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

Regulations 2022
Curriculum and Syllabi
(Updated upto April 2023, as per 20th Academic Council)

M.Tech. (Avionics)

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

REGULATIONS 2022

CURRICULUM AND SYLLABI

(Updated upto April 2023, as per 20th Academic Council)

M.TECH. AVIONICS

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 ambiance.
- To network with global Institutions of Excellence, Business, Industry, and Research Organizations.
- To contribute to the knowledge base through Scientific inquiry, 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 a 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

M. TECH (AVIONICS)

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: To impart adequate knowledge in practical and theoretical domains in the field of Avionics Engineering through rigorous post-graduate education.

PEO 2: To provide skills required to have successful technical and managerial careers in Avionics industries and Aviation Engineering Management.

PEO 3: To develop creativity, ability, and potential, generate innovative ideas, and contribute to the development and other needs of Aviation industries.

PEO 4: To develop a sustained interest in learning and adapting new technology developments to meet the needs of changing industrial scenarios.

PROGRAMME OUTCOMES

- Ability to design, analyze, and conduct experiments to interpret data in the field of Avionics Engineering.
- Ability to design a system or a component to meet design requirements with constraints exclusively meant for Avionics Engineering.
- Familiarity with modern engineering tools and skills required to analyze problems in Avionics Engineering as a member of multidisciplinary teams.
- Understanding of professional and ethical responsibilities with reference to a career in the field of Avionics Engineering and other professional fields.

- Understand the importance of the design and development of a Flight Control System, Navigation System, and System Simulation, from a systems integration point of view.
- Ability to communicate effectively both in verbal and non-verbal forms.
- Capability to understand the value of lifelong learning.
- Development of a firm scientific, technological, and communications base that helps find placement in the Aircraft industry and R&D organizations related to Avionics Engineering and other professional fields.
- Acquire skills and knowledge required for undertaking doctoral studies and research in inter and multidisciplinary areas

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS 2022

M.Tech. / MCA / M.Sc. / M.Com. / M.A. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means post graduate degree programme (M.Tech. / MCA / M.Sc. / M.Com. / M.A.)

ii) **"Branch"** means specialization or discipline of programme like M.Tech. in Structural Engineering, Food Biotechnology etc., M.Sc. in Physics, Chemistry, Actuarial Science, Biotechnology etc.

iii) **"Course"** means a theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, 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 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	
M.Com.	
M.A.	

2.2 ADMISSION REQUIREMENTS

2.2.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination as specified in the clause 3.2 [Eligible entry qualifications for admission to programmes] of this Institution or any other University or authority accepted by this Institution.

2.2.2 The other conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

3.0 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

3.1. The minimum and maximum period for completion of the programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA	4	8
M.Sc.	4	8
M.Com.	4	8
M.A.	4	8

3.1.1 Each academic semester shall normally comprise of 90 working days. Semester end examinations shall follow within 10 days of the last Instructional day.

3.1.2 Medium of instruction, examinations and project report shall be in English.

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	Aeronautical Engineering	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.
2.	Civil Engineering	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.
		M. Tech. (Construction Engineering and Project Management)	B.E. / B.Tech. in Civil Engineering / Structural Engineering / B.Arch. or Equivalent degree in relevant field.
3.	Mechanical Engineering	M.Tech. (CAD/CAM)	B.E. / B.Tech. in Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace / Aeronautical / Material Science / Polymer / Plastics / Marine Engineering or Equivalent degree in relevant field.
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		M.Tech. (Artificial Intelligence and Data Science)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
7.	Information Technology	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
8.	Computer Applications	MCA	BCA / B.Sc. Computer Science / B.E. / B.Tech. / B.Sc. Mathematics, B.Sc. Physics / Chemistry / B.Com. / BBA / B.A. with Mathematics at graduation level or at 10 + 2level or equivalent degree in relevant field.
9.	Mathematics	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	Physics	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	Chemistry	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Biotechnology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Microbiology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		M.Tech. Biotechnology	B.Tech. / B.E. in Biotechnology or Equivalent degree in relevant field.
		M.Tech. Food Biotechnology	B.E. / B.Tech. in Biotechnology / Food Biotechnology / Chemical Engineering / Biochemical Engineering / Industrial Biotechnology or Equivalent degree in relevant field.
13.	Commerce	M.Com	B.Com. / BBA
14.	Arabic and Islamic Studies	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or) Any under graduate degree with Part 1 Arabic (or) Any under graduate degree with AalimSanad / Diploma / Certificate in Arabic or Islamic Studies.

3.3. STRUCTURE OF THE PROGRAMME

3.3.1 The PG. programmes consist of the following components as prescribed in the respective curriculum:

i. Core courses
ii. Elective courses
iii. Laboratory integrated theory courses
iv. Project work
v. Laboratory courses
vi. Open elective courses
vii. Seminar
viii. Mini Project
ix. Industry Internship
x. MOOC courses (NPTEL- Swayam, Coursera etc.)
xi. Value added courses

3.3.2 The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

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

3.3.4 The curriculum of programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Range of credits
M.Tech.	76 - 80
MCA	86
M.Sc.	77 - 85
M.Com.	88
M.A.	72

3.3.5 Credits will be assigned to the courses for all programmes as given below:

- ❖ One credit for one lecture period per week or 15 periods of lecture per semester.
- ❖ One credit for one tutorial period per week or 15 periods per semester.
- ❖ One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester.
- ❖ One credit for 160 hours of industry internship per semester for all programmes (except M.Com.)
- ❖ Four credits for 160 hours of industry internship per semester for M.Com.

3.3.6 The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 32	18 to 26
MCA	9 to 32	18 to 26
M.Sc.	9 to 32	10 to 26
M.Com.	9 to 32	16 to 28
M.A.	9 to 32	NA

3.3.7 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

3.3.8 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

3.3.9 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, aliter to open electives, during the entire period of study, with approval of Head of the department offering the course and parent department.

3.4. ONLINE COURSES

3.4.1 Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester (in case of M.Tech. M.Sc. & MCA programmes) 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 shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

3.4.2 Students shall undergo project related online course on their own with the mentoring of the project supervisor.

3.5 PROJECT WORK

3.5.1 Project work shall be carried out by the student under the supervision of a faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research organization, with the approval of the Head of the Department/ Dean of School. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist / Competent authority

from the organization and the student shall be instructed to meet the faculty periodically and to attend the review meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last instructional day of the semester in which project is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work and shall re-register in the subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD/ Dean of School as Class Advisor for the class throughout their period of study.

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.

4.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School 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.

5.0 COURSE COMMITTEE

5.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course

coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

6.0 CLASS COMMITTEE

6.1 A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted in every semester:

6.2 The composition of the class committee will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department
ii) Faculty members of all courses of the semester
iii) All the students of the class
iv) Faculty advisor and class advisor
v) Head of the Department – Ex officio member

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

6.4 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 of courses.

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

7.0 REGISTRATION AND ENROLLMENT

7.1 The students of first semester shall register and enroll 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.

7.2 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.

7.3 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.

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

8.0 BREAK OF STUDY FROM PROGRAMME

8.1 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:

8.1.1 Medical or other valid grounds

8.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance

8.1.3 Debarred due to any act of indiscipline

8.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

8.3 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).

8.4 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.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT WORK

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum no. of credits to be earned to enroll for project semester
M.Tech.	18
MCA	22
M.Sc.	18
M.Com	NA
M.A.	NA

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

10.1 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.

10.2 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.

10.3 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.

10.4 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. However, he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

10.5 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.

10.6 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.

10.7 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.

11.0 REDO COURSES

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

11.2 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.

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	**Weightage of Marks**
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	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 75% weightage for continuous assessments and 25% 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 The assessment of seminar course including its component and its weightage shall be decided by a committee of faculty members constituted by the Head of the Department. This committee shall ensure the conduct of assessment of components and award marks accordingly.

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 School for that purpose. However, there is no substitute examination for semester end examination.

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

14.0 SUPPLEMENTARY EXAMINATION

14.1 Final Year 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 credit can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both odd and even semesters.

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

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

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

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

15.2 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.

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of School and it shall be declared by the Controller of Examinations.

15.4 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 fees tothe Controller of Examinations. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as convener, the faculty member of the course and a senior faculty member knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

15.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

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

If 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" grade is excluded for calculating GPA.

"U" and**"I"** grades are excluded for calculating CGPA.

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

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

15.6.1 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 PG programme within the minimum prescribed period of study (except clause 8.1.1)

15.6.2 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 8.1.1)

15.6.3 The students who do not satisfy clause 15.6.1 and clause 15.6.2 shall be classified as second class.

15.6.4 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.

16.0 DISCIPLINE

16.1 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.

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

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

17.1 A student shall be declared to be eligible for the award of the Master's Degree, if he/she has:

i. Successfully acquired the required credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
ii. No disciplinary action is pending against him/her.
iii. Enrolled and completed at least one value added course.

iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

17.2 The award of the degree must have been approved by the Institute.

18.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

****

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

M.TECH AVIONICS

CURRICULUM & SYLLABI, REGULATION 2022

SEMESTER– I

Sl. No.	Course Code	Course Title	L	T	P	C
1	MAE 6185	Advanced Applied Mathematics	3	1	0	4
2	AEE 6101	Digital Avionics (Lab Integrated)	3	0	2	4
		Bridge Course				
3	AEE 6181	Basics of Flight Vehicle (for Electrical Stream) **(or)**	3	0	0	3
4	EEE 6181	Advanced Electronics and Control System (for Mechanical Stream)	3	0	0	3
5	ECE 6181	Electro Optic Systems	3	0	0	3
6	AEE 6102	Flight Instrumentation and Data Acquisition	3	0	0	3
7	E1	Elective I	3	0	0	3
8	AEE 6103	Mathematical Modeling and Simulation laboratory	0	0	3	1
9	ENE 6181	English for Career Development	1	1	0	1
		Credits				22

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1	AEE 6201	Aircraft Guidance and Control (Lab integrated)	3	0	2	4
2	AEE 6202	Aircraft Navigation Systems	3	0	0	3
3	E2	Elective II	3	0	0	3
4	E3	Elective III	3	0	0	3
5	E4	Elective IV	3	0	0	3

6	GEE 6201	Research Methodology and IPR	2	0	0	2
7	AEE 6204	Programming in Ada	1	0	3	2
8	AEE 6205	UAV/MAV Design Laboratory	1	0	3	2
		Credits				**22**

SEMESTER III

Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	AEE 7101	Digital Fly-By-Wire Control	3	0	0	3
2	E5	Open Elective	3	0	0	3
3	E6	Elective IV	3	0	0	3
4	AEE 7201	Project Work – Phase I #	0	0	12	6*
5	AEE 7202	Industry Internship *	0	0	2	1
6		MOOC Course				0
		Credits				**16**

SEMESTER IV

Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	AEE 7201	Project Work – Phase II*	0	0	36	18*
		Credits				**6 + 18 = 24**

Overall Total Credits: 78

* Industrial training will be undertaken during the first-year of summer vacation for 15 days. The credit will be awarded in the 3rd Semester.

Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

- Enrollment in at least one value-added course is mandatory.
- The students shall pursue a MOOC course related to the project in the thirds Semester and the progress in this regard shall be monitored during Project Phase – I review.

LIST OF ELECTIVES

Course Code	Course Title	L	T	P	C
AEEY 01	UAV SystemDesign-1	3	0	0	3
AEEY 02	UAV SystemDesign-2	3	0	0	3
AEEY 03	Payload And Sensors for UAVs	3	0	0	3
AEE Y04	Advanced Aerodynamics For UAV	3	0	0	3
AEEY 05	The propulsion system for UAV	3	0	0	3
AEEY 06	Smart Structures and Materials	3	0	0	3
AEEY 07	Digital Image Processing and Aerial Survey	3	0	0	3
AEEY 08	Airborne Actuators and Sensors	3	0	0	3
AEEY 09	Soft Computing for Avionics Engineers	3	0	0	3
AEEY 10	Missile Guidance and Control	3	0	0	3
AEEY 11	Fault Tolerant Computing	3	0	0	3
AEEY 12	Programming in Ada	3	0	0	3
AEEY 13	Mathematical Modeling and Simulation	3	0	0	3
AEEY 14	Microwaves and Radar	3	0	0	3
AEEY 15	Electronic Warfare	3	0	0	3
AEEY 16	Real-time Embedded Programming	3	0	0	3
AEEY 17	Display Engineering	3	0	0	3
AEEY 18	Flight Mechanics	3	0	0	3
AEEY 19	Active Control Technology	3	0	0	3
AEEY 20	Avionics Network Technology	3	0	0	3
AEEY 21	Fault Tolerant Control	3	0	0	3
AEEY 22	Satellite Communications	3	0	0	3

SEMESTER I

MAE 6185	ADVANCED APPLIED MATHEMATICS	L	T	P	C
SDG: 4		3	1	0	4

COURSE OBJECTIVES:

The aim of this course is

COB1: To develop a working knowledge of the central ideas of linear algebra.

COB2: To study and understand the concepts of probability and random variable of the various functions and Markov chain. Simple ideas of conditional probability and matrices how can be used to give a thorough and effective account of discrete-time Markov chains.

COB3: To understand the graph isomorphism and Hamiltonian paths and cycles.

COB4: To formulate and construct a mathematical model for a linear programming problem in a real-life situation.

COB5: Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations.

MODULE I LINEAR ALGEBRA 9+3

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations –QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations -Toeplitz matrices and some applications.

MODULE II ONE-DIMENSIONAL RANDOM VARIABLES AND RANDOM PROCESSES 9+3

Random variables: Probability function – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. Random processes: Classification – Auto correlation – Cross correlation – Stationary random process – Markov process – Markov chain – Poisson process – Gaussian process.

MODULE III GRAPH THEORY 9+3

Basic definitions - Adjacency matrix of a graph - Dijkstra's algorithm - Paths and circuits, Eulerian and Hamiltonian, Weighted graph, Network flow - Travelling salesman problem - Trees and Rooted trees, Spanning trees and cut-sets - Tree traversal - Expression trees

MODULE IV LINEAR PROGRAMMING PROBLEM 9+3

Formulation – Graphical solution – Simplex method – Two phase method – Transportation and Assignment Models, Sequencing problems.

MODULE V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS 9+3

Fourier transforms: Definitions, properties – Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poison's equations.

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Bronson, R. Matrix Operation, Schaum's outline series, McGrawHill, Newyork (1989).
2. Mathews, J. H. and Howell, R., Complex analysis for Mathematics and Engineering, Narosa, 2005.
3. Oliver, C. Ibe, Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
4. Taha, H.A., Operations Research: An Introduction, Ninth Edition, Pearson Education, Asia, New Delhi 2012.
5. Sankara Rao, K., Introduction to Partial Differential Equations, Prentice Hall of India, Pvt. Ltd., New Delhi, 1997.
6. Veerarajan, T., Discrete Mathematics with Graph Theory and Combinatorics, Tata Mc Graw Hill Publishing Co., New Delhi, 2011.

REFERENCES:

1. Andrews, L.C. and Phillips, R.L., Mathematical Techniques for Engineering and Scientists, Prentice Hall of India, 2006.
2. O'Neil P.V., Advanced Engineering Mathematics, (Thomson Asia Pvt. Ltd., Singapore) 2007, Cengage Learning India Private

Limited.

3. Bondy. J.A. and Murthy, U.S.R., Graph Theory with Applications, Macmillan, 1977.
4. Bondy. J.A. and Murthy, U.S.R., Graph Theory with Applications, Macmillan, 1977.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: understand and solve linear algebra problems.

CO2: solve one-dimensional random variable and random processes problems.

CO3: apply graph theory network techniques in Avionics.

CO4: deal with linear programming problems.

CO5: apply Fourier transform and PDE techniques to solve general problems in Avionics.

Board of Studies (BoS) :
14th BOS of Mathematics & AS held on 30.06.2022

Academic Council:
19th Academic Council held on 29.09.2022

	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	H						H				L	M	
CO2		H	M		L		H						H		L
CO3	H	H	M		H			H					H	H	
CO4	M	H		M			L						L	H	
CO5	H	L			M			M	M					H	M

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

Learning of Linear Algebra, Random Process and Transforms will lead to knowledge of applications in Avionics Engineering.

AEE 6101	DIGITAL AVIONICS (Lab Integrated)	L	T	P	C
SDG: 9		3	0	2	4

COURSE OBJECTIVES:

COB1: To introduce the role of avionics system and its architecture.

COB2: To understand the avionics system design development and integration using simulation tools.

COB3: To know modular avionics packaging and EMI/EMC requirements in avionics.

COB4: To study system assessment, validation, certification, and maintenance of avionics system.

COB5: Upon completion of the course, the students will obtain practical knowledge of the avionics system integration and operation of avionics bus systems.

MODULE I INTRODUCTION TO AVIONICS 6

Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems and design, defining avionics System/subsystem requirements-importance of ilities‘, Avionics system architectures.

MODULE II AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION 10

MIL-STD-1553B, ARINC-429, ARINC-629, CSDB, AFDX and its Elements, Avionics system design, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation.

MODULE III AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER 10

Trends in display technology, Alphanumeric displays, character displays etc., Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for Power System Design.

MODULE IV MAINTENANCE AND PACKAGING 8

BIT and CFDS, Automatic Test Equipment - Speeds maintenance - ATLAS, Remote diagnostics and maintenance support-Life Cycle Costs for Military and Civil Avionics -Modular Avionics Packaging - Trade-off studies - ARINC and DOD types - system cooling - EMI/EMC requirements & standards.

MODULE V SYSTEM ASSESSMENT, VALIDATION AND CERTIFICATION 11

Fault-tolerant systems - Hardware and Software, evaluating system design and Future architecture - Hardware assessment-FARs guide certification requirements Fault Tree analysis –Failure mode and effects analysis – Criticality, damaging modes and effects analysis - Software development process models - Integrated Avionics and systems- Security and Integrated Standard (SIL) - Software Assessment and Validation -Civil and Military standards - Certification of Civil Avionics.

PRACTICAL EXPERIMENTS:

1. Testing of installation of MIL –STD-1553, ARINC-49 and ARINC -629 card (Self-test)
2. Configuring MIL –STD-1553, ARINC-429 and ARINC -629 cards in transmitting and receiving mode.
3. Testing of installation and configuring of AFDX card in transmitting and receiving mode.
4. Using the interactive driver to transmit or receive the data
    a) On a single PC by loop back connection.
    b) PC to PC by connecting a shielded pair of wires.
5. Transmit and receive the messages
    a) Using loop back connection with single card.
    b) Using connector (shielded pair of wires).
6. Development of Basic AT mega -8-bit controller for rotary wing and fixed wing

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:

1. Spitzer, C.R. ―Digital Avionics Systems‖, Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
2. Cary R. Spitzer, ―The Avionics Handbook‖, CRC Press, 2000.
3. Collinson R.P.G. ―Introduction to Avionics‖, Chapman and Hall, 1996.
4. Middleton, D.H. ―Avionics Systems‖, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
5. Jim Curren, ―Trend in Advanced Avionics‖, IOWA State University, 1992.

COURSE OUTCOMES:

CO1: To impart the basic concepts of Avionics Systems to the engineers.
CO2: To provide the necessary knowledge on the working of avionics systems in an aircraft.
CO3: To give exposure to various topics such as Avionics system architecture, Avionics bus systems, integration, display systems and packaging.
CO4: To deploy these skills effectively in the understanding and analysis of avionics systems.
CO5: To develop knowledge and have a better understanding of easy maintenance of the Avionics 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
CO1	M		L			L		M	
CO2		L		M		H			
CO3			M				L		M
CO4				L		M			
CO5					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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEE 6181	BASICS OF FLIGHT VEHICLE	L	T	P	C
SDG: 9	(For Electrical Stream)	3	0	0	3

COURSE OBJECTIVES:

COB1: To provide knowledge of the basic concepts of flight vehicles including classifications, components, and forces acting on it.

COB2: To introduce the knowledge of aircraft performance and its related equations.

COB3: To provide knowledge on analysis of longitudinal, lateral, and directional stability and controls.

COB4: To educate the concept related to aircraft structures safety.

COB5: To provide the overall theories behind for the development of aircraft and rocket propulsion.

MODULE I CONFIGURATION OF AIRPLANE AND BASIC AERODYNAMICS **7**

Aircrafts and its classifications - Components of an airplane and their functions - Airfoil and streamlines - Forces acting on an airplane - Lift and drag – Types of Drag– Speed and power – International Standard Atmosphere. Wind Tunnel Testing Techniques for Forces and Moments.

MODULE II AIRCRAFT PERFORMANCE **11**

Straight and level flight– Conditions for minimum Drag and minimum power– Climbing and gliding –Range and Endurance – Take-off and Landing – V-n diagram.

MODULE III STABILITY AND CONTROL **11**

Concepts of static and dynamic stability and control– Yaw and sideslip – Dihedral effect – Rudder requirements – Directional and spiral divergence – Dutch roll– Autorotation and spin.

MODULE IV AIRCRAFT STRUCTURES **9**

Introduction to Aircraft structures - Loads - Types of construction - Design feature of Aircraft materials.

MODULE V PROPULSION 7

Aircraft propulsion, Rocket propulsion, power plant classification, Principles of operation, Areas of their application

L – 45; TOTAL HOURS: 45

TEXT BOOKS:

1. Kermode, A.C, ‗Mechanics of Flight ‘English Book Store, New Delhi, 1982.
2. John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2017.

REFERENCES:

1. Van Sickle Neil, D ‗Modern Airmanship ‘VanNostr and Reinhol, New York, 1985.
2. Megson T.H. ‘Aircraft Structures for Engineering Student’s II Edition, Edward Arnold, Kent, U.S.A. 1990.

COURSE OUTCOMES:

At the end of this course students will be able to

CO1: Identify the different parts of the aircraft and its functions.

CO2: Solve the problems related to the aircraft performance which covers from takeoff to landing.

CO3: Relate the link between stability of the aircraft and its solving methods.

CO4: Give the justification for materials used in the components of the aircraft.

CO5: Differentiate the principle involved for aircraft propulsion and rocket propulsion.

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
CO1	M								
CO2		L							
CO3			M						
CO4				L					
CO5					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 basics of flight vehicles leads to encourage the quality of design in sustainable industrialization.

EEE 6181	ADVANCED ELECTRONICS AND CONTROL	L	T	P	C
SDG: 9	SYSTEM	3	0	0	3

(For Mechanical Stream)

COURSE OBJECTIVES:

COB1: To introduce the mathematical modelling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.

COB2: To impart the knowledge on the concept of stability.

COB3: To impart knowledge on the various methods to analyze stability in both time and frequency domain.

COB4: To recall the fundamentals of PID control and familiar various performance measures used in control systems.

COB5: To model, analyses the system in state space and its observer design in detail.

MODULE I SYSTEM AND THEIR RESPONSES 10

Introduction on the systems – Basic elements of control system – Open and closed loop system – Transfer function – block diagram reduction – Mathematical model of Physical systems: Thermal system, Pneumatic system, Hydraulic system, Flight Control system.

MODULE II TIME DOMAIN ANALYSIS 8

Time response – test signals – response of first and second order systems for unit step input–Time domain Specification.

MODULE III FREQUENCY DOMAIN ANALYSIS 10

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

MODULE IV DESIGN OF CONTROLLERS 8

Controllers' introduction - P, PI, PID types – Design of PID Controllers – Electronic PID Controller - Examples of controllers modeling.

MODULE V STATE SPACE ANALYSIS 9

Concepts of State Variable and State Model – State Space to Transfer Function and Transfer Function to State Space Modes – Solving Time Invariant

State Equation – Controllability – Observability – State Observers – Design of Control Systems with Observers.

TOTAL HOURS: 45

REFERENCES:

1. Asif Sabanovic and Kouhei Oshnishi, Motion Control Systems" Willey, 2011.
2. Bequette. B.W., "Process Control Modelling, Design and Simulation", Prentice Hall of India, 2004.
3. Kuo. B.C, "Automatic Control Systems", Prentice Hall, 2004.
4. Ogata.K, "Modern Controls Engineering ", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
5. Nagrath.I.J and Gopal, "Control System Engineering", New Age international (P) Ltd., 2006.

COURSE OUTCOMES:

Students will be able to

CO1: Differentiate between the open loop and closed loop of a control system.

CO2: Characterize the responses and evaluate the range of stability for the physical systems using time domain techniques.

CO3: Describe and assess the range of stability for the physical systems using frequency domain technique.

CO4: Develop the PID control and capable to analyze performances of the control systems.

CO5: Examine the system in state space and its observer design in detail

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
CO1	M								
CO2		L							
CO3			M						
CO4				L					
CO5					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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

ECE 6181	ELECTRO OPTIC SYSTEMS	L	T	P	C
SDG: 4, 8, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To describe the concepts of Electromagnetic radiations

COB2: To discuss the characteristics of LASERs and its applications in aviation systems.

COB3: To provide exposure on various optical phenomena

COB4: To explain the various imaging system

COB5: To compare the image compression standards applied in onboard avionics.

MODULE I OPTICAL RADIATION 9

Electro Magnetic spectrum, Light Waves, Electro-Optic Effect, Self electro optic effect, Thermal radiation, Laws of Black body radiation, Emissivity and Kirchhoff's law, Black body sources, Atmospheric propagation characteristics: ray propagation, conic surfaces for refraction/reflection, Scattering effect, Transmission through rain, Scintillations.

MODULE II LASER SYSTEMS 10

Theory of Laser operation, Optical resonators, spectral properties, beam properties, Temporal and Spatial coherence, Introduction to gas, solid and semiconductor lasers, Modulators: Electro-optic, Magneto-optic, liquid crystal devices and Acousto-optic modulators, Q switching, Mode locking, Cavity dumping, wave front modulation and spatial light modulators, Holography, CGHs and binary optics, Gyroscopes, Laser gyro, fibre optic gyro, Ring Laser gyro, Laser hazards and Safety measures.

MODULE III INFRARED SYSTEMS 9

Infrared and thermal detectors, Description and design features of typical passive search and detection, Infrared imaging, Forward Looking Infra Red (FLIR), Tracking and Homing systems. Satellite Radiometers.

MODULE IV IMAGING DEVICES AND TRACKING SYSTEMS 9

Imaging tubes: Vidicon, Pyroelectric-vidicon, Image intensifier tubes, CCD, CMOS, Focal plane arrays (FPA), Optical tracking, Sensor steering and

stabilization, Servo Control. Opto mechanical design of camera and systems. Description and design features of laser ranging and guidance system, LIDAR.

MODULE V FIBER OPTIC SYSTEMS 8

Types of fiber optic cables and their characteristics, fiber optic sources and detectors, Avionics fiber optic data busses: IEEE Std 1393, MIL STD 1773 etc. Multiplexing schemes for onboard avionics, Fiber optic gyro.

L – 45; TOTAL HOURS: 45

TEXT BOOKS:

1. John Wilson, John Hawkes, “Optoelectronics”, 3rd Edition, Pearson Education, 2018.
2. S.C. Gupta, “Optoelectronic Devices and Systems”, 2nd Edition, Prentice Hall of India, 2014.
3. Richard D. Hudson Jr., “Infrared System Engineering”, Wiley-Blackwell Publishing, 2016.

REFERENCES:

1. Keith Atkins, “Jane's Electro-optic Systems, 2006/2007, 12th Edition, Janes Information Group Ltd, Surrey, 2006.
2. William L. Wolfe, “Introduction to Infrared System Design”, Illustrated Edition, SPIE Press, 1997.
3. “IEEE 1393-1999 - IEEE Standard for Space borne Fiber Optic Data Bus”, IEEE Standards Association, 1999.

COURSE OUTCOMES:

On completion of the course, the students will

CO1: Summarize the emission and propagation characteristics of EM wave radiations

CO2: Relate the properties of LASER to the needs in avionics.

CO3: Discuss the principles of various imaging systems

CO4: Analyze the importance of infrared and thermal detection in aviation systems.

CO5: Choose the appropriate fiber-optic systems for the onboard avionics.

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
CO1	M								
CO2		L							
CO3			M						
CO4				L					
CO5					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

Statement: Knowing the basics of electro optical systems and its implementations makes the student capable of enriching the lifelong learning in this field.

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

Statement: Able to apply the theoretical concepts of EOS and wave propagation techniques for various applications and sustainable industrialization. It offers safe and inclusive work environment for the professionals irrespective of the environmental conditions.

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

Statement: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEE 6102	FLIGHT INSTRUMENTATION AND DATA	L	T	P	C
SDG: 9	ACQUISITION	3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the concept of measurement, error estimation and classification of aircraft instrumentation and displays.

COB2: To study air data instruments and synchronous data transmission system.

COB3: To study the gyroscope and its driven mechanism and its applications

COB4: To study aircraft compass system and its deviation compensator and flight management.

COB5: To impart knowledge about the basic data acquisition, telemetry system and its application.

MODULE I MEASUREMENT SCIENCE AND DISPLAYS 12

Instrumentation brief review – concept of measurement- Errors and errors estimation-functional elements of an instrument system – Transducers-classification-static and dynamic characteristics – calibration – classification of aircraft instruments – Instrument displays panels and cockpit layout.

MODULE II AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS 12

Air data instruments – airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Stall and Mach warning system - synchronous data transmission system.

MODULE III GYROSCOPIC INSTRUMENTS 12

Gyroscope and its properties, Operating mechanism, gyro system, Gyro Horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, turn coordinator, acceleration and turning errors.

MODULE IV AIRCRAFT COMPASS SYSTEMS & FLIGHT MANAGEMENT SYSTEM 12

Direct reading compass, magnetic heading reference system- detector element, deviation compensator. FMS – Engine Instruments -Flight Planning – flight path optimization – operational modes, 4D flight management.

MODULE V DATA ACQUISITION SYSTEMS 12

Data acquisition and Handling systems: Introduction – signal conditioners – instrumentation, amplifiers – filters. Data Conversion – multiplexer – A/D – D/A conversion. Telemetry – Airborne and ground system – PC based telemetry system. Application of telemetry in UAVs and Satellites.

L – 45; TOTAL HOURS: 45

TEXT BOOKS:

1. Pallet, E.H.J, - Aircraft Instruments & Integrated systems-II, Longman Scientific and Technical, Mc Graw-Hill-1992.
2. Murthy, D.V.S - Transducers and Measurements-II, Mc-Graw Hill-1995.

REFERENCES:

1. Doeblin, E.O – Measurement Systems Application and Design-II, Mc-Graw Hill, New York, 1999.
2. Harry.L. Stilz – Aerospace Telemetry II, Vol I to IV, Prentice-Hall, space Technology Series.

COURSE OUTCOMES:

CO1: The learners will able to measure the error and can find the error estimation in the aircraft instruments.

CO2: The learners will be able to know about the various air data systems and synchronous data transmissions systems.

CO3: The learners will be able to know the principles of gyroscope and its property and application in flight instruments.

CO4: The learners will be able to know the principles of DGU, FMS and its operation and principles of engine instruments.

CO5: The students will also have an exposure to various data acquisition components.

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
CO1	M								
CO2		L							
CO3			M						
CO4				L					
CO5					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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions

AEE 6103	MATHEMATICAL MODELLING AND	L	T	P	C
SDG: 9	SIMULATION LABORATORY	0	0	3	1

COURSE OBJECTIVES:

COB1: To introduce MATLAB and Simulink modelling environment.

COB2: To design and model aircraft subsystems, using Simulink.

LIST OF LAB EXPERIMENTS:

1. Matrix and Vector, and solving Linear Equations using MATLAB
2. Plotting of 2D and 3D Graph using MATLAB
3. Image Processing with MATLAB
4. Solving Ordinary Differential Equation with MATLAB
5. GUI application design using MATLAB
6. Spectral Analysis of Real-Time Signal with MATLAB
7. Modelling of Communication Systems using Simulink.
8. Radar Tracking Using MATLAB Function Block
9. Create and Configure Flight Instrument Component and an Animation Object with Simulink.
10. Lightweight Airplane Design modelling with MATLAB and Simulink.

P – 45; TOTAL HOURS: 45

REFERENCES:

1. Amos Gilat, “MATLAB: An Introduction with Applications”, 4th Edition, John Wiley, 2012
2. Shailendra Jain, “Modeling and Simulation using MATLAB – Simulink”, 2nd Edition, Wiley International, 2015.
3. Marcello R. Napolitano, “Aircraft Dynamics: From Modeling to Simulation”, 1st Edition, Wiley, 2011.
4. Raveendranathan K C, “Communication Systems Modelling and Simulation using Matlab and Simulink”, CRC Press, 2011.

COURSE OUTCOMES:

On completion of the course Students will be able to

CO1: recall the built-in Matlab functions for solving basic mathematical problems

CO2: demonstrate the properties of functions by graph plotting

CO3: apply MATLAB tools for image processing and differential equation

CO4: analyze and interpret the spectrum of real-time communication signals.

CO5: estimate the performance of communication systems and aircraft instrumentation by modelling and simulating them with Simulink
CO6: design a lightweight aircraft using Simulink modelling.

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
CO1	M		L		M				
CO2		L				L	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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

SEMESTER II

		L	T	P	C
AEE 6201	**AIRCRAFT GUIDANCE AND CONTROL**				
SDG: 9	**(Lab Integrated)**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To introduce advanced concepts of Guidance and Control of an aircraft needed in modelling the guidance and control methods.

COB2: To give the exposure on 6-DOF equations of motion

COB3: To impart knowledge on advanced systems of Longitudinal and Lateral autopilot.

COB4: To give a brief explanation about different control systems such as Pitch orientation, Yaw orientation, Acceleration, Glide Slope Coupler and Fly-by-Wire.

COB5: To introduce basic operating principle and guidance law of missiles and launch vehicles.

MODULE I INTRODUCTION 4

Introduction to Guidance and control - definition, Historical background.

MODULE II AUGMENTATION SYSTEMS 7

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts.

MODULE III LONGITUDINAL AUTO PILOT 12

Displacement Autopilot-Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

MODULE IV LATERAL AUTOPILOT 10

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm.

MODULE V MISSILE AND LAUNCH VEHICLE GUIDANCE 12

Operating principles and design of guidance laws, homing guidance laws- short range, medium range and BVR missiles, Launch Vehicle- Introduction, Mission

requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes

PRACTICALS:

1. Stability analysis using Root locus, Bode plot, Nyquist plot and Polar plot techniques
2. Design of lead, lag and lead-lag compensator for aircraft dynamics
3. Performance Improvement of Aircraft Dynamics By pole placement technique
4. Development of Longitudinal Equations of Motion
5. Design of displacement longitudinal autopilot
6. Design of Automatic Glide Slope Control System and Flare Control System
7. Development of Lateral Equations of Motion
8. Design of Lateral Autopilot
9. Design of Turn Co-ordination system
10. Design of Automatic Lateral beam guidance system
11. Design of Van-Guard Missile system
12. Design of Kalman filters
13. Basic implementation of ADSP-BF 561 processor for image processing.

NOTE: Implementation using X-plane, Flight-Gear & Aerosim (experiments from 5 to 11)

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

REFERENCES:

1. Blake Lock, J.H ‘Automatic control of Aircraft and missiles ‘, John Wiley Sons, New York, 1990.
2. Stevens B.L & Lewis F.L, ‘Aircraft control & simulation’, John Wiley Sons, New York, 1992.
3. Collinson R.P.G, ‘Introduction to Avionics’, Chapman and Hall, India, 1996.
4. Garnel.P. & East.D.J, ‘Guided Weapon control systems’, Pergamon Press, Oxford, 1977.
5. Nelson R.C ‘Flight stability & Automatic Control’, McGraw Hill, 1989.
6. Bernad Etikin,’Dynamic of flight stability and control’, John Wiley, 1972.

COURSE OUTCOMES:

CO1: Students will understand the advanced concepts of Guidance and Control of an aircraft to the engineers and to provide the necessary mathematical knowledge that are needed in modelling the guidance and control methods.

CO2: The students will have an exposure on various topics such as 6-DOF equations of motion, autopilots and augmentation systems and missile guidance systems.

CO3: The students will have an exposure on various topics such as Root locus, analysis of stability through Root locus plots, Bode plot, Lead Lag compensator, PID controller and tuning, controller and autopilot design.

CO4: Students will be able to understand the basic principles on missiles and guidance laws.

CO5: Students will be able to deploy these skills effectively in the solution of problems in Avionics engineering.

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
CO1	M								
CO2		L							
CO3			M						
CO4				L					
CO5					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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEE 6202	AIRCRAFT NAVIGATION 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 know satellite navigation and hybrid navigation system integration.

COB4: To study various radio navigation system and its usage in air traffic regulation and landing of aircrafts

COB5: To study about the basic principles of Kalman Filter, GPS and it's position and velocity determining signal structure.

MODULE I NAVIGATION SYSTEMS & INERTIAL SENSORS 6

Introduction to navigation – Types – Introduction to Inertial Sensors - Mechanical - Ring Laser - Gyro- Fiber optic gyro – MEMS system.

MODULE II INERTIAL NAVIGATION SYSTEMS 9

INS components: transfer function and errors - Earth in inertial space - Coriolis Effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning – compensation errors - Gimbal lock - Initial calibration and Alignment Algorithms.

MODULE III RADIO NAVIGATION 12

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 edition,1997.
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.
3. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
4. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
5. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
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.

COURSES OUTCOMES:

Upon completion of the course:

CO1: Students will understand the advanced concepts of Aircraft Navigation

CO2: To provide the necessary mathematical knowledge that 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, Satellite 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):
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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

GEE 6201	RESEARCH METHODOLOGY AND IPR	L	T	P	C
SDG: 4,8,9		2	0	0	2

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To analyze the research design, information retrieval and problem formulation techniques.

COB3: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB4: To execute the effective communications of research findings and apply the ethics in research

COB5: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

PREREQUISITE:

- Basics of core engineering, probability and statistics.
- Basics of flowchart and algorithm techniques.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN 6

Research - objectives – types - Research process, solving engineering problems-Identification of research topic - Formulation of research problem, literature survey and review. Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle, Design of experimental setup, Mathematical modelling - Simulation, validation and experimentation.

MODULE II DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA 8

Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision – limitations, Application of Computer in Research- Spreadsheet tool-Basic principles of Statistical Computation. Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis

testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES 8

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.

MODULE IV THE RESEARCH REPORT 8

Purpose of written report - Audience - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism – Thesis writing, - Organization of contents - style of writing- graphs, charts and Presentation tool - Referencing, Oral presentation and defence - Ethics in research - List of funding agencies - scope for research funding - Patenting, Intellectual Property Rights.

L – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Ganesan R, “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
2. George E. Dieter, “Engineering Design”, McGraw Hill – International edition, 2020.
3. Kothari C.R, “Research Methodology” – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2020.
4. Kalyanmoy Deb, “Genetic Algorithms for optimization”, Kangal report, No.2001002.

REFERENCES:

1 Holeman, J.P, ”Experimental methods for Engineers”, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.
2 Govt. of India, ”Intellectual Property Laws; Acts, Rules & Regulations”, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2020.
3 R Radha Krishnan & S Balasubramanian, ”Intellectual Property Rights”. 1st Edition, Excel Books, 2012.
4 Derek Bosworth and Elizabeth Webster. ”The Management of Intellectual Property”, Edward Elgar Publishing Ltd., 2013.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Formulate the research problem

CO2: Design and Analyze the research methodology

CO3: Apply statistical techniques for hypothesis construction

CO4: Analyze and interpret the data to construct and optimize the research hypothesis

CO5: Report the research findings as publications, copyright, trademarks and IPR

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	P O9	PO1 0	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	H	H	M	L	L	L	L	L	L	L	H	H	H
CO2	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO3	H	H	H	H	M	L	L	L	L	L	L	-	H	H	H
CO4	H	H	H	H	M	-	M	M	M	M	M	-	H	H	H
CO5	H	H	H	H	M	-	M	M	M	M	M	-	H	H	H

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

SDG 4: Analysis and design of core field design promotes engineering skills and quality education.

Statement: This course enables the student to analyze the existing technology for further solution and its qualitative measures in terms of societal requirements..

SDG 8: Development of new technologies with core field design provides sustainable economic growth and productive employment.

Statement: To apply the hybrid techniques and concepts for different applications provides sustainable economic growth and productive employment.

SDG 9: Creative and curiosity of core field design fosters innovation and sustainable industrialization.

Statement: This course plays major roles through innovative ideas in industry towards modern infrastructures and sustainability.

AEE 6204	PROGRAMMING IN ADA	L	T	P	C
SDG: 9		1	0	3	2

COURSE OBJECTIVES:

COB1: To introduce the basic Ada program and its packages and different types of programming in Ada.

COB2: To interface the Ada programming in C and introduce the object-oriented programming language.

MODULE I OBJECT-ORIENTED PROGRAMMING 5

Overview- History of Ada -Inheritance, dynamic dispatching (polymorphism)- Encapsulation. Basic Ada structures, program units, Ada structures, lexical elements, identifiers, numeric literals, character literals, Basic types- integer, float, Boolean, user-defined types & rule types-Enumeration. Array, records, limited and private limited types, control structure- if, case, loop, loop iteration schemes, subprograms-declaration, parameter passing- local and global variables.

MODULE II ADA PACKAGES 5

Declaration and bodies-packages-compilation units, I/O capabilities, Text file I/o, various text files, package command line options, child packages, exceptions - declarations, handling, generics definitions, formal parameters, visibility rules.

MODULE III INTERFACING WITH OTHER LANGUAGES 5

Interfacing with C, Java vs. Ada, Ada applets, Java interfaces and aliased components- flight safety and Ada, recursion and efficiency, software inspection, debugging, Ada bindings, other Ada capabilities.

PRACTICALS:

1. Introduction to Ada programming
2. Data types and syntax for programming
3. Conditional and looping program introduction
4. Subprogram and Call-routines programming
5. Introduction to packages and type of programming in Ada
6. Record introduction and programming
7. Arrays and their types
8. Introduction to Pointers and programming
9. Exception raising and handling

10. Interfacing with C
11. Object-oriented Programming concepts
12. Various library introductions and usage**.**

L- 15; P- 45; TOTAL HOURS: 60

REFERENCES:

1. Introduction to Ada, by Raphaël Amiard and Gustavo A. Hoffmann, Release 2023-01.
2. Shvets, A. T. (2019). Beginning Ada Programming: From Novice to Professional. Germany: Apress.
3. Weems, C., Dale, N. B., McCormick, J. W. (2000). Programming and Problem Solving with ADA 95. United States: Jones and Bartlett.

COURSE OUTCOMES:

Upon completion of the course,

CO1: Students will be able to gain basic Ada knowledge and code the programs.

CO2: Students are able to interface Ada programming in C with object-oriented concepts.

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
CO1	M		L		H		L	H	
CO2		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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEE 6205	UAV/MAV DESIGN LABORATORY	L	T	P	C
SDG: 9		1	0	3	2

COURSE OBJECTIVES:

COB1: To give basic knowledge about the design and analysis of the controlled flights.

COB2: To provide knowledge on the assembly of a designed controlled flight.

MODULE I INTRODUCTION TO UAV/MAV 5

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

MODULE II BASICS OF AIRFRAME 5

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 COMMUNICATION PAYLOADS AND PATH PLANNING 5

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

PRACTICALS:

1. Introduction to various types of RPV/RC- Controlled flights
2. Introduction to various multi-copter configurations.
3. Wing Analysis using XFLR analysis
4. Weight estimation and components selection for drones.
5. Assembling of drone and inspection of various components.
6. Calibration of ESC and motors.
7. Binding of Receiver and Transmitter.
8. Introduction to various Flight controllers
9. Basic connection of flight controller and its calibration
10. Mission planner Introduction and calibration procedures
11. Machine-in-loop autonomous flight mission planning
12. Simulator training for drone flying

13. Test Flight and Ground flight.

L- 15; P- 45; TOTAL HOURS: 60

COURSE OUTCOMES:

Upon completion of the course,

CO1: Students will be able to design and do the analysis for a controlled flight.

CO2: Students will be able to construct a drone and have a basic experience of flying the controlled flight.

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
CO1	M		L		H		L		
CO2		L		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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

SEMESTER III

AEE 7101	DIGITAL FLY-BY-WIRE CONTROL	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the advanced concepts of Fly-by-wire that are needed in understanding modern aircraft control strategies.

COB2: To understand various elements of Fly by wire elements.

COB3: To give a detailed explanation about architecture of digital Fly by Wire system.

COB4: To study the basic requirements for DFBW system.

COB5: To gain knowledge built-in issues such as built in test, reliability, redundancy, failure and maintenance, implementation, generic failures.

MODULE I INTRODUCTION TO FLY-BY-WIRE CONTROL 9

Need for FBW systems, Historical perspectives in design Programs-Douglas Long Beach Programs, WPAFB B 47 In House Program, LTV IAP, Sperry Phoenix Programs, CAS and SAS, CCV and ACT concepts.

MODULE II ELEMENTS OF DFBW CONTROL 9

Description of various elements of DFBW systems - Concept of redundancy and reliability, Fault coverage and redundant architecture.

MODULE III DFBW ARCHITECTURES 9

Need for redundant architecture, discussion on triplex vs. quadruplex architecture for DFBW system, Concept of cross-strapping, Actuator command voting and servo force voting etc.

MODULE IV SOME REQUIREMENTS FOR DFBW SYSTEM DESIGN 9

Survivable Flight control System programs, ADP Phases-Simplex package Evaluation -FBW without Mechanical Backup-Survivable Stabilator Actuator package, Reliability requirements and their relevance to DFBW system design, redundant power supply requirements, Environmental and weight, volume constraints

MODULE V DESIGN ISSUES IN DFBW SYSTEM DESIGN 9

Thermal consideration, Built-in-test features, reliable software development, Redundancy management (voting, monitoring), Failure and maintenance philosophies, Implementation, Issues of digital control laws, Generic failures in Hardware and software. Advanced concepts in DFBW System Design.

L- 45; TOTAL HOURS: 45

REFERENCES:

1. Vernon R Schmitt, James W Morris and Gavin D Jenny, “Fly By Wire-A Historical Perspective”, SAE International, 1998.
2. AGARD-CP-137, “Advances in Control systems”, (Chap.10, 17,21, 22, 23, 24)
3. AGARD-CP-384, “Active Control Systems Review”, Evaluations and Projections.
4. AGARD-CP-260, “Stability and Control” (Chap.15)
5. ‘Modern Air Combat’, Salamander Books Ltd, 2001.

COURSE OUTOMES:

Upon completion of this course,

CO1: Students will understand the advanced concepts of Fly-by-wire to the engineers

CO2: To provide the necessary mathematical knowledge that is needed in understanding modern aircraft control strategies.

CO3: The students will have an exposure on various topics such as evolution of FBW, Elements, architecture, design and design issues of DFBW.

CO4: Students will be able to deploy these skills effectively in the analyzing and understanding modern control methods.

CO5: Students will be able to easily identify and rectify the design issues in the DFBW system.

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEE 7102	PROJECT WORK - PHASE I	L	T	P	C
SDG: 9		0	0	12	6

COURSE OBJECTIVES:

COB1: To improve the professional competency and research aptitude.

COB2: Aims to develop the work practice of students to apply theoretical and practical tools/techniques

COB3: To solve real life problems related to industry and current research

COB4: To improve the skills towards report/documentation preparation

GUIDELINES **9**

Project work can be a design project/experimental project and/or computer simulation project on any of the topics of communication systems. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential (Industry oriented Projects), they may be permitted to continue their project outside the parent institute. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, Objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least four faculty members of which internal guide and other experts in the specified area of the project shall be two essential members.

COURSE OUTOMES:

Upon completion of this course,

CO1: At the end of the project work phase I the student will be able to learn the tool required for the design, analysis of their preliminary work

CO2: Select the specific devices for different application along with justification.

CO3: Apply the practical knowledge while solving real time Problems.

CO4: Conclude the subject knowledge through proto type models.

CO5: Prepare an appropriate documentation

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEE 7103	INDUSTRY INTERNSHIP	L	T	P	C
SDG: 9		0	0	2	2

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 a 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 the School and the training has to be taken up at a stretch.
- In the case of an 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 the industry internship report and viva voce examination shall be 60% and 40% respectively.

COURSE OUTOMES:

Upon completion of this course,

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 analyzing underlying issue/s to challenges.

Board of Studies (BoS):
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

MOOC COURSE

COURSE OBJECTIVES:

COB1: To learn the basics principles and concepts of the topic in which a project work is undertaken by the student..

GUIDELINES **9**

Students shall identify a MOOC course related to his/her project topic in consultation with the project supervisor.

- Student shall register for a MOOC course with minimum two credit offered by any recognized organization during the project phase I.
- Selection and completion of MOOC course by the students shall be endorsed by Head of the Department.

COURSE OUTOMES:

Upon completion of this course,

CO1: Familiarize the basic principles and concepts related to the topic of his/her project work

CO2: Utilize the knowledge gained in the field of study to perform literature review with ease.

CO3: Formulate the experimental / analytical methodology required for the project work.

Board of Studies (BoS):
17th BoS held on 03.02.2023

Academic Council:
20th AC held on 13.04.2023

SEMESTER IV

AEE 7201	**PROJECT WORK - PHASE I**	**L**	**T**	**P**	**C**
SDG: 9		**0**	**0**	**36**	**18**

COURSE OBJECTIVES:

COB1: To improve the professional competency and research aptitude.

COB2: Aims to develop the work practice of students to apply theoretical and practical tools/techniques

COB3: To solve real life problems related to industry and current research

COB4: To improve the skills towards report/documentation preparation

GUIDELINES **9**

Project work can be a design project/experimental project and/or computer simulation project on any of the topics of communication systems. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential (Industry oriented Projects), they may be permitted to continue their project outside the parent institute. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, Objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least four faculty members of which

internal guide and other experts in the specified area of the project shall be two essential members.

COURSE OUTOMES:

Upon completion of this course,

CO1: At the end of the project work phase I the student will be able to learn the tool required for the design, analysis of their preliminary work

CO2: Select the specific devices for different application along with justification.

CO3: Apply the practical knowledge while solving real time Problems.

CO4: Conclude the subject knowledge through proto type models.

CO5: Prepare an appropriate documentation

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

ELECTIVES

AEEY 01	UAV SYSTEM DESIGN - I	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce Fundamental concepts of UAV systems design

COB2: This course provides an in-depth understanding of the state-of-the-art propulsion issues specific to UAVs, including propulsion options, cycle analysis, principles of operation, systems, components, performance and efficiencies.

COB3: Understanding of different types of Smart Materials and their applications in the UAV components

MODULE I OVERVIEW - UAV SYSTEMS 8

Introduction Aviation History and Overview of UAV systems, Definitions and Terminology, UAV fundamentals, Examples of UAV systems-very small, small, Medium and Large UAV.

MODULE II AERODYNAMICS OF UAV SYSTEMS 10

The Air Vehicle Basic Aerodynamics: Basic Aerodynamics equations, induced drag, the boundary layer, Flapping wings, Performance: Overview, climbing flight, Range and Endurance-for propeller and jet -driven UAV, range- a jet-driven, Classes and Missions of UAVs- Design and selection of UAV based on Mission Planning, Payloads, Launch Systems, Trade Off study, Trajectories.

MODULE III FUEL AND ELECTRIC PROPULSION SYSTEM FOR UAV 10

Internal combustion engine, Piston Engine, micro-turbine jet Engine - Electric Propulsion System Power Supply - Permanent Magnet Brushless DC Motor - Lithium Batteries, Fuel Cells, Solar Photovoltaic, Electric Propulsion System Power Units - Parallel Hybrid Structure, Series Hybrid Structure, Series-Parallel Hybrid Structure.

MODULE IV AIRFRAME DESIGN 7

Scale Effects, Packaging Density, Aerodynamics, Structures and Mechanisms, Selection of power-plants, Modular Construction, Ancillary Equipment

MODULE V MATERIALS 10

Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory.

Introduction to Smart Materials, Principles of Piezoelectricity, Principles of Magnetostriction, Introduction to Electro-active Materials, Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagias Materials, Self-Healing Polymers.

L- 45; TOTAL HOURS: 45

TEXTBOOK:

1. Reg Austin, Unmanned Aircraft Systems, John Wiley & Sons Ltd., 2010.

REFERENCES:

1. G Panday, Basics of Unmanned Aerial Vehicles: Time to start working on Drone Technology, Notion press, 2021
2. M V Gandhi and B S Thompson, Smart Structures and Materials, Chapman and Hall, 1992
3. Brian Culshaw, Smart Structures and Materials, Artech House, 2000.

COURSE OUTCOMES:

Students were able to

CO1: Categorize Design terminologies and Sub systems of UAV

CO2: Examine UAV aerodynamics Characteristics & performance parameters

CO3: Choose Suitable power plant based on UAV category

CO4: Select and Group different systems in designing UAV

CO5: Summarize different types of material used in the design of UAV

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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:. Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEEY 02	UAV SYSTEM DESIGN - 2	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the basic knowledge of UAV types and applications.

COB2: To introduce mathematical calculation involved in the design of UAV.

COB3: To integrate and configure various sensors such as gyroscope, accelerometer and actuators.

COB4: To understand the basic knowledge about the communication and payload and simulation.

COB5: To understand about waypoint navigation and ground control software.

MODULE I INTRODUCTION TO UAV 9

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

MODULE II BASICS OF AIRFRAME 9

Airframe –dynamics –modelling- structures –wing design- engines types-equipment maintenance and management-control surfaces-specifications.

MODULE III AVIONICS HARDWARE 9

Autopilot –AGL-pressure sensors-servos-accelerometer –gyros-actuators-power supply processor, integration, installation, configuration, and testing.

MODULE IV COMMUNICATION PAYLOADS AND CONTROLS 9

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control Frequency range –SAS-flight director-commands and videos-elements of control loops flight computer sensor -displays- parameter settings-modems-memory system simulation-ground test-analysis trouble shooting.

MODULE V PATH PLANNING AND MAV 9

Waypoints navigation-ground control software-Recent trends in UAV-Case Studies

L- 45; TOTAL HOURS: 45

REFERENCES:

1. Jane's Unmanned Aerial Vehicles and Targets, Jane's Information Group; ASIN: 0710612575,1999
2. R. Said and H. Chayeb, "Power supply system for UAV", KTH, 2002.
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
4. Skafidas, "Microcontroller Systems for a UAV", KTH, TRITA-FYS 2002:51 ISSN 0280-316 X.34, 2002
5. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Roadto Autonomy", Springer, 2007
6. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc,1998,
7. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
8. P.J. Swatton, "Ground studies for pilots' flight planning", Sixth edition, 2002.

COURSE OUTCOMES:

Upon completion of this course,

CO1: Students will understand the advanced concepts of UAV System Design to the engineers

CO2: Students gains the mathematical knowledge that are needed in modelling and analyzing an unmanned system.

CO3: The students will have an exposure on various topics such as Design and development of UAVs, payloads and design standards.

CO4: Concluding with case studies of different such unmanned systems and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

CO5: the students will be able to configure the drone with the help of ground control software.

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEEY 11	FAULT TOLERANT COMPUTING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide knowledge on the Fault-tolerant systems, fault diagnosis, adaptive control, robust control, and redundancy control and study future issues.

COB2: To learn about error detection such as mechanisms, measures, protection systems.

COB3: To design the parametric faults and decoupling from disturbance.

COB4: To understand the error recovery mechanisms, recovery for completion and cooperating process.

COB5: To understand the principles of fault diagnosis.

MODULE I FAULT TOLERANCE 10

Principles of fault tolerance – redundancy – quantitative reliability – evaluation – exception handling. Application of fault tolerant systems in aircraft – reliability strategies – Fault Tolerant Processor – Hardware and software.

MODULE II ERROR DETECTION 12

Measure for error detection – Mechanisms for error detection – Measures for damage confinement and damage assessment – Protection mechanisms – Protection in multi-level systems.

MODULE III ERROR RECOVERY 12

Measures for error recovery – mechanisms for error recovery – check points and audit trials – the recovery cache – Concurrent processes – recovery for competing process – recovery for cooperating process – distributed systems – fault treatment – location and repair.

MODULE IV SOFTWARE FAULT TOLERANCE 4

The recovery block scheme – Implementation of recovery block – Acceptance – tests – run-time overheads.

MODULE V SYSTEMS STRUCTURE AND RELIABILITY 7

System structure – systems model – Software / Hardware interaction and multi-level systems – atomic actions – systems reliability – systems specification - Erroneous transitions and states – component / design failure – errors and faults.

L- 45; TOTAL HOURS: 45

REFERENCES:

1. Anderson and Lee, Fault tolerant principles and practice, Prentice – Hall, 1981
2. Siewiorek, C.P. and Swartz, R.S Theory and practice of reliable system design, McGraw – Hill, 1983.
3. John D. Musa, Anthony Jannino, Kzuhira, Okunito, Software reliability measurement, prediction and application, McGraw – Hill, 1989.

COURSE OUTCOMES:

Upon completion of this course,

CO1: Students will understand the advanced concepts of Fault Tolerance to the engineers.

CO2: Students will be able to provide the necessary mathematical knowledge that is needed in understanding the necessary procedures involved.

CO3: The students will have an exposure on Redundancy, Fault Tolerant system architecture and design, error handling and recovery.

CO4: students will be able to design the parametric faults and decoupling from disturbance and the error recovery mechanisms, recovery for completion and cooperating process.

CO5: Students will be able to deploy these skills effectively in the solution of problems in avionics engineering.

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEEY 14	MICROWAVES AND RADAR	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the various Microwave sources and their working.

COB2: To become familiar with radar equation and range.

COB3: To provide an understanding of the basic concepts, operation of modern radar systems.

COB4: To develop the knowledge and techniques necessary to analyze the performance of radar systems.

COB5: To give an overview of radar applications.

MODULE I MICROWAVE SOURCES 10

Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source – Gunn Diode and Tunnel diode.

MODULE II RADAR PRINCIPLES 8

Introduction to Radar – Radar range equation – Receiver noise and signal to noise ratio- Radar cross section (RCS) – Radar system – Radar Antennas.

MODULE III TYPES OF RADARS 10

CW and FMCW radars-Tracking radars-MTI radar -Principles of coherent MTI radars -Digital MTI, Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium-PRF Mode.

MODULE IV TRACKING RADAR 10

Radar signal processing - Tracking with radar – Monopulse Tracking – conical scan and sequential lobing – limitations to tracking Accuracy- Kalman Tracker - Fundamentals of Airborne radar.

MODULE V APPLICATIONS OF RADAR 7

Distance measuring equipment (DME) – Tactical air navigation systems (TACAN) -Microwave Landing System (MLS) - Global Positioning System (GPS) - Air traffic services, Primary surveillance and secondary aerodrome surveillance.

L- 45; TOTAL HOURS: 45

REFERENCES:

1. Fred E.Nathanson " Radar design Principles " Signal processing and the environment, Prentice Hall, 2004.
2. Y. Liao, Microwave Devices and Circuits, Prentice Hall, 1980.
3. M.I. Skolnik, Introduction to Radar System (Second Edition) McGraw Hill, 1980.
4. M.I. Skolnik, Radar Handbook (Second Edition) McGraw Hill, 1990.
5. Guy V. Morris, Linda L. Harkness, Airborne Pulsed Doppler radar, Second Edition, Artech House Publishers, 1996.
6. Blackman S.S., "Multiple target tracking with radar applications" Artech House 1986.
7. Byron Edde, "Radar Principles, Technology, Applications", Pearson Education India, 2009

COURSE OUTCOMES:

Upon completion of this course,

CO1: Study the various Microwave sources and their working

CO2: Describe the Principle of Radar.

CO3: Explain the concepts of different types of Radars.

CO4: Study the relevant signal processing.

CO5: Discuss the application of Radar including Navigational 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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEEY 21	FAULT TOLERANT CONTROL	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the advanced concepts of fault tolerant control system modelling for the physical processes and estimation the errors using various advanced concepts.

COB2: To introduce the advanced concept of analytical redundancy such as its faults and disturbance, Properties and design, specification.

COB3: To introduce the advanced concept of parity equation formulation such as the implementation of single residual with its output relation, fault system and its design.

COB4: To understand and study about the design for directional residual with its errors and faults.

COB5: To study and understand the advanced topics such as Kalman Filter fault diagnosis using principal component analysis, fault diagnosis using ANN and Fuzzy clustering.

MODULE I INTRODUCTION 9

Scope of -Approaches to fault detection and diagnosis: -Model free methods and Model based methods - Introduction to Random Variables-Distribution-Bivariate distribution- Multivariate Distribution-Normal Distribution-Maximum likelihood distribution-Hypothesis testing.

MODULE II ANALYTICAL REDUNDANCY CONCEPT 9

Additive faults and disturbance Multiplicative faults and disturbance Residual Generation-Detection Property-Isolation Property-Computational Property-Design of Residual Generation-Specification and implementation.

MODULE III PARITY EQUATION FORMULATION 9

Implementation of single residual-Implementation with input output relation-Fault system matrix Design for structure residual-Structural Definition-Canonical Structures Handling Disturbance-Residual structure form multiple faults.

MODULE IV DESIGN FOR DIRECTIONAL RESIDUAL 9

Directional specifications-Parity Equation-Linearly dependent columns Residual generation for parametric faults-Representation of parametric fault-Design for

parametric fault and model errors-Robustness in residual generation-Perfect decoupling from disturbance.

MODULE V ADVANCE TOPICS 9

Fault diagnosis using Kalman Filtering-Fault diagnosis using principal component analysis –Fault diagnosis using ANN and Fuzzy clustering, Case study: Aircraft fault detection.

L- 45; TOTAL HOURS: 45

REFERENCES:

1. Janos.J.Gertler, “Fault detection and diagnosis in engineering systems”, second edition, Marcel Dekker, 1998.
2. Rami S.Mangoubi, “Robust Estimation and Failure detection”, Springer-Verlag London, 1998.

COURSE OUTCOMES:

Upon completion of this course,

CO1: students will understand the advanced concepts of Fault Tolerant Control to the engineers

CO2: Students will gain the necessary mathematical knowledge that are needed in modelling physical processes.

CO3: The students will have an exposure on various topics such as Multivariate distribution, likelihood distribution, analytical redundancy concept, parity equation and directional residual.

CO4: Students will be able to deploy these skills effectively in the solution of Problems in avionics engineering.

CO5: Students will be able to understand the advanced concepts in Kalman Filtering with faults and analysis.

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
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.

AEEY 22	SATELLITE COMMUNICATIONS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the advanced concepts of Spacecraft communication systems and to provide the necessary mathematical knowledge of physical processes.

COB2: To understand the modulation and multiplexing schemes such as FDMA, TDMA, ADMA and DAMA.

COB3: To introduce the concept on satellite link design with its interference and characteristics.

COB4: To introduce the basic concept of satellite telemetry systems, application in spacecraft systems, command system issues.

COB5: To implement various application in the satellite communication systems.

MODULE I ELEMENTS OF SATELLITE COMMUNICATION 9

Satellite Systems, Orbital description and Types of orbits, Kepler's laws, Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.

MODULE II TRANSMISSION, MULTIPLEXING, MULTIPLE ACCESS AND CODING 9

Different modulation and Multiplexing Schemes, Multiple Access Techniques FDMA, TDMA, CDMA, and DAMA, Coding Schemes, Satellite Packet Communications.

MODULE III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

MODULE IV SATELLITE TELEMETRY, TRACKING AND TELECOMMAND 9

Introduction to telemetry systems - Aerospace transducer - signal conditioning – multiplexing methods - Analog and digital telemetry - Command line and remote-

control system - Application of telemetry in spacecraft systems - Base Band Telemetry system - Computer command & Data handling, Satellite command system-Issues.

MODULE V APPLICATIONS 9

GPS- VSAT-VSAT Technologies, RADARSAT, INSAT, IRS – PSLV – GSLV**.**

L- 45; TOTAL HOURS: 45

REFERENCES:

1. Wilbur L. Pritchard and Joseph A.Sciulli, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 1986.
2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 1986.
3. Tri T Ha, Digital Satellite Communication, Macmillan Publishing Company, 1986.
4. Kadish, Jules E, Satellite Communications Fundamentals, Artech House, Boston 2000
5. Lida, Takashied., Satellite communications: System and its design technology, Ohmsha Tokyo2000
6. Maral, Gerard, Satellite communications systems: Systems, techniques and technology, John Wiley, Newyork 2002.

COURSE OUTCOMES:

Upon completion of this course,

CO1: Students will understand the advanced concepts of Spacecraft communication systems to the engineers and to provide the necessary mathematical knowledge that are needed in understanding the physical processes.

CO2: The students will have an exposure on various topics such as Orbital mechanics, elements of satellite communication system links.

CO3: Students will be able to understand the multiplexing, multiple access, telemetry commands.

CO4: Students will be able to understand the tracking and telecommand of the satellite systems design and communication.

CO5: Students will be able to deploy these skills effectively in the solution of problems in avionics engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M							M	
CO2		L			L				H
CO3			M		M		L		
CO4				L				L	H
CO5	M		M		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: Implementation of electro optic systems and its components are addressing the industry issues and offer the solutions.