tunnel circuit, Power requirements – Power economy bypressurization - Power economy by choice of working fluid - Power economyby reduction in stagnation temperature.

MODULE II HIGH-SPEED WIND TUNNEL 10

Types of high-speed tunnels , Supersonic wind tunnels - Test section flow parameters - Dynamic pressure - Mass flow rate - Test section velocity Maximum velocity - Free stream Reynold'snumber, Components of supersonic wind tunnels - Air storagetanks - Settling chamber / wide angle diffusers Convergent - divergent (C-D) nozzle – Diffuser, Power required for the operation of supersonic wind tunnels, Closed circuit supersonic wind tunnel, Actual Flowin the supersonic wind tunnel -Starting the wind tunnel with the model inThetest section, Sizing of the wind tunnel model - Condensation and Liquefaction, Shock tubes – operation and equations.

MODULE III MEASUREMENT TECHNIQUES 10

Steady and unsteady pressure, velocity and temperature measurements – Force and moment measurements – three component and six component balances – internal balances – Principles of Hotwire anemometer, PIV, LD techniques. Skin friction drag calculation.

MODULE IV FLOW VISUALISATION 10

Requirements and importance of flow visualization techniques. Classification of various methods. Smoke and tuft grid techniques – dye injection special techniques – optical methods of flow visualization. Oil flow visualization.

MODULE V INTRODUCTION OF HYPERSONIC FACILITIES 5

Nature of hypersonic flow regime. Hypersonic facilities and Heating requirements for the simulation of re-entrybodies.

PRACTICALS

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 a various model - Car model / Building model / Launch vehicle model by flow visualization technique.
7. Flow over streamlined bodies with different angle of attack by flow visualization technique.
8. Supersonic flow visualization studies

L – 45 ; P – 30 ; TOTAL HOURS – 75

TEXT BOOKS:

1. Barlow J. B., Rae W.H. and Pope A., “Low speed wind tunnel testing” , 3 Rd Edition, Wiley-Interscience, 1999.

2. Pope. A and Goin K.L., “High speed wind tunnel testing”, John Wiley, 1985.

3. Van Dyke, Milton, and Milton Van Dyke. An album of fluid motion. Vol. 176. Stanford: Parabolic Press, 2002.

4. Josyula, Eswar, ed. Hypersonic nonequilibrium flows: fundamentals and recent advances. American Institute of Aeronautics and Astronautics, Inc., 2015.

REFERENCES:

1. Anderson Jr, John David. Fundamentals of aerodynamics. Tata McGraw-Hill Education, 2010.
2. Anderson, J.D., “Introduction to Flight”, 5ThEdition (Special Indian Edition),2009.

3. Bendat J.S., and Peirsol A. G., “Random Data Analysis and MeasurementProcedures”, 4ThEdition, Wiley, 2010.
4. Rathakrishnan, Ethirajan. Instrumentation, measurements, and experiments in fluids. CRC press, 2020.
5. Goldstein R. J. (Ed.), Francis T., “Fluid Mechanics Measurements”, TaylorFrancis, Washington 2017.
6. W-J Yang, “Handbook of Flow Visualization”, 2NdEdition, Taylor and Francis,2001.
7. Tropea C., Yarin A., Foss F. J. (Eds.), “Handbook of Experimental FluidMechanics”, Springer, 2009.

COURSE OUTCOMES:

Students will be able to

CO1: handle the low-speed wind tunnel with its accessories.

CO2: carry out the pressure distribution experiment and able to find the coefficient of pressure value.

CO3: identify the measuring instruments used for various parameter measurment.

CO4: explore the flow visualization outcome of bluff bodies and streamline bodies.

CO5: identify the facilities required for safe landing of reentry vehicles.

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18^{th} Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	M	L	L		L			M	M	L	H	L
CO2	H	M	M	L	L		L			M	M	L	H	L
CO3	H	M	M	M	M		M			H	H	L	H	L
CO4	H	M	M	M	M		M			H	H	L	H	L
CO5	H	M	M	M	M		M			H	H	L	H	L

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement : the holistic understanding of various experimental measuring tecniques for low and high speed flows

AED 2216	SOLID MECHANICS LABORATORY	L	T	P	C
SDG: 09		0	0	2	1

COURSE OBJECTIVES:

COB1: To provide training in testing and evaluation of mechanical properties of thematerials like hardness, fatigue strength, tensile strength, flexural strength,rigidity modulus etc.

PRACTICALS

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.

P – 30; TOTAL HOURS - 30

REFERENCES:

1. R. C. Hibbeler, – 'Mechanics of Materials' – Prentice Hall – 2013 – 9th Edition
2. James M. Gere -'Mechanics of Materials' – CENGAGE Learning Custom Publishing – 2012 – 8th Edition

COURSE OUTCOMES:

CO1: Evaluate the mechanical properties of materials and compare it with theoretical models.

CO2: Understand the fracture pattern of different specimen.

Board of Studies (BoS):
14thBoS of Aero held on 19.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	M	M									H	M
CO2	H	L	M	M									H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement:The holistic understanding of different material testing to identified properties like strength, toughness and hardness etc.

GED 2201	**WORKPLACE SKILLS AND APTITUDE FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 8		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To expose them to reading for specific purposes, especially in professional contexts

COB2: To expose them to the process of different kinds of formal writing

COB3: To prepare the students to be successful in their career

COB4: To familiarize various problem-solving techniques in aptitude and puzzles.

MODULE I EXTENSIVE READING & WRITING 07

Reading for comprehension - inferring and note-making – Process of writing-paragraph development - elements of business writing: Email, memos.

MODULE II INTENSIVE READING & WRITING 08

Intensive reading and reviewing - Interpretation of charts, graphs - Résumé - Letter of enquiry, thanksgiving letters.

MODULE III QUANTITATIVE APTITUDE 08

Percentage - Ratio and Proportion - Profit and Loss – Averages, Allegations and Mixtures.

MODULE IV LOGICAL COMPETENCY 07

Syllogism – Blood Relations- Number, Alpha and Alpha numeric series - Puzzles – Cubes and Dice - Odd One Out-Coding and Decoding

L – 30; Total Hours - 30

REFERENCES:

1. Sharma, R.C. and Mohan, Krishna (2010). Business Correspondence and Report Writing. 4th edition. Tata McGraw Hill Education Private Limited, New Delhi
2. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Demonstrate reading skills with reference to business related texts

CO2: Draft professional documents by using the three stages of writing

CO3: Apply various short cut techniques for solving complicated aptitude problems

CO4: To understand various problems and patterns of different ways to solve it

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		L		H						H				
CO2			L							H				
CO3			L				M							
CO4		H		M										
CO5														

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: Demonstrating, Drafting and applying various techniques for sustainable growth to employment.

GED 2202	**INDIAN CONSTITUTION AND HUMAN RIGHTS**	**L**	**T**	**P**	**C**
SDG: 16		**2**	**0**	**0**	**0**

COURSE OBJECTIVES:

COB1: To explicate the emergence and evolution of Indian Constitution.

COB2: To have an insight into the philosophy of fundamental rights and duties, and Directive Principles.

COB3: To differentiate the structure of executive, legislature and judiciary.

COB4: To understand human rights and its implication - local and international and redressal mechanism.

MODULE I INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION 8

Meaning of the constitution law and constitutionalism - Historical Background of the Constituent Assembly - Government of India Act of 1935 and Indian Independence Act of 1947 - The Constituent Assembly of India - Enforcement of the Constitution - Indian Constitution and its Salient Features - The Preamble of the Constitution. Citizenship.

MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES 7

Fundamental Rights and its Restriction and limitations in different complex situations - Directive Principles of State Policy (DPSP) & its present relevance in our society with examples- Fundamental Duties and its Scope and significance in nation building - Right to Information Act 2005.

MODULE III GOVERNANCE IN INDIA 8

The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions. The Union legislature – The Parliament – The Lok Sabha and the Rajya Sabha, Composition, powers and functions – Government of the State - The Governor – the Council of Ministers and the Chief Minister – Powers and Functions-Elections-Electoral Process and Election Commission of India - Indian judicial system.

MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION 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 - Roles of National Human Rights Commission of India -

Special Constitutional Provisions for SC & ST, OBC - Special Provision for Women, Children & Backward Classes.

L – 30; Total Hours – 30

TEXT BOOKS:

1. B.K. Sharma, Introduction to the Constitution of India, 6th ed., PHI Learning Private Limited, New Delhi 2011

2. Durga Das Basu "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th / 20th Edn. 2008

3. M.P. Jain, Indian Constitutional Law, 7th ed., LexisNexis, Gurgaon. 2014.

REFERENCES:

1. Fadia B.L "Indian Government and Politics", Sahitya Bhavan Publications. 2010
2. Kashyap Subhash C "Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT. 2017
3. M.V.Pylee "An Introduction to Constitution of India", Vikas Publishing. 2002
4. Sharma Brij Kishore "Introduction to the Indian Constitution", 8th Edition, PHI Learning Pvt. Ltd. 2015
5. Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: describe the emergence and evolution of Indian Constitution.

CO2: realize the status and importance of fundamental rights, fundamental duties and directive principles of state policy and relation among them by understanding the articulation of its basic values under the Constitution of India.

CO3: compare the various structure of Indian government.

CO4: recognize the human rights, cultural, social and political rights and its relationship with Indian constitution. .

Board of Studies (BoS) :	**Academic Council:**
4thBoS of SSSH held on 28.06.2021	17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			M			H	M	L	M		M	
CO2			H			M	H	M			H	
CO3			M			H	M	L			L	
CO4			H			H	H	M	M			H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Application of human, legal and political rights leading to empowerment in real-life situations for protection of fundamental freedoms and freedom from violence, abuse, trafficking and exploitation are at the core of human rights.

SEMESTER V

MSD 3181	**FUNDAMENTALS OF ENTREPRENEURSHIP**	**L**	**T**	**P**	**C**
SDG: All 1-17.		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fit between individual and their entrepreneurial ambitions.

COB2: To identify the customers and find a problem worth solving.

COB3: To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas

COB4: To develop a solution for customers' problem and analyze the problem solution fit & product market fit.

COB5: To build and demonstrate a Minimum Viable Product (MVP) for startup

MODULE I — PROBLEM IDENTIFICATION AND OPPORTUNITY DISCOVERY — 9

Entrepreneurial Thinking, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study

MODULE II — CUSTOMER, SOLUTION AND BUSINESS MODEL — 10

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

MODULE III — VALIDATION AND FINANCIALS — 10

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 — GO TO MARKET — 8

Positioning and Branding, Golden Circle model: Sinek's theory value proposition, Branding Elements, Market Penetration Strategy, Collaboration Tools and Techniques, Channels – Case Study

MODULE V MANAGING GROWTH AND FUNDING 8

Sales Planning, Customer Acquisition Strategy, Selling Skills, Identifying Funding Sources, Mapping Start-Up Cycle to Funding Options, Funding Plan, , Creating business valuation

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. https://web.nen.wfglobal.org/en/home - Wadhwani Foundation
3. W. Chan Kim , Renée A. Mauborgne, "Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant", Harvard Business Press, 2015.

REFERENCES:

1. Anil Lamba , "Romancing the Balance Sheet: For Anyone Who Owns, Runs Or Manages a Business", HarperCollins Publishers India, 2016.
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
3. "Anatomy of Business Plan" – Linda Pinson, OMIM publication , Seventh Edition, 2008.
4. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process

CO2: Craft solution to the problem through value proposition canvas and develop a business model using lean canvas

CO3: Provide product solution demo and deliver a minimum viable product

CO4: Work as a team and create brand strategy marketing for product/service

CO5: Prepare, make an outstanding sale pitch for startup

AED 3101	**PROPULSION II**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To analyse the design aspects and flow features of supersonic intakes.

COB2: To analyze design aspects and performance characteristics of axial and radial type turbines.

COB3: To study the matching characteristics of jet engines compressor and turbine.

COB4: To study and analyse the design parameters of exhaust nozzles and thrust vector control mechanism.

COB5: To give exposure about preliminary concepts of ramjet and scramjet engine.

MODULE I SUPERSONIC INTAKES 8

Supersonic inlet flows - Starting problems in supersonic inlets — Shock swallowing by area variation - External deceleration - Modes of inlet operation – Supersonic inlet performance.

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 8

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.

MODULE IV NOZZLES 10

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 V 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.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

At the end of the course Students will be able to

CO1: Apply and analyze design features of supersonic intakes of jet engines.

CO2: Analyze axial and radial type turbines design aspects and performance characteristics.

CO3: Do matching of jet engines compressor and turbine.

CO4: Apply the basic design features of exhaust nozzles.

CO5: Do preliminary design of ramjet & scramjet propulsion systems.

Board of Studies (BoS):	**Academic Council:**
16th BoS of Aero held on 03.08.2022	19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: This course gives design exposure about aero engines components and matching procedure.

		L	T	P	C
AED 3102 **SDG: 09**	**AIRCRAFT STRUCTURAL DESIGN AND ANALYSIS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Study the bending stress distribution for unsymmetrical thin wall members

COB2: Obtain the shear flow distribution for open section Structural members

COB3: Obtain the shear flow distribution for closed section Structural members

COB4: study the bukling stresses for thin plates

COB5: Obtain the shear force and bending moment distribution for Aircraft Structural components

MODULE I SHEAR FLOW IN OPEN SECTIONS 10

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 STATICALLY IN DETERMINATE STRUCTURES 10

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

MODULE III SHEAR FLOW IN CLOSED SECTIONS 9

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 9

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 7

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

L - 45; TOTAL HOURS – 45

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. 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.

COURSE OUTCOMES:

CO1: Analyze the bending stresses of the structural members of aircraft under different loading conditions.

CO2: Analyze the shear flow of the open walled thin sections of the aircraft under different loadings.

CO3: Analyze the shear flow of the closed walled thin sections of the aircraft under different loadings.

CO4: Obtain analytical solutions for the buckling of thin plates.

CO5: Carry out stress analysis on thin walled Structures such as wing and fuselage under different loading conditions.

Board of Studies (BoS):
16th BoS of Aero held on 03.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The holistic understanding of bending stress and shear flow distribution in the thin Structural members

AED 3103	HIGH SPEED AERODYNAMICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the concepts of compressibility.

COB2: To make the student understand the theory behind the formation of normal and oblique shocks.

COB3: To understand the basics of expansion waves at supersonic flows.

COB4: To introduce the various methods used for solving supersonic flow problems.

COB5: To introduce the compressible flow theories to assess the flow over wings.

MODULE I ONE DIMENSIONAL COMPRESSIBLE FLOW 9

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 AND OBLIQUE SHOCK WAVES 9

Prandtl equation and Rankine – Hugonoit relation, normal shock equations, Pitot static tube corrections for supersonic flows. Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak, and detached shocks,

MODULE III EXPANSION WAVES AND NOZZLE CONTOUR 9

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 9

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 WING CHARACTERISTICS IN HIGH-SPEED FLOWS 9

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

L – 45; 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.
4. Rathakrishnan, E., “Gas Dynamics”, 6th Edition, Prentice Hall of India, 2017.

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.

COURSE OUTCOMES:

Students will be able to

CO1: Perform one-dimensional isentropic flow calculations.

CO2: apply normal shock/oblique shock relations for calculation of flow field properties.

CO3: use Prandtl-Meyer expansion and Method of Characteristics to obtain 2D supersonic nozzle contour.

CO4: estimate the performance of swept wings at high speed flight.

CO5: Predict the properties of hypersonic flows.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The holistic understanding of high-speed flow characteristics leads to encourage the quality of design in sustainable industrialization.

AED 3104	CONTROL ENGINEERING	L	T	P	C
SDG: 09		2	0	2	3

COURSE OBJECTIVES:

COB1: To analyze the system modeling and various methods of representation.

COB2: To provide adequate knowledge on time response analysis of systems and steady-state error calculations.

COB3: To educate the necessity for frequency domain analysis using numerous plots and enhance knowledge of stability analysis

COB4: To provide knowledge on the design procedure of compensators and its applications and state space approach

MODULE I SYSTEM REPRESENTATION AND ANALYSIS 7

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 DOMAIN ANALYSIS 7

Time response – Time domain specifications – Types of test input – First order system - Type I and Type II System – Response - Error coefficients – Steady state error – P, PI, PID modes of feedback control - Tuning of PID Controller using MATLAB

MODULE III FREQUENCY DOMAIN ANALYSIS & STABILITY 10

Performance specifications - correlation to time domain specifications - bode plots – gain and phase margin - 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.

MODULE IV COMPENSATOR DESIGN & MODELING IN STATE SPACE 6

Compensator design using bode plots: Lag, Lead, Lead-Lag Compensator. Realization of Lag, lead, and Lead-Lag networks - Introduction to State Space Approach

PRACTICALS

- Transfer function of separately excited DC Generator and determine the stability using pole-zero map.
- Time response analysis of a Type-1 system with the standard test inputs.
- Stability analysis of a system using Bode plot.
- Stability analysis of a control system using Root locus.
- State space model of a Quadcopter.
- State space model of an IMU System.
- Lag, Lead, and Lag-Lead compensator design.
- Design of P, PI, and PID controller for a first-order system.
- Study of synchro for angle detection in Radar.

L – 30 ; P – 30 ; TOTAL HOURS –60

TEXT BOOKS:

3. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
4. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New age International Publishers, 2003.
5. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.

REFERENCES:

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

COURSE OUTCOMES:

Students will be able to

CO1: Analyze complex systems using mathematical models.

CO2: Get the time response of first and second-order systems analytically and interpret the response.

CO3: Perform frequency response analysis of physical systems and interpret the stability of the system

CO4: Design an appropriate compensator for the given system to meet the desired specifications and implement a state space approach for the process

Board of Studies (BoS):
16th BoS of Aero held on 03.08.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M					L				L		H	L	
CO2	H	M									M		H	L	
CO3	H	M	L	M	L		L				M		H		
CO4	H	M	L	L							H		H		
CO5	H	H	L	L						L	L	L	H	L	

Note: L - Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: This course provides insight into the process of designing controllers for diverse systems and assessing system stability through a range of mathematical techniques

AED 3105	**PROPULSION LABORATORY**	**L**	**T**	**P**	**C**
SDG: 9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To carryout experiments to study the free and force convection concepts.

COB2: To introduce the various performance parameters of propeller.

COB3: To study and analyse the free and wall jet application in exhaust nozzles.

COB4: To determine the various spray characteristics of injectors.

COB5: To expose students to solid fuels preparation, determination of calorific values of prepared fuel and ballistic evaluation.

PRACTICALS

List of Experiments:

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

P – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Saravanamuttoo, H.I. H., Rogers, G.F.C., Cohen H., Paul Straznicky, “GasTurbineTheory”,6th Edition, Pearson Education Canada,2008.
2. Hill Philip, Peterson Carl, “Mechanics and Thermodynamics of Propulsion”, Addison Wesly, 1992.

REFERENCES:

1. Kroes Michael J, Wild Thomas W, “Aircraft Power plants”,7th Edition, Tata Mc Graw Hill, 2010.
2. Mattingly J.D.,“Elements of Gas Turbine Propulsion”, Tata Mc Graw Hill, 2005.

3. El Sayed Ahmed, “Aircraft Propulsion and gas turbine engines”, Taylor and Francis (CRC press), 2008.
4. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons, 2000.
5. Roy Bhaskar,“ Aircraft Propulsion”, Elsevier(India),2008.

COURSE OUTCOMES:

At the end of the course Students will be able to

CO1: Validate the experimental and theoretical heat transfer coefficients.

CO2: Evaluate the performance of a typical propeller.

CO3: Calculate the heat of combustion of typical aviation fuels.

CO4: Discover the spray characteristics of injector.

CO5: Evaluate the ballistic characteristics of hybrid rocket motor.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	M	-	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	-	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	-	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	-	-	-	-	-	-	-	-	H	H
CO5	H	H	H	M	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The holistic understanding of heat transfer mechanism, jet flow characteristics, propeller performance, fuel energy calculation, solid fuel processing techniques and ballistic test of hybrid rocket motor.

GED 3101	**COMMUNICATION SKILLS FOR CAREER SUCCESS**	**L**	**T**	**P**	**C**
SDG: 4		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To develop students' proficiency in English at CEFR B2 level (Business Vantage)

COB2: To develop students' receptive skills (Listening and Reading) in a wide range of situations

COB3: To develop students' productive skills (Speaking and Writing) in a wide range of situations

COB4: To expose students to the nuances of the English language, grammar and usage.

MODULE I BRIEF EXCHANGES OF COMMUNICATION 08

Listening to telephonic conversations - gap filling exercises- short conversations – Promoting a product-Reading short passages and answering matching tasks-Writing short notes and messages. - Framing questions

MODULE II WORKPLACE COMMUNICATION 07

Listening to monologues - gap filling exercises - Mini presentations- role play-Reading longer texts – gap filling- Writing memo , emails and Fax - Writing reports on conferences, seminars

MODULE III INTERPERSONAL COMMUNICATION 08

Listening to conversations – Collaborative discussion using prompts - Reading comprehension-multiple choice-texts - Writing enquiry letters & replies to customers

MODULE IV NEGOTIATING AND PERSUADING 07

Listening to interviews - Group Discussions - Multiple choice and gap filling-writing work reports- cause and effect - Complaint letter and sales letter

P-30: TOTAL HOURS - 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree Maitrey Printech Pvt. Ltd, Noida, 2016.
2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.

3. Simon Sweeney, ‘Communicating in Business’ Teacher’s Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, ‘Communicating in Business’ Student’s Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. ‘Business Vocabulary in Use’. Advanced. Cambridge University Press, Cambridge, 2004

COURSE OUTCOMES:

CO1: Use the LSRW skills effectively in business and general situations

CO2: Demonstrate receptive skills effectively in various formal and informal communication situations.

CO3: Demonstrate productive skills effectively in various formal and informal communication situations

CO4: Use appropriate grammar and vocabulary in any context.

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3	PSO 4	PSO 5
CO1									M	H							H
CO2									M	H							H
CO3									M	H							H
CO4										H							M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

GED 3101	**COMMUNICATION SKILLS FOR CAREER SUCCESS**	**L**	**T**	**P**	**C**
SDG: 4		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To develop students' proficiency in English at CEFR B2 level (Business Vantage)

COB2: To develop students' receptive skills (Listening and Reading) in a wide range of situations

COB3: To develop students' productive skills (Speaking and Writing) in a wide range of situations

COB4: To expose students to the nuances of the English language, grammar and usage.

MODULE I BRIEF EXCHANGES OF COMMUNICATION 08

Listening to telephonic conversations - gap filling exercises- short conversations – Promoting a product-Reading short passages and answering matching tasks-Writing short notes and messages. - Framing questions

MODULE II WORKPLACE COMMUNICATION 07

Listening to monologues - gap filling exercises - Mini presentations- role play-Reading longer texts – gap filling- Writing memo , emails and Fax - Writing reports on conferences, seminars

MODULE III INTERPERSONAL COMMUNICATION 08

Listening to conversations – Collaborative discussion using prompts - Reading comprehension-multiple choice-texts - Writing enquiry letters & replies to customers

MODULE IV NEGOTIATING AND PERSUADING 07

Listening to interviews - Group Discussions - Multiple choice and gap filling-writing work reports- cause and effect - Complaint letter and sales letter

P-30: TOTAL HOURS - 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree Maitrey Printech Pvt. Ltd, Noida, 2016.
2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.

3. Simon Sweeney, ‘Communicating in Business’ Teacher’s Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, ‘Communicating in Business’ Student’s Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. ‘Business Vocabulary in Use’. Advanced. Cambridge University Press, Cambridge, 2004

COURSE OUTCOMES:

CO1: Use the LSRW skills effectively in business and general situations

CO2: Demonstrate receptive skills effectively in various formal and informal communication situations.

CO3: Demonstrate productive skills effectively in various formal and informal communication situations

CO4: Use appropriate grammar and vocabulary in any context.

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3	PSO 4	PSO 5
CO1									M	H							H
CO2									M	H							H
CO3									M	H							H
CO4										H							M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

AED 3106	**INTERNSHIP I**	**L**	**T**	**P**	**C**
SDG: 9		**0**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB 1: To build a network of professional relationships and contacts.

COB 2: To appreciate ideas to improve work effectiveness and efficiency by analysing challenges and considering skill sets acquired from the course.

GUIDELINES:

- The students shall undergo industry training in any industry relevant to the field study or internship at research organizations / eminent academic institutions for the minimum period of 15 days during the summer vacation of second year.
- In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.
- In the case of industry internship, 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 / academic organization.
- The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.
- The credit will be awarded in the 5th Semester.

COURSE OUTCOMES:

At the end of the course Students will be able to

CO 1: Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means.

CO2: Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course.

Board of Studies (BoS) :

16th BoS of AERO held on 03.08.2022.

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO 1	M	M	M	L	M	M	M	L	M	M	M	L	M	H
CO 2	H	H	H	M	H	H	H	M	H	H	H	M	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The student acquires industrial and business experience through internship and can promote new and innovative ideas in the work place after graduation. Also, the course facilitates the students to become a successful entrepreneur in their field of study.

SEMESTER VI

AED 3211	AVIONICS	L	T	P	C
SDG: 09		3	0	2	4

COURSE OBJECTIVES:

COB1: To understand the avionics system design development and integration using simulation tools.

COB2: To introduce the microprocessor, its architecture, and programming using the microprocessor.

COB3: To introduce the role of avionics systems and their architecture and data buses.

COB4: To introduce modern cockpit instruments and the power requirement of avionics systems.

COB5: To introduce various types of navigation systems, Fly-by-wire, voting, and built-in maintenance systems.

MODULE I INTRODUCTION 7

Need for Avionics in Civil and Military Aircraft systems– integrated avionics and weapon systems – typical avionics subsystems, design, technologies – the importance of ilities'.

MODULE II PRINCIPLE OF DIGITAL SYSTEMS 9

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

MODULE III DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – salient features and application of Data buses – MILSTD-1553B – ARINC 429 - Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design

MODULE IV FLIGHT DECKS AND COCKPITS 9

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 - Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit - radar – Electronic warfare

MODULE V NAVIGATION & FLIGHT CONTROL SYSTEMS 11

Introduction to Accelerometer and Gyroscope – Platform and Strap down – Navigation algorithms - INS system block diagram - introduction to GPS -system description -basic principles -position and velocity determination - Different types of radio navigation- ADF, VOR, DME – Hyperbolic Navigation Introduction.

Description of various elements of DFBW systems - Concept of redundancy and reliability - Built-in-test features, BIT and CFDs, Automatic Test Equipment - Civil and Military standards - Certification of Civil Avionics

PRACTICALS

DIGITAL ELECTRONICS

- Addition/subtraction of binary numbers.
- Multiplexer/demultiplexer 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 digits 7 segment display & switches & LED's.
- 16 channel analogs 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,
2. Goankar, R.S., “Microprocessors Architecture-Programming and applications”, Wiley and Sons Ltd., New Delhi, 1993.
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”, 3 rd. Edition, The English Book House, New Delhi.

COURSE OUTCOMES:

Students will be able to

CO1: Identify the use of various avionics systems and their advantages over the conventional system.

CO2: To program and perform the various operations using a microprocessor.

CO3: Acquire knowledge of the communication protocol and architecture of avionics systems.

CO4: Keep abreast of the basic principles, theory, and operation of modern cockpit display systems

CO5: work with a different navigation system and understand the basics of operation behind different flight control systems

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M					L				L		H	L	
CO2	H	M									M		H	L	
CO3	H	M	L	M	L		L				M		H		
CO4	H	M	L	L							H		H		
CO5	H	H	L	L						L	L	L	H	L	

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The holistic understanding of different types of Avionics control systems used in the aircraft and their functioning principles.

AED 3212	**FLIGHT DYNAMICS**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the basic equations of aircraft and its moments.

COB2: To introduce the study of various performance of an Aircraft.

COB3: To understand the longitudinal stability of the aircraft.

COB4: To know the various factors of directional stability of the aircraft.

COB5: To analyse the importance of dynamic stability of the aircraft

MODULE I FORCES ON THE AIRPLANE 09

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 09

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 manoeuvres, stick force gradients

MODULE IV LATERAL AND DIRECTIONAL STABILITY AND CONTROL 09

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

MODULE V DYNAMIC STABILITY 09

Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional. dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

L - 45; 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.
3. Etkin, B., “Dynamics of Flight Stability and Control”, Edn. 2, John Wiley, NY, 1982.
4. Mc Cornick B. W, “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1995

REFERENCES:

1. Nelson, R.C. “Flight Stability and Automatic Control”, McGraw Hill Book Co., 1998.
2. Babister, A.W., “Aircraft Dynamic Stability and Response”, Pergamon Press, Oxford, 1980.

COURSE OUTCOMES:

CO1: 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.

CO2: Construct the drag polar curve for low speed and high-speed aircrafts

CO3: Detect several factors and its controllability to make aircraft directional stability

CO4: Identify the different between stability and controllability

CO5: Recognize how the various wing sections of the aircraft helps to make lateral stability.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The course offers comprehensive insights into aircraft performance and its stability across various axes.

AED 3213	**AIRCRAFT DESIGN PROJECT**	**L**	**T**	**P**	**C**
SDG: 09		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To train the students on preliminary aircraft design work using suitable procedures to evolve the basic configuration design.

COB2: To introduce the essential equations and methods used for aircraft design process.

PRACTICALS

List of Experiments:

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.

P – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Daniel P Raymer “Aircraft Design A Conceptual Approach” Fourth Edition AIAA Education series, 1989.
2. John D Anderson Jr. “Introduction to Flight” 6th Edition Mcgraw Hill Publications, 2010.
3. Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986.
4. Kuechemann, D, “ The Aerodynamic Design of Aircraft, American Institute of Aeronautics publishers, 2012.

REFERENCES:

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

COURSE OUTCOMES:

Students will be able to

CO1: Identify information requirements and sources for aircraft design and evaluation.

CO2: Apply the fundamental principles of Aerodynamics, Flight performance & stability and propulsion to evolve the configuration of an aircraft.

CO3: Learn project management and time management skills.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M	

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement : The holistic understanding of parameter and variables used in aircraft performance and stability

AED 3214	**AIRCRAFT STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 09	**LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: 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. Determination of principal stresses on the beam with combined loading.
8. Calibration of photo-elastic material and determination of Stresses in circular discs and beams.
9. Determination of natural frequency of beams
10. Determination of pure shear on structure - Wagner 's beam.

P- 30: TOTAL HOURS – 30

COURSE OUTCOMES:

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

CO 1: Evaluate the material properties of aircraft structural members.

CO 2: Obtain experimental results of static and dynamic structural responses and compare with that of theoretical values.

CO 3: Determine the stress pattern for different cross sections using photo-elastic apparatus.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	H							M		H	H
CO2	H	M	L	M							M		H	H
CO3	H	L	L	L							M		H	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course allows the student to design and analyze aircraft structural components.

GED 3201 SDG: 4	REASONING AND APTITUDE FOR ENGINEERS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

COB1: To develop students' critical reading skills

COB2: To foster their writing skills

COB3: To enlighten the various methods of solving quantitative problems

COB4: To make students ready for clearing placement and competitive examination

MODULE I OBJECTIVE ENGLISH 07

Reading Comprehension - Sentence Rearrangement - Cloze Test – Error Spotting

MODULE II VOCABULARY DEVELOPMENT 08

Vocabulary (Synonyms and Antonyms, one word Substitutes, Spellings, Idioms and Phrases, etc) - Fill in the blanks - Paragraph Completion

MODULE III GENERAL MENTAL ABILITY 08

Time speed and Distance –Problems on Trains – Boats and Streams - Permutation and Combination - Probability

MODULE IV 07

Data Interpretation (charts, graphs, tables, data sufficiency, etc.) – Time and work-Pipes and Cisterns-Venn Diagrams-Mensuration

P- 30, TOTAL HOURS 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016

7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019

COURSE OUTCOMES:

CO1: Demonstrate their reading ability

CO2: Exhibit their vocabulary and writing skills

CO3: Apply the problem-solving techniques

CO4: Gain confidence mentally and be successful in their career

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										M		
CO2										H		
CO3										L		
CO4												M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

SEMESTER VII

		L	T	P	C
AED 4101	**COMPUTATIONAL FLUID DYNAMICS**	**L**	**T**	**P**	**C**
SDG: 4 & 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the basic equations governing fluid flow problems
COB2: To apply suitable discretization technique and appropriate grid generation technique for the chosen problem
COB3: To apply different CFD methods to solve fluid dynamic problems.
COB4: To explore use of CFD in real life engineering applications.
COB5: To familiarize the students with the use of commercial CFD packages/open Foam.

MODULE I GOVERNING EQUATIONS OF FLUID DYNAMICS 8

Review of Governing Equations - Conservation forms - The Navier-stokes equation - The Euler's equation - physical boundary condition - Hyperbolic equations - parabolic equation - elliptic equations - supersonic blunt body problems.

MODULE II BASICS OF DISCRETIZATION & GRID GENERATION 10

Finite differences, Difference equations, Explicit and Implicit approaches - Error and stability analysis. Finite volume techniques, Errors and uncertainty.
General transformation of the equations, Matrices and Jacobians, Stretched (Compressed) grids, Boundary- Fitted Coordinate System - elliptic grid generation, adoptive grids, modern development in grid generation, finite volume grid generation; unstructured meshes.

MODULE III CFD TECHNIQUES 10

The Lax-Wendroff Technique, MacCormack's Technique - Space marching, The relaxation technique and its use with low speed inviscid flow, Aspects of numerical dissipation and dispersion; Implicit (ADI) technique the pressure correction technique; Pressure correction formula, the SIMPLE algorithm.

MODULE IV APPLICATIONS 9

Quasi one-dimensional nozzle flow, Inviscid two-dimensional supersonic flow, Incompressible Couette flow, viscous supersonic flows over flat plate. Inviscid flow simulation, viscous flow/ boundary layer simulations – Introduction to Turbulence modeling

MODULE V INTRODUCTION TO CFD CODING & COMMERCIAL PACKAGES 8

Hands on training on use of commercial CFD packages and Open FOAM importance and usage - CFD in Machine Learning.

L – 45, TOTAL HOURS- 45

TEXT BOOKS:

1. John D. Anderson, Jr., "Computational Fluid Dynamics", McGraw-Hill, Inc., 1995.
2. T. J. Chung, "Computational fluid Dynamics", Cambridge University Press, UK 2013.

REFERENCES:

1. John C. Tannehill, Dale A. Anderson, Richard H. Pletcher," Computational fluid mechanics and Heat Transfer", Special Indian Edition, Taylor Francis, 1997.
2. S.V Partaker, "Numerical heat transfer and fluid flow", Hemisphere publishing Corp, Taylor & Francis group, Newyork, 1980.
3. Data-Driven Fluid Mechanics: Combining First Principles and Machine Learning, A book based on the von Karman Institute Lecture Series
4. H. Versteeg, W. Malalasekera, Introduction to Computational Fluid Dynamics, An: The Finite Volume Method, PHI; 2nd edition, 2007.

OUTCOMES:

Students will be able to

CO1: understand the basic equations governing fluid flow problems

CO2: apply suitable discretization technique and appropriate grid generation technique for the chosen problem

CO3: apply different CFD methods to solve fluid dynamic problems.

CO4: use CFD solution methods in real life engineering applications.

CO5: practice commercial CFD packages/open Foam in aeronautical applications.

Board of Studies (BoS) :
16th BoS held on 03.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L										L	L
CO2	M	M	L		L								M	M
CO3	L	L	L		L								M	M
CO4	L	L	M	L								M	H	H
CO5	L	L	L		M				L		L	M	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4 & 9: Quality Education and Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: applying knowledge of CFD in simulation study will pave way for designing innovative engineering appliances leading to resilient infrastructure and sustainable industrialization.

		L	T	P	C
AED 4102	**AIRCRAFT DESIGN AND MODELLING LABORATORY**	**0**	**0**	**4**	**2**
SDG: 09					

COURSE OBJECTIVES:

COB1: To introduce the detailed design procedure in structural point of view to be adapted for the design of selected type of aircraft.

COB2: Develop skills in design of aircraft components using computer aided tools.

PRACTICALS

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

List of Experiments:

1. V-n diagram of design aircraft.
2. Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment and torque diagrams
3. Detailed design of an aircraft wing – Design of spars and stringers, bending stress and shear flow calculations – buckling analysis of wing panels.
4. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
5. Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations – buckling analysis of fuselage panels.
6. Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads.
7. Design of wing-root attachment.
8. Landing gear design
9. Preparation of a detailed design report with CAD drawings.

P – 60 ; TOTAL HOURS –60

TEXT BOOKS:

1. Daniel P Raymer "Aircraft Design A Conceptual Approach" Fourth Edition AIAA Education series, 1989.
2. John D Anderson Jr. "Introduction to Flight" 6th Edition Mcgraw Hill Publications, 2010.
3. Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986.
4. Kuechemann, D, " The Aerodynamic Design of Aircraft, American Institute of Aeronautics publishers, 2012.

REFERENCES:

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

COURSE OUTCOMES:

Students ill be able to

CO1: finalize the V-n diagram of the selected aircraft also estimate the limiting loads on the aircraft during flight

CO2: in a position to design aircraft wings, fuselage, loading gears and able to design in terms of structural point of view.

CO3: Prepare CAD drawings of the designed aircraft.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	P O8	PO 9	PO 10	PO1 1	PO 12	PSO1	PSO2	PS O3
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M	

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: It will ensure that the aircraft industries needs will be accomplished by the holistic approach of course content and teaching approach.

AED 4103	**COMPUTATION MECHANICS LAB**	**L**	**T**	**P**	**C**
SDG: 9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To familiarize the students with the application of CFD/ CSM codes and their applications in aeronautics.

COB2: To train the students to compute the flow features and stress distributions over aircraft components.

PRACTICALS

List of Experiments:

- CFD Analysis of
    1. Grid Independence study
    2. Flow over an airfoil
    3. Flow over a cone cylinder fuselage configuration
    4. Free jet flow
    5. C-D Nozzle Flow
    6. Heat transfer problem

- Structural Analysis of
    1. Wing spar
    2. Schrenck's Diagram (SF and BM Dig)
    3. Fuselage bulkhead
    4. Plate with a circular hole
    5. Landing Gear

P – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. T. J. Chung, "Computational fluid Dynamics", Cambridge University Press, UK 2013.
2. ANSYS User manual

REFERENCES:

1. John D. Anderson, Jr., "Computational Fluid Dynamics", McGraw-Hill, Inc., 19
2. John C. Tannehill, Dale A. Anderson, Richard H. Pletcher, " Computational fluid mechanics and Heat Transfer", Special Indian Edition, Taylor Francis, 1997.

COURSE OUTCOMES:

Students will be able to

CO1: Identify suitable computational domains, boundary conditions for simple flow problems

CO2: Select the appropriate meshing techniques and suitable solver for the flow problems

CO3: Simulate the flow around various configurations and interpret the results obtained

CO4: Analyse the structural response of different Aircraft structural components for Various loads

Board of Studies (BoS) :

16th BoS of AERO held on 03.08.2022.

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	L	M	M				H	M	H		H	H
CO2	L	L		M				L	M	M			H	H
CO3		L	L	L	M					H	H		H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: applying knowledge of Computation Mechanics study for designing innovative engineering appliances leading to resilient infrastructure and sustainable industrialization

AED 4104	INTERNSHIP II	L	T	P	C
SDG: 9		0	0	0	1

COURSE OBJECTIVES:

COB 1: To develop and improve business skills in communication, technology, quantitative reasoning, and teamwork.

COB 2: To appreciate ideas to improve work effectiveness and efficiency by analyzing challenges and considering viable options.

GUIDELINES:

- The students shall undergo industry training in any industry relevant to the field study or internship at research organizations / eminent academic institutions for the minimum period of 15 days during the summer vacation of second year.
- In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.
- In the case of industry internship, 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 / academic organization.
- The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.
- The credit will be awarded in the 5th Semester.

COURSE OUTCOMES:

At the end of the course Students will be able to

CO 1: Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means.

CO 2: Exhibit critical thinking and problem-solving skills by analysing underlying issue/s to challenges.

Board of Studies (BoS) :
16th BoS of AERO held on 03.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L	M	M	M	L	M	M	M	L	M	H
CO2	H	H	H	M	H	H	H	M	H	H	H	M	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The student acquires industrial and business experience through internship and can promote new and innovative ideas in the work place after graduation. Also, the course enables the students to become a successful entrepreneur in their field of study.

SEMESTER VIII

AED 4201	**PROJECT WORK**	**L**	**T**	**P**	**C**
SDG: 4, 9		**0**	**0**	**18**	**9**

COURSE OBJECTIVES:

COB1: To explore the team sprits among the students

COB2: To investigate the real time problems related to industries

COB3: To provide knowledge on the different algorithms and techniques

COB4: To learn the different testing tools to analyze the results.

COB5: To inculcate the presentation skills and write effective reports

PROCEDURE

The students are allowed to do their project as an individual or as a team of two to three students. 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.

COURSE OUTCOMES:

At the end of the course Students will be able to

CO1: Explore various algorithms and scrutiny relevant knowledge within the domain for the specified problem defined.

CO2: Examine the problem based on constraint and information.

CO3: Design and plan the implementation of the algorithm for given problem satisfying the functional requirements, adhering to the limitations.

CO4: Evaluate and critically assess results based on the testing strategy adaptable to the domain.

CO5: Document the process with the results obtained with the prescribed format..

Board of Studies (BoS) :
16th BoS of AERO held on 03.08.2022.

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L	M	M	M	L	M	M	M	L	M	H
CO2	H	H	H	M	H	H	H	M	H	H	H	M	H	H
CO3	M	M	L	L	M	M	L	L	M	M	L	L	M	M
CO4	H	H	M	L	H	H	M	L	H	H	M	L	H	H
CO5	M	H	M	L	M	H	M	L	M	H	M	L	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG No. 4: Quality Education: Ensuring inclusive and equitable quality education for all persons Statement: By doing projects using engineering solutions, will enable students to gain quality educations.

SDG No. 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Student doing projects in multiple domains will promote industrialization and foster innovation.

PROFESSIONAL ELECTIVE COURSES

AEDX 01	**INDUSTRIAL AERODYNAMICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To Introduce into turbulence and turbulent fluxes of matter and energy in the atmospheric boundary layer

COB2: To introduce the methods for describing airflow around vehicles and flow formation.

COB3: To develop a detailed understanding of the issues associated with the development of wind energy.

COB4: To gain the concept of bluff bodies flow characterisation.

COB5: To understand the system of dispersion of aerial pollutants in the outdoor atmosphere after being emitted from the sources.

MODULE I ATMOSPHERIC BOUNDARY LAYER 9

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. Overview of Thermal boundary layer. Case studies related to depression formation.

MODULE II VEHICLE AERODYNAMICS 9

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. Case study: Formula – 1 racing car aerodynamic analysis.

MODULE III WIND ENERGY COLLECTORS 9

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

MODULE IV BUILDING AERODYNAMICS 9

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. Effect of Urban heat Islands (UHI) in public health.

MODULE V AIR POLLUTANT DISPERSION 9

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. Case studies: Volcanic eruption and nuclear bomb explosion.

L –45 ; 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, 2013.

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.

COURSE OUTCOMES:

Students will be able to

CO1: determines the drag values between the atmosphere and the surfaces.

CO2: calculate lift, drag and moments over an vehicle.

CO3: solve the issues related to wind energy collector location selection and grid connection.

CO4: resolve the practical problems involved in effect of wind loads on buildings.

CO5: identify the control devices and its technology used for air pollution.

Board of Studies (BoS) :	**Academic Council:**
15th BoS of AERO held on 11.12.2021	18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L		L			L			M	L	H	L	
CO2	H	M	L		L			L			M	L	H	L	
CO3	H	H	L	L	L			ML			M	M	H	L	
CO4	H	M	L		M			L			M	M	H	L	
CO5	H	H	L	L	M			L		H		M	H	L	

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: an overview of various aerodynamics concepts applied in industries and understanding atmosphere pollutant

AEDX 02	**HELICOPTER AERODYNAMICS**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basics of helicopter.

COB2: To acquire the knowledge of various controls of helicopter.

COB3: To understand the basic components of helicopter system.

COB4: To understand the ideas of structural points of helicopter.

COB5: To understand the basic ideas of aerodynamics of helicopter.

MODULE I BASIC HELICOPTER 09

Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, drive to main and tail rotor, considerations on blade. Rotor controls various types of rotors, Geometry of the rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

MODULE II HELICOPTER CONTROL SYSTEM 09

Flight Control Systems: Cyclic control; Collective control; Swash plate; Yaw control: Anti-Torque Control, Tail rotor, bleed air; Main Rotor Head: Design and Operation features; Blade Dampers: Function and construction; Rotor Blades: Main and tail rotor blade construction and attachment; Trim control, fixed and adjustable stabilizers hovering performance.

MODULE III HELICOPTER COMPONENTS 9

Blade forces and motion in forward flight, Force, torque and flapping coefficient, Helicopter trim, Analysis, Performance in forward flight. Transmissions: Gear boxes, main and tail rotors; Clutches, free wheel units and rotor brake, Tail rotor drive shafts, flexible couplings, bearings, vibration dampers and bearing hangers.

MODULE IV HELICOPTER STRUCTURES 09

Helicopter Structures: Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary, fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue.

MODULE V AERODYNAMICS FOR HELICOPTER 09

Momentum and simple blade element theories, Blade advance ratio, Figure of merit-Profile and induced power estimation, Constant chord and ideal twist rotors, over pitching. Auto rotation and Ground effect, Rotor alignment; Main and tail rotor tracking; Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance, helicopter spin and stall.

L - 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Radhakrishnan, Helicopter aerodynamics, PHI, 2018.
2. John Seddon, Simon Newman, “Basic Helicopter Aerodynamics”, John Wiley & Sons, Ltd, 2011.

REFERENCES:

1. J Gordon Leishman, “Principles of Helicopter Aerodynamics”, Cambridge University Press, 2006.
2. Lalit Gupta, Helicopter Engineering; Himalayan Books New Delhi 1996
3. Joseph Schafer, Basic Helicopter Maintenance, Jeppesen 1980.
4. R W Prouty, Helicopter Aerodynamics, Phillips Pub Co 1985.
5. John Fay, The Helicopter and How It Flies, Himalayan Books 1995

COURSE OUTCOMES:

CO1: Understand the functioning of a typical helicopter including the working of its flight control systems.

CO2: Understand the differences between the aerodynamics of an aircraft and a helicopter

CO3: Understand the structural considerations of a helicopter including the study of failure modes.

CO4: Analyze the flight performance of a helicopter during both hovering and forward flight.

CO5: Apply the above concepts to do preliminary design of a helicopter system for a given mission.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement : The holistic understanding of heat transfer mechanism, jet flow characteristics, propeller performance, fuel energy calculation, solid fuel processing techniques and ballistic test of hybrid rocket motor.

AEDX 03	**WIND TUNNEL MODEL DESIGN**	**L**	**T**	**P**	**C**
SDG: 09		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB1: To introduce the overall importance of model making procedures and standards.

COB2: To understand the role of inspection, servicing and quality assurance steps to be cover to 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 SERVICE AND INSPECTIONS OF MODELS 7

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

L –15 ; TOTAL HOURS – 15

TEXTBOOKS:

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

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.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: identify the requirements and basic standards for selecting the materials for wind tunnel model.

CO2: carry out the procedure to be followed in periodic servicing and inspection methods of model mounted in wind tunnel.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H	
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The holistic understanding of wind tunnel model testing and inspection approach leads to encourage the quality of purpose in sustainable industrialization.

AEDX 04	**VISCOUS FLOWS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the basic equations of viscous flows.

COB2: To make the student understand the solution methods of Newtonian viscous flow.

COB3: To explore the theory related to laminar boundary layer.

COB4: To introduce the various methods used for solving turbulent flow problems.

COB5: To introduce the compressible boundary layer theories on various cases.

MODULE I FUNDAMENTAL EQUATIONS OF VISCOUS FLOWS 7

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 11

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 9

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 MEAN FLOW 9

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 9

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.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Frank M.White, “Viscous fluid flow”, Tata McGraw Hill Publications, 2011.
2. Davidson, Peter Alan. Turbulence: an introduction for scientists and engineers. Oxford university press, 2015.

REFERENCES:

1. Schlichting .H, “Boundary layer theory”, McGraw Hill Publications, Newyork. 2016
2. Tsinober, Arkady, ed. An informal conceptual introduction to turbulence. Dordrecht: Springer Netherlands, 2009.

COURSE OUTCOMES:

Students will be able to

CO1: Identify the equations involved for viscous flow concepts.

CO2: Solve the fundamental problems related to Newtonian viscous flows.

CO3: Identify and solve the problems of laminar boundary layer.

CO4: Choose the appropriate turbulence model for turbulent flows.

CO5: Formulate the integral relation of compressible boundary layer and its solution methods.

Board of Studies (BoS) :

17th BoS held on 03.02.2023

Academic Council:

20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	L	L		L			L	L	L	H	H
CO2	H	H	H	L	L					M	M		H	M
CO3		H						M		L	L		M	M
CO4	L	M	M	M						L	L		L	L
CO5	M	M	M	L	L			L	L	H			L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: A complete approach and learning of viscous flow field intelligence will assists to advance the performance with correlated to fluid-based industries in extreme limits.

AEDX 05	**HYPERSONIC AERODYNAMICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1:To introduce the basic concepts of hypersonic flows and theireffects on flight Vehicles.

COB2: To make the student understand the various solution methods for solving hypersonic flows.

COB3: To introduce the theory about hypersonic boundary layer concept.

COB4: To present the overall concept belongs to shock wave boundary layer interactions.

COB5: To introduce the effect of temperature in hypersonic flows.

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 11

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 9

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 and its effects.

MODULE IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

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 9

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.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dyanmics", McGraw hill Series, New York, 2019.

REFERENCES:

1. John. D. Anderson. Jr., "Modern compressible flow with historical perspective". McGraw Hill Publishing Company, New York, 2003.
2. John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington.D .C., 1994.

COURSE OUTCOMES:

Students will be able to

CO1: Differentiate hypersonic and supersonic aerodynamics flow properties.

CO2: Solve the problems related to inviscid hypersonic flows.

CO3: Apply the viscous flow concept and identify the solution methods for hypersonic boundary layer.

CO4: Predict parameter involved in viscous interactions of hypersonic flows.

CO5: Recognize the effect of chemical mixture and gases at high temperature.

Board of Studies (BoS) :
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	L	L		L			L	L	L	H	H
CO2	H	H	H	L	L					M	M		H	M
CO3		H						M		L	L		M	M
CO4	L	M	M	M						L	L		L	L
CO5	M	M	M	L	L			L	L	H			L	L

Note:L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The consequences of temperature and chemical reaction are the major impacts in the hypersonic flow regimes. Understanding the causes will improve the superior execution in rocket and missile manufacturing related industries.

AEDX 06	**OPTICAL FLOW DIAGNOSTICS**	**L**	**T**	**P**	**C**
SDG: 9		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB1: To introduce the optical flow diagnostic and fundamentals of image processing.

COB2: To describe the basics of each technique and its limitations.

MODULE I INTRODUCTION TO OPTICAL DIAGNOSTICS 08

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

MODULE II VECTOR AND SCALAR MEASUREMENTS 07

Introduction to particle image velocimetry (PIV) and laser Doppler velocimetry. Mie/Rayleigh scattering - Laser induced fluorescence - thermography – pressure / temperature sensitive paints.

TOTAL HOURS: 15

TEXT BOOKS:

1. Buchhave P et al., Optical Diagnostics for Flow Processes, Springer, 1994

REFERENCES:

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

COURSE OUTCOMES:

Students will be able to

CO1: Solve problems based on image processing methods.

CO2: Recognize various techniques and their limitations in flow diagnostics.

Board of Studies (BoS):

18th BOS of AERO held on 24.11.2023

Academic Council:

21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	L	M	L						I		H	H
CO2	H	H	L	M	L		L				M		L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement : Learn about advancements in optical methods which contribute for the scientific progress and technological development.

AEDX 07	**INTRODUCTION TO MULTI - PHASE FLOW**	**L**	**T**	**P**	**C**
SDG:		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To introduce the basic knowledge of governing equation of multi-phase flows.

COB2: To gain the understanding of flow over bodies at various Reynolds number.

COB3: To familiarize the various parameters involved for bubble growth

COB4: To introduce the concept of flow pattern of multi phase flow problems.

MODULE I INTRODUCTION TO MULTI PHASE FLOW 07

Introduction about Multiphase flow models, Multiphase flow notation, Size distribution functions. Governing equations - Conservation of mass, Equation of motion, Equations for conservation of energy, Heat transfer between separated phases, Particles and turbulence, Effect on turbulence stability.

MODULE II SINGLE PARTICLE MOTION 07

Flows around a sphere at high Reynolds number and low Reynolds number, Molecular effects, Unsteady particle motions, Unsteady potential flow, Unsteady Stokes flow, Effect of concentration on particle drag

MODULE III BUBBLE GROWTH AND COLLAPSE 08

Bubble shapes and terminal velocities, Marangoni effects, Rayleigh-Plesset equation, Bubble contents, Stability of vapor/gas bubbles, Thermal effects on growth, Bubble growth by mass diffusion.

MODULE IV FLOW PATTERNS 08

Multiphase flow patterns, Examples of flow regime maps, Slurry flow regimes, Flow pattern classifications, Disperse phase separation and dispersion, Particle size and particle fission, inhomogeneity instability, Limits on separated flow, Kelvin-Helmoltz instability, Stratified flow instability

TOTAL HOURS: 30

TEXT BOOKS:

1. C. E. Brennen, Fundamentals of multiphase flow, Cambridge University Press, 2005.
2. N.I. Kolev, Multiphase Flow Dynamics : Fundamentals, Springer, 2007.

REFERENCES:

1. C.T. Crowe, Multiphase Flow Handbook, CRC Press, 2005.
2. G. Wallis, One Dimensional Two Phase Flows, Mc-Graw Hill, 1969.

COURSE OUTCOMES: Students will be able to

CO1: formulate the equation involved for multi-phase flow problems.

CO2: differentiate the effect of various Reynolds number flows on bodies.

CO3: identify the essential parameter to affect the bubble growth.

CO4: discover the various flow pattern and its interpretation.

Board of Studies (BoS) :
Mention details of BoS
18th BOS of AERO held on 24.11.2023

Academic Council:
Mention Number and date
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	L	H	L			L					H	L
CO2	H	H	L	H				L			M		H	L
CO3	H	H	L	H				L			M		H	L
CO4	H	H	L	H	L			L					H	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Formulation and exploration of different multi-phase flow techniques to solve complex engineering problems.

AEDX 08	SPACE MECHANICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study about the planet earth, gravitational fields and atmosphere layers.

COB2: To introduce concepts of solar system, milky way, the galaxies, universe and planets motion.

COB3: To expose students to equation of motion of rocket and multistage concepts of rockets.

COB4: To study and analyse different types of orbits, satellite motion and their trajectories.

COB5: To understand the importance of interplanetary mission and satellite applications.

MODULE I EARTH AND ATMOSPHERE 8

The Planet Earth; Earth's Gravitational Field; Earth as an Ellipsoid;Peer-shaped Earth; Ellipticity of the Earth; The Geoid and Its Importance; ThermalStructure of the Atmosphere; Atmospheric Density Variation; Van-Allen RadiationBelt; The Ionosphere – D layer, interplanetary margins, electron density.

MODULE II SOLAR SYSTEM 9

Motion and Rotation of the Planets; Geocentric and Heliocentric Systems;Sidereal and Synodic Periods; Ecliptic Plane and the Zodiac; Direct and RetrogradeMotions; Configuration and Phases of Interior Planets; Configurations of ExteriorPlanets; Asteroids; Comets; Meteors, Meteorites and Tektites; Micrometeorites; TheMilky Way, the Galaxies and the Universe.

MODULE III TRAJECTORY OF A ROCKET 10

Mass Ratio and Propellant Mass Fraction; Equation of Motion of anIdeal Rocket; Motion of a Rocket in a Gravitational Field; Simplified VerticalTrajectory; Burn- out Velocity and Burn- out Height; Step- Rockets; Ideal MissionVelocity and Losses; Effect of Launch Angle; Factors Causing Dispersion of Rocketsin Flight; Dispersion of Finned Rockets; Stability of Flight.

MODULE IV SATELLITE LAUNCH AND SATELLITE ORBITS 9

Orbits and Trajectories; Conic Sections; Kepler'sLaws of Satellite Motion; Orbital Velocity of Satellites; Orbital Periods; EccentricElliptical Orbits; Effect of Injection Conditions; Perturbation of Orbits; Effect ofEarth's Rotation; Low Earth Orbits; Geostationary Satellites; Sun- synchronousSatellites.

MODULE V SATELLITE APPLICATIONS AND INTERPLANETARY MISSION: 9

Satellite for Meteorological, Communication, Navigational andGeodetic Applications; Atmospheric Sounding; Satellites for Geophysical andInterplanetary Studies.Parking Orbit; Transfer Trajectory; Impulsive Shot; Launching ofInterplanetary Spacecraft.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Glasstone, S., "Source book on the Space Science", Van Nostrand Reinhold Inc., U.S. (2007).
2. Stuhlinger, E. and Mesmer, G. "Space Science & Engineering", McGraw Hill; First Edition (January 1, 1965).

REFERENCES:

1. Hess, W.N,, "Space Science",Gordon & Breach Science Publishers Ltd; 2nd edition (1 August 1968).
2. Cornelisse, J.W., Schoyer H.F.R., Wakker K.F., "Rocket Propulsion and Space".

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: calculate various atmospheric properties and differentiate the earth shape concepts.

CO2: identify solar systems, planet motion, configurations, interior plants and understand the Milky Way, the Galaxies and the Universe.

CO3: solve the rocket multistage parameters and suggest suitable trajectory for rocket missions.

CO4: distinguish various satellite orbits and give requirements of different satellites.

CO5: recognize various application of satellites and interplanetary missions.

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	,M	M	H	M	L	-	-	-	-	-	-	-	M	M
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	M	M	M	M	L	-	-	-	-	-	-	-	M	M
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement:
This course covers the basics of space engineering, design of trajectory for satellite launches and interplanetary mission helps to innovation and fulfill aerospace industry needs for sustainable industrialization.

AEDX 09	**HEAT TRANSFER**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the heat transfer principles and the behavior of thermal systems.

COB2: To expose students to the governing differential and algebraic equations associated with free and forced convection.

COB3: To introduce concepts of radiative heat transfer and radiation shields.

COB4: To study and analyse the heat exchangers.

COB5: To expose students to the heat transfer applications in Aerospace industries.

MODULE I HEAT CONDUCTION 9

conduction–convection–radiation, Steady and unsteady state heat conduction in solids-effect of variation of thermal conductivity on heat transfer in solids, 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 AND FORCED CONVECTION 13

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.

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 III RADIATIVE HEAT TRANSFER 8

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 IV HEAT EXCHANGERS 8

Types-overall heat transfer coefficient-LMTD-NTU method of heat Exchanger analysis, Thin fin Analysis.

MODULE V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 7

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

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Yunus A. Cengel.,"Heat Transfer–A practical approach",5th Edition, Tata McGraw-Hill,2015.
2. Incropera.F.P. and Dewitt.D.P., "Introduction to Heat Transfer",JohnWiley andSons,2002.

REFERENCES:

1. Lienhard, J.H.,"A Heat Transfer Text Book",Dover publication,2011.
2. Holman, J.P."HeatTransfer",6th Edition, McGraw-Hill Book Co., Inc., New York,1991.

COURSE OUTCOMES:

CO1: Differentiate the different modes of heat transfer in various media and solve the simple cases of conduction, convection and radiation using their governing equations.

CO2: Differentiate forced convection from free convection and solve the simple cases of forced convection using analytical as well as numerical techniques.

CO3: Use the concept of black body to solve simple ideal cases of radiation using its governing equations.

CO4: Apply the laws of heat transfer in the cases of heat exchangers of standard types.

CO5: Apply the heat transfer concept and explain the problems involving heat transfer in the aerospace vehicles.

Board of Studies (BoS):
16th BoS of Aero held on 03.08.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	H	H	H	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The holistic understanding of different heat transfer mechanism and problems involving heat transfer in the aerospace vehicles.

AEDX 10	**MICRO GAS TURBINE**	**L**	**T**	**P**	**C**
SDG: 4 & 9		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB 1 - To introduce aerodynamic and performance parameters of micro gas turbine

COB 2 - To analyze design and integrate micro gas turbine for specific applications

MODULE I INTRODUCTION 5

Aerodynamics of Micro-turbines - Micro turbine Performance characteristics.

MODULE II DESIGN AND APPLICATION 10

Components of Microturbines - Design and material aspects - Microturbine Fuels and Emissions - Microturbines in Integrated Systems – Applications - The Future for Microturbine Technology.

TOTAL HOURS: 15

TEXT BOOKS:

1. Claire Soares, Micro Turbines, Butterworth-Heinemann 2007

REFERENCES:

1. Claire Soares, Gas Turbines - A Handbook of Air, Land and Sea Applications, Butterworth-Heinemann; 2nd edition, 2014.
2. P.P. Walsh & P. Fetcher, Gas Turbine Performances – 2nd Edition, Wiley-Blackwell, March 2004.
3. Ronald H. Aungier, Turbine Aerodynamics: Axial-Flow and Radial-Flow Turbine Design and Analysis, 2006, DOI:10.1115/1.802418.

COURSE OUTCOMES:

Students will be able to

CO1 recognize aerodynamic and performance parameters of micro gas turbine

CO2 design and integrate micro gas turbine for specific applications

Board of Studies (BoS): 16th BoS of Aerospace Engineering held on 03.08.2022	**Academic Council:** 19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	L	M	L	L									L	L
CO 2	M	M	L	L	L		L				L		M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4 & 9: Quality Education and Build resilient Infrastructure promote inclusive and sustainable industrialization and foster innovation.

Statement: applying knowledge of micro gas turbine design and integration will pave way for designing innovative engineering appliances leading to foster innovation and sustainable industrialization.

AEDX 11	**COMBUSTION**	**L**	**T**	**P**	**C**
SDG: 4 & 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Comprehend chemical kinetics and physics of combustion.

COB2: Analyze premixed flame characteristics.

COB3: Analyze diffusion flame characteristics

COB4: Understand combustion phenomena of jet engines and acquire knowledge about supersonic combustion process.

COB 5: Comprehend all types of rocket engine combustion systems & Hybrid rockets.

MODULE I COMBUSTION FUNDAMENTALS 9

Review of thermodynamics of combustion - Basic Reaction Kinetics, Elementary reactions, Multistep reactions, Global kinetics. Physics of Combustion - Fundamental laws of transport phenomena, Conservation Equations.

MODULE II PREMIXED FLAME 9

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 - Turbulent Premixed flame.

MODULE III DIFFUSION FLAME 8

Introduction to Droplet Combustion - Liquid fuel combustion, Atomization, Spray Combustion - Gaseous fuel Jet diffusion flame - Solid fuel combustion.

MODULE IV COMBUSTION IN JET ENGINES 10

Combustion in gas turbine engines - combustion instability, ramjet combustion - Dual Mode Combustion - Introduction to supersonic combustion - Analysis of reactions and mixing processes in supersonic combustion - supersonic burning with detonation shocks.

MODULE V COMBUSTION IN ROCKET ENGINES 9

Solid propellant combustion – various solid propellant combustion models - combustion in liquid rocket engines – combustion in hybrid rockets.

L-45: 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. S.N.B. Murthy and E.T. Curran, “Scramjet Propulsion”, Progress in Astronautics and Aeronautics, Volume 189, 2001”
4. Turns, S. R., “An Introduction to Combustion Concepts and Applications”, 2nd Edition, McGraw Hill International Editions, New Delhi, 2000.

COURSE OUTCOMES:

Students will be able to

CO 1: Apply chemical kinetics principles in understanding combustion phenomena.

CO 2: Analyze premixed flame characteristics.

CO 3: Analyze diffusion flame characteristics

CO 4: Understand combustion phenomena of jet engines and supersonic combustion process.

CO 5: Comprehend all types of rocket engine combustion systems & Hybrid rockets.

Board of Studies (BoS) :
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	L	L	L										L	L
CO2	L	L	L										L	L
CO3	L	L	L										M	M
CO4	L	M	M	L							L	M	H	H
CO5	M	M	M								L	M	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4 & 9: Quality Education and Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: applying knowledge of combustion study will pave way for designing innovative engineering appliances leading to resilient infrastructure and promote innovation

AEDX 12	**CRYOGENICS**	**L**	**T**	**P**	**C**
SDG: 09		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB1: To provide knowledge on the properties of materials at low temperature

COB2: To familiarize with various gas liquefaction systems and to provide design aspects of cryogenic storage and transfer lines

MODULE I INTRODUCTION TO CRYOGENIC SYSTEMS 6

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 9

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.

L – 15; TOTAL HOURS –15

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.

COURSE OUTCOMES:

CO1: Acquire knowledge properties of material at cryogenic temperatures, Cryogenic fluids and their properties.

CO2: Design Cryogenic Fluid Storage and Transfer Systems and know about various liquefaction systems.

Board of Studies (BoS) :
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L	-	-	-	-	-	-	-	-	M	M
CO2	H	M	M	L	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The holistic understanding of properties of material at cryogenic temperatures, Cryogenic fluids and Cryogenic systems for aerospace vehicles.

AEDX 13	ROCKET PROPULSION	L	T	P	C
SDG: 09		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the fundamentals of rocket propulsion and performance parameters.

COB2: To expose students to the different types of propellants and their characteristics.

COB3: To study and analyzes the design of solid rocket motor components and types of solid propellant burning.

COB4: To study and analyse the liquid rocket motor and their systems.

COB5: To expose students about hybrid rocket motor concepts and advanced propulsion system.

MODULE I FUNDAMENTALS OF ROCKET PROPULSION 8

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, Liners, Insulators and Inhibitors, Combustion of Solid Propellants, 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.

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 8

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 AND ADVANCED PROPULSION 12

Introduction to hybrid rockets – Classification –working principle of hybrid rocket. Typical Fuels and Oxidizers. Advantages and disadvantages. Application Areas. Performance and Limitations. Electric rocket propulsion – ion propulsion techniques and plasma rockets. Nuclear rocket – types. Solar sail. Preliminary concepts in nozzle less propulsion.

L – 45; 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

COURSE OUTCOMES:

CO1: Evaluate performance parameters for rocket engines and nozzles.

CO2: Assessing combustion properties of solid & liquid propellants.

CO3: Analyze solid rocket motor performance parameters and propellant grain structure.

CO4: Acquire knowledge about different feed systems of liquid propellant rocket engine.

CO5: Evaluate performance parameters for hybrid rocket engine and acquire knowledge about advanced propulsion systems.

Board of Studies (BoS) :
17thBoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	M	-	-	-	-	-	-	-	-	H	H
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO3	M	M	L	L	-	-	-	-	-	-	-	-	H	H
CO4	M	M	L	L	-	-	-	-	-	-	-	-	M	M
CO5	H	H	M	M	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course gives design exposure about different types of rocket motor systems and burning behavior of different propellants.

AEDX 14	**ROCKETS AND MISSILES**	**L**	**T**	**P**	**C**
SDG: 09		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide knowledge of different rocket systems used in the solid and liquid rockets.
COB2: To study the various aerodynamic and moment forces acting on the rockets and missiles.
COB3: To expose students to the two-dimensional rocket equations and descriptions of different types of trajectories.
COB4: To introduce the concept of multi-staging of launch vehicles and ballistic missiles and thrust vector control mechanisms.
COB5: To study various materials used in rockets and missiles.

MODULE I SOLID AND LIQUID ROCKET SYSTEMS 12

Introduction - Rockets - purpose – classifications – components – functions, Solid-fuel rockets – basic concepts, design, solid propellants, Grain geometry, Casing, Nozzle, Performance. The ignition system in rockets – types of igniters and igniter design considerations.
Injection system and propellant feed systems of liquid rockets and their design considerations – design considerations of liquid rocket thrust chambers– combustion mechanisms.

MODULE II AERODYNAMICS OF ROCKETS AND MISSILES 9

Airframe components of rockets and missiles – forces acting on a missile while passing through the 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 III ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 9

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 IV STAGING AND CONTROL OF ROCKETS AND MISSILES 8

The design philosophy behind multi-staging of launch vehicles and ballistic missiles – multistage vehicle optimization – stage separation techniques in the atmosphere and 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 V MATERIALS FOR ROCKET AND MISSILE APPLICATIONS 7

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.

L – 45; TOTAL HOURS: 45

TEXT BOOKS:

1. Cornelisse, J.W., Schoyer H.F.R., Wakker K.F., "Rocket Propulsion and Space Dynamics", 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.

COURSE OUTCOMES:

CO1: Identify the various parts of a solid rocket propellant and propellant grain geometry and acquire knowledge of the ignition and feed systems of the liquid rocket and their design parameters.

CO2: Apply the law of aerodynamics to the flight performance of the rockets and missiles.

CO3: Solve the rocket performance-related problems and find the range and altitude gained in the ideal conditions.

CO4: Recognize various types of multi-staging in the rockets and distinguish their separation techniques.

CO5: Differentiate the various materials used in the rockets and missiles.

Board of Studies (BoS):
18th BOS of AERO held on 24.11.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M	M	M	-	-	-	-	-	-	-	-	M	H
CO2	L	M	M	L	-	-	-	-	-	-	-	-	M	M
CO3	L	M	M	L	-	-	-	-	-	-	-	-	M	H
CO4	M	H	H	M	-	-	-	-	-	-	-	-	H	H
CO5	M	L	L	L	-	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

Statement: This course gives exposure to the aerodynamics of rockets and missiles, trajectory estimations, multistage knowledge, and materials used for rockets and missiles.

AEDX 16	**MACHINE DESIGN**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Study the principles in the formation of mechanisms and their kinematics.

COB2: Analyze the construction features of Gears and Gear Trains.

COB3: Understand the effect of friction in different machine elements.

COB4: Acquire knowledge on importance of balancing, Governors and Gyroscopic effects.

COB5: Study the importance of vibration.

MODULE I KINEMATICS OF MACHINES 9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Cam and followers – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion.

MODULE II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains.

MODULE III FRICTION 9

Types of friction – Friction Drives -friction in screw threads – bearings – Friction clutches – Belt drives.

MODULE IV BALANCING AND MECHANISM FOR CONTROL 9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines -Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Gas turbine engine-Partial balancing in engines- Governors and Gyroscopic effects.

MODULE V VIBRATION 9

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. AmbekarA.G.,Mechanism and Machine Theory‖ Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., —Theory of Machines and Mechanisms, Oxford University Press, 2003

REFERENCES:

1. Ghosh.A, and A.K.Mallick, —Theory and Machine ‖, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
2. Ramamurthi. V., "Mechanisms of Machine", Narosa Publishing House, 2005.
3. Rao.J.S. and Dukkipatti R.V. —Mechanisms and Machines ‖, Wiley-Eastern Ltd., New Delhi, 1998.
4. Robert L.Norton, "Design of Machinery", McGraw-Hill, 2012.
5. Thomas Bevan, —Theory of Machines‖, CBS Publishers and Distributors, 2010

COURSE OUTCOMES:

Students will be able to

CO1: describe the principles in the formation of mechanisms and their kinematics.

CO2: construct the Gears and Gear Trains.

CO3: calculate the of friction in different machine elements.

CO4: acquire knowledge on importance of balancing, Governors and Gyroscopic effects.

CO5: describe the importance of vibration.

Board of Studies (BoS) :

15th BoS of AERO held on 11.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	,M	M	H	M	L	-	-	-	-	-	-	-	M	M
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	M	M	M	M	L	-	-	-	-	-	-	-	M	M
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement : understanding of machine kinematics and design procedures of machine elements

AEDX 17	**THEORY OF ELASTICITY**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Understand the equilibrium equations for the structural members

COB2: study strain displacement and compatibility conditions

COB3: understand plane stress and strain problems

COB4: Understand the stress distribution in different members

COB5: Study the torsion effect in different cross-sectional members

MODULE I ANALYSIS OF STRESS 10

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

MODULE II ANALYSIS OF STRAIN 12

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. Polar coordinates strain displacement relations, stress-strain relations, Axis symmetry Problems.

MODULE III PLANE STRESS AND PLANE STRAIN PROBLEMS 8

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 STRESS CONCENTRATION 7

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

MODULE V 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.

L - 45; 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.

COURSE OUTCOMES:

CO1: 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

CO2:. Use the equilibrium equations stated by the displacements (Lame equations) and compatibility conditions stated by stresses (Beltrami-Michell equations).

CO3: Determine the boundary restrictions in calculations. Solve the basic problems of the theory of elasticity by using Airy function expressed as inharmonic function.

CO4: Identify and develop relation for stress distribution in the members

CO5: Solve the torsional load for different cross-sectional members

Board of Studies (BoS):
16th BoS of Aero held on 03.08.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Holistic understanding of stress strain distribution and deformation in the member under loading conditions

		L	T	P	C
AEDX 18	**AIRCRAFT STRUCTURAL TESTING**	**L**	**T**	**P**	**C**
SDG: 09	**AND QUALIFICATION**	**1**	**0**	**0**	**1**

COURSE OBJECTIVE:

COB1: To study and understand the various aircraft structural testing methods, theory and their industrial applications.

MODULE I INTRODUCTION 7

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.

L – 45: Total Hours – 15

TEXT BOOKS:

1. Full-Scale Structural Testing, John E. McCarty**,** ASM International, Volume 21, doi**:** https://doi.org/10.31399/asm.hb.v21.9781627081955, 2001.

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, 1993.

COURSE OUTCOMES:

Students will be able to:

CO 1: Understand the role of structural testing application and procedures for aircraft structures

CO 2: Identify the appropriate test method for the load applied on an aircraft

Board of Studies (BoS):	**Academic Council:**
16th BoS of Aerospace Engineering held on 03.08.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	L									H	H
CO2	H	L	H	L									H	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course gives exposure to various methods to test the response of aero structural components for the applied loads.

AEDX 19	**VIBRATION AND AERO ELASTICITY**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Explain and correlate the properties of complex structures to the overall vibration characteristics in order to design systems having required dynamical properties.

COB2: Apply theoretical and numerical procedures to predict the dynamic response of either discrete or continuous structural systems under different loading conditions.

COB3: Develop reduced order models to treat systems with a large number of DOF.

COB4: Understand and implement approximate methods for the numerical solution of distributed parameter systems.

COB5: knowledge and understanding of aero elastic phenomena and their effect.

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.Approximate methods, Rayleigh's method, Dunkerlay's method, Rayleigh-Ritz method, matrix Iteration method.

MODULE V ELEMENTS OF AEROELASTICITY 9

Vibration due to coupling of bending and torsion - aeroelastic problems - collars triangle - wing Divergence - aileron control reversal – flutter – buffeting.

L – 45; 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. 3. Benson H.Tongue, “Principles of Vibration”, Oxford University Press, 2000.
4. Singiresu S. Rao, “Mechanical Vibrations”, Addison- Wesley Publishing Company, 1995.

COURSE OUTCOMES:

Students will be able to

CO1: Calculate natural frequency and period of simple vibrating mechanical systems

CO2: Construct simple vibration models of mechanical systems and perform time- and frequency-domain vibration analysis for SDOF

CO3: Construct simple vibration models of mechanical systems and perform time- and frequency-domain vibration analysis for MDOF

CO4: Estimate the vibrations of continuous systems: bars, beams and plate

Apply approximate methods for vibrations of continuous systems

CO5: Gain knowledge on various Aero elastic problems experienced by an aircraft.

Board of Studies (BoS):

17th BoS held on 03.02.2023

Academic Council:

20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	M	-	-	-	-	-	-	-	-	H	H
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO3	M	M	L	L	-	-	-	-	-	-	-	-	H	H
CO4	M	M	L	L	-	-	-	-	-	-	-	-	M	M
CO5	H	H	M	M	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course gives understanding of different models to predict the vibration behavior

AEDX 20	**SMART STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 09		1	**0**	**0**	1

COURSE OBJECTIVE:

COB1: 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 10

Introduction to Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction 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 & MATERIALS 5

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, SelfHealing Polymers, Intelligent System Design, Emergent System Design.

L – 15; 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.

COURSE OUTCOMES:

Students will be able to

CO1: Gain knowledge on the behavior of smart materials such as piezoelectric ceramics, shape memory alloys and electro active polymers

CO2: Identify state-of-the-art approaches for making structures smarter (e.g. health assessment, self-heal and adapt to environment)

Board of Studies (BoS):	**Academic Council:**
17th BoS held on 03.02.2023	20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M	L	L	-	-	-	-	-	-	-	-	H	H
CO2	L	M	L	L	-	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Holistic understanding of advanced material used in the aviation industries

AEDX 21	**EXPERIMENTAL TECHNIQUES FOR AIRCRAFT STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Demonstrates principles of experimental approach.

COB2: Teaches regarding the working principles of various strain gauges.

COB3: Possess knowledge on strain rosettes.

COB4: Gives an insight into the principles of photo elasticity.

COB5: To study and understand the various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.

MODULE I EXTENSOMETERS 8

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 10

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 TRANSMISSION PHOTO ELASTICITY 9

Two-dimensional photo elasticity, Concept of light, photo elastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials.

MODULE IV THREE-DIMENSIONAL PHOTO ELASTICITY AND DIGITAL PHOTO ELASTICITY 9

Three-dimensional photo elasticity, Stress freezing, Slicing, Application to a complex problem, Integrated photo elasticity, Principle of optical equivalence.

MODULE V NDT IN AEROSPACE INDUSTRIES 9

Ultrasonic testing (UT), Radiographic Testing (RT), X-ray fluorescence testing, Eddy current testing (ET), Magnetic particle testing (MT), Leak detection testing (LT), Acoustic emission (AE), Video borescope inspection, Thermography

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., “Experimental Stress Analysis”, Tata McGraw-Hill, New Delhi, 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 and Sons Inc., New York, 1972.
2. K. Ramesh, “Digital Photoelasticity – Advanced Techniques and Applications”, Springer, 2000.
3. Max Mark Frocht, “Photoelasticity”, illustrated Edition, Wiley & Sons Inc, 1968
4. Sadhu Singh, “Experimental Stress Analysis”, 2nd Edition, Khanna, 1990.
5. Donglas C Lalia, NDT for Aircraft, Jeppesen.

COURSE OUTCOMES:

Students will be able to

CO1: Differentiate and use the type of strain gauges suitable for different applications.

CO2: Evaluate the structural responses using different experimental stress analysis techniques and compare with that of the analytical data

CO3: Understand the procedure to locate the areas of stress concentration on different types of structural elements using the photo-elastic methods.

CO4: Gain knowledge of 3D photo elasticity and digital photo elasticity.

CO5: Identify the appropriate technique for the flaw detection in aircraft structures.

Board of Studies (BoS) :
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		H	H	H	H	H		L				H	H	M	H
CO2		H	H	H	H	H					M		H	M	H
CO3		H	M	H	H	H							L	M	M
CO4		H	M	M	H	M							M	M	M
CO5		M	M	H	H	L		L				M	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course introduces the physical principle used by various experimental techniques and also provides a guideline to select an experimental technique for a given application.

AEDX 23	**ANALYSIS OF COMPOSITE STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To get the knowledge on the composition and uses of composite materials, their structural and mechanical properties

COB2: To derive constitutive equations of composite materials and understand mechanical behavior at micro levels

COB3: To derive the constitutive equations of composite materials and understand mechanical behavior at macro levels

COB4: To estimate the behavior of laminated plates for the given condition and predict its failure behavior.

COB5: To get the knowledge on the fabrication processes of composite structures and sandwich structures and its failure.

MODULE I INTRODUCTION 6

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 9

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 10

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 – vibration of composite plates .

MODULE V FABRICATION PROCESSES OF COMPOSITES AND SANDWICH CONSTRUCTIONS 10

Various open and closed mould processes – Manufacture of fiber – netting analysis – autoclave – vacuum bag molding – filament winding – pultrusions – resin transfer molding – Repair of composite materials and NDT methods - Basic modes of sandwich construction – materials used for sandwich construction – failure modes of sandwich panels.

L – 45; 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. MadhujiMuhkapadhyay., "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.

COURSE OUTCOMES: Students will be able to

CO1: Understand the composition and uses of composite materials, their structural and mechanical properties

CO2: Apply constitutive equations of composite materials and understand mechanical behavior at micro levels

CO3: Apply constitutive equations of composite materials and understand mechanical behavior at macro levels

CO4: Determine the mechanical properties and predict the failure behavior of laminated composites

CO5: Understand the concepts of fabricating composite and sandwich structures.

Board of Studies (BoS) : 18th BOS of AERO held on 24.11.2023

Academic Council: 21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	M	M	-	-	-	-	-	-	-	-	H	H
CO2	H	H	H	H	-	-	-	-	-	-	-	-	H	M
CO3	H	H	H	H	-	-	-	-	-	-	-	-	H	M
CO4	H	H	M	H	-	-	-	-	-	-	-	-	H	M
CO5	M	H	L	M	-	-	-	-	-	-	-	-	H	H

Note:L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course aims to equip students with the knowledge and skills to analyze and design composite materials with a strong emphasis on sustainable development.

AEDX24	**FINITE ELEMENT METHOD**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basic concepts on the formulation methods in finite element analysis.
COB2: To understand the characteristics of one-dimensional finite elements such as bars, beams, and truss members.
COB3: Derive stiffness matrix for 2D Elements and determine the behavior of the structure in 2D Problems.
COB4: To understand the characteristics of iso-parametric elements.
COB5: To solve the problems in the field of fluid flow heat transfer, torsion and vibrations using finite element approaches.

MODULE I INTRODUCTION 6

Basic Concepts, applicability and applications, Generalization of finite element concepts, Solution of differential equations using weighted residual methods, Principle of minimum potential energy, Rayleigh and Ritz Method, Convergence criteria of finite element method.

MODULE II ONE DIMENSIONAL ELEMENTS 9

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

MODULE III TWO DIMENSIONAL ELEMENTS 10

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

MODULE IV ISOPARAMETRIC ELEMENTS 8

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

MODULE V APPLICATIONS IN HEAT TRANSFER, FLUID MECHANICS AND SOLID MECHANICS 12

Heat transfer problems, steady state fin problems, flow field problems, torsion problems, Single Degree of Freedom, Multiple Degrees of Freedom System, Case studies.

L – 45; 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.
7.

COURSE OUTCOMES: Students will be able to:

CO1: Understand the concepts behind formulation methods in FEM.

CO2: Identify the application and characteristics of FEA elements such as bars, beams, and truss members.

CO3: Derive stiffness matrix for 2D Elements and determine stresses in 2 D Problems.

CO4: Identify the application and characteristics of iso-parametric elements.

CO5: Obtain finite element equations and solve field problems involving fluid flow heat transfer, torsion and vibrations.

Board of Studies (BoS) :
18th BOS of AERO held on 24.11.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	L	-	-	-	-	-	-	-	-	M	M
CO2	H	H	H	M	M	-	-	-	-	-	-	-	M	M
CO3	H	H	H	H	M	-	-	-	-	-	-	-	H	H
CO4	H	H	H	H	M	-	-	-	-	M	-	-	H	H
CO5	H	H	H	H	H	-	-	-	-	H	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The Finite Element Method, a powerful tool in engineering analysis and design, will be explored with a focus on its applications in addressing pressing societal and environmental challenges.

		L	T	P	C
AEDX 25	**AVIATION RULES AND REGULATION**	**L**	**T**	**P**	**C**
SDG:09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Understand the requirement of airworthiness certification in civil aircraft

COB2: Can understand how to record the various data for future investigation in civil aircraft.

COB3: Can know the basic requirements and knowledge for institution certification.

COB4: To provide basic knowledge of eligibility and requirements for maintenance licensing

COB5: Explore the various flight testing and basic requirements for safe flying.

MODULE I C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIRMENTS & RESPONSIBILITIES OF OPERATORS 10

Responsibilities of operator / 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 periods and component - 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 ENGINEER -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 12

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'– MISCELLANEOUSREQUIREMENTS: Registration Markings of aircraft; weight and balance control of an aircraft; provision of first aid kits & physician's kit in an aircraft; use furnishing materials in an aircraft; concessions; aircraft logbooks; document to be carried on board on Indian registered aircraft; procedure for issue of taxing permit; procedure for issue of type approval of aircraft components and equipment including instruments.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. " Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

REFERENCES:

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

COURSE OUTCOMES:

CO1: students are tested by preparing the basic checklists and their Usage.

CO2: students are tested with various data acquisition and interpretation knowledge

CO3: To interpret the student's knowledge of the approval procedure of DGCA on the various organization.

CO4: Students gain the knowledge on applying and preparing for the AMC examination.

CO5: Students use various testing knowledge acquired in the aircraft for safe flying.

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L		L			L			M	L	H	L	
CO2	H	M	L		L			L			M	L	H	L	
CO3	H	H	L	L	L			M			M	M	H	L	
CO4	H	M	L		M			L			M	M	H	L	
CO5	H	H	L	L	M			L		H		M	H	L	

Note: L - Low Correlation M -Medium Correlation H - High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

Statement: Understanding the requirements of civil aviation airworthiness, basic requirements, and knowledge for appearing the license certification, along with the record maintenance will pave the way for the student to become the AME licensed technician in a renowned organization.

AEDX 26	**AIRFRAME REPAIR AND MAINTENANCE**	**L**	**T**	**P**	**C**
SDG: 09		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To make the students to understand the Airframe components and the tools used to maintain the components.

COB2: Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.

COB3: To make student understand the basic safety practices to be followed in Aircraft maintenance shop.

COB4: To maintain the basic components of various systems.

COB5: To acquire the knowledge of the Hazardous materials handling.

MODULE I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 09

Equipment’s 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 - repair techniques - close tolerance fasteners - sealing compounds - forming/shaping.

MODULE II PLASTICS AND COMPOSITES IN AIRCRAFT 09

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

Cleaning of fibre 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 III AIRCRAFT JACKING, ASSEMBLY AND RIGGING 9

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

MODULE IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 09

Trouble shooting and maintenance practices - service and inspection – inspection and maintenance of landing gear systems. & Brake system and Anti-skid system - Inspection and maintenance of conditioning and pressurization system, installation and maintenance of instruments- auxiliary power units (APUs).

MODULE V SAFETY PRACTICES 09

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

L - 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair ", McGraw Hill, New York, 1992.
2. Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York, 1987.
3. Airframe &Powerplant Mechanics, “General Hand Book”, AC65-9A, English Books Store, Connaught Circus, New Delhi.

REFERENCES:

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

COURSE OUTCOMES:

CO1: To undergo inspection of various types of materials used in airframe and repair it.

CO2: To repair the composite and plastic components of the aircraft.

CO3: Gain knowledge of the standard maintenance practices for aircraft systems

O4: Troubleshoot the hydraulic and pneumatic system of the aircraft

CO5: Know the basic safety measures to be carried out during the airframe maintenance.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO2	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO3	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	M	L	-	-	-	-	-	-	-	H	H
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Holistic understating of different inspection and repair procedure followed in the aviation industries

AEDX 27	**ADVANCED MANUFACTURING TECHNOLOGIES**	**L**	**T**	**P**	**C**
SDG: 09		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the wear mechanism in cutting tools and to predict its life

COB2: To learn the special machining process in creating holes and finishing it

COB3: To assess the principle and mechanism of metal removal of various unconventional machining processes

COB4: To understand the concept of various micro fabrication technology.

MODULE I METAL CUTTING AND TOOL MATERIALS 06

Orthogonal and oblique cutting - Types of tool wear, Abrasion, Diffusion, Oxidation, Fatigue and Adhesive wear - Prediction of tool life – Tool materials, Cemented carbide, Coated carbide - Selection of machining parameters and Tools.

MODULE II SPECIAL MACHINING 08

Deep hole drilling - Gun drills - Gun boring - Trepanning - Honing - Lapping - Super finishing - Burnishing - Broaching - High speed machining.

MODULE III UNCONVENTIONAL MACHINING 08

Principles, processes, Various influencing parameters and Applications of Ultrasonic machining, Electro Discharge Machining, Electro Chemical Machining, Electron and Laser Beam Machining, Plasma Arc Machining and Water Jet Machining.

MODULE IV MICROFABRICATION 08

Wafer preparation – monolithic processing – moulding – Printed circuit board hybrid and multi-chip module technology –electronic material and processing– stereolithographic surface acoustic wave (SAW) devices, Surface Mount Technology.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Armarego E.J.A. and Brown R.H., “The machining of metals ", Prentice Hall, 1982.
2. Battacharya," Theory of metal cutting ", NCB Agency, 1984.
3. HMT Manual, “Non-traditional machining methods ", 1975.

REFERENCES:

1. Sadasivan T.A. and Sarathy D. "Cutting tools for Productive Machining ", Widia (India) Limited, 1999.
2. Pandey P.S. and Shah N. "Modern Manufacturing Processes ", 1980.
3. Rich E. and Knight K., "Artificial Intelligence ", McGraw Hill Inc, 1991.

COURSE OUTCOMES:

Students will be able to

CO1: Distinguish different materials used for cutting tools and to select the machining parameters for improving the tool life

CO2: Demonstrate various types of machining that can be carried out in special purpose machines.

CO3: Identify the process parameters, their effect and applications of different processes

CO4: Realize the applications of Micro fabrication technology.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		L		L							H	M	
CO2	H	M		L		L							H	M	
CO3	H	M		L		L							H	M	
CO4	H	M		L		L							H	M	

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Understanding the fundamentals of advanced manufacturing technique helps to produce near-net shape components and reduce the wastage of materials which in turn enhances the productivity of industries.

AEDX 28	MEASUREMENT SYSTEMS	L	T	P	C
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the principles employed in measurements in aircraft structures.

COB2: To understand the principles employed in measurements in aerodynamic stream.

COB3: Possess knowledge in measuring pressure and sound in the systems.

COB4: To develop competency in understanding of vibration and the various techniques of measurement and control of vibration.

COB5: To understand the techniques employed in measurements in space.

MODULE I INTRODUCTION TO EXPERIMENTAL METHODS 8

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

MODULE II FLOW MEASUREMENTS 10

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 PRESSURE AND SOUND MEASUREMENT 10

Basic methods of pressure measurements, deadweight gauges and manometers, elastic transducers, elastic transducers, high pressure measurement, low pressure measurement, sound measurement – sound level meter, microphones, acoustic intensity and acoustic emission

MODULE IV MOTION AND VIBRATION MEASUREMENT 9

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), MEMS-based Sensor, Piezoelectric accelerometer, Rate gyroscope principles, Rate-integrating gyroscope principles, Laser gyros, LVDT, RVDT

MODULE V SPACECRAFT ATTITUDE DETERMINATION 8

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

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Measurement Systems-Application and Design,5th Edition, Ernest O Doebelin, Dhanesh N Manik, Tata McGraw Hill, 2007

REFERENCES:

1. Spacecraft Dynamics and Control-A Practical Engineering Approach, Marcel J. Sidi, Cambridge University Press, 1997
2. Experimental Methods for Engineers, Seventh Edition, J. P. Holman, Tata McGraw Hill, 2004.

COURSE OUTCOMES:

Students will be able to

CO1: Possess knowledge in fundamental in measurements of aircraft structures.

CO2: Understand the measurement systems of various physical parameters and working methods of flow visualization techniques**.**

CO3: Gain knowledge in the principles employed in measurements of pressure and sound.

CO4: Describe vibration measuring instruments for industrial / real life applications along with suitable method.

CO5: Understand the techniques employed in measurements in space.

Board of Studies (BoS) :
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	H	H		L					H	M	H
CO2	H	H	H	H	H					M	M	H	M	H
CO3	H	M	H	H	H							L	M	M
CO4	H	M	M	H	M					L	M	M	M	M
CO5	H	M	H	H	L							L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course gives exposure to the basic measurement systems in the real time engineering applications.

AECX29	**AIRCRAFT GENERAL ENGINEERING & MAINTENANCE**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of mooring, jacking and towing procedures of aircraft.

COB2: To know about the ground servicing of various sub systems.

COB3: To understand the basic ides of shop safety.

COB4: To understand the type of inspections and regulatory authorities.

COB5: To understand the aircraft hardware and materials.

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- Fixed/Mobile Units.

MODULE II GROUND SERVICING OF VARIOUS SUB SYSTEMS 8

Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

MODULE III MAINTENANCE OF SAFETY 7

Shop safety –Electrical & Fire safety, Safety around- Compressed gases- Hazardous materials- Machine tools- Environmental cleanliness – Precautions.

MODULE IV INSPECTION/PUBLICATIONS 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 10

Hand tools – Precision instruments – Special tools and equipment's 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.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Kroes Watkins Delp, “Aircraft Maintenance and Repair”, McGraw Hill, New York, 1993.
2. Lalit Gupta”Aircraft General Engg”, Jain Book Depot, New Delhi,2010

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.
3. Aviation Maintenance Technician Hand Book-FAA-H-8083-32A

COURSE OUTCOMES:

At the end of the course Students will be able to

CO1: Keep abreast with procedure and standard maintenance practices.

CO2: Gain knowledge on maintenance and flight safety aspects.

CO3: Gain knowledge on theoretical aspects of ground servicing of aircraft.

CO4: Acquire knowledge on importance of aircraft documentation and various inspection schedules.

CO5: Identify and gain knowledge on special aircraft tools and equipment.

Board of Studies (BoS) :
16th BoS of AERO held on 03.08.2022.

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	H	L	-	-	-	-	-	-	-	-	M	L
CO2	H	M	L	L	-	-	-	-	-	-	-	-	M	L
CO3	M	M	M	M	M	L	-	-	-	-	-	-	L	L
CO4	H	L	-	-	-	-	-	-	-	-	-	-	L	L
CO5	M	M	L	L	M	-	-	-	-	-	-	M	M	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The course allows the student to know about the aircraft general and maintenance practices in civil aviation.

AEDX 30	**AIR TRAFFIC CONTROL AND DESIGN**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the various flight rules and airspace used in Air Traffic Control.

COB2: To gain the basic knowledge of Aircraft separation in space and procedure for scheduling the flight plan

COB3: To understand RADAR based separation and Emergency coordination procedure

COB4: To know the physical characteristics and classification of runway.

COB5: 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-classifications of ATS air spaces – altimeter setting procedures-establishment, designation and identification of units providing ATS – various divisions and its responsibility and 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 & EMERGENCY COORDINATION PROCEDURES. 10

Radar service, basic radar terminology- identification procedures using primary and secondary radar. Glide path assurance control and co-ordination between radar/non radar control – emergencies-flight information and advisory service-alerting service coordination and emergency procedures- rules of the air.

MODULE IV PHYSICAL CHARACTERISTICS OF RUNWAY& 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- obstacle restriction..

MODULE V VISUAL AIDS FOR NAVIATION AND LANDING 9

Visual aids for navigation, wind direction indicator-landing direction indicator location and characteristics of signal area – signalling, 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-emergency and other services.

L – 45; TOTAL HOURS: 45

TEXT BOOKS:

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

REFERENCES:

2. "Aircraft Manual (India) Volume1", latest edition –The English Book Store, 17-1, Connaught Circus, New Delhi.
3. "PANS-RAC-ICAO DOC4444", Latest edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

COURSE OUTCOMES: Students will be able to

CO1: Understand various airspace and flight rules followed in Air Traffic services.

CO2: To know various types of separation followed in the airspace for safe operation of air traffic.

CO3: To know the use of RADAR in separation and co-ordination of various air traffic services.

CO4: To plan the layout of runway and aerodrome construction procedures.

CO5: To understand the various navigation aids for aircraft landing obstacle clearance near the airfield.

Board of Studies (BoS) :
18th BOS of AERO held on 24.11.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M	L	L	-	-	-	-	-	-	-	-	H	H
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO3	M	M	L	L	-	-	-	-	-	-	-	-	H	H
CO4	M	M	L	L	-	-	-	-	-	-	-	-	M	H
CO5	H	H	M	M	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement:serves as a declaration of intent and commitment to integrate sustainability principles into the planning, design, and operation of air traffic control systems and infrastructure.

AEDX31 SDG: 9	BEHAVIOR OF MATERIALS AT HIGH TEMPERATURE	L T P C 3 0 0 3

COURSE OBJECTIVES:

COB1: To examine and comprehend the structural and mechanical properties of super alloy materials, their behavior under high-temperature conditions**.**

COB2: To develop an understanding of different oxidation types and methods employed to combat corrosion.

COB3: To deepen insights into the factors influencing the functional life of components operating at elevated temperatures, with a focus on the understanding of creep behavior.

COB4: Explore the spectrum of fracture behaviors in materials, ranging from brittle to ductile transitions across a temperature gradient.

COB5: To facilitate informed decision-making in ablative material selection; understand their functional applications and the benefits they offer.

MODULE I SUPER ALLOYS 12

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 II OXIDATION & CORROSION 9

Oxidation, Pilling-Bed worth ratio, kinetic laws of oxidation, defect structure and control of oxidation by alloy additions. 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 III 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 IV FRACTURE 7

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 V ABLATION 5

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

L – 45; 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.

COURSE OUTCOMES:

Students will be able to

CO1: Heighten the role of super alloys in high temperature applications

CO2: Identify factors influencing functional life of components at elevated temperatures.

CO3: Evaluate fracture mechanism types and Interpret data from fracture maps of different alloys.

CO4: Comprehend ablative heat transfer phenomenon and suggest suitable ablative materials for space applications.

Board of Studies (BoS) :

18th BOS of AERO held on 24.11.2023

Academic Council:

21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H											H	
CO2		H												
CO3	H			M									H	
CO4		H											H	
CO5	H		L											L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Industry, Innovation, and Infrastructure

Statement : Advanced materials and alloys, which are crucial for technological innovation in various industries, particularly in aerospace, energy, and manufacturing. And fracture mechanics implies a need for on-going research and development.

AEDX 32	PRODUCT DEVELOPMENT AND 3D PRINTING TECHNOLOGIES	L	T	P	C
SDG: 09		2	0	0	2

COURSE OBJECTIVES:

COB1: Understand the rapid prototyping process and tool design

COB2: Acquires the data collection and slicing of model using CAD

COB3: Understand the various liquid based 3D printing types and technologies

COB4 : Understand the various solid based 3D printing types and technologies

MODULE I INTRODUCTION 7

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation.

MODULE II RAPID PROTOTYPING & TOOLING 8

Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation

MODULE III LIQUID BASED 3D PRINTING 7

Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies.

Solid ground curing (SGC): Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies

MODULE IV SOLID BASED 3D PRINTING 8

Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.

Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration

L – 30; TOTAL HOURS: 30

TEXT BOOKS:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
2. Rapid Tooling: Technologies and Industrial Applications, Peter D. Hilton, Hilton/Jacobs, PaulF. Jacobs, CRC press, 2000.

REFERENCES:

1. Ian Gibson, Davin Rosen, Brent Stucker “Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.
2. Rapid Prototyping: Theory and practice, Ali K. Kamrani, EmadAbouel Nasr, Springer, 2006

COURSE OUTCOMES: Students will be able to

CO1: Produce the different prototypes of model after completion of module.

CO2: design the model using CAD modelling and slice the model for 3D printing

CO3: select the suitable liquid 3D printing method and printing techniques for the model developed.

CO4: select the suitable solid 3D printing method and printing techniques for the model developed.

Board of Studies (BoS) :
18th BOS of AERO held on 24.11.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	M	-	-	-	-	-	-	-	-	H	H
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO3	M	M	L	L	-	-	-	-	-	-	-	-	H	H
CO4	M	M	L	L	-	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Empowering individuals with the skills and knowledge to harness the transformative potential of 3D printing technology.

AEDX 33	**MICROPROCESSOR AND MICROCONTROLLER FOR AIRCRAFT SYSTEMS**	**L**	**T**	**P**	**C**
SDG:09		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: Understand the basic architecture of the microprocessor and its programming

COB2: Study the interfacing of various devices with microprocessor

COB3: Understand the architecture and programming of basic microcontroller

COB4: Impart the knowledge of interfacing the microcontroller to real time application

MODULE I MICROPROCESSOR 8

Introduction to Microprocessor - Block diagram of 8085 Microprocessor – Architecture of Intel 8085 – Microprocessor-Addressing modes of 8085 – Instruction set classification- Instruction formats – Addressing Modes – Simple programs using 8085.

MODULE II INTERFACING MICROCONTROLLER 7

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display 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 - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

L - 30; TOTAL HOURS – 30

TEXT BOOKS:

1. Goankar R.S, “Microprocessors, Programming to Architecture 8085”, 5thEdition, Penram International publishing Pvt. Ltd., New Delhi, 2002.

2. Mohammad Ali Mazidi and Janice GillispieMaszidi “The 8051 Microcontroller and Embedded Systems” Pearson education, 2003, ISBN-9788131710265, 2ndEdition

REFERENCES:

1. Douglas, Hall, “Microprocessors and Interfacing”, Revised edition, Tata McGraw Hill Publication.
2. V.K. Mehta, “Principles of Electronics”, 2nd Edition, S. Chand & Co., New Delhi,2002.
3. Kenneth J. Ayla, “The 8051 Micro controller”, Thomson learning, 3rd edition, 2004, ISBN-140186158X

COURSE OUTCOMES:

CO1: Students acquire the knowledge of microprocessors and their programming Language.

CO2: Give the practical interface problem to students to interface the aircraft systems

CO3: Students acquire the knowledge of microcontrollers and its programming Language.

CO4: Test the practical interface knowledge by interfacing the microcontroller to aircraft systems

Board of Studies (BoS) :
15th BoS of AERO held on 11.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M	L	-	-	-	-	-	-	-	H	H	H
CO2	,M	M	H	M	L	-	-	-	M	-	-	-	M	M	,M
CO3	H	H	H	M	L	-	-	L	-	-	-	-	H	H	H
CO4	M	M	M	M	L	-	-	-	-	-	-	-	M	M	M
CO5	M	M	M	M	L	-	-	-	-	-	-	-	M	M	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

Statement: Understanding the basic knowledge of microprocessors and microcontrollers and their interfacing with real-world sensors leads the students to develop their own controllers for the projects and industrial requirements.

AEDX 34	MATHEMATICAL MODELLING AND SIMULATION	L	T	P	C
SDG: 09		2	0	0	2

COURSE OBJECTIVES:

COB1: Students will understand the advanced concepts of Mathematical Modeling and Simulation

COB2: student is provided with the necessary mathematical knowledge that is needed in modeling physical processes.

COB3: students are introduced to make the simulation of their system using the data available from modeling

COB4: students are introduced to various simulation tools and gained the knowledge of modeling

MODULE I SYSTEM MODELS AND SIMULATION 7

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, and Cobweb models.

MODULE II PROBABILITY, CONCEPTS IN SIMULATION 7

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 SIMULATION 10

Discrete events, Representation of time, Generation of arrival patterns, Simulation programming tasks, Gathering statistics, Counters and summary statistics, Simulation language. Continuous System models, Differential equations, Analog methods, digital-analog simulators, Continuous system simulation language (CSSLs), Hybrid simulation, Simulation of autopilot, and Interactive systems.

MODULE IV FLIGHT SIMULATOR AS A TRAINING DEVICE AND RESEARCH TOOL 6

Introduction, the advantage of the simulator, the effectiveness of the Simulator, The user’s role, Simulator Certification, Data sources, Validation, in-flight simulators

L – 30 ; 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. R.C.Dorf and R.H.Bishop, “Modern Control Systems”, Addison-Wesley (MATLAB Reference), 1995.

COURSE OUTCOMES:

Students will be able to

CO1: understand the advanced concepts of Mathematical Modeling and Simulation to the engineers

CO2: acquire necessary mathematical knowledge that is needed in modeling physical processes

CO3: have exposure to various topics such as System Models, probability concepts in simulation, and flight simulators

CO4: deploy these skills effectively in understanding the concepts and working of a flight simulator.

Board of Studies (BoS):

16th BoS of Aero held on 03.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M					L				L		H	L	
CO2	H	M									M		H	L	
CO3	H	M	L	M	L		L				M		H		
CO4	H	M	L	L							H		H		
CO5	H	H	L	L						L	L	L	H	L	

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: students were able to write a program using various MATLAB tools

AEDX 35	MEMS DEVICES AND FABRICATION	L	T	P	C
SDG:09		1	0	0	1

COURSE OBJECTIVES:

To impart knowledge on the concept of

COB1: To introduce the concepts of micro and nano electromechanical devices

COB2: To know the fabrication process of Microsystems

COB1: To know the design concepts of micro sensors and micro actuators

MODULE I INTRODUCTION TO MEMS & MICROFABRICATION 10

Introduction to Design of MEMS and NEMS, History of MEMS Development, Characteristics of MEMS - Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals. Micro fabrication - microelectronics fabrication process: Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

MODULE II MEMS DEVICES 5

Design of micro sensors: pressure sensors and gyroscopes – Design of actuators, actuation using electrostatic forces, RF switch.

TOTAL HOURS: 15

TEXT BOOK:

1. Senturia, S. D. (2001). Microsystem design. Boston: Kluwer Academic Publishers.

REFERENCES:

1. Ananthasuresh, G. K., Vinoy, K. J., & Gopalakrishnan, S. (2012). Micro and Smart Systems: Technology and Modeling: Technology and Modeling. Wiley Global Education.
2. Liu, C. (2012). Foundations of MEMS. Pearson Education India.

COURSE OUTCOMES:

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

CO1: Interpret the basics of micro/nano electromechanical systems including their applications and advantages

CO2: Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.

CO3: Analyze the key performance aspects of electromechanical transducers including sensors and actuators

Board of Studies (BoS):
16th BoS of Aero held on 03.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	H	L								M	H	M
CO2	H	H	H	H	H					H	M	H	H	H
CO3	H	L	H	H	H		L			H	M	H	H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course gives exposure to design, analysis, fabrication and testing the MEMS based components.

AEDX 36	**SATELLITE TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Understand the basics of satellite orbits

COB2: Understand the satellite segment and earth segment

COB3: Analyze the various methods of satellite access

COB4: Understand the applications of satellites

COB5: Understand the basics of satellite Networks

MODULE I SATELLITE ORBITS 9

Kepler‟s Laws, Newton‟s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

MODULE II SPACE SEGMENT 9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.

MODULE III SATELLITE NAVIGATION & GLOBAL POSITIONING SYSTEMS 9

Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers, GPS C/A code accuracy, Differential GPS.

MODULE IV EARTH STATION TECHNOLOGY 9

Transmitters, Receivers, Antennas, Tracking systems, Terrestrial Interface, Power Test methods, Lower Orbit Considerations.

MODULE V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Dennis Roddy, ―Satellite Communication‖, 4th Edition, Mc Graw Hill International, 2006.
2. imothy, Pratt, Charles, W. Bostain, Jeremy E. Allnutt, "Satellite Communication, 2nd Edition, Wiley Publications,2002

REFERENCES:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, ―Satellite Communication Systems Engineering‖, Prentice Hall/Pearson, 2007.
2. N.Agarwal, ―Design of Geosynchronous Space Craft‖, Prentice Hall, 1986.
3. Bruce R. Elbert, ―The Satellite Communication Applications‖, Hand Book, Artech House Bostan London, 1997.
4. Tri T. Ha, ―Digital Satellite Communication‖, II nd edition, 1990.
5. Emanuel Fthenakis, ―Manual of Satellite Communications‖, Mc Graw Hill Book Co., 1984.
6. Robert G. Winch, ―Telecommunication Trans Mission Systems‖, Mc Graw-Hill Book Co., 1983.
7. Brian Ackroyd, ―World Satellite Communication and earth station Design‖, BSP professional Books, 1990.
8. G.B.Bleazard, ―Introducing Satellite communications―, NCC Publication, 1985.
9. M.Richharia, ―Satellite Communication Systems-Design Principles‖, Macmillan 2003.

COURSE OUTCOMES:

Students will be able to

CO1: Analyse the satellite orbits

CO2: Analyse the earth segment and space segment

CO3: Analyse the satellite Link design

CO4: Analyse different communication systems

CO5: Design various satellite applications

Board of Studies (BoS) :

17th BoS held on 03.02.2023

Academic Council:

20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	L	L								H	H
CO2	H	H	H	L	L								H	M
CO3	L	H	L	L									M	M
CO4	L	M	M	M									L	L
CO5	M	M	M	L	L								L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The holistic understanding of various systems and technologies used in the satellite.

AEDX 37	**SPACE DEBRIS**	**L**	**T**	**P**	**C**
SDG: 4 & 9		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB1: To introduce the basic space debris environment and its danger

COB2: To employ active and passive technologies for debris removal

MODULE I Introduction 6

Basics of space debris - space debris environment, and mitigation principles - Forces acting on an object in space - dangers it contains - legal and regulatory considerations.

MODULE II Active and Passive Technologies for Debris Removal 9

Technologies for passivation and deorbiting - aerothermodynamics ruling the re-entry of an object in the atmosphere - Active Debris Removal and Design for Demise – Spacecraft Design for optimal destruction during re-entry - future of the space debris problem.

TOTAL HOURS: 15

REFERENCES:

1. Lakshya Vaibhav Datta, Introduction to Space Debris: Challenges and Removal Techniques, LAP Lambert Academic Publishing, 2013.
2. Heiner Klinkrad, Space Debris: Models and Risk Analysis, Springer Science & Business Media, 2006.
3. Kevin Barry, Space Debris Mitigation and Remediation: Historical Best Practices and Lessons Learned for Economically Preserving and Utilizing Common Areas, New Space, Sep 2022, PP 246-258.

COURSE OUTCOMES:

Students will be able to

CO1 Understand the basic space debris environment and its danger

CO2 Apply active and passive technologies for debris removal understand the basic equations governing fluid flow problems

Board of Studies (BoS) :

17th BoS held on 03.02.2023

Academic Council:

20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L										L	L
CO2	M	M	L		L								M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4 & 9: Quality Education and Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: applying knowledge of space debris study will pave way for designing innovative engineering appliances leading to resilient infrastructure and sustainable industrialization.

AEDX 38	**AIRCRAFT NAVIGATION AND GUIDANCE SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce various types of navigation systems

COB2: To understand the dead reckoning navigation system and its error correction.

COB3: To satellite navigation and hybrid navigation system integration.

COB4: To study various navigation system and its usage in air traffic regulation and landing aircrafts.

COB5: To study about the basic principles of Kalman Filter, GPS and its position and velocity determining signal structure.

MODULE I INERTIAL NAVIGATION SENSOR AND GYROSCOPE 6

Introduction to navigation – Types – Introduction to Inertial sensors Introduction to navigation – Types – Introduction to Inertial sensors – Mechanical – Ring Laser – Gyro- Fiber optic gyro – MEMS system.

MODULE II INERTIAL NAVIGATION SYSTEMS 10

Ins COMPONENTS: transfer functions and errors –Earth in inertial space – Coriolis Effect – INS Mechanization. Platform and Strap down – Navigation algorithms – INS block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning – compensation errors- Gimbal Lock – Initial calibration and alignment algorithms, Introduction to IRS.

MODULE III RADIO NAVIGATION 11

Different types of radio navigation – ADF – VOR – DME – Doppler – Hyperbolic Navigations – LORAN, DECCA and Omega –TACAN.

MODULE IV APPROACH AND LANDING AIDS 6

ILS, MLS, GLS -Ground controlled approach system – surveillance systems – radio altimeter, gyro compassing.

MODULE V SATELLITE NAVIGATION & HYBRID NAVIGATION 12

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.

L – 45; TOTAL HOURS: 45

REFERENCES:

1. Myron Kyton, Walfred Fried, “Avionics Navigation Systems” John Wiley & Sons, 2 editions, 1997.
2. Nagaraja, N.S “Elements of Electronic Navigation”, Tata McGraw-Hill Publications, 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.
6. Sen, A.K. & Bhattacharya, A.B. “Radar System and Radar Aids to Navigation”, Khanna publishers, 1988.
7. Slater, J.M.Donnel, C.F.O and others, “Inertial Navigation Analysis and Design”, McGraw-Hill Book company, New York, 1964.

COURSE OUTCOMES: Upon completion of course:

CO1: Students will understand the advanced concepts of aircraft navigation.

CO2: To provide the necessary mathematical knowledge those are needed in modeling the navigation process and methods.

CO3: The students will have an exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation systems, Satellites Navigation - GPS

CO4: The students will study about advanced radio navigation systems such as ADF, VOR, DME – Doppler- Hyperbolic Navigations – LORAN, DECCA and Omega – TACAN.

CO5: Landing aids and will be able to deploy these skills effectively in the analysis and understanding of navigation systems in an aircraft.

Board of Studies (BoS) :
18th BOS of AERO held on 24.11.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M	L	L	-	-	-	-	-	-	-	-	H	H
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO3	M	M	L	L	-	-	-	-	-	-	-	-	H	H
CO4	M	M	L	L	-	-	-	-	-	-	-	-	M	H
CO5	H	H	M	M	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: underscores the importance of integrating sustainability considerations into the design, development, and operation of aircraft navigation and guidance systems to support the broader goals of sustainable development and environmental stewardship within the aviation industry.

AEDX 39	**UAV AND MAV SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 09		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: Understand the basic knowledge on UAV/MAV design

COB2: To acquaint the students to various airframe structures and various components used in UAV design.

COB3: Introduce the basic methods of designing the calibration and implementation of flight controllers.

COB4: Students will plan the autonomous mission and understand the various types of payloads.

MODULE I INTRODUCTION 8

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

MODULE II AIRFRAME AND COMPONENTS 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 FLIGHT CONTROLLER AND GCC 7

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

MODULE IV PATH PLANNING AND AUTONOMOUS MISSION 7

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

L – 30; TOTAL HOURS: 30

TEXT BOOKS:

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

REFERENCES:

1. 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.
2. Benson H.Tongue, "Principles of Vibration", Oxford University Press, 2000.

COURSE OUTCOMES: Students will be able to

CO1: Acquire knowledge on various UAV System Design to the engineers

CO2: Understand the various components of UAV and its uses in flying the mission.

CO3: have an exposure on design of various flight controller and its operation.

CO4: plan the autonomous mission and path planning for the various mission

Board of Studies (BoS) :
18th BOS of AERO held on 24.11.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	M	-	-	-	-	-	-	-	-	H	H
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO3	M	M	L	L	-	-	-	-	-	-	-	-	H	H
CO4	M	M	L	L	-	-	-	-	-	-	-	-	M	M
CO5	H	H	M	M	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: By aligning UAV and MAV initiatives with the SDGs, stakeholders can leverage these technologies to advance sustainable development objectives and create positive impacts on a global scale.

PHYSICS ELECTIVE

		L	T	P	C
PHDX 01	**NON DESTRUCTIVE TESTING OF MATERIALS**	**2**	**0**	**0**	**2**

SDG: 4

COURSE OBJECTIVES:

COB1: To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

COB2: To study the working and instrumentation of thermography and eddy current testing methods and apply to interpret the results and investigate the possible defects.

COB3: To get full exposure about principle, instrumentation and standards of various radiographic NDT methods and improve the skill to identify the defects suitably.

COB4: To get deep insight into the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods.

COB5: To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

MODULE I SURFACE NDT METHODS 7

Liquid Penetrant Inspection – Principles, Types of dye and methods of application,developers, advantages and limitations of various methods, Interpretation of results. Magnetic Particle Inspection- Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Interpretation of field indicators, Particle application, Inspection,Residual magnetism Principles and methods of demagnetization.

MODULE II THERMOGRAPHY AND EDDY CURRENT TESTING 7

Thermography- Principles, Contact and non contact inspection methods, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Applications, advantages, Limitations, Interpretation/Evaluation.

MODULE III RADIOGRAPHY 8

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square law, characteristics of films -graininess, density, speed, contrast, characteristic curves. Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Digital Radiography.

MODULE IV ULTRASONIC TESTING 8

Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection.

L – 30; Total Hours – 30

TEXT BOOKS:

1. ASM Metals Handbook,Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, 2018.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.

REFERENCES:

1. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.

2. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005.

3. Charles, J. Hellier, Handbook of Nondestructive evaluation, McGraw Hill, New York 2001.

4. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science

International Limited (2006).

COURSE OUTCOMES:

CO1: Demonstrate the importance, principle, concept and inspection methods of various surface NDT methods and apply the same to interpret the results effectively.

CO2: Comprehend the ideas behind working of thermography and eddy current testing methods and apply them to interpret the results of testing and analyse the defects and problem.

CO3: Grasp the fundamental principles, and standards of various radiographic NDT methods and utilise them to identify the defects and defect location suitably.

CO4: Assimilate the ideas concerning the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods and identify the areas for their application.

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 21.6.21	17^{th} AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 02	**MATERIALS SCIENCE FOR ENGINEERING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 4

COURSE OBJECTIVES:

COB1: To impart knowledge on the fundamentals of materials science and engineering.

COB2: To provide a basis for understanding properties and applications of dielectric materials.

COB3: To expose the students to different classes of materials, their properties, structures and imperfections

COB4:To aid the teaching learning process through relevant illustrations, animations, web content and practical examples

MODULE I CLASSIFICATION OF MATERIALS 6

Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, structure and properties, additives for polymer products, effect of environment on materials, composites

MODULE II PROPERTIES OF MATERIALS 10

Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture- Electronic Properties:Free electron theory, Fermi energy, density of states, band theory of solids, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials - Magnetic Properties: Origin of magnetism in metallic and ceramic materials, para-magnetism, diamagnetism, ferro and ferrimagnetism- Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity- Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials.

MODULE III CRYSTALLOGRAPHIC STRUCTURES AND IMPERFECTIONS 7

Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals.

MODULE IV THERMODYNAMICS AND KINETICS 7

Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusivity.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1. William D. Callister, Jr., David G. Rethwisch, Materials Science and Engineering, Edition 9, Wiley, 2014.
2. Michael F. Ashby, David R.H. Jones , Engineering Materials 1 An Introduction to Properties, Applications and Design · Volume 1, Elsevier Science, 2012
3. Michael F. Ashby, David R.H. Jones , Engineering Materials 2: An Introduction to Microstructures, Processing and Design · Volume 2, Elsevier Science, 2013
4. Reza Abbaschian, Robert E. Reed-Hill, Physical Metallurgy Principles - SI Version, Cengage Learning, NY, 2009
5. "Encyclopedia of Polymer Science and Technology" 3rd Edition, Vol.1-12, Wiley Interscience , 2003

COURSE OUTCOMES

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

CO1. select suitable material for specific application.

CO2. analyse crystallographic structure of metals and their imperfections.

CO3. develop metal alloys with varying properties by selecting suitable heat treatment

CO4. correlate the various properties of material with their structure.

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: *Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.*

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 03	BIOMATERIALS	L	T	P	C
		2	0	0	2

SDG: 4

COURSE OBJECTIVES:

COB1: To gain basic knowledge in classification of biomaterials and their properties.

COB2: To provide a basis for understanding properties of metallic implant materials.

COB3: To enable the students to correlate theoretical principles with practical applications.

COB4:To help students understand biocompatibility & toxicological screening of biomaterials

MODULE I INTRODUCTION TO BIOMATERIALS 8

Introduction: Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Surface properties of materials, physical properties of materials, mechanical properties-Materials for biophotonic applications.

MODULE II IMPLANT MATERIALS 10

Metallic implants: Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion-ceramic implants : bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics-Polymer implants: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin.

MODULE III BIOCOMPATIBILITY AND TOXICOLOGICAL SCREENING OF BIOMATERIALS 6

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ-implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

MODULE IV PRACTICAL ASPECTS OF BIOMATERIALS 6

Preparation of biomaterials - Microscopic study & analysis of different biomaterials- alginate – material preparation and characterization - Testing of various biomaterials- case studies on industrial and clinical applications of biomaterials.

L – 30; Total Hours –30

TEXT BOOKS:

1. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill, 2003
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. Implant biomaterials: A comprehensive review, World Journal of Clinical Cases, 2015

REFERENCES:

1. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, Introduction to Biomedical Engineering, Elsevier, 2005.
2. Park J.B., Biomaterials Science and Engineering, Plenum Press, 2007.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,Woodhead Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.
4. D F Williams, Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume, VCH Publishers 1992.

COURSE OUTCOMES:

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

CO1: differentiate common use of biomaterials as metals, ceramics, polymers and apply them to classify its chemical structure, properties and morphology.

CO2: comprehend ideas involving general properties of implant materials and apply the same to identify the benefits of implant materials.

attain knowledge about the biocompatibility & toxicological screening of

biomaterials and realize its usage in real life.

CO4: reflect upon the practical ideas of using biomaterials

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17^{th} AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	L	L	M	M	M	L	L	L	M	-	-	-
CO3	M	L	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	M	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: *Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.*

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 04	OPTICAL FIBRE COMMUNICATION	L	T	P	C
		2	0	0	2

SDG: 4

COURSE OBJECTIVES:

COB1: To facilitate the knowledge about optical fibres and its transmission characteristics.

COB2: To make the students to learn about LED and laser diodes.

COB3: To make the students understand the various types of opticalReceiversand sensors.

COB4: To enrich the knowledge on optical amplifiers and networks.

MODULE I INTRODUCTION TO OPTICAL FIBRES 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.

MODULE II FIBER OPTICAL SOURCES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED – LED structure - LED characteristics – Semiconductor Lasers diode, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers - applications.

MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 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 - Fiber optic sensors: Intrinsic and Extrinsic sensors, amplitude, phase, wavelength and polarization modulation.

MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8

Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers - Optical Networks: Basic networks, SONET/SDH, WDM Networks, Nonlinear effects on network performance, Performance of WDM + EDFA systems, Solitons, Optical CDMA, Ultrahigh capacity networks.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communication, 3rd Edition, McGraw-Hill International, Singapore, 2013.

REFERENCES:

1 Govind P. Agrawal, Fiber-Optic Communication Systems (Wiley Series in Microwave and Optical Engineering) , Wiley 4th Edition, 2010.

2 J. Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 3rd Edition, 2010.

3 D. C. Agrawal, Fiber Optic Communication, S.Chand& Co Ltd., 2005.

4 Rajiv Ramaswami, KumarSivarajan, Galen Sasaki, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann, 2009.

5 B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd, 2014.

COURSE OUTCOMES:

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

CO1: realize basics of optical fiber and differentiate various modes andconfigurations.

CO2: understand and assimilate the working principle of LED andDiode Laser.

CO3: select suitable photodetectors/sensorsfor different types of applications.

CO4: analyze the mechanism of optical amplifiers and analyze opticalnetworks.

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 21.6.21	17^{th} AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 05	**SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 4

COURSE OBJECTIVES:

COB1: To study about electronic states of semiconductors.

COB2: To understand the physics of semiconductor devices

COB3: To gain knowledge on various methods involved in nanofabrication of semiconductor devices

COB4: To study the working principle of optoelectronic devices and various display devices

MODULE I ELECTRONIC STATES OF SEMICONDUCTORS 8

Energy bands in solids – Dynamics of electrons in periodic potential: Kronig – Penny model – Direct and Indirect Bandgaps – Brillouin Zone – Energy band structure in semiconductors (ZnO, GaAs) – concept of effective mass of electron and concept of holes.

MODULE II INTRODUCTION TO SEMICONDUCTOR DEVICES 6

Semiconductors: N and P type (Qualitative), PN junction diode under forward and reverse bias –– Zener diode, Schottky diode – Tunnel diode –bipolar junction transistor (BJT) - metal–oxide–semiconductor field-effect transistor (MOSFET), CMOS.

MODULE III DEPOSITION TECHNIQUES OF SEMICONDUCTING MATERIALS 6

Deposition of Semiconductor thin films – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering, Types of lithography: Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE IV OPTOELECTRONIC DEVICES 10

Light Emitting Diodes (LED) - double hetero LED structure - LED characteristics - White LED – Applications, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical detection – PIN and avalanche photodiodes, Luminescence, Cathode Luminescence, Electro Luminescence, Transparent Conductors, Liquid crystal displays – Dynamic scattering and Twisted nematic display, Charge-coupled devices (CCD)

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1) W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2) Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3) D. S. Dhaliwal et al., Prevail :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.

REFERENCES:

1. V.K. Mehta, Rohit Mehta, Principles of Electronics (Multicolour Edition) S. Chand Publishers, 10th Rev. Edn. 2006 Edition
2. Albert Malvino, David J. Bates Electronic Principles (SIE), McGraw Hill, 7th Edition, 2017
3. U. Mishra, J. Singh, Semiconductor Device Physics and Design, Springer, 2014
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, Wiley Publishers, 3ed 2008.
5. Bhattacharya Pallab, Semiconductor Optoelectronic Devices, Second Edition, By Pearson 2017
6. Joseph A. Castellano, Handbook of Display Technology, Springer, 1992
7. Yoshio Nishi, Advances in Non-volatile Memory and Storage Technology, Elsevier 2014

COURSE OUTCOMES:

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

CO1: study about electronic states of semiconductors.

CO2: understand the physics of semiconductor devices and identify its significance towards information technology (IT).

CO3: gain insight into various fabrication techniques towards the realization of nano-dimensional semiconductor devices.

CO4: attain knowledge on working principles of optoelectronic devices and display technologies and can recognize their importance in commercial applications.

Board of Studies (BoS) :	**Academic Council:**
13th BoS of Physics held on 14.09.2023	21st AC held on 20.12.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	M	M	M
CO2	M	L	M	H	L	M	H	M	L	L	L	M	M	M	M
CO3	L	M	H	H	L	H	M	M	L	H	L	M	M	M	M
CO4	M	L	H	M	L	M	M	H	L	M	L	M	M	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 06	**SENSORS AND ACTUATORS**	**L**	**T**	**P**	**C**
SDG: 4		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1:To understand the basic concept of measurements and sensors

COB2:To avail knowledge on variable resistance, capacitance and Inductance sensors.

COB3: To study about special sensors.

COB4: To get introduced towards MEMS technology and various actuators.

MODULE I INTRODUCTION TO MEASUREMENTS AND SENSORS 8

Sensors: functions – main technical requirement and trends, units and trends – calibration methods – classification of errors – error analysis – limiting error – probable error – propagation of error – odds and uncertainity – principle of transduction – classification: static and dynamic characteristics – mathematical model of transducers: zero, first and second order transducers.

MODULE II VARIABLE RESISTANCE, CAPACITANCE AND INDUCTANCE SENSORS 8

Characteristics and operation of resistive potentiometers – resistive pressure sensor – resistive position sensor - strain gauges: types, gauge factor calculation – resistive thermometer – thermistor Capacitive pressure sensor, Inductive sensor: Change in self-inductance with number of turns, change in self-inductance with change in permeability – inductive pressure transducer – inductive position transducer, LVDT – piezo resistive sensors.

MODULE III SPECIAL SENSORS 7

Photoconductors – optical detectors -photodiodes, phototransistors – charge coupled device (CCD) – Fabry Perot sensor - Hall effect – magneto resistive, magneto strictive sensors – microphones: resistive, capacitive, Fiber optic – thermocouple.

MODULE IV MICROSYSTEMS AND ACTUATORS 7

Microelectro-mechanical systems (MEMS), Micro fabrication and Applications, micro actuators– actuation principle, shape memory actuator: one way, two way and pseudo elasticity – types of micro actuators – electrostatic, inverse piezoelectric effect – Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Jacob Fraden, Hand Book of Modern Sensors: physics, Designs and Applications, 3rd edition, Springer, New York, 2015.
2. Jon. S. Wilson, Sensor Technology Hand Book, 1st edition, Elsevier, Netherland, 2011.
3. John G Webster, Measurement, Instrumentation and sensor Handbook, 2nd edition, CRC Press, Florida, 2014.

REFERENCES:

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., PREVAIL :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.
4. Tai-Ran Hsu, MEMS & Microsystem, Design and Manufacture, 1st ed., McGraw Hill India, New Delhi, 2017.
5. MassoodTabibArar, Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures, 1st ed., Kluwer Academic publishers, New York, 2014.

COURSE OUTCOMES:

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

CO1: get exposed to the basics of measurements and sensors

CO2: familiarize towards variable inductance, capacitance and resistance sensors and recognize their importance in commercial applications.

CO3: gain knowledge about special sensors and their applications.

CO4:apply the ideas to conceptualize MEMS technology and different actuators in engineering field

Board of Studies (BoS) :

13th BoS of Physics held on 14.09.2023

Academic Council:

21st AC held on 20.12.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	M	L	M	M	M	L	L	L	M	M	M	M
CO2	M	L	M	L	L	M	M	M	L	L	L	M	M	M	M
CO3	M	L	H	H	L	H	M	M	L	H	L	M	M	M	M
CO4	M	L	H	M	L	M	M	M	L	M	L	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 07 **FUNDAMENTALS OF NANOTECHNOLOGY AND ITS APPLICATIONS** **L T P C**
2 0 0 2

SDG: 4

COURSE OBJECTIVES:

: To introduce the basic concepts of Nanoscience through quantum mechanical theories and solid state physics.

: To provide knowledge about the various synthesis methods applicable to different nano materials

: To enrich the knowledge of students in various characterisation techniques.

COB4: To provide knowledge on applications of poymer based nano materials in various fields.

MODULE I BASICS OF NANO SCIENCE 7

Introduction to Nanoscience & Nanotechnology : Review of classical mechanics – overview Quantum Mechanics. Background to nanoscience and nanotechnology - scientific revolutions - nanosized effects – surface to volume ratio – atomic structure – molecular and atomic size - quantum effects - formation of nano sized particles – energy at the nanoscale.

MODULE II SYNTHESIS OF NANOMATERIALS 8

Nanomaterial Fabrication: Bottom-up vs. top-down - Preparations of Nanomaterials by mechanical and physical methods : – High energy ball milling – melt quenching and annealing – vapour deposition – Pulsed laser deposition – Magnetron sputtering - Microwave plasma evaporation. Chemical Methods of Preparation : Sol-gel method –Electrodeposition – Electrospinning. Arc method for carbon nanotubes – nanofibres and rods – synthesis of Graphene- Handling of nano particles - Health hazards – Precautions.

MODULE III CHARACTERIZATION OF NANOMATERIALS 8

Characterisation of Nanomaterials: XRD – particle size determination - SEM - FESEM - TEM – AFM – Nanoindentor – UV-VIS spectroscopy – FTIR, FT-Raman, Photoluminescence, NMR, ESR - Dielectric characterization – Magnetic characterization.

MODULE IV APPLICATION OF NANO MATERIALS 7

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) - Biosensor (principle, component, types, applications) - agriculture (nano-fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems (encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1 Nanotechnology: basic science and emerging technologies by Mick Wilson, Kamali Kannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.

2 Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.

3 Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.

4 Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

COURSE OUTCOMES:

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

understand basic principles of nanomaterials and apply them todifferentiate the significance of nanomaterials compared to bulk materials.

familiarize the various synthesis methods of nanomaterials andcompare them with the preparation of materials in bulk form.

get useful ideas about characterization techniques and differentiatedifferent techniques.

CO4: understand the various applications of nanomaterilas and realize the role of nanomaterials in various fields

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: *Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.*

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

CHEMISTRY ELECTIVE

CHDX 01	CHEMISTRY OF CONSTRUCTION MATERIALS	L	T	P	C
		2	0	0	2

SDG: 9

COURSE OBJECTIVES:

To impart knowledge on

COB1: chemistry of cement and concrete

COB2: properties of steel and mechanism of corrosion

COB3: quality of water and its impact on concrete

COB4: analytical techniques for concrete research

MODULE I CHEMISTRY OF CEMENT AND CONCRETE 8

Cement - chemical composition - Bogue's compounds - hydration of cement - hydrated products - influence of hydrated products on properties of cement - types of cement - microstructure of aggregate phase and hydrated cement paste - Interfacial transition zone in concrete : significance and microstructure

MODULE II CHEMISTRY OF STEEL AND CORROSION 8

Steel for construction - chemical composition - types of steels - influence of chemical composition on properties. Corrosion of steel - mechanism of corrosion of steel in water and concrete medium - types of corrosion of steel associated to civil engineering. Corrosion prevention and control : coatings & inhibitors - working mechanism. Cathodic protection to steel : Concept - working mechanism - sacrificial anodes

MODULE III WATER CHEMISTRY FOR CONCRETE 7

Water quality parameters – pH, solids, hardness, alkalinity, chloride and sulphates in water and their determination- Water quality for building construction – Effect of water impurities on concrete strength and durability- Carbonate and Sulphate attack-Chloride attack –Alkali-Silica reactions in concrete-Case studies

MODULE IV ANALYTICAL TECHNIQUES FOR CONCRETE RESEARCH 7

Analytical techniques for cement concrete research - FITR spectroscopy - SEM - XRD - Cyclic voltammetry (CV) - Thermo-gravimetric analysis (TGA) and

Differential thermal analysis (DTA) - Advanced chloride and water analysis techniques.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Wieslaw Kurdowski, Cement and Concrete Chemistry, Springer Netherlands, 2014.

REFERENCES:

1. P.C Jain and Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd.,New Delhi , 2013.
2. S SUmare and S S Dara, A text Book of Engineering Chemistry, S. Chand and Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company,NewYork, 1984.
4. B. Sivasnakar, Engineering Chemistry, Tata McGrow - Hill Publication Limited, New Delhi,second reprint 2008.
5. P. Kumar Mehta and Paulo J.M. Moteiro, "Concrete : Microstructure, Properties and Materials", McGraw Hill Education (India) Pvt. Ltd., 4th Edition, New Delhi, 2014
6. APHA Standard Methods for the Examination of Water & Wastewater, American Public Health Association, USA, 2005.

COURSE OUTCOMES:

CO1: Explain the properties of cement and concrete

CO2: Describe the properties of steel, mechanism of corrosion and its prevention

CO3: Enumerate the impact of water quality on the concrete

CO4: Elaborate the principle, instrumentation and applications of various analytical techniques for concrete research

Board of Studies (BoS) :	**Academic Council:**
11th BoS of Chemistry held on 17.06.2021	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	L	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	L	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

CHDX 02	CHEMISTRY OF MATERIALS AND ELECTROCHEMICAL DEVICES	L	T	P	C
		2	0	0	2

SDG: 9

COURSE OBJECTIVES:

The students will be conversant with

COB1: concepts of corrosion, types and various methods to control corrosion.

COB2: the chemicals, chemical reactions, construction and working of different batteries and fuels cells.

COB3: the types, properties and manufacture of refractories and abrasives.

COB4: types, functions of lubricants and mechanism of lubrication.

MODULE I CORROSION AND ITS CONTROL 8

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion. Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating — electroless plating.

MODULE II ELECTROCHEMICAL DEVICES 8

Electrochemical cell, electrolytic cell - introduction to batteries – classification – primary: dry alkaline – secondary: lead–acid, nickel–cadmium and lithium batteries, Fuel cells – classification based on temperature and electrolyte - hydrogen–oxygen fuel cell, applications – solar cells: construction and working – dye sensitised solar cells.

MODULE III REFRACTORIES AND ABRASIVES 7

Refractories: Introduction - refractory - classification – based on chemical nature - characteristic and selection of good refractory - properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability – general manufacture of refractory – components, properties and uses of: silica, magnesite, zirconia refractories - super refractories - application of refractories.

Abrasives: classification - Moh’s scale – properties - natural abrasives: diamond, corundum, emery, garnet, quartz - synthetic abrasives: preparation, properties and uses: carborundum, alundum, boron carbide (norbide), tungsten carbide, zirconium silicate – grinding wheel – abrasive paper and cloth - Rockwell scale test - knoop hardness test.

MODULE IV LUBRICANTS 7

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils - properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue - semisolid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jain P.C and Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Co., New Delhi. 2016.

REFERENCES:

1. E. McCafferty, "*Introduction to Corrosion Science*" Springer, May 2010.

2. Tulika Sharma "*Electrochemical devices*" LAP Lambert Academic Publishing, 2011.

3. Jeffry S Gaffney, Nancy A Marley *General chemistry for engineers*, Elsevier, 2018.

4. Don M Pirro, Martin Webster, Ekkehard Daschner "*Lubrication Fundamentals*", Taylor & Francis Gp, LLC, 2016.

5. Theo Mang, Wilfred Dresel "*Lubricants and Lubrication*" Wiley-VCH, 2017

COURSE OUTCOMES:

The students will be able to

CO1: apply specific methods to control corrosion of different materials.

CO2: illustrate the construction and working of different types of cells, batteries and fuel cells.

CO3: compare the properties and devise a method of manufacture of refractories and abrasives.

CO4: analyze and choose the right type of lubrication based on the type of machines.

Board of Studies (BoS) :
11th BoS of Chemistry held on 17.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	-	-	-	-	-	L	-	-	-	-	M	-	M	-
CO2	H	-	-	-	-	-	M	-	-	-	-	L	-	M	-
CO3	M	-	-	-	-	-	-	-	-	-	-	-	-	L	-
CO4	H	-	-	-	-	-	L	-	-	-	-	L	-	M	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CHDX 03 SDG: 9	CHEMISTRY AND INSTRUMENTATION FOR ELECTRICAL AND ELECTRONIC APPLICATIONS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

COB1: Synthesis, properties and applications of electrical and electronic devices.

COB2: Classification and types of fuel cells.

COB3: Types of sensors and their applications.

COB4: Principle, instrumentation and applications of analytical techniques.

MODULE I ELECTRICAL AND ELECTRONIC DEVICES 7

Solar Cell- Si solar cell, quantum dot solar cell, LCD : components, liquid crystals and their composition, electrodes – OLEDS: components, synthesis and modification of small molecules, polymers, phosphors - FRP-synthesis, properties and electrical applications - Solders : composition and uses – Capacitors : synthesis and modification of capacitor materials, fabrication.

MODULE II FUEL CELLS 7

Difference between batteries and fuel cells - classification 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) microbial fuel cell, - hydrogen storage materials, challenges in using hydrogen as a fuel.

MODULE III SENSORS 7

Definition, receptor, transducer, classification of chemical sensors based on operating principle of transducer, Ion-selective electrodes, Conductometric gas sensors (chemoresistors), Electrochemical sensors, Potentiometric MOSFET gas sensor, Touch sensors (oximeter, glucometer), Chemocapacitors, Biochips and microarray.

MODULE IV ANALYTICAL TECHNIQUES 9

Voltammetry: cyclic voltammetry, electrogravimetry - principle, instrumentation and applications of: UV-Vis spectrophotometry, Atomic emission spectroscopy-Photoluminescence spectrophotometry, atomic absorption spectrophotometry –-FT-IR spectroscopy, Raman spectroscopy, TGA-DTA analyzer, TEM.

L – 30; Total Hours – 30

TEXT BOOKS:

1. P.C. Jain & Monica Jain, Engineering Chemistry, Dhanpatrai Publishing Company (P) Ltd., New Delhi (2016).

REFERENCES:

1. K.M. Gupta & Nishu Gupta, Advanced electrical and electronic materials: process and applications, Wiley-Scrivener (2015).
2. S. Vairam, P. Kalyani and Suba Ramesh, Engineering Chemistry, Wiley India Ltd., New Delhi (2011).
3. B. Viswanathan & M. Aulice Scibioh, Fuel Cells: Principles and Applications, University Press (2008).

COURSE OUTCOMES:

CO1: Illustrate the construction and applications of electrical and electronic devices.

CO2: Classify the fuel cells and elaborate the different types of fuel cells.
CO3: Explain the different types of sensors and their applications.

CO4: State the principle and illustrate the instrumentation of various analytical techniques.

Board of Studies (BoS) :
11th BoS of Chemistry held on 17.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	L	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	H	-	-	-	-	-	M	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

CHDX 04	**FUNCTIONAL MATERIALS AND APPLICATIONS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 11 & 12

COURSE OBJECTIVES:

To make the students conversant with

COB1: specific materials for hardware components fabrication, data storage and their related properties

COB2: selection of advanced materials for various current applications

COB3: materials for the fabrication of sensors

COB4: essential characterization techniques and software tools with chemistry background

MODULE I MATERIALS FOR HARDWARE AND DATA STORAGE 7

Specific materials for electrical and electronic gadgets-computers, instruments (Semiconductors-N, S doped Silicon, CdX QDs, metal nano and other applications). Networking of networks and connecting devices - materials used in robotic construction (metal alloys, kevlor, biodegradable smart materials). Data storage and magnetic hard disk and devices- pendrive (flash memory-ferro magnetic and super paramagnetic materials, optical dics). Nanomaterials to enhance the lifetime and storage of CD, DVD and BD (Nano incorporated Polycarbonate, Al and lacquer) - Nanomaterials and small molecules for data storage.

MODULE II ADVANCED MATERIALS AND APPLICATIONS 8

Materials for 3D printing (Nylon, ABS, PLA, Ti, Au and Ag). Solar panels function monitoring-IOT enabled (crystalline Si, organometallics) – Displays and LCD, LEDs and its types-OLEDs (Group III-V materials). RGB analysis - sensing and TV/system screen (QDs and anthocyanins). Semiconductor chemistry for VLSI processing technology (metalloid staircase, Si, Ge, GaAs)-materials for inkjet printable circuit board (nanocarbon based) - Right material for signal speed and right thermal coefficient of expansion - Remote sensing (photodectectors and radiometers). Solder:-Lead based solder - issues and alternative for lead free solder (Conductive inks).

MODULE III MATERIALS FOR FABRICATION OF SENSORS 8

Wireless Sensors – Introduction to sensors (chemo/bio/gas sensors)-Wearable/touch sensors-Components - selection of materials - Device fabrication and function monitoring - wireless, Smartphone based and IOT enabled-Properties of materials, anti-corrosive, water proof, insulation and lamination. Robotics in surgery, gene coding and molecular modelling. Biochips and DNA microarray chips(fluorescent dyes, glass/nylon).

MODULE IV ANALYTICAL TECHNIQUES AND SOFTWARE SOLUTIONS 7

Characterization tools – UV-Visible (DRS), FT-IR, SEM, TEM, AFM, TG-DTA and XRD (Principle and applications only). Introduction to softwares- ChemOffice, Image J, Origin - Molecular modelling, comparison of old drug structures with new, drug designing-drug for COVID-19 and drug delivery. Molecular docking (drug interaction in a human body).

L – 30; Total Hours – 30

TEXT BOOKS:

1. P. Roy, S.K. Srivastava, Nanomaterials for Electrochemical Energy Storage Devices (Book), John Wiley & Sons, 2019.

2. K. Brun, T. Allison, R. Dennis, Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems (Book), Elsevier, 2000.

REFERENCES:

1. B.J. Cafferty, A.S. Ten, M.J. Fink, S. Morey, D.J. Preston, M. Mrksich, G.M. Whitesides, Storage of Information Using Small Organic Molecules, ACS Central Science, 2019, 5, 911−916.

2. Nabeel Ahmad P. Gopinath and Rajiv Dutta, 3D Printing Technology in Nanomedicine (Book), Elsevier, 2019.

3. Aaftaab Sethi, Khusbhoo Joshi, K. Sasikala and Mallika Alvala, Molecular Docking in Modern Drug Discovery: Principles and Recent Applications, IntechOpen, (2019), DOII: 10.5772/intechopen.85991.

4. W-L. Xing, J. Cheng, Frontiers in Biochip Technology, Springer, 2006.

5. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, 3rd Edition, Springer, 2015.

COURSE OUTCOMES:

CO1: Identification of suitable materials in electronic gadgets and data storage systems.

CO2: Application of specific functionalized materials for advanced applications

CO3: Choose appropriate materials for fabricating the different types of sensors

CO4: Hands on experience of software and exposure to material properties

Board of Studies (BoS) :
15th BoS of Department of Chemistry held on 15.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	-	L	-	H	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	H	-	-	-	-	-	-	-	-
CO3	-	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG: 11 & 12

Statement : Identification of suitable materials towards the manufacturing of electronic gadgets and data storage systems without much affecting the natural resources and application of the fabricated devices to the sustainable cites and communities.

CHDX 05 **CHEMISTRY OF FUELS, COMBUSTION AND LUBRICANTS**

L	T	P	C
2	0	0	2

SDG: 9

COURSE OBJECTIVES:

The students will be conversant with

COB1: types, composition and process of manufacture of solid, liquid and gaseous fuels.

COB2: determination of calorific value and calculation of GCV and NCV.

COB3: types, concepts of corrosion and different methods for control of corrosion.

COB4: types, functions of lubricants and mechanism of lubrication.

MODULE I FUELS 8

Introduction – classification of fuels – calorific value – characteristics of a good fuel – comparison of solid, liquid and gaseous fuel – solid fuels – coal – ranking of coal – proximate analysis of coal – pulverised coal – metallurgical coke – manufacture of coke (Otto Hoffman) – Liquid fuel – petroleum – refining of petroleum – cracking – fixed bed catalytic cracking - synthetic petrol – Fischer-Tropsch process – biodiesel - Gaseous fuel – CNG – LPG – Biogas – producer gas – water gas

MODULE II COMBUSTION 8

Introduction – calorific value - Calorific value: Gross and net calorific value - Bomb Calorimeter - Gas calorimeter - Definition of combustion – theoretical calculation of calorific values (Dulong’s formula) - Gross and net calorific values (problems) - air-fuel ratio - minimum requirement of air for complete combustion of fuels (problems) –– Analysis of flue gas - Orsat’s gas analysis method

MODULE III CHEMISTRY OF CORROSION 7

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating –– electroless plating.

MODULE IV LUBRICANTS 7

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils- properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue – semi solid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jain P.C and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co., New Delhi. 2016.

REFERENCES:

1. Stephen R Turns, "An Introduction to Combustion: Concepts and Applications", McGraw Hill Education, July 2017,
2. Samir Sarkar, "Fuels and Combustion", University Press, 2009
3. Dipak K Sarkar "Thermal power plant: Design and operations – Chapter-3", Elsevier, 2015.
4. E. McCafferty, "Introduction to Corrosion Science" Springer, May 2010.
5. Don M Pirro, Martin Webster, Ekkehard Daschner "Lubrication Fundamentals", Taylor & Francis Gp,LLC, 2016.
6. Theo Mang, Wilfred Dresel "Lubricants and Lubrication" Wiley-VCH, 20172nd Edition, India, 2012. (ISBN 13: 9788131704370)

COURSE OUTCOMES:

The students will be able to

CO1: compare and interpret the different purpose of application, composition, and calorific value of different fuels.

CO2: calculate the minimum amount of air required, GCV and NCV for the combustion of the fuels.

CO3: apply specific methods to control corrosion of different materials.

CO4: analyze and choose the right type of lubrication based on the type of machines.

Board of Studies (BoS) :
11thBoS of Chemistry held on 17.06.2021

Academic Council:
!7th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	-	-	-	-	M	-	-	-	-	-	-	M	-
CO2	H	H	-	L	-	-	M	-	-	-	-	-	-	L	-
CO3	H	L	-	-	-	-	-	-	-	-	-	-	M	M	-
CO4	H	M	-	-	-	-	L	-	-	-	-	-	M	L	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Industry, Innovation & Infrastructure

The holistic understanding of the materials used as fuels and lubricants and devices towards sustainable solutions for the advances in mechanical systems.

CHDX 06	INSTRUMENTAL METHODS OF POLYMER ANALYSIS	L	T	P	C
SDG: 4		2	0	0	2

COURSE OBJECTIVES:

COB1: to impart knowledge on spectroscopic analysis of polymers.

COB2: to equip with the knowledge of optical methods and X-ray diffraction methods for understanding the morphology and orientation of molecules

COB3: to develop an understanding on separation of various mixtures by different chromatographic techniques.

COB4: to understand the chemical elemental structure of polymers by NMR and mass spectroscopic technique.

MODULE I ULTRAVIOLET, VISIBLE AND IR SPECTROSCOPY 9

Principle- Instrumentation-Double beam spectrophotometers – single beam spectrophotometers -sources of radiation – Detectors – I operational procedure – qualitative and quantitative analysis – applications in polymer analysis.

Fourier Transform Infrared Spectroscopy -principle- instrumentation – optical materials – sources- detectors – typical spectrophotometers –– calibration and standardization – sample preparation - analysis – interpretation of FTIR spectra- principle of identification and characterization of polymers using IR

MODULE II NMR SPECTROSCOPY 7

Fundamental concepts – chemical shift – spin –spin- coupling. Instrumentation - data acquisition and spectral interpretation. Solid state NMR (magic angle), Applications of NMR and FT NMR in the characterization of polymers

MODULE III CHROMATOGRAPHY AND THERMAL ANALYSIS 7

Thermal analysis: DSC, TG/DTA, TMA, DMA, DETA with examples. gel permeation chromatography (GPC) – High pressure liquid chromatography (HPLC) – Thin layer chromatography (TLC - Gas chromatography (GC) – sample preparation. Chromatographic process and instrumentation – compositional separation and detectors – various types – Analyses. The uses and applications of various chromatographic techniques – pyrolysis gas chromatography.

MODULE IV X-RAY DIFFRACTION & NEWTON SCATTERING 7

Principle & basic concept of absorption of X-rays- monochromatic X-ray sources – X-ray detectors - Instrumentation – Experimental technique -Analysis by X-ray absorption. Absorption apparatus – X-ray diffraction – Diffraction apparatus. Application to polymer analysis.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch “Principles of Instrumental Analysis” 7th edition, Publisher Cengage Learning, 2016
2. Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, “Introduction to Spectroscopy” 5th edition, Publisher Cengage Learning , 2015
3. Yang, Rui “Analytical methods for polymer characterization” CRC Press, 2018.
4. Joseph D. Menczel, R. Bruce Prime “Thermal analysis of polymers: fundamentals and applications” John Wiley, 2019.

REFERENCES:

1. Galen W. Euring, “Instrumental methods of chemical analysis”, McGraw Hill International editions, New York, 1985.
2. B.J. Hunt & MI Jones Blackie, “Polymer Characterisation”, Academic professional, London, 1997.
3. Hubert Lobo, Jose V.B.Bonilla, “Handbook of Plastic analysis” , Marcel Dekker inc, New York, 2003.
4. RA pethrick & JV Daukins, “Modern techniques for polymer characterization” , John Wiley & sons Chichester, UK, 1999.
5. D. Campbell and R. White, “Polymer characterization”, Chapman & Hall, London 1989.
6. Arza Seidel, “Characterization and Analysis of Polymers”, John wiley and sons, New jersey, 2008.
7. Nicholas P. Cheremisinoff, “Polymer Characterization: Laboratory Techniques and Analysis”, Noyes publications, New jersey, 1996.
8. John M Chalmers, Robert J Meier, “Molecular characterization and analysis of polymers” Elsevier, 2008

COURSE OUTCOMES

CO1: Gaining knowledge on principles of various instruments

CO2: Understand about various characterization techniques

CO3: Interpretation the polymer by different techniques

Board of Studies (BoS) :	**Academic Council:**
11th BoS of Chemistry held on 17.06.2021	!7th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	L	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	L	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Aims at ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all

This course will provide deep knowledge on analysis of polymers using different instrumental methods.

CHDX 07	**MEDICINAL CHEMISTRY**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 9

COURSE OBJECTIVES:

To impart knowledge on

COB1: The basic factors governing drug design.

COB2: The software tools for molecular docking.

COB3: The synthetic pathway of antinfective, antineoplastic, cardiovascular and steroidal drugs.

COB4: The mode of action and side effects of synthetic drugs.

MODULE I INTRODUCTION TO DRUG DESIGN 7

Development of new drugs: Procedure followed in drug design – Literature survey - Search for Active Pharmaceutical Ingredient(s) - Molecular modification – Types of pharmaceutical form / mode of administration, Chemical Characterization of Medicinal Drugs - Molecular docking.

MODULE II ANTIINFECTIVE DRUGS 8

Synthesis, mode of action and side effect of Dapsone and Clofazimine (antileprotic) – Isoniazid, Rifampicin, Pyrazinamide and Ethambutol (antitubercular) – Fluconazole and griseofulvin (antifungal) – Chloroquine and Primaquine (antimalarial) - Semisytheticpencillin, Streptomycin, Ciprofloxacin (Antibiotics) - Nevirapine and Zidovudine (Antiviral)

MODULE III ANTINEOPLASTIC AND CARDIOVASCULAR DRUGS 8

Synthesis, mode of action and side effect of Mechlorethamine, Cyclophosphamide, Melphalan, Fluorouracil, 6-Mercaptopurine (Antineoplastic) – Sorbitrate, methylprednisolone, Methyldopa, quinidine (Cardiovascular).

MODULE IV STEROIDS AND RELATED DRUGS 7

Synthesis, uses and mode of action - (A) Androgens -testosterone (B) Estrogens and progestational agents – progesterone, (C) Adrenocorticoids – prednisolone, dexamethasone, Remdesivir (D) Glucocorticoids – Cortisol (E)Anabolicsteroids - nandrolone, oxandrolone (F) Neurosteroids – allopregnanolone.

L – 30; Total Hours – 30

TEXT BOOKS:

1. An Introduction to Drug Design, S. N. Pandeya and J. R.Dimmock, New Age International, 1997.
2. Burgers's Medicinal Chemistry and Drug Discovery, Fifth Edition; M. E. Wolff, John Wiley and Sons, 1996.
3. The organic chemistry of drug design and drug action, R. B. Silverman and M. W. Holladay, Academic Press, 3rd Edition, 2014.
4. Introduction to medicinal chemistry**:** How Drugs Act and Why, A. Gringuage, Wiley-VCH, 1996.
5. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry; Eleventh Edition; Lippincott Williams & Wilkins, 2004.

REFERENCES:

1. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley, 2nd Edition 2008.

COURSE OUTCOMES:

CO1: Carry out searches to retrieve information relevant to the development of a new drug.

CO2: Describe and justify the role and importance of the various disciplines involved in the different phases of drug discovery and development.

CO3: Explain how synthetic methods are used to make early decisions in the drug discovery and development.

CO4: Elaborate the mode of action and side effect of the drugs.

Board of Studies (BoS) :
11th BoS of Chemistry held on 17.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	M	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	L	-	-	-	-	-	-	L	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 :Industry, Innovation & Infrastructure

Understanding of drugs preparation and usage in sustainable method reduces unwanted side effects and help to environments.

HUMANITIES ELECTIVE – I
(SEMESTER III)

		L	T	P	C
SSDX 01	**ENGINEERING ECONOMICS AND MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 4, 8, 9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To present the major concepts and techniques of engineering economic analysis that is needed in the decision making process by providing insights to the basic microeconomic concepts of demand, supply and equilibrium.

COB2: To generate theoretical knowledge and understanding of macroeconomic aggregates such as national income and inflation and the major challenges associated with the measurement of these aggregates.

COB3: To develop analytical and critical thinking skills on money, banking and public finance and use them to judge the appropriateness of economic development and policy options.

COB 4: To introduce the basic concepts of management and planning and highlight the contribution of planning to the attainment of organization's objectives.

COB 5: To apprise the students about important management concepts and create awareness about the corporate social responsibilities and ethical aspects.

MODULE I DEMAND AND SUPPLY ANALYSIS 9

Introduction to Engineering Economics – Engineering efficiency – Economic efficiency - Scope of Engineering Economics, Engineers' contributions to economic growth- Problem solving and decision making - Laws of Demand and Supply - Difference between Microeconomics and Macroeconomics - Equilibrium between Demand and Supply, Elasticity of Demand - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 8

Concepts of National Income and measurement – GDP Growth Rate - Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – Meaning of Inflation, its types causes and preventive measures.

MODULE III MONEY, BANKING AND PUBLIC FINANCE 10

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) – Economic Reforms in India – LPG Policy.

MODULE IV PRINCIPLES OF MANAGEMENT AND PLANNING 8

Nature of management and its process - Importance of Management- Functions and Principles of Management - Nature, Purpose and Kinds of Planning.

MODULE V ENGINEERING MANAGEMENT 10

Strategic Management-Manager and Environment - Globalization and Technology Intermediation, Corporate Social Responsibility of business - meaning, importance, arguments for and against Corporate Social Responsibility - Business Ethics- Role of Ethics in Engineering Practice- meaning, importance - State intervention in business - Pros and Cons of intervention.

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. Krugman, P, Wells, R, and Graddy, K., “Essentials of Economics”, Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, “Economics for Engineers”, Himalaya Publishing House, 1stEdition, New Delhi, India, 2015.

REFERENCES:

1. Andrew Gillespie, “Foundations of Economics”, OUP Oxford, England, 2007.
2. Acemoglu, D., Laibson, D., & List, J., “Microeconomics”, Pearson Education, 2nd Edition, Boston, 2017.
3. Brinkman John , “Unlocking the Business Environment”, Routledge, 1st Edition, London, United Kingdom, 2010.(ISBN 9780340942079)
4. Cleaver Tony, “Economics: The Basics”, Routledge, 3rd Edition, London, United Kingdom, 2014.
5. H. L. Ahuja, “Macroeconomics”, S Chand Publishing; Twenty Edition, New Delhi, India, 2019.

6. Koutsoyiannis A, “Modern Microeconomics”, Palgrave Macmillan, 2nd Edition, U.K, 2003.
7. R.A. Musgrave and P.B. Musgrave, “Public Finance in Theory and Practice” , McGraw Hill Education India, Fifth Edition, India, 2017.
8. Mell Andrew and Walker Oliver, “The Rough Guide to Economics”, Rough Guide Ltd, 1st Edition, London, 2014.
9. R. Paneerselvam, “Engineering Economics”, PHI Publication, 2nd Edition, New Delhi, India, 2014.
10. Robbins S.P. Decenzo David A and Coulter, “Fundamentals of Management: Essential Concepts and Applications”, Pearson Education, 9th Edition, London, England, 2014.

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: interpret the forces driving demand and supply and their impact on market conditions.

CO2: demonstrate various dimensions of macroeconomic variables like national income, money supply, employment, etc. in analyzing the effects on business.

CO3: explicate the different aspect of Governmental activities and their rationality and describe how they can be pursued through fiscal and monetary policy.

CO4: develop skills to plan, organize, direct and control the resources of the organization for obtaining common objectives or goals.

CO5: augment managerial skills and adopt ethical practices in various functional areas and engineering practices.

Board of Studies (BOS) :

5th BoS of SSSH held on 29.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1		H	H	M		H	H				H	H
CO2		H	M			M					H	H
CO3			M	M		H	H		H			H
CO4						M	H	H	M		M	H
CO5						M	H	H	M		M	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.
SDG 12: Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

SSDX 02 SDG: 17	SOCIOLOGY OF SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.

COB2: To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.

COB3: To demonstrate the relationship between science, technology and society.

COB4: To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.

COB5: To appraise the impact of science and technology on different socio-cultural institutions and processes.

MODULE I INTRODUCTION 8

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 9

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

MODULE III SCIENCE, TECHNOLOGY AND SOCIETY 9

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and postindependence science - Science education in contemporary India – primary level to research level - Performance of universities in the development of technology - Interrelationship between industry and universities.

MODULE IV SCIENCE, TECHNOLOGY AND SOCIAL ISSUES 10

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development - Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

MODULE V GLOBALIZATION, SCIENCE, TECHNOLOGY AND CHANGE 9

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society - Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Giddens A. “Sociology” Wiley India Pvt. Ltd2017
2. Heald Haralambos, R.M “Sociology Themes and Perspectives”, Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

REFERENCES:

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al “Introductory Sociology”, Palgrave, New York. 2002
3. Das Gupta, Samir and ‘‘An Introduction to Sociology”, Pearson, Delhi. 2012.
4. Francis Abraham M. “Contemporary Sociology: An Introduction to Concepts and Theories”**,** New Delhi, Oxford University Press. 2014

5. Inkless, A, “What is Sociology”, Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M “Social Stratification”, Prentice Hall, New Delhi. 1969.

COURSE OUTCOMES:

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

CO1: recognize the fundamental tenets of Sociology.

CO2: interpret the relationship between individual and society in a sociological perspective.

CO3: categorize and constructively identify their own assumptions about the relationships among society, science and technology

CO4: appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.

CO5: able to link and reflect on current and ongoing sociological debates on development and role of technology.

Board of Studies (BOS) :

5th BoS of SSSH held on 29.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	H	M	L	H	L	
CO2			M			H	H	M	H	H	M	L
CO3			H	M	H	H	M		M	H	H	M
CO4			M			H	H	L	L	M	H	H
CO5			M			H				M		L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

To inculcate knowledge and socialize youth in building participation, institutions and partnership for inclusive development for the implementation of sustainable development goals.

SSDX 03	**INDUSTRIAL ECONOMICS AND MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 8 and 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide a wholesome idea about the concept of industrial economics and identify the classifications of firms based on ownership and control.

COB2: To impart theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

COB3: To equip the students with the framework that will be useful for applying economic models in business strategy, competition policy and regulations.

COB4: To understand the importance of Industrial Policy in the development of Industries in India.

COB5: To elucidate industrial growth in India by examining its performance and problems in industrial sector.

MODULE I INTRODUCTION TO INDUSTRIAL ECONOMICS 9

Definition and scope of industrial economics - Concept and importance of industry; Concept and organization of a firm - Classification of firms based on ownership - sector (industries, formal vs. Informal) - size and use - based classification - Separation of ownership and control - Localization of industries .

MODULE II MARKET STRUCTURE 9

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot Kinked Demand and Price Leadership – Measurement of economic concentration – Policy against monopoly and restrictive trade practices – Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9

Production and Production function – Types, Factor Inputs – Input-Output Analysis**,** Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin's small and large number case - Kinked demand curve theory - Bain's limit pricing – Production Possibility Frontier.

9

MODULE IV INDUSTRIAL POLICY

Industrial Policy: Industrial Policy in India -1948, 1956, 1977, 1980, 1990, 1991 - Industrial Performance after Independence.

MODULE V INDUSTRIAL GROWTH IN INDIA 9

Trends and prospects - Public enterprises; efficiency - Productivity and performance constrain - Small scale industries: definition, role - Policy issues and performance - Capacity utilization - Industrial sickness and Exit - Technology transfer - Privatization.

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. Barthwal R R “Industrial Economics: An Introductory Textbook”, New Age International Pvt. Ltd Publishers, 2017
2. P.J. Devine, N. Lee, R.M. Jones, W.J. Tyson, “An Introduction to Industrial Economics”, Routledge.2019.

REFERENCES:

1. Ferguson, Paul R. and Glenys J. Ferguson, “Industrial Economics - Issues and Perspectives”, Macmillan, London. 1994
2. Gregory Mankiw “Principles of Microeconomics”, Havcourt Asia Publishers, 2001.
3. Mohanty Binode Ed. “Economic Development Perspectives”, Vol. 3, Public Enterprises and Performance, Common Wealth Publishers, New Delhi, 1991
4. Mote and Paul “Managerial Economics, Tata McGraw Hill, 2001
5. Peterson and Lewis “Managerial Economics”, 4th Ed., Prentice Hall, 2004

COURSE OUTCOMES:

CO1: Develop knowledge on the concept and organization of firms and the implications of the separation of ownership and control.

CO2: Acquire familiarity with various market structures and formulate appropriate pricing strategies.

CO3: Think analytically using various economic models concerning market structures and apply them to the real world of industry.

CO4: To compare the various Industrial Policies introduced in India and recognize the role of these policies in making required industrial development in India.

CO5: Clearly diagnose and illustrate the challenges in industrial economy in India and develop effective and comprehensive solution on them.

Board of Studies (BoS) :
Mention details of BoS
5th BoS of SSSH held on 29.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1			H	M			H		M		M	L
CO2			H		M		H		M		M	L
CO3			H				H		M		M	M
CO4			H				H		M		H	M
CO5			H				H		M		H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

SSDX 04	DYNAMICS OF INDIAN SOCIAL STRUCTURE	L	T	P	C
SDG: 10, 16		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide knowledge on the components of the Indian social structure.

COB2: To learn the nature and contemporary structure of Indian social institutions.

COB3: To sensitize students about social stratification in Indian Society.

COB4: To create awareness about the social problems occurring in contemporary India.

COB5: To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

MODULE I INDIAN SOCIAL STRUCTURE 9

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

MODULE II INDIAN SOCIAL INSTITUTIONS 9

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family , dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

MODULE III SOCIAL STRATIFICATION IN INDIA 9

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste - Caste - class interface - Religious minorities.

MODULE IV SOCIAL PATHOLOGY 9

Social Problem - 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 V SOCIAL CHANGE IN INDIA 9

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Sharma,K.L., “Indian Social Structure and Change”, Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., “Social Problems in India”, Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., “Society in India”, Rawat Publication: New Delhi, 2014.

REFERENCES:

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Dube S.C., “India's Changing Villages: Human Factors in Community Development”, London, Routledge and Kegan Paul, 2003.
3. Hasnain N., “Indian Society: Themes and Social Issues”, Mc Graw Hill, 2019.
4. Jayapalan, N., **“**Indian Society and Social Institutions” Atlantic Publishers, 2001.
5. Pandey Vinita., “Indian Society and Culture”, Rawat Publications, New Delhi, 2016
6. Rao Sankar., “Sociology of Indian Society”, S. Chand Publisher, New Delhi, 2004.

COURSE OUTCOMES:

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

CO1: explain about the social structure and social institutions that constitute society in India.

CO2: differentiate the various categories of inequalities and their challenges.

CO3: describe the social stratification and its impact in society.

CO4: analyze the social problems encountered in contemporary India.

CO5: correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

Board of Studies (BoS) :
5th BoS of SSSH held on 29.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H			H	M			M		
CO2			M			M	H	L				H
CO3			M			M	H	L				H
CO4			H			H	H		M			M
CO5			H		H	M	H	M		H		H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 10: Reduce inequality within and among countries.
SDG16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

To sensitize and impart pertinent knowledge to youths to combat the contemporary issues and challenges facing Indian society in order to remedy its social pathos and injustices in the path of achieving sustainable development in India.

MATHEMATICS ELECTIVE
(SEMESTER III)

MADX 01	**TRANSFORMS AND PARTIAL**	**L**	**T**	**P**	**C**
SDG: 4	**DIFFERENTIAL EQUATIONS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To formulate and solve partial differential equations of first, second and higher orders

COB2: To introduce basics and engineering applications of Fourier series

COB3: To develop Fourier transform techniques

COB4: To introduce analytic solutions of PDEs by using Fourier series

COB5: To acquaint with Z -Transform techniques for discrete time systems

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 9+3

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 9+3

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

MODULE III FOURIER TRANSFORMS 9+3

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

MODULE IV APPLICATIONS OF FOURIER SERIES 9+3

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

MODULE V Z – TRANSFORM 9+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, 2011.

2. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017.

3. Ramana, B.V, "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2010.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics", 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.

2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.

3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.

4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form and solve the partial differential equations using different methods

CO2: derive a Fourier series of a given periodic function by evaluating Fourier coefficients

CO3: apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms

CO4: solve partial differential equations by using Fourier series

CO5: solve difference equations using Z-transform

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M														
CO2	M														
CO3	H														
CO4	M														
CO5	M														

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various mathematical techniques like matrices and calculus will lead to knowledge of applications in Computer Science

MADX 02	**DISCRETE MATHEMATICS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To introduce logical and mathematical ability to deal with abstraction

COB2: To acquaint with the concepts of predicate calculus.

COB3: To introduce the notations and concepts used in set theory

COB4: To apply and use the terms function, domain, codomain, range, image, inverse image and composition

COB5: To introduce basic concepts from abstract algebra, especially the essential concepts in group theory

MODULE I PROPOSITIONAL CALCULUS 9+3

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 9+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 SET THEORY 9+3

Basic concepts –Notations-Subset –Algebra of sets –The power set – Ordered pairs and Cartesian product- Relations on sets – Types of relations and their properties – Relational matrix and the graph of a relation – Partitions – Equivalence relations –Partial ordering –Poset – Hasse diagram – Lattices and their properties– Boolean algebra – Homomorphism.

MODULE IV FUNCTIONS 9+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 V ALGEBRAIC SYSTEMS 9+3

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

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

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

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

REFERENCES:

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

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

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

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form truth tables and write principal normal forms

CO2: write the negation of a quantified statement involving either one or two quantifiers.

CO3: prove that a proposed statement involving sets is true, or give a counterexample to show that it is false.

CO4: compute the connection between bijective functions and inverses. Be able to find the inverse of an invertible function.

CO5: give intrinsic structure of groups both abstract and specific examples illustrating the mathematical concepts involved.

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M														
CO2	M														
CO3	H														
CO4	M														
CO5	M														

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various mathematical techniques will lead to knowledge of applications in Communication Engineering

		L	T	P	C
MADX 03	**PROBABLITY AND STATISTICS**	**L**	**T**	**P**	**C**
SDG:4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To impart knowledge on the basic concepts of probability

COB2: To understand random variables and distribution functions

COB3: To acquaint with joint density function and generating functions

COB4: To introduce sampling techniques and estimation

COB5: To perform hypothesis testing and draw inference

MODULE I PROBABILITY 9+3

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

MODULE II RANDOM VARIABLE AND DISTRIBUTION FUNCTIONS 9+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 9+3

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

MODULE IV SAMPLING AND ESTIMATION 9+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 9+3

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.

L – 45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. T.Veerarajan, “Probability and Statistics”, Tata McGraw-Hill New Delhi, 2008.
2. Miller, I., Miller, M.,Freund, J. E., “Mathematical statistics”, 7th Edition, Prentice Hall International, New Jersey 1999.
3. S.P.Gupta, “Applied Statistics”, Sultan Chand & Sons 2015.

REFERENCES:

1. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elesvier 2016
2. S.C.Gupta and V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons New Delhi 2012
3. Arora and Arora, “Comphrensive Statistical Methods”, S. Chand, New Delhi 2007.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: do problems on probability, Baye’s theorem and descriptive statistics.

CO2: evaluate moment generating functions and calculate probabilities using distributions.

CO3: calculate probabilities and derive the marginal and conditional distributions of bivariate random variables

CO4: classify random samplings and calculate point and interval estimates

CO5: make an informed decision, based on the results of inferential procedures

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L													
CO2	M	L													
CO3	M	L													
CO4	M	L		M											
CO5	H	L		M											

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all

Learning of various statistical methods will lead to knowledge of applications in Electronics and communication Engineering

		L	T	P	C
MADX 04	**RANDOM PROCESSES**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To acquire knowledge of the theory of probability, Baye's theorem and Tchebechev inequality

COB2: To understand random variables and discrete and continuous probability distributions

COB3: To demonstrate the techniques of two dimensional random variables and its distributions

COB4: To introduce the random process, stationary, Markov process and the study of correlation functions

COB5: To study spectral analysis and Weiner-Khinchine theorem

MODULE I PROBABILITY 9+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 RANDOM VARIABLES AND ROBABILITY DISTRIBUTIONS 9+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 9+3

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV RANDOM PROCESSES 9+3

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities- Autocorrelation function and its properties - Cross Correlation function and its properties.

MODULE V SPECTRAL DENSITY 9+3

Linear system with random inputs – Ergodicity-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, New Delhi, 2008.
2. Papoulis, “Probability, Random Variables and Stochastic Processes”, 4th Edition, Tata McGraw Hill Company, New Delhi,2002.
3. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, John Wiley & Sons, New Jersey 2007.

REFERENCES:

1. Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,London,2009.
2. Trivedi K S, “ Probability and Statistics with reliability, Queueing and Computer Science Applications”,Prentice Hall of India, 2nd edition, New Delhi, 200

COURSE OUTCOMES: At the end of the course students will be able to

CO1: evaluate probability, apply Baye’s theorem and calculate bounds using Tchebechev inequality

CO2: calculate probabilities and expected values for distributions

CO3: calculate probabilities and derive the marginal and conditional distributions of bivariate random variables

CO4: evaluate stationary process, compute correlation functions and related identities

CO5: compute power spectral density functions and apply Weiner-Khinchine theorem

Board of Studies (BoS) :
12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L													
CO2	M	L													
CO3	M	L													
CO4	H	M													
CO5	H	M													

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various techniques in Random Processes will lead to knowledge required for applying in many projects.

MADX 05	**NUMERICAL METHODS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To familiarize with the methods of solving equations numerically

COB2: To introduce interpolation techniques and finite difference concepts

COB3: To acquire knowledge on Numerical differentiation and integration

COB4: To solve ordinary differential equations numerically

COB5: To solve partial differential equations numerically

MODULE I NUMERICAL SOLUTIONS OF EQUATIONS 9+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 9+3

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 9+3

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 9+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 BOUNDARY VALUE PROBLEMS FOR PDE 9+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, New Delhi, 2007.
2. Gerald C.F., 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, New York, 2006.
2. Jain M.K., S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003
3. Sastry.S.S,"Introductory Methods of Numerical Analysis",Fifth Edition,PHI Learning Private Ltd., New Delhi, 2012.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: solve algebraic, transcendental and system of equations by numerical methods

CO2: apply various interpolation techniques and finite difference concepts

CO3: carry out numerical differentiation and integration using different methods whenever regular methods are not applicable

CO4: solve first order ODE using single and multi step methods

CO5: solve the boundary value problems in PDE by finite differences

Board of Studies (BoS) :

12th BOS of Mathematics and AS department held 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L													
CO2	M														
CO3	M	L													
CO4	M	L													
CO5	M	L													

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various methods in numerical analysis will lead to use of applications in many projects in Engineering

HUMANITES ELECTIVES – VI SEMESTER

SSDX 11	**ECONOMICS OF SUSTAINABLE DEVELOPMENT**	**L**	**T**	**P**	**C**
SDG: 1-17		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations.

COB2: To develop a capacity to undertake a theoretically grounded analysis of environment issues and identify and describe what the United Nations and other governing bodies are doing to assist in a more sustainable world.

COB3: To have an insight of the emerging debate about reconciling ecological sustainability with poverty alleviation in the context of globalization and development.

COB4: To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 8

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components – Sustainable Development Goals – Quality education, Gender equality, innovation and infrastructure, peace and justice - Sustainable engineering practices.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 6

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, Paris Agreement, Montreal Protocol, Basel Convention.
Community Participation in Sustainable Development, Common Property Resource Management, Innovation, Industry and Sustainable Development.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 7

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 9

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 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An Introduction to Sustainable Development", Glen Educational Foundation, 1st Edition, England, UK, 2008.

2. Sayer, J. and Campbell, B, "The Science of Sustainable Development: Local Livelihoods and the Global Environment" (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.

REFERENCES:

1. Anderson, David A, "Environmental Economics and Natural Resource Management", Routledge, 3rd edition, England, UK, 2010.
2. Berck, P., "The Economics of the Environment", New Delhi: Pearson India, 2015.
3. Karpagam M, "Environmental Economics: A Textbook.pdf", Sterling Publishers Pvt. Ltd, New Delhi, 2021.
4. Kumar, Pushpam, "Economics of the Environment and Development",Ane Book Publication, New Delhi, India, 2009.
5. Karpagam M and Jaikumar Geetha, "Green Management Theory and Applications", Ane Books Pvt. Ltd, New Delhi, India, 2010.
6. Sengupta Ramprasad, "Ecology and Economics: An Approach to Sustainable Development", Oxford University Press, New Delhi, 2004.
7. Muthukrishna, S, "Economics of Environment", PHI Learning Pvt. Ltd., New Delhi, India, 2010.

COURSE OUTCOMES:

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

CO1: Develop awareness of the ethical, economic, social and political dimensions that influence sustainable development.

CO2: Clearly articulate their views and beliefs with regards to environmental issues.

CO3: Identify and describe the major economic forces that shape our approach to the environment issues and demonstrate responsible globalization through global governance.

CO4: Account for strategies, international agreements and major policy instruments for a sustainable use of resources and ecosystem services.

Board of Studies (BoS) :
4th BoS of SSSH held on 28.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1		H	H		H	H	H		H		H	H
CO2			H			H	H		H		H	H
CO3	M	M	H			H	H		H		H	H
CO4			H			H	H	H	H		H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 1: End poverty in all forms and everywhere.

SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

SDG 3: Ensure healthy lives and promote well-being for all at all ages

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

SDG 5: Achieve gender equality and empower all women and girls

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

SDG 10: Reduce income inequality within and among countries

SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

SDG 12: Ensure sustainable consumption and production patterns

SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Statement: The holistic understanding of all the 17 SDGs aims to end poverty, ensure prosperity, and protect the planet.

SSDX 12	**SOCIOLOGY OF INDUSTRIAL RELATION**	**L**	**T**	**P**	**C**
SDG: 8, 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To familiarize sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.

COB2: To highlight the structure and functions of industrial organizations

COB3: To explicate the dynamics of organizational behavior, leadership and communication.

COB4: To provide an overview in labour legislation and labour welfare

MODULE I INTRODUCTION 7

Sociology of Industrial relation - 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 -The Industrial Employment (Standing Orders) Act, 1946 Industrial conflict- strike, lockout and trade unions- Emerging role of trade unions in India.

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 7

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. Grievance Handling and Disciplinary Action, Code of Conduct, Industrial Relations in changing scenario, Employers' organisations.

MODULE IV LABOUR LEGISLATION AND LABOUR WELFARE 9

Labour Legislation-Objectives, Principles, Classification and Evolution. International Labour Organisation. Social Justice and Labour Legislation, Indian Constitution and Labour Laws- The Factories Act, 1948, The Inter-state Migrant Workmen Act, 1979, The Contract Labour (Regulation and Abolition) Act, 1970, The Child Labour (Prohibition and Regulation) Act, 1986. Labour welfare-Concept, Scope, Types, and Principles, Industrial Health and Hygiene, Industrial Accidents and safety, Occupational Diseases. Social Security-Concept and Scope, Social Assistance and Social assurance.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Mamoria ,Gankar., "Dynamics of Industrial relations", Himalaya Publishing House,Mumbai, 2007.
2. Narender Singh ., "Industrial Sociology", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
   Kumar., "Industrial Sociology", Lakshmi Narain Agrawal Publishers, Agra, 2019.
3. SharmisthaBhattacharjee, "Industrial Sociology", Aavishkar Publishers, Jaipur, 2016.

REFERENCES:

1. Bhatnagar M., "Industrial Sociology",S. Chand Publications, New Delhi, 2012.
2. MisraRajan., "Industrial Sociology", University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.), New Delhi, 2013.
3. Newstorm W John, "Organizational Behavior", Mc. Graw Hill Publishing Co., New Delhi, 2006.
4. Nina, Bandlej (ed)., "Economic Sociology of Work", Bingley: Emerald Group Publishing Ltd, 2009.
5. Richard Brown, John Child, S.R. Parker, "The Sociology of Industry", Routledge Publisher, 2015.
6. Sushil Kumar Saxena, Satish Mittal, "Industrial Sociology",Common Wealth Publishers, 2012.
7. Watson, Tony, "Sociology, Work and Industry (5th edition), Oxon: Routledge, 2008.

COURSE OUTCOMES:

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

CO1: Understand the sociological perspectives for dealing with social relationships in production and service organizations.

CO2: Have deeper knowledge in structure of authority, roles and responsibility in organizational settings.

CO3: Assess the role of leadership, communication and behavioral acumen to govern the organization.

CO4: Describe the importance of labour legislation and labour welfare

Board of Studies (BoS) :
4th BoS of SSSH held on 28.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H						M	H		M
CO2						M	L	M	M		H	M
CO3			M			M		M	H	H	H	M
CO4						H						H

Note:L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: The holistic understanding of industrial relations leads to equal access to opportunity, and equal pay for work of equal value for male and female contributions is necessary for gender equality as well as for inclusive economic growth. Explore work opportunities, understand career processes and appreciate the meaning and purpose of work in people's lives which leads to decent work and safe working practices.

SSDX 13	**PROFESSIONAL ETHICS AND HUMAN VALUES**	**L**	**T**	**P**	**C**
SDG: 8		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To render basic insights and inputs to the students to inculcate human values to grow as responsible human beings with a proper personality.

COB2: To create awareness on senses of engineering ethics.

COB3: To inculcate knowledge and exposure on safety and risk, risks benefit analysis and professional rights.

COB4: To instill social values and loyalty and to appreciate the rights of others
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MODULE I HUMAN VALUES 7

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

MODULE II ENGINEERING ETHICS 7

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - Theories about right action - Self-interest - Customs and Religion - Uses of ethical theories - Valuing Time – Co-operation – Commitment.

MODULE III SAFETY, RESPONSIBILITIES AND RIGHTS 8

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

MODULE IV CONTEMPORARY ISSUES 8

Globalisation-Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Ethics-Ethics and codes of business conduct in MNC.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S., “Engineering Ethics”, Prentice Hall of India, New Delhi, 2019.
2. Kiran. D R, “Professional Ethics and Human Values”, Mc Graw Hill Publishers,New Delhi, 2013.
3. Naagarazan R.S., “Professional Ethics and Human Values”, New Age International Publishers, New Delhi, 2006.
4. R Sangal, RR Gaur and G P Bagaria, “Foundational Course in Human Values & Professional Ethics”, Excel Books, India, 2010.

REFERENCES:

1. Charles D. Fleddermann , “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004.
2. Charles E Harris, Michael S.Protchard and Michael J Rabins., “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
6. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York, 2010.
7. Subramanian. R,“Professional Ethics - Includes Human Values”, Oxford HED Publishers, 2017.\

COURSE OUTCOMES:

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

CO1: Apply moral and ethical values scrupulously that ought to guide the engineering profession.

CO2: Understand the ethical issues related to engineering aspects.

CO3: Assess safety and risk and execute risk benefit analysis.

CO4: Become responsible engineers, experimenters, researchers or businessmen

Board of Studies (BoS) :
4thBoS of SSSH held on 28.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H				H	H				M
CO2			M			M		H		H	M	
CO3			M		M	H		H				H
CO4			L				H	H	H		M	M

Note:L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8 :Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: Holistic understanding of professional ethics explores work opportunities, understand career processes and appreciate the meaning and purpose of work in people’s lives leading to a decent work and safe working practices and environments.

		L	T	P	C
SSDX 14	**GENDER, TECHNOLOGY AND DEVELOPMENT**	**L**	**T**	**P**	**C**
SDG: 8		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To conceptualize what is gender and sex and draw a line of distinction between the two.
COB2: To develop students' sensibility to the difference in gender roles, responsibilities, rights and injustice.
COB3: To reflect critically on the ways in which new technologies have sharpened and/or blurred gender difference.
COB4: To develop an insight to the gender and development with the paradigm shift from time to time.

MODULE I UNDERSTANDING GENDER 7

Basic Concepts: Sex/Gender, Gender roles, Gender socialization, - Construction of Gender- Making Women, Making Men Gender stereotyping, Femininity and Masculinity, Patriarchy, Heteronormativity, LGBTIQ - Theoretical Background to gender and feminist thinking: Liberal, Radical, Marxist, Socialist, Post-modern Feminism.

MODULE II GENDER ROLES AND GENDER INJUSTICE 7

Gender Roles and Relations-Types of Gender Roles Gender Roles and Relationships Matrix. Health conditions, Sex Ratio, Education: Literacy & Gender Bias - Work Related Issues: Existing Prejudices, gender Related Violence, Gender Discrimination - Political participation: Lack of women's representation - Economic Conditions- Social Conditions: divorce, rape, domestic violence.

MODULE III GENDER, TECHNOLOGY AND CHANGE 8

A historical perspective – Technology as masculine culture – Household technology – medical technology: New Reproductive technologies – Impact of Technological Change on Women. The Digital Divide: Unequal Access, Unequal Effects – Outcome and impact of ICT's Policies and projects for women. How gender influences technologies and the social organization of scientific and technical workspaces.

MODULE IV GENDER AND DEVELOPMENT 8

Gender, Governance and Sustainable Development - Women's role in Development - Women in Development (WID), Women and

Development (WAD) - Gender and Development (GAD); Gender Mainstreaming and Gender Budgeting - Gender and Human Rights

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Bhasin, Kamala., "Understanding Gender", New Delhi: Kali for Women, 2000.
2. John, Mary E., "Gender and Development in India, 1970-90's: Some reflections on the constitutive role of context' Chaudhuri, Maitrayee. (ed.) Feminism in India", New Delhi: Kali for women. pp. 246-258, 2004.
3. Menon, Nivedita, "Embodying the Self: Feminism, Sexual Violence and the Law" in Partha Chatterjee and Pradeep Jeganathan (ed)- Subaltern Studies XI: Community, Gender and Violence", Permanent Black and Ravi Dayal, 2000.
4. Gender and Technology: A reader ., Edited by Nina E. Lerman, Ruth Oldenziel, and Arwen P. Mohun, John Hopkins University Press, Baltimore , 2003.

REFERENCES:

1. Lourdes Beneria , GünseliBerik , Maria Floro .,"Gender, Development and Globalization: Economics as if All People Mattered", 2nd edition , Routledge, 2015.
2. Moser, Caroline, "Gender Planning and Development: Theory, Practice and Training", Routledge, 1993.
3. Rege, Sharmila., "Sociology of Gender: The Challenge of Feminist Sociological Knowledge", Sage publications: New Delhi, 2003.
4. Jain S.C., Women and Technology, Rawat Publication, Jaipur Begh, 1985.

COURSE OUTCOMES:

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

CO1: Distinguish important concepts related to gender in contemporary society.

CO2: Interpret the gender discrimination works in our society and how to counter it.

CO3: Illustrate how the intersection of gender and technology involves gender shaping technology and technology shaping gender.

CO4: Apply gender sensitive perspective on development and human rights.

Board of Studies (BoS) :
4thBoS of SSSH held on 28.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	H		H		H	L
CO2			H			H	M			H		L
CO3			H			H	H	H			M	H
CO4			H			H	H		H			H

Note:L- Low Correlation M - Medium Correlation H -High Correlation

SDG 5: Achieve gender equality and empower all women and girls

Statement: To imbibe gender concern and gender perspective in the invention, and application of technology, planning and designing production and innovating strategies for engendering gender equality.