MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

SYLLABUS

BACHELOR OF SCIENCE

IN

AERONAUTICAL ENGINEERING

REVISED ON 2024

DEPARTMENT OF AERONAUTICAL ENGINEERING (AE)
MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)
MIRPUR CANTONMENT, DHAKA-1216, BANGLADESH

TABLE OF CONTENTS — **Page No**

CHAPTER 1

GENERAL INFORMATION

CHAPTER 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT MIST

CHAPTER – 1

GENERAL INFORMATION

1.1 Introduction to MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT) and other foreign institutions of science and technology. With a view to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) that promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. The motto of MIST is Technology for Advancement. Founded on 19 April 1998, MIST started its journey on 31 January 1999 by offering a four-year bachelor's degree on Civil Engineering. Bachelor degree on Computer Science Engineering course started on 2001. Bachelor courses on Electrical, Electronic & Communication Engineering and Mechanical Engineering started its journey from 2003. Bachelor of Science program on Aeronautical Engineering (AE) and Naval Architecture and Marine Engineering (NAME) program were started from 2008-2009 and 2012-2013 respectively. Besides, four new departments started their academic session from 2014-2015 i.e. Nuclear Science & Engineering (NSE), Biomedical Engineering (BME), Architecture (Arch) and Environmental, Water Resources & Coastal Engineering (EWCE).

MIST has a diverse group of students including foreign ones contributing to the dynamic and inclusive learning environment that defines our institution. Presently students from Maldives, Palestine, Nepal, Sudan and Gambia are also studying in different Engineering Programs. MIST envisages creating facilities for the military as well as civil students from home and abroad dedicated to pursuing standard curriculum leading to Graduation Degree. As an Institution without any gender bias, MIST is already on a steady stride in upholding its motto “Technology for Advancement”. MIST remains committed to contributing to the wider spectrum of the national educational arena and playing a significant role in the development of human resources and ardently pursuing its goal to grow into a “Centre of Excellence”. MIST has well-equipped classrooms with multimedia and web cameras with internet facilities and laboratories with modern equipment. The medium of instruction for all engineering programs is English. All academic programs of MIST are affiliated with the Bangladesh University of Professionals (BUP) and have close cooperation with the Bangladesh University of Engineering and Technology (BUET) and Dhaka University (DU).

1.2 Vision and Mission of MIST

Vision:
To be a centre of excellence for providing quality education in the field of science, engineering and technology and conduct research to meet the national and global challenges.

Mission:
MIST is working on the following missions:

Provide comprehensive education and conduct research in diverse disciplines of science, engineering, technology, and engineering management.

Produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the socio-economic development of Bangladesh and global needs.

Conduct collaborative research activities with national and international communities for continuous interaction with academia and industry.

Provide consultancy, advisory, testing, and other related services to government, non-government and autonomous organizations including personal for widening practical knowledge and to contribute in sustainable development of the society.

1.3 Motto and Values of MIST

Motto:
As an Institution without gender biasness, MIST is steadily upholding its motto "**Technology for Advancement**" and remains committed to contribute to the wider spectrum of national educational arena, play a significant role in the development of human resources and gradually pursuing its goal to grow into a '**Centre of Excellence**'.

Values:

- **a. Humanity-** MIST not only makes our students graduates but also strives to make them humane.
- **b. Discipline-** Discipline remains the corner stone of continuous success stories of MIST.
- **c. Morality-** Morality is innate. MIST helps nurture it and develops our students as Quality Engineers with Morality.
- **d. Quality-** MIST keeps focusing on quality education with inspiration to life-long learning so that our graduates are recognized in the world and can prove their acquired skills.

1.4 Salient Features of MIST

a. Rigorous admission and selection process for the best possible screening interactive sessions in the classroom.
b. Qualified faculty members.
c. Regular guest lectures and educational visits.
d. Culture of timeliness, commitment, and uninterrupted curriculum.
e. Flexibility in choosing competent faculties through outsourcing.
f. Well-thought-out and continuous feedback and assessment system.
g. Effective teaching through the innovative method.
h. Industrial attachment for on job training.
i. Emphasis on code of conduct and dress code.

j. Focus to develop students as good humans with all possible attributes of a successful leader.
k. Tranquil, pollution-free and secure campus life.

1.5 Location

MIST is located at Mirpur Cantonment, northwest edge of the greater Dhaka city, a hub of knowledge for the armed forces. Mirpur Cantonment is a small, calm, and quiet education village and free from all possible pollution of city life. A garland like a lake with migratory birds, three sides with extended green fields in the summer and water bodies in the rainy season, whistling birds on the tree branches, and overall bounty of nature adds to the already existing splendid academic atmosphere. Other neighboring academic institutions are National Defense College (NDC) and Defense Services Command and Staff College (DSCSC) – two international standard education centers.

1.6 Faculties

1.6.1 Faculty of Civil Engineering (FCE):
- Civil Engineering (CE)
- Architecture (Arch)
- Environmental, Water Resource and Coastal Engineering (EWCE)
- Petroleum and Mining Engineering (PME)

1.6.2 Faculty of Electrical and Computer Engineering (FECE):
- Computer Science and Engineering (CSE)
- Electrical, Electronic and Communication Engineering (EECE)

1.6.3 Faculty of Mechanical Engineering (FME):
- Mechanical Engineering (ME)
- Aeronautical Engineering (AE)
- Naval Architecture and Marine Engineering (NAME)
- Industrial and Production Engineering (IPE)

1.6.4 Faculty of Science and Engineering (FSE):
- Biomedical Engineering (BME)
- Nuclear Science and Engineering (NSE)
- Department of Science (Mathematics, Physics, Chemistry) and Humanities

Presently MIST has 12 (twelve) departments to conduct B Sc. Engineering program under 04 (four) different engineering faculties. The departments impart education basing on common objectives and outcomes set by MIST and have defined program objectives and outcomes, specific to the departments respectively

1.7 Eligibility of Students for Admission in MIST.

The students must fulfill the following requirements:

a. Bangladeshi Students. Minimum qualifications to take part in the admission test are as follows:

(1) The applicant must have passed SSC/equivalent examination in Science Group obtaining GPA 4.00 (without fourth subject) in the scale of 5.0 and in HSC/Equivalent examination from Board of Intermediate and Secondary Education/ Madrasa Education Board/Technical Education Board in science group the applicant must have obtained a minimum total Grade Point 17 in four subjects (Mathematics, Physics, Chemistry and English).

(2) The applicant must have qualified in minimum five subjects including Mathematics, Physics, Chemistry and English Language with minimum 'B' in average in GCE 'O' Level and in 'A' level he/she must have obtained minimum two 'B' grades or equivalent and one 'C' grade or equivalent in Mathematics, Physics and Chemistry.

(3) Applicants who have passed HSC or Equivalent examination in the current year or one year before the notification for admission can apply.

(4) Sex: Male and Female.

b. Foreign Students. Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

(1) Educational qualifications as applicable for Bangladeshi civil students or equivalent.

(2) Must have security clearance from respective Embassy/High Commission in Bangladesh.

(3) Sex: Male and Female.

In the event of non-availability of foreign students, Bangladeshi civil candidates will fill up the vacancies.

1.8 Number of Seats.

The highest number of seats (excluding incoming student officers from academies) for 04(Four) years Bachelor Degree in Engineering programs (Unit– A) and 5 (Five) years Bachelor Degree of Architecture programs are as follows:

Allocation of Seats

Ser	Unit	Department	Total Seats	Civil Ward (General, Freedom Fighter, Tribal)	Mil Ward
1	A	Civil Engineering (CE)	76	46	30
2		Computer Science and Engineering (CSE)	101	61	40
3		Electrical, Electronic and Communication Engineering (EECE)	88	53	35
4		Mechanical Engineering (ME)	96	57	39
5		Aeronautical Engineering (AE)	40	22	18
6		Naval Architecture and Marine Engineering (NAME)	42	22	20
7		Biomedical Engineering (BME)	45	24	21
8		Nuclear Science and Engineering (NSE)	45	24	21
9		Environmental, Water Resources & Coastal Engineering (EWCE)	45	24	21
10		Industrial and Production Engineering (IPE)	45	24	21
11		Petroleum and Mining Engineering (PME)	45	24	21
12	B	Architecture (Arch)	35	21	14
	Total		703	402	301

1.9 Admission Procedure

1.9.1 Syllabus for Admission Test: Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (comprehension and functional) subjects of HSC examinations of all boards of secondary and higher secondary school certificates. Admission test will be conducted out of 200 marks and the distribution of marks is given below:

Ser.	Unit	Subjects	Marks
1.	Unit A (Engineering and Architecture)	Mathematics	90
2.		Physics	70
3.		Chemistry	30
4.		English	10
5.			Total = 200
6.	Unit B (Architecture)	Drawing and Architecture related topics	200

1.9.2 Final Selection: Students will be selected based on results of the admission test. Individual choice for selection of departments will be given preference as far as possible. In case of a tie in the result of admission test, the difference will be judged on the basis of marks obtained in Mathematics, Physics, Chemistry and English respectively in the admission test.

1.9.3 Medical Check Up: Civil candidates selected through the admission test will go for medical checkup in MIST/ CMH. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in medical policy of MIST will be declared unsuitable for admission.

1.10 Students Withdrawal Policy

1.10.1 For Poor Academic Performance.

The under graduate (B.Sc.) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms, for Architecture programme it is planned for 3 regular levels, comprising of 10 regular terms. It is expected that all students will earn degree by clearing all the offered courses in the stipulated time. In case of failure, the following policies will be adopted:

a. Students failing in any course/ subject will have to clear/pass the said course/subject by appearing it in supplementary/ self study (for graduating student) examination as per examination policy.
b. Students may also retake the failed subject/ course in regular term/short term as per examination policy.
c. Maximum grading for supplementary/ self study examination etc of failed subjects will be B+ as per examination policy.
d. One student can retake/reappear in a failed subject/ course only twice. However, With the Permission of Academic Council of MIST, a student may be allowed for third time as last chance.
e. In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council , MIST. However, he/she has to complete the whole undergraduate program within 06 (six) academic years(for Architecture 07 academic years) from the date of his/her registration.
f. Minimum credit requirement for the award of bachelor’s degree in Engineering (B.Sc Engg) and Architecture (B. Arch) will be decided by the respective department as per existing rules. However the minimum CGPA requirement for obtaining a bachelor degree in engineering and Architecture is 2.20.

g. Whatever may be the cases, students have to complete the whole undergraduate program within 06 (six) academic years from the date of registration.

h. All other terms and conditions of MIST Examination Policy remain valid.

1.10.2 Withdrawal on Disciplinary Ground

a. **Unfair Means:** Adoption of unfair means may result in expulsion of a student from the program and so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

(1) Communicating with fellow students for obtaining help in the examination.

(2) Copying from another student's script/ report /paper.

(3) Copying from desk or palm of a hand or from other incrimination documents.

(4) Possession of any incriminating document whether used or not.

b. **Influencing Grades:** Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

c. **Other Indiscipline Behaviors:** Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/ program or is considered detrimental to MIST's image.

d. **Immediate Action by the Disciplinary Committee of MIST:** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the institution. In case of withdrawal/ expulsion, the matter will be referred to the Academic Council, MIST for post-facto approval.

1.10.3 Withdrawal on Own Accord

a. **Permanent Withdrawal:** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.

b. **Temporary Withdrawal:** A student, if he/she applies, may be allowed to withdraw temporarily from the program/ subject by the approval of Academic Council of MIST, but he/she has to complete the whole program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

CHAPTER - 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT MIST

2.1 Introduction

MIST has started a course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will apply to students for administering undergraduate curriculum through the Course System. This policy will be introduced to create a continuous, even, and consistent workload throughout the term for the students.

2.2 The Course System

2.2.1 The salient features of the Course System are as follows:

a. Number of theory courses will be generally 06 or as per syllabus in each term. However, with the recommendation of the course coordinator and Head of the Department, Commandant MIST may allow up to 07 courses in exceptional cases if dept can accommodate within 24 Cr. hr.
b. Students will not face any level repeat for failing.
c. Students will get scope to improve their grading.
d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.
e. Continuous evaluation of students' performance.
f. Promotion of student-teacher interaction and contact.

2.2.2 Besides the professional courses about each discipline, the undergraduate curriculum places a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics, and chemistry. Due importance is also given to the study of several subjects in humanities and social sciences.

2.2.3 The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science, and humanities subjects; while the third and subsequent years focus on specific disciplines.

2.3 Number of Terms in a Year

There will be two terms Spring Term (Jan-Jun) and Fall Term (Jul-Dec) in an academic year.

2.4 Duration of Terms

The duration of each of Term I (Spring) and Term II (Fall) (maximum 22 weeks) may be as under:

Ser	Events	Duration
1.	Classes before Mid Term	7 weeks
2.	Mid Term Vacation	1 week
3.	Classes after Mid-term	7 weeks
4.	Makeup Classes and Preparatory leave	2/3 weeks
5.	Term Final Examination	2/3 weeks
6.	Term End Vacation	1/2 week

2.5 Course Pattern and Credit Structure

The undergraduate program is covered by a set of theoretical courses along with a set of laboratories (sessional) courses to support them.

2.6 Course Designation System

2.6.1 Each course is designated by a maximum of four-letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

a. The first digit corresponds to the year/level in which the course is normally taken by the students.
b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.
c. The right-most digit is an odd number for theoretical courses and an even number for sessional courses.

2.6.2 The course designation system is illustrated as follows:

AE 101 **Introduction to Aeronautical Engineering**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1st Year/ 1st Level course
Department Identification code (Aerospace and Avionics Common)

AEAS 206 **Mechanics of Solids Sessional**

Course Title
Even digit designates a sessional course
Reserved for departmental use
Signifies 2nd Year/ 2nd Level course
Department Identification Code (Aerospace Discipline)

AEAV 305 **Communication Engineering**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 3rd Year/ 3rd Level course
Department Identification Code (Avionics Discipline)

2.7 Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. Theoretical Courses: One lecture per week per term is equivalent to one credit.
b. Sessional Courses: Credits for sessional courses is half of the class hours per week per term.
Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another.

2.8 Types of Courses

The types of courses included in the undergraduate curricula are divided into the following groups:

a. **Core Courses:** In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete all the designated core courses of his/her discipline.
b. **Prerequisite Courses:** Some of the core courses are identified as prerequisite courses for a specific subject.
c. **Optional Courses:** Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

2.9 Course Offering and Instruction

2.9.1 The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.

2.9.2 Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

2.10 Teacher Student Interaction

The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

2.11 Student Adviser

2.11.1 One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

2.11.2 However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

2.11.3 For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous term. The adviser may permit the student to drop one or more courses based on previous academic performance.

2.12 Course Registration

2.12.1 Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

2.12.2 **Registration Procedure.** At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

2.12.3 <u>Pre-conditions for Registration</u>.

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.
b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.
c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre-requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre-requisite course is found to be satisfactory.

2.12.4 <u>Registration Deadline</u>. Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

2.12.5 <u>Penalty for Late Registration</u>. Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

2.12.6 <u>Limits on the Credit Hours to be taken</u>

A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Comdt, a lesser number of credit hours to suit individual requirements. Only graduating students may be allowed to register less than 15 Cr Hr without approval of Commandant. A list of all such cases to be forwarded to Register Office, ICT dte and Controller of Exam Office by the respective Department.

2.12.7 <u>Course Add/Drop</u>

A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular term. Dropping a course is permitted within the first four weeks of a regular term. Add or drop is not allowed after registration of courses for Supplementary-I and Supplementary-II Examination.

Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar's Office, where the required numbers of photocopies are made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.

All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

2.12.8 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However, application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

2.13 The Grading System

The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva-voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree.
Letter grades and corresponding grade points will be given as follows:

Grading System

Numerical Markings	Grade	Grade Points
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25

40% to below 45%	D	2.00
below 40%	F*	0.00
	AB	Absent
	DC	Dis-collegiate
	VW	Voluntary Withdrawn
	X	Project/Thesis Continuation
	E	Expelled
	S	Satisfactory

* Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

2.14 Distribution of Marks

2.14.1 Theory. Forty percent (40%) of marks of a theoretical course shall be allotted for Continuous Assessment, i.e. assignments, class tests, pop quizzes, observations, projects and mid-term assessment. These marks must be submitted to Office of the Controller of Examinations before commencement of final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes.

Distribution of marks for a given course per credit is as follows:

Class Performance	5%
Class Attendance	5%
Class Test/Assignment	20%
Mid Term Assessment (Exam/Project)	10%
Final Examination (Section A & B)	60%
Total	**100%**

Note:

a. In final exam, each section can be used for achieving not more than two course outcomes (COs). The remaining COs should be attained from mid-term assessment or class tests. Course teacher has to inform the student the beginning of the terms.

b. Course teacher of a particular course has to inform the department whether he/she wants to assess mid-term through exam or project within first two weeks of beginning of a term. The duration of mid-term examination should not be more than 50 minutes which has to be conducted in between 6th to 9th week of a semester. If mid-term *assessment is done through project, then there should be project report and presentation.*

c. The weightage of class performance can be assessed through checking attentiveness during classes or arranging unnoticed pop quizzes.

d. The number of class tests shall be n for 3.0 and above credit courses and (n-1) shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3.

e. All class test will carry 20 marks each. Exam software system will finally convert these achieved marks into total class test marks as per credit hour. i.e for n=1(20), n=2 (40), n=3 (60), n=4(80) etc.

f. Irrespective of the result of the continuous assessment (class performance, class test, mid-term assessment), a student has to appear in the final examination (where applicable) for qualifying/passing the concern course/ subject.

2.14.2 **Laboratory/Sessional/Practical Examinations**. Laboratory/sessional courses are designed and conducted by the concerned departments. Examination on laboratory/sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the laboratory/sessional courses on the basis of the followings:

Conduct of Lab Tests/Class performance	25%
Report Writing/programming/project work	15%
Mid Term Evaluation (exam/project/assignment)	20%
Final Evaluation (exam/project/assignment)	30%
Viva Voce/ Presentation	10%
Total	**100%**

Note: the above distribution of percentage is a general guideline. Department can rearrange to some extent if required.

2.14.3 **Laboratory/Sessional Course in English**. The distribution will be as under:

Class performance/observation	10%
Written Assignment	15%
Oral Performance	25%
Listening Skill	10%
Group Presentation	30%
Viva Voce	10%
Total	**100%**

2.14.4 **Class attendance.** Class attendance is considered as a part of continuous assessment.

2.15 <u>Basis for awarding marks for class attendance</u>.

	Marks
90% and above	100%
85% to less than 90%	90%
80% to less than 85%	80%
75% to less than 80%	70%
70% to less than 75%	60%
Below 70%	00%

2.16 <u>Collegiate and Non-collegiate</u>

Students having class attendance of 85% or above in individual subject will be treated as collegiate and less than 85% and up to 70% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear in the examination subject to payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 70% will be treated as dis-collegiate and will not be allowed to appear in the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

2.17 <u>Calculation of GPA</u>

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes n courses in a term having credits of $C_1, C_2, \dots, C_n$ and his grade points in these courses are $G_1, G_2, \dots, G_n$ respectively then

$$GPA = \frac{Grade\ points\ earned\ in\ the\ semester}{Credits\ completed\ in\ the\ semester}$$

$$= \frac{Summation\ of\ \ (Credit\ hours\ in\ a\ course *\ Grade\ point\ earned\ in\ that\ course)}{Total\ number\ of\ credit\ hours\ completed}$$

$$GPA = \frac{\sum_{i=1}^{n} Ci * Gi}{\sum_{i=1}^{n} Ci}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of $TC_1, TC_2, \dots, TC_n$ and his GPA in these terms are GPA_1, GPA_2, GPA_n respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TCi * GPAi}{\sum_{i=1}^{n} TCi}$$

2.17.1 Numerical Example

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credits, C_i	Grade	Grade G_i	Points, C_I*G_i
AE 110	1.50	A-	3.50	5.250
AE 101	3.00	A+	4.00	12.000
CHEM 101	3.00	A	3.75	11.250
MATH 121	3.00	B	3.00	9.000
HUM 111	3.00	B-	2.75	8.250
HUM 103	3.00	B	3.00	9.000
PHY 115	3.00	A+	4.00	12.000
CSE 112	1.50	A	3.75	5.625
Total	21.00			72.375

GPA = 72.375/21.00 = 3.45

Suppose a student has completed four terms and obtained the following GPA.

Level	Term	Credit Earned,TC_I	Hours GPA Earned, GPA_i	GPA_i*TC_i
1	1	21.00	3.73	78.330
1	2	20.50	3.93	80.565
2	1	19.75	3.96	78.210
2	2	20.25	4.00	81.000
Total		**81.50**		**318.105**

CGPA = 318.105/81.50 = 3.90

2.18 Minimum Earned Credit and GPA Requirement for Obtaining Engineering Degree

Minimum credit hour requirements for the award of bachelor‘s degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum CGPA requirement for obtaining a Bachelor‘s degree in engineering and other discipline is 2.20.

2.19 Minimum Earned Credit and GPA Requirement for Obtaining Degree (Additional Course)

Minimum credit hour requirements for the award of Bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided by the respective department (BUGS). However, at least 157 credit hours for engineering must be earned to be eligible for graduation. This must include the specified core courses. The minimum GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20. A student may take additional courses with the consent of his Advisor in order to raise GPA, but he/she may take a maximum of 15 such additional credits beyond respective credit-hours requirements for Bachelor's degree during entire period of study.

2.20 Impacts of Grade Earned

a. The courses in which a student has earned a 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an 'F' grade will not be counted towards his/her earned credits or GPA calculation. However, the 'F' grade will remain permanently on the Grade Sheet and the Transcript.
b. A student who obtains an 'F' grade in a core course will have to repeat that particular course. However, if a student gets an 'F' in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an 'F', he/she will not be eligible to get a grade better than 'B+' in that repeated course.
c. If a student obtains a grade lower than 'B+' in a particular course he/she will be allowed to repeat the course only once for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than 'B+' for an improvement course.
d. A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. program.
e. If a student obtains a 'B+' or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

2.21 Classification of Students

2.21.1 At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Level	Credit Hours Earned	
	Engineering	Architecture
Level 1	0.0 to 36.0	0.0 to 34.0
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0
Level 4	More than 108.0	More than 110.0 to 147.0
Level 5		More than 147.0

2.21.2 However, before the commencement of each term all students other than new batch are classified into three categories:

Category 1: This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

Category 2: This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

Category 3: This category consists of students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

2.21.3 Definition of Graduating Student. Graduating students are those students who will have $\leq$ 24 credit hours for completing the degree requirement.

2.22 Performance Evaluation

i. The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

ii. Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward their degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists.

a. The term GPA falls below 2.20.

b. The Cumulative Grade Point Average (CGPA) falls below 2.20.

c. The earned number of credits falls below 15 times the number of terms attended.

iii. All such students can make up for their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and supplementary exams, if there are any, with better grades. When the minimum GPA and credit requirements are achieved the student is again returned to good standing.

2.23 Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for a Bachelor’s degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

2.24 Time Limits for Completion of Bachelor's Degree

A student must complete his studies within a maximum period of six years for engineering and seven years for architecture bachelor's degree.

2.25 Attendance, Conduct and Discipline

MIST has strict rules regarding the issues of attendance in class and discipline.

Attendance. All students are expected to attend classes regularly. MIST believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

Conduct and Discipline. During their stay in MIST all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

2.26 Teacher-Student Interaction

The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator (CC) is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

2.27 Absence during a Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an F grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

2.28 Recognition of Performance

As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends will be given as per existing rules and practices.

2.29 Types of Different Examination

Following different types of final Examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. **Term Final Examination:** At the end of each normal term (after 22wk or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. **Supplementary Examination:** It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) / Fall Term(Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.

c. **Improvement Examination:** It will be taken during Supplementary-I and Supplementary-II Examination. Questions will be same as the question of the regular examination of that Supplementary Examination (if any). Student can take maximum two subjects at a time (two subjects in supplementary-I and one subject in supplementary-II) and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than 'B+' in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better then 'B+' for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i,e previous to improvement examination, shall be reflected in the transcript.

2.30 Rules of Different Examinations

2.30.1 Term Final Examination. Following rules to be followed:

a. Registration to be completed before the commencement of the Term. A student has to register his desired courses paying registration, examination fee, and other related fees.

b. Late registration will be allowed without penalty within the first two weeks of the term.

c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.

d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.

e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

2.30.2 <u>Supplementary Examination</u>. Following rules to be followed:

a. Supplementary-I is defined as the provision of giving exam in the first week of Spring Term (Jan-Jun) / Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively.
b. Students will be allowed to register for a maximum of two theory courses (Failed/Improvement) in Supplementary-I and maximum of one theory course (Failed/Improvement) in Supplementary-II.
c. No class will be conducted.
d. Forty percent (40%) marks will be considered from the previous exams.
e. Maximum grading in Supplementary Exam will be 'B+'.
f. No Sessional Exam will be conducted.
g. Examination will be taken on 60% marks like Term Final Examination.
h. If a student fails in a course more than once in regular terms, then for calculating 40% marks best one of all continuous assessment marks will be counted.19
i. If anyone fails in the laboratory/sessional course, that course cannot be taken in the supplementary examination.
j. If any student fails in a course, he can clear the course retaking it 2nd time or, he can clear the examination appearing at the supplementary examination as any one fails twice in a course, can only retake it in the regular term for appearing third time. But anyone fails even after appearing third time. He/she has to take of Academic Council of MIST for appearing 4th (last) time in a course and need to pay extra financial penalty. If any student fails even 4th time in a course, will not be allowed to appear anymore in this same course.
k. Registration of Supplementary-I Exam to be done within 5th wk after completion of Fall Term (July to Dec) and registration of Supplementary-II exam to be done during the Mid-Term break of Spring Term (Jan to Jun), paying all the required fees.
l. There will be no provision for add/drop courses after registration.
m. Question Setting, Moderation, and Result Publication to be done following the same rules of Spring (Jan to Jun) / Fall (July to Dec) Term Final Exam as per existing Examination Policy.
n. Moderation of the questions for Supplementary-I will be done in the 5th week after completion of Fall Term (July to Dec) Final Exam and Supplementary II with the moderation of the questions of Spring Term (Jan to Jun).
o. Separate Tabulation sheet to be made.
p. Thesis: if a student cannot complete thesis in two consecutive terms, with the recommendation of the supervisor, he/she may continue for next one/two term within six academic years.

2.30.3 <u>Improvement Examination</u>. Following rules to be followed:

a. Improvement examination is to be taken during the Supplementary-I and Supplementary-II examinations.
b. For Improvement examination, registration is to be done during the registration of Supplementary-I and Supplementary-II examinations by paying all the fees.
c. Question Setting, Moderation and Result Publication to be done with courses of Supplementary-I and Supplementary-II examinations.

d. Any student gets a grading below ‘B+’ and desires to improve that course, he will be allowed to appear the improvement examination for that particular course.
e. Highest grade of Improvement examination will be ‘B+’.
f. One student is allowed to appear at Improvement exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time (two courses at supplementary-I and one course at supplementary-II).

2.31 Irregular Graduation

If any graduating student clears his/her failed course in Spring Term/Fall Term/Supplementary examinations and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Spring Term/Fall Term/Supplementary examinations and that student will be allowed to apply for provisional certificate.

CHAPTER 3

DEPARTMENT OF AERONAUTICAL ENGINEERING (AE)

3.1 Introduction to the Program

The necessity of induction of B.Sc. in Aeronautical Engineering (AE) program at Bangladesh has long been felt and MIST is the pioneer technical institute to introduce Aeronautical Engineering Program in Bangladesh. Compared to any other institute of engineering including BUET, MIST has the highest preparedness to introduce Aeronautical Engineering because of the requirement of defense where study and practice of Aeronautical Engineering is a part of service requirement as well as Aeronautical Engineering is required to introduce space-based research in our country.
The proposed B.Sc. in Aeronautical Engineering (AE) program has 02 (two) major disciplines namely Aerospace and Avionics. The proposed syllabus comprises a total of 160 credits & (195+8 weeks) contact hours for both Aerospace and Avionics discipline.
Aeronautical Engineering plays a vital role in all fields of modern human activities. It has established itself as one of the most important branches of engineering. The department offers a comprehensive curriculum covering fundamental principles of aerodynamics, propulsion, structures, materials, control systems, and avionics. Students engage in rigorous coursework that integrates theoretical understanding with hands-on experiences through lab sessions, projects, and internships. Aeronautical Engineering Department fosters a culture of research and innovation, encouraging faculty and students to explore cutting-edge technologies and address contemporary challenges in aerospace engineering. Research areas may include advanced propulsion systems, unmanned aerial vehicles (UAVs), Aerodynamics, Computational Fluid Dynamics, Structural Analysis, Aerospace Materials, Avionics and other disciplines. In addition to lectures and practical sessions in the classroom, the undergraduate program also includes industrial/educational visits to different reputed industries/places both home and abroad. The new generation of Aeronautical engineers is encouraged to undertake research and development activities in the above areas and this department is committed to the study and analysis of fundamental as well as applied problems. Problems of military and national importance have consequently received great emphasis in the activities of this department. The Aeronautical Engineering program of MIST was first accredited by BAETE (Board of Accreditation for Engineering and Technical Education) on 14th November 2016. Again in July 2022, the department received accreditation under Outcome Based Education (OBE) following the guidelines of the BAETE Manual (Version 1, 2017) for three years.
In addition to the above, there are opportunities for postgraduate studies and research leading to higher degrees i.e. M. Sc. (Engg), M. Engg and Ph.D.

3.2 Vision and Mission of the Program

Vision: To be a part of an internationally recognized center of excellence offering a study program of high-quality teaching, research, aviation-related consultancy, and activities with national relevance innovation and creativity in the field of Aeronautical Engineering.

Mission:

1. To produce engineers and researchers with sound knowledge on fundamentals of traditional, modern and emerging areas of Aeronautical Engineering.
2. To achieve professional knowledge of aircraft design and maintenance along the innovative design research abilities and managerial skills, which are essential for sustainable national and global development.
3. To provide aviation related consultancy and promote student an awareness of the life-long learning and work as part of teams on disciplinary projects.

3.3 Program Objectives/Program Educational Objectives (PEO)

1. Our graduates will possess the skills to effectively tackle complex technical challenges within the field of Aeronautical Engineering, whether working independently or collaboratively in teams

2. Our graduates will be able to build up successful professional careers in the fields of aviation (civil and military), government organizations, and academia in the associated fields demonstrating leadership skills.

3. Our graduates will be able to pursue continuous learning through professional development, practical training and specialized certifications

4. Our graduates will be able to undertake postgraduate and doctorate and excel in academic and research careers.

5. Our graduates will embody ethical principles and play a constructive role in fostering both national and global socio-economic development, ensuring sustainability for generations to come.

3.4 Learning Outcomes/Program Outcomes (PO)

Based on the suggestion of the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Bachelor in Aeronautical Engineering (AE) program will have the following learning outcomes:

- **a.** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **b.** Identify, formulate, research the literature and analyze complex engineering problems, and reach substantiated conclusions using first principles of mathematics, the natural sciences, and the engineering sciences.
- **c.** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal, and environmental concerns.
- **d.** Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
- **e.** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

3.5 Program Objectives/Program Educational Objectives and Learning Outcomes/Program Outcomes Matrix

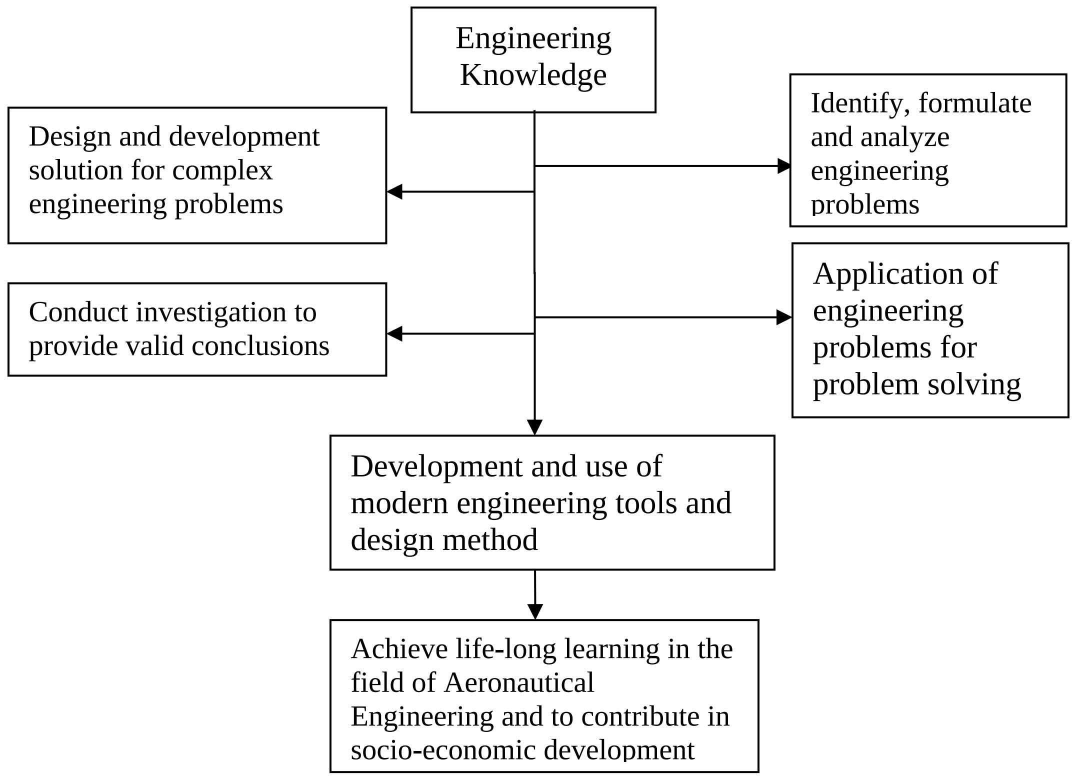
No	POs Statement	PEO-I	PEO-2	PEO-3	PEO-4	PEO-5
I.	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**Yes**	No	No	No	No
2.	Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.	**Yes**	No	No	No	No
3.	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.	No	No	No	**Yes**	**Yes**
4.	Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	No	No	**Yes**	**Yes**	No

5.	Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	No	**Yes**	**Yes**	**Yes**	No
6.	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.	No	No	No	No	**Yes**
7.	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.	No	No	No	No	**Yes**
8.	Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.	No	No	No	No	**Yes**
9.	Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.	**Yes**	**Yes**	No	No	No
10.	Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.	No	**Yes**	No	No	**Yes**
11.	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.	No	**Yes**	No	No	**Yes**
12.	Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.	No	No	**Yes**	No	**Yes**

3.6 Generic Skills

1. Apply the principles and theory of aeronautical engineering knowledge to the requirements, design and development of different aviation systems with appropriate understanding.
2. Define and use appropriate research methods and modern tools to conduct a specific project.
3. Learn independently, be self- aware and self- manage their time and workload.
4. Apply critical thinking to solve complex engineering problems
5. Analyze real time problems and justify the appropriate use of technology
6. Work effectively with others and exhibit social responsibility

3.7 Curriculum/ Skill mapping



CHAPTER 4

COURSE CURRICULUM OF BACHELOR IN AE

4.1 Course Schedule

The course schedule for the undergraduate students of the Department of Aeronautical Engineering (AE) is enumerated below:

Summary of Course Curriculum for Aerospace Discipline

Level/ Term	Language /Communicative language	General Education/Non-Skill Course	Basic Science	Math	Inter disciplinary Course	Program Core	Technical Elective	Total
1-I	1.50	2.00	3.00	3.00	5.25	4.50	0.00	19.25
1-II	0.00	4.00	9.00	3.00	5.25	0.00	0.00	21.25
2-I	1.50	2.00	0.00	3.00	4.00	8.25	0.00	18.75
2-II	0.00	2.00	0.00	3.00	0.00	16.50	0.00	21.50
3-I	0.00	2.00	0.00	0.00	0.00	17.00	3.00	22.00
3-II	0.00	1.00	0.00	0.00	0.00	16.25	3.00	20.25
4-1	0.00	2.00	0.00	0.00	0.00	13.50	3.00	18.50
4-II	0.00	2.00	0.00	0.00	0.00	13.50	3.00	18.50
% of Total Course	**1.88%**	**10.63%**	**7.50%**	**7.50%**	**9.06%**	**55.94%**	**7.50%**	**100%**
Total Credit Hr	**3.00**	**17.00**	**12.00**	**12.00**	**14.50**	**89.50**	**12.00**	**160.00**

Summary of Course Curriculum for Avionics Discipline

Level/ Term	Language /Communicative language	General Education/Non-Skill Course	Basic Science	Math	Inter disciplinary Course	Program Core	Technical Elective	Total
1-I	1.50	2.00	3.00	3.00	5.25	4.50	0.00	19.25
1-II	0.00	4.00	9.00	3.00	5.25	0.00	0.00	21.25
2-I	1.50	2.00	0.00	3.00	4.00	12.00	0.00	22.50
2-II	0.00	2.00	0.00	3.00	0.00	15.75	0.00	20.75
3-I	0.00	2.00	0.00	0.00	0.00	17.00	3.00	22.00
3-II	0.00	1.00	0.00	0.00	0.00	15.25	3.00	19.25
4-1	0.00	2.00	0.00	0.00	0.00	13.50	3.00	18.50
4-II	0.00	2.00	0.00	0.00	0.00	11.50	3.00	16.50
% of Total Course	**1.88%**	**10.63%**	**7.50%**	**7.50%**	**9.06%**	**55.94%**	**7.50%**	**100%**
Total Credit Hr	**3.00**	**17.00**	**12.00**	**12.00**	**14.50**	**89.50**	**12.00**	**160.00**

4.2 Contact hours and credit hours' distribution in eight terms

For Aerospace Discipline

Level/Term	Theory Contact Hours	Sessional Contact Hours	Theory Credit Hours	Sessional Credit Hours	Total Contact Hours	Total Credit Hours
1/I	14.00	10.50	14.00	5.25	24.50	19.25
1/II	16.00	10.50	16.00	5.25	26.50	21.25
2/I	15.00	7.50	15.00	3.75	22.50	18.75
2/II	17.00	9.00	17.00	4.50	26.00	21.50
3/I	17.00	10.00	17.00	5.00	27.00	22.00
3/II	16.00	6.50+8 weeks	16.00	4.25	22.50+8 weeks	20.25
4/I	14.00	9.00	14.00	4.50	23.00	18.50
4/II	14.00	9.00	14.00	4.50	23.00	18.50
For (Aerospace)	123.00	72.00+8 weeks	123.00	37.00	195.00+8 weeks	160.00

For Avionics Discipline

Level/Term	Theory Contact Hours	Sessional Contact Hours	Theory Credit Hours	Sessional Credit Hours	Total Contact Hours	Total Credit Hours
1/I	14.00	10.50	14.00	5.25	24.50	19.25
1/II	16.00	10.50	16.00	5.25	26.50	21.25
2/I	18.00	9.00	18.00	4.50	27.00	22.50
2/II	17.00	7.50	17.00	3.75	24.50	20.75
3/I	17.00	10.00	17.00	5.00	27.00	22.00
3/II	15.00	6.50+8 weeks	15.00	4.25	21.50+8 weeks	19.25
4/I	14.00	9.00	14.00	4.50	23.00	18.50
4/II	12.00	9.00	12.00	4.50	21.00	16.50
For (Avionics)	123.00	72.00+8 weeks	123.00	37.00	195.00+8 weeks	160.00

4.3 Final Year Design and Research Project

Final Year Design and Research Project will have to be undertaken by students under a supervisor in partial fulfillment of the requirement of his/her degree. Credits allotted to the Final Year Design and Research Project will be 6 corresponding to 12 contact hours.

4.4 Term wise Distribution of Courses

LEVEL 1, TERM-I (Aerospace & Avionics)

Course No	Course Name	Type of Course	Contact hours	Credits
PHY 117	Waves and Oscillations, Optics and Structures of Matter	Theory	3.00	3.00
EECE 161	Electrical Circuit Analysis-I	Theory	3.00	3.00
MATH 101	Differential and Integral Calculus	Theory	3.00	3.00
AE 101	Introduction to Aeronautical Engineering	Theory	3.00	3.00
GEBS 101	Bangladesh Studies	Theory	2.00	2.00
		Subtotal (Theory)	**14.00**	**14.00**
LANG 102	Communicative English-I	Sessional	3.00	1.50
EECE 162	Electrical Circuit Analysis-I Sessional	Sessional	3.00	1.50
SHOP 108	Workshop Technology Sessional –I	Sessional	1.50	0.75
AE 110	Aeronautical Engineering Drawing-I	Sessional	3.00	1.50
		Subtotal (Sessional)	**10.50**	**5.25**
				Total = Contact hours: 24.50; Credits: 19.25

LEVEL-1, TERM- II (Aerospace & Avionics)

Course No	Course Name	Type of Course	Contact hours	Credits
PHY 119	Electricity and Magnetism, Thermal Physics and Mechanics	Theory	3.00	3.00
CHEM 101	Fundamentals of Chemistry	Theory	3.00	3.00
MATH 103	Differential Equations and Matrix	Theory	3.00	3.00
CSE 173	Computer Programming and Application	Theory	3.00	3.00
GEA 101	Principles of Accounting	Theory	2.00	2.00
GES 101	Fundamentals of Sociology	Theory	2.00	2.00
		Subtotal (Theory)	**16.00**	**16.00**
CHEM 102	Chemistry Sessional	Sessional	3.00	1.50
PHY 120	Physics Sessional	Sessional	3.00	1.50
CSE 174	Computer Programming and Application Sessional	Sessional	3.00	1.50
SHOP 112	Workshop Technology Sessional –II	Sessional	1.50	0.75
		Subtotal (Sessional)	**10.50**	**5.25**
				Total = Contact hours: 26.50; Credits: 21.25

LEVEL 2, TERM-I (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits
ME 249	Engineering Mechanics (Statics and Dynamics)	Theory	4.00	4.00
AE 205	Numerical Analysis and Applications	Theory	3.00	3.00
AE 213	Electronics-I	Theory	3.00	3.00
MATH 201	Vector Analysis, Laplace Transform and Co-ordinate Geometry	Theory	3.00	3.00
GEE 201	Fundamentals of Economics	Theory	2.00	2.00
		Subtotal (Theory)	**15.00**	**15.00**
AE 206	Numerical Analysis and Applications Sessional	Sessional	3.00	1.50
AE 214	Electronics-I Sessional	Sessional	1.50	0.75
LANG 202	Communicative English-II	Sessional	3.00	1.50
		Subtotal (Sessional)	**7.50**	**3.75**
Total = Contact hours: 22.50; Credits: 18.75				

LEVEL 2, TERM-I (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits
AE 213	Electronics-I	Theory	3.00	3.00
AEAV 211	Electrical Circuit Analysis- II	Theory	3.00	3.00
AE 205	Numerical Analysis and Applications	Theory	3.00	3.00
ME 249	Engineering Mechanics (Statics and Dynamics)	Theory	4.00	4.00
MATH 201	Vector Analysis, Laplace Transform and Coordinate Geometry	Theory	3.00	3.00
GEE 201	Fundamentals of Economics	Theory	2.00	2.00
		Subtotal (Theory)	**18.00**	**18.00**
AEAV 212	Electrical Circuit Analysis- II Sessional	Sessional	1.50	0.75
AE 206	Numerical Analysis and Applications Sessional	Sessional	3.00	1.50
AE 214	Electronics-I Sessional	Sessional	1.50	0.75
LANG 202	Communicative English-II	Sessional	3.00	1.50
		Subtotal (Sessional)	**9.00**	**4.50**
Total = Contact hours: 27.00; Credits: 22.50				

LEVEL 2, TERM-II (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits
AE 203	Fundamentals of Fluid Mechanics	Theory	3.00	3.00
AEAS 205	Mechanics of Solids	Theory	3.00	3.00
AE 207	Thermodynamics	Theory	3.00	3.00
AEAS 225	Aircraft Systems	Theory	3.00	3.00
GELM 275	Leadership and Management	Theory	2.00	2.00
MATH 221	Complex Variable and Fourier Analysis	Theory	3.00	3.00
		Subtotal (Theory)	**17.00**	**17.00**
AEAS 204	Fundamentals of Fluid Mechanics Sessional	Sessional	1.50	0.75
AEAS 206	Mechanics of Solids Sessional	Sessional	3.00	1.50
AE 208	Thermodynamics Sessional	Sessional	1.50	0.75
AE 210	Aeronautical Engineering Drawing-II	Sessional	3.00	1.50
		Subtotal (Sessional)	**9.00**	**4.50**
				Total = Contact hours: 26.00; Credits: 21.50

LEVEL 2, TERM-II (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits
AEAV 223	Electronics-II	Theory	3.00	3.00
AEAV 217	Aircraft Electrical System	Theory	3.00	3.00
AE 203	Fundamentals of Fluid Mechanics	Theory	3.00	3.00
AE 207	Thermodynamics	Theory	3.00	3.00
GELM 275	Leadership and Management	Theory	2.00	2.00
MATH 221	Complex Variable and Fourier Analysis	Theory	3.00	3.00
		Subtotal (Theory)	**17.00**	**17.00**
AEAV 224	Electronics-II Sessional	Sessional	1.50	0.75
AEAV 218	Aircraft Electrical System Sessional	Sessional	1.50	0.75
AE 208	Thermodynamics Sessional	Sessional	1.50	0.75
AE 210	Aeronautical Engineering Drawing-II	Sessional	3.00	1.50
		Subtotal (Sessional)	**7.50**	**3.75**
				Total = Contact hours: 24.50; Credits hours: 20.75

LEVEL 3, TERM-I (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits
AEAS 301	Heat Transfer	Theory	3.00	3.00
AEAS 331	Material Science & Aerospace Materials	Theory	3.00	3.00
AE 335	Applied Aerodynamics	Theory	3.00	3.00
AE 337	Aerospace Propulsion	Theory	3.00	3.00
AE/AEAS 3XX	Elective I	Theory	3.00	3.00
GEEM 339	Engineering Ethics and Moral Philosophy	Theory	2.00	2.00
	Subtotal (Theory)		**17.00**	**17.00**
AE 336	Applied Aerodynamics Sessional	Sessional	1.50	0.75
AE 338	Aerospace Propulsion Sessional	Sessional	1.50	0.75
AEAS 302	Heat Transfer Sessional	Sessional	1.50	0.75
AEAS 332	Material Science & Aerospace Materials Sessional	Sessional	1.50	0.75
AE 350	Probability and Statistics for Aeronautical Engineering	Sessional	4.00	2.00
Subtotal (Sessional)			**10.00**	**5.00**
Total = Contact hours: 27.00; Credits: 22.00				

LEVEL – 3, TERM – I (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits
AEAV 301	Digital Systems	Theory	3.00	3.00
AEAV 303	Signals and Systems	Theory	3.00	3.00
AE 335	Applied Aerodynamics	Theory	3.00	3.00
AE 337	Aerospace Propulsion	Theory	3.00	3.00
AE/AEAV 3XX	Elective I	Theory	3.00	3.00
GEEM 339	Engineering Ethics and Moral Philosophy	Theory	2.00	2.00
Subtotal (Theory)			**17.00**	**17.00**
AEAV 302	Digital Systems Sessional	Sessional	3.00	1.50
AE 338	Aerospace Propulsion Sessional	Sessional	1.50	0.75
AE 336	Applied Aerodynamics Sessional	Sessional	1.50	0.75
AE 350	Probability and Statistics for Aeronautical Engineering	Sessional	4.00	2.00
Subtotal (Sessional)			**10.00**	**5.00**
Total = Contact hours: 27.00; Credits hours: 22.00				

Note: List of AE/AEAS/AEAV 3XX is given in sections 4.11, 4.12 & 4.13

LEVEL 3, TERM-II (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits
AE 329	Measurement and Aircraft Instruments	Theory	3.00	3.00
AEAS 317	Mechanics of Structures, Structural Vibration and Aero Elasticity	Theory	4.00	4.00
AEAS 319	Machine Design	Theory	3.00	3.00
AE/AEAS 3XX	Elective II	Theory	3.00	3.00
AEAS 325	Computational Fluid Dynamics	Theory	3.00	3.00
		Subtotal (Theory)	**16.00**	**16.00**
AE 300	Industrial Training	Sessional	8 Weeks	1.00
AE 330	Measurement and Aircraft Instruments Sessional	Sessional	1.50	0.75
AEAS 326	Computational Fluid Dynamics Sessional	Sessional	1.50	0.75
GERM 350	Fundamentals of Research Methodology	Sessional	2.00	1.00
AEAS 320	Machine Design Sessional	Sessional	1.50	0.75
		Subtotal (Sessional)	**6.50hr+ 8weeks**	**4.25**
Total = Contact hours: 22.50+8weeks; Credits: 20.25				

LEVEL –3, TERM – II (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits
AEAV 305	Communication Engineering	Theory	3.00	3.00
AEAV 307	Electro-Magnetic Field Theory	Theory	3.00	3.00
AEAV 313	Digital Signal Processing	Theory	3.00	3.00
AE/AEAV 3XX	Elective II	Theory	3.00	3.00
AE 329	Measurement and Aircraft Instruments	Theory	3.00	3.00
		Subtotal (Theory)	**15.00**	**15.00**
AE 300	Industrial Training	Sessional	8 weeks	1.00
AEAV 306	Communication Engineering Sessional	Sessional	1.50	0.75
AEAV 314	Digital Signal Processing Sessional	Sessional	1.50	0.75
AE 330	Measurement and Aircraft Instruments Sessional	Sessional	1.50	0.75
GERM 350	Fundamentals of Research Methodology	Sessional	2.00	1.00
		Subtotal (Sessional)	**6.50hr+ 8 weeks**	**4.25**
Total = Contact hours: 21.50 +8 weeks; Credit hours: 19.25				

Note: List of AE/AEAS/AEAV 3XX is given in sections 4.11, 4.12 & 4.13

LEVEL 4, TERM-I (Aerospace)

Course No	Course Name	Type of Course	Contact hours	Credits
AEAS 405	Aerospace Vehicle Design	Theory	3.00	3.00
AE 411	Control Systems Engineering	Theory	3.00	3.00
AE 447	Space Engineering	Theory	3.00	3.00
GESL 409	Environment Sustainability and Law	Theory	2.00	2.00
AE/AEAS 4XX	Elective III	Theory	3.00	3.00
		Subtotal (Theory)	**14.00**	**14.00**
AE 400	Final Year Design and Research Project	Sessional	6.00	3.00
AE 412	Control Systems Engineering Sessional	Sessional	1.50	0.75
AEAS 406	Aerospace Vehicle Design Sessional	Sessional	1.50	0.75
		Subtotal (Sessional)	**9.00**	**4.50**
				Total = Contact hours :23.00; Credit hours: 18.50

LEVEL 4, TERM-I (Avionics)

Course No	Course Name	Type of Course	Contact hours	Credits
AEAV 401	Microwave Engineering	Theory	3.00	3.00
AE 411	Control Systems Engineering	Theory	3.00	3.00
AE 447	Space Engineering	Theory	3.00	3.00
GESL 409	Environment Sustainability and Law	Theory	2.00	2.00
AE/AEAV 4XX	Elective III	Theory	3.00	3.00
		Subtotal (Theory)	**14.00**	**14.00**
AE 400	Final Year Design and Research Project	Sessional	6.00	3.00
AE 412	Control Systems Engineering Sessional	Sessional	1.50	0.75
AEAV 402	Microwave Engineering Sessional	Sessional	1.50	0.75
		Subtotal (Sessional)	**9.00**	**4.50**
				Total = Contact hours :23.00; Credit hours: 18.50

Note: List of AE/AEAS/AEAV 4XX are given in sections 4.11, 4.12 & 4.13

LEVEL 4, TERM-II (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits
AEAS 407	Turbo Machinery	Theory	3.00	3.00
AEAS 413	High Speed Aerodynamics	Theory	3.00	3.00
AEAS 439	Rotor-dynamics and Aircraft Performance	Theory	3.00	3.00
GEPM 469	Project Management and Finance	Theory	2.00	2.00
AE/AEAS 4XX	Elective IV	Theory	3.00	3.00
		Subtotal (Theory)	**14.00**	**14.00**
AE 400	Final Year Design and Research Project	Sessional	6.00	3.00
AEAS 408	Turbo Machinery Sessional	Sessional	1.50	0.75
AEAS 414	High Speed Aerodynamics Sessional	Sessional	1.50	0.75
		Subtotal (Sessional)	**9.00**	**4.50**
				Total = Contact hours: 23.00; Credits: 18.50

LEVEL – 4, TERM – II (Avionics)

Course No	Course Name	Type of Course	Contact hours	Credits
AEAV 407	Radar Engineering	Theory	3.00	3.00
AEAV 443	Aircraft Communication and Navigation	Theory	4.00	4.00
GEPM 469	Project Management and Finance	Theory	2.00	2.00
AE/AEAV 4XX	Elective IV	Theory	3.00	3.00
		Subtotal (Theory)	**12.00**	**12.00**
AE 400	Final Year Design and Research Project	Sessional	6.00	3.00
AEAV 408	Radar Engineering Sessional	Sessional	1.50	0.75
AEAV 444	Aircraft Communication and Navigation Sessional	Sessional	1.50	0.75
		Subtotal (Sessional)	**9.00**	**4.50**
				Total = Contact hours: 21.00; Credit: 16.50

Note: List of AE/AEAS/AEAV 4XX are given in sections 4.11, 4.12 & 4.13

4.5 Core Courses offered in both Aerospace and Avionics Discipline

SL No.	Course Code	Course Name
1.	AE 101	Introduction to Aeronautical Engineering
2.	AE 110	Aeronautical Engineering Drawing-I
3.	AE 205	Numerical Analysis and Applications
4.	AE 206	Numerical Analysis and Applications Sessional
5.	AE 213	Electronics-I
6.	AE 214	Electronics-I Sessional
7.	AE 203	Fundamentals of Fluid Mechanics
8.	AE 207	Thermodynamics
9.	AE 208	Thermodynamics Sessional
10.	AE 210	Aeronautical Engineering Drawing-II
11.	AE 335	Applied Aerodynamics
12.	AE 337	Aerospace Propulsion
13.	AE 336	Applied Aerodynamics Sessional
14.	AE 338	Aerospace Propulsion Sessional
15.	AE 350	Probability and Statistics for Aeronautical Engineering
16.	AE 329	Measurement and Aircraft Instruments
17.	AE 330	Measurement and Aircraft Instruments Sessional
18.	AE 300	Industrial Training
19.	AE 400	Final Year Design and Research Project
20.	AE 411	Control Systems Engineering
21.	AE 412	Control Systems Engineering Sessional
22.	AE 447	Space Engineering

4.6 Core Courses offered in Aerospace Discipline

SL No.	Course Code	Course Name
1.	AEAS 204	Fundamentals of Fluid Mechanics Sessional
2.	AEAS 205	Mechanics of Solids
3.	AEAS 206	Mechanics of Solids Sessional
4.	AEAS 225	Aircraft Systems
5.	AEAS 301	Heat Transfer
6.	AEAS 302	Heat Transfer Sessional
7.	AEAS 331	Material Science & Aerospace Materials
8.	AEAS 332	Material Science & Aerospace Materials Sessional
9.	AEAS 317	Mechanics of Structures, Structural Vibration and Aero Elasticity
10.	AEAS 319	Machine Design
11.	AEAS 320	Machine Design Sessional
12.	AEAS 325	Computational Fluid Dynamics
13.	AEAS 326	Computational Fluid Dynamics Sessional
14.	AEAS 405	Aerospace Vehicle Design
15.	AEAS 406	Aerospace Vehicle Design Sessional
16.	AEAS 407	Turbo Machinery
17.	AEAS 408	Turbo Machinery Sessional
18.	AEAS 413	High Speed Aerodynamics
19.	AEAS 414	High Speed Aerodynamics Sessional
20.	AEAS 439	Rotor-dynamics and Aircraft Performance

4.7 Core Courses offered in Avionics Discipline

SL No.	Course Code	Course Name
1.	AEAV 211	Electrical Circuit Analysis- II
2.	AEAV 212	Electrical Circuit Analysis- II Sessional
3.	AEAV 223	Electronics-II
4.	AEAV 224	Electronics-II Sessional
5.	AEAV 217	Aircraft Electrical System
6.	AEAV 218	Aircraft Electrical System Sessional
7.	AEAV 301	Digital Systems
8.	AEAV 302	Digital Systems Sessional
9.	AEAV 303	Signals and Systems
10.	AEAV 305	Communication Engineering
11.	AEAV 306	Communication Engineering Sessional
12.	AEAV 307	Electro-Magnetic Field Theory
13.	AEAV 313	Digital Signal Processing
14.	AEAV 314	Digital Signal Processing Sessional
15.	AEAV 401	Microwave Engineering
16.	AEAV 402	Microwave Engineering Sessional
17.	AEAV 407	Radar Engineering
18.	AEAV 408	Radar Engineering Sessional
19.	AEAV 443	Aircraft Communication and Navigation
20.	AEAV 444	Aircraft Communication and Navigation Sessional

4.8 Basic Science and Math Courses offered for Aerospace and Avionics Discipline

SL No.	Course Code	Course Name
1.	PHY 117	Waves and Oscillations, Optics and Structures of Matter
2.	PHY 119	Electricity and Magnetism, Thermal Physics and Mechanics
3.	PHY 120	Physics Sessional
4.	CHEM 101	Fundamentals of Chemistry
5.	CHEM 102	Chemistry Sessional
6.	MATH 101	Differential and Integral Calculus
7.	MATH 103	Differential Equations and Matrix
8.	MATH 201	Vector Analysis, Laplace Transform and Co-ordinate Geometry
9.	MATH 221	Complex Variable and Fourier Analysis

4.9 Communicative Language and General Education Courses offered for Aerospace and Avionics Discipline

SL No.	Course Code	Course Name
1.	LANG 102	Communicative English-I
2.	LANG 202	Communicative English-II
3.	GEBS 101	Bangladesh Studies
4.	GEA 101	Principles of Accounting
5.	GES 101	Fundamentals of Sociology
6.	GEE 201	Fundamentals of Economics
7.	GELM 275	Leadership and Management
8.	GEEM 339	Engineering Ethics and Moral Philosophy
9.	GERM 350	Fundamentals of Research Methodology
10.	GESL 409	Environment Sustainability and Law
11.	GEPM 469	Project Management and Finance

4.10 Interdisciplinary Courses offered for Aerospace and Avionics Discipline

SL No.	Course Code	Course Name
1.	EECE 161	Electrical Circuit Analysis-I
2.	EECE 162	Electrical Circuit Analysis-I Sessional
3.	SHOP 108	Workshop Technology Sessional –I
4.	SHOP 112	Workshop Technology Sessional –II
5.	CSE 173	Computer Programming and Application
6.	CSE 174	Computer Programming and Application Sessional
7.	ME 249	Engineering Mechanics (Statics and Dynamics)

4.11 Elective Courses for Aerospace and Avionics Discipline

SL No.	Course Code	Course Name
1.	AE 315	Aircraft Stability and Control
2.	AE 419	Maintenance Management and Repair of Aircraft
3.	AE 421	Aviation Safety
4.	AE 423	Aerospace Management
5.	AE 431	Weapons Engineering
6.	AE 445	Advanced Computational Fluid Dynamics
7.	AE 449	Advanced Space Engineering
8.	AE 455	Human Performance and Limitations
9.	AE 457	Airworthiness Legislations
10.	AE 459	Entrepreneurship Development
11.	AE 499	Quadrotor Dynamics

4.12 Elective Courses for Aerospace Discipline

SL No.	Course Code	Course Name
1.	AEAS 307	Aircraft Loading and Structure Analysis
2.	AEAS 427	Noise Control and Vibration
3.	AEAS 429	Rotorcraft Performance
4.	AEAS 433	Computational Structural Analysis
5.	AEAS 435	Aircraft Structural Design
6.	AEAS 443	Pressurization and Air Conditioning Systems
7.	AEAS 451	Avionics Technology
8.	AEAS 461	Advanced Materials Processing Technologies
9.	AEAS 463	Fluid Power and Control
10.	AEAS 465	Composite Materials

4.13 Elective Courses for Avionics Discipline

SL No.	Course Code	Course Name
1.	AEAV 309	Aircraft Avionics Systems
2.	AEAV 403	Electric and Magnetic Properties of Materials
3.	AEAV 409	Microprocessor and Interfacing
4.	AEAV 413	Mobile Cellular Communications
5.	AEAV 415	Satellite Communications
6.	AEAV 417	Optoelectronics
7.	AEAV 419	Electronics Warfare
8.	AEAV 421	Optical Fiber Communication
9.	AEAV 425	Fundamentals of Computational Fluid Dynamics
10.	AEAV 427	VLSI Circuits and Design
11.	AEAV 435	Computer Networks

4.14 Equivalence of Courses

Syllabus 2020		Syllabus 2024	
Course Code	**Course Name**	**Course Code**	**Course Name**
PHY 101	Waves and Oscillations, Optics and Modern Physics (3.00)	PHY 117	Waves and Oscillations, Optics and Structures of Matter (3.00)
AEAS 103	Fundamentals of Aeronautical Engineering (3.00)	AE 101	Introduction to Aeronautical Engineering (3.00)
AEAS 110	Aeronautical Engineering Drawing-I (1.50)	AE 110	Aeronautical Engineering Drawing-I (1.50)
PHY 111	Electricity and Magnetism, Thermal Physics and Mechanics (3.00)	PHY 119	Electricity and Magnetism, Thermal Physics and Mechanics (3.00)
PHY 102	Physics Sessional (1.50)	PHY 120	Physics Sessional (1.50)
AEAV 205	Numerical Analysis and Applications (3.00)	AE 205	Numerical Analysis and Applications (3.00)
AEAV 206	Numerical Analysis and Applications Sessional (1.50)	AE 206	Numerical Analysis and Applications Sessional (1.50)
AEAV 226	Numerical Analysis and Applications Sessional (0.75)		
AEAV 201	Electrical Circuit Analysis- II (3.00)	AEAV 211	Electrical Circuit Analysis- II (3.00)
AEAV 202	Electrical Circuit Analysis- II Sessional (1.50)	AEAV 212	Electrical Circuit Analysis- II Sessional (0.75)
AEAV 203	Electronics-I (3.00)	AE 213	Electronics-I (3.00)
AEAV 204	Electronics-I Sessional (0.75)	AE 214	Electronics-I Sessional (0.75)
AEAS 203	Fundamentals of Fluid Mechanics (3.00)	AE 203	Fundamentals of Fluid Mechanics (3.00)

Syllabus 2020		Syllabus 2024	
Course Code	**Course Name**	**Course Code**	**Course Name**
AEAS 207	Thermodynamics (3.00)	AE 207	Thermodynamics (3.00)
AEAS 208	Thermodynamics Sessional (0.75)	AE 208	Thermodynamics Sessional (0.75)
AEAS 210	Aeronautical Engineering Drawing-II (1.50)	AE 210	Aeronautical Engineering Drawing-II (1.50)
AEAS 215	Aircraft Aerospace Systems (3.00)	AEAS 225	Aircraft Systems (3.00)
AEAV 215	Electronics-II (3.00)	AEAV 223	Electronics-II (3.00)
AEAV 216	Electronics-II Sessional (1.50)	AEAV 224	Electronics-II Sessional (0.75)
MATH 217	Complex Variable, Fourier Analysis and Statistics (4.00)	MATH 221	Complex Variable and Fourier Analysis (3.00)
AEAS 335	Applied Aerodynamics (3.00)	AE 335	Applied Aerodynamics (3.00)
AEAS 336	Applied Aerodynamics Sessional (0.75)	AE 336	Applied Aerodynamics Sessional (0.75)
AEAS 337	Aerospace Propulsion (3.00)	AE 337	Aerospace Propulsion (3.00)
AEAS 338	Aerospace Propulsion Sessional (0.75)	AE 338	Aerospace Propulsion Sessional (0.75)
AEAS 322	Heat Transfer Sessional (1.50)	AEAS 302	Heat Transfer Sessional (0.75)
AEAV 324	Digital Signal Processing Sessional (0.75)	AEAV 314	Digital Signal Processing Sessional (0.75)
AEAV 329	Measurement and Aircraft Instruments (3.00)	AE 329	Measurement and Aircraft Instruments (3.00)

Syllabus 2020		Syllabus 2024	
Course Code	**Course Name**	**Course Code**	**Course Name**
AEAV 330	Measurement and Aircraft Instruments Sessional (0.75)	AE 330	Measurement and Aircraft Instruments Sessional (0.75)
GERM 352	Fundamentals of Research Methodology (2.00)	GERM 350	Fundamentals of Research Methodology (1.00)
AEAS 437	Aerospace Vehicle Design (3.00)	AEAS 405	Aerospace Vehicle Design (3.00)
AEAS 438	Aerospace Vehicle Design Sessional (1.50)	AEAS 406	Aerospace Vehicle Design Sessional (0.75)
AEAS 447	Space Engineering (3.00)	AE 447	Space Engineering (3.00)
AEAS 400	Final Year Design and Research Project (6.00)	AE 400	Final Year Design and Research Project (6.00)
AEAV 400	Final Year Design and Research Project (6.00)		
AEAV 411	Control Systems Engineering (3.00)	AE 411	Control Systems Engineering (3.00)
AEAV 412	Control Systems Engineering Sessional (0.75)	AE 412	Control Systems Engineering Sessional (0.75)
AEAV 442	Microwave Engineering Sessional (0.75)	AEAV 402	Microwave Engineering Sessional (0.75)
AEAS 315	Aircraft Stability and Control (3.00)	AE 315	Aircraft Stability and Control (3.00)
AEAS 419	Maintenance Management and Repair of Aircraft (3.00)	AE 419	Maintenance Management and Repair of Aircraft (3.00)
AEAS 421	Aviation Safety (3.00)	AE 421	Aviation Safety (3.00)

Syllabus 2020		Syllabus 2024	
Course Code	**Course Name**	**Course Code**	**Course Name**
AEAS 423	Aerospace Management (3.00)	AE 423	Aerospace Management (3.00)
AEAS 431	Weapons Engineering (3.00)	AE 431	Weapons Engineering (3.00)
AEAS 449	Space Engineering-II (3.00)	AE 449	Advanced Space Engineering (3.00)
AEAS 455	Human Performance and Limitations (3.00)	AE 455	Human Performance and Limitations (3.00)
AEAS 457	Airworthiness Legislations (3.00)	AE 457	Airworthiness Legislations (3.00)
AEAS 459	Entrepreneurship Development (3.00)	AE 459	Entrepreneurship Development (3.00)
AEAV 451	Avionics Technology (3.00)	AEAS 451	Avionics Technology (3.00)

CHAPTER 5

DETAILED OUTLINE OF UNDERGRADUATE COURSES OFFERED BY AE DEPARTMENT

5.1 Core Courses Offered in Both Aerospace and Avionics Discipline

COURSE INFORMATION			
Course Code	: AE 101	Contact Hours	: 3.00
Course Title	: Introduction to Aeronautical Engineering	Credit Hours	: 1.50

PRE-REQUISITE

None.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course offers an introductory exploration of aircraft components, aerodynamics, airfoil characteristics, and flight mechanics, including takeoff, cruise, and landing maneuvers. Students will learn about aircraft structure, performance parameters, cockpit instrumentation, and navigation systems, equipping them with a comprehensive understanding of the engineering principles that underpin aeronautical innovation.

OBJECTIVE

1. To grasp concepts of aircraft classifications and components.
2. To understand aerodynamic principles.
3. To explain airfoil dynamics.
4. To describe flight mechanics and navigation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the classification of aircraft, and functionality of aircraft structures, and various aircraft components, including airframes, engines, instruments, and avionics systems.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **describe** principles of aerodynamics, including Bernoulli's theorem, to analyze incompressible flows and their effects on aeronautical engineering.	PO1	C2			K3	T, F, ASG.

CO3	Be able to **interpret** airfoil characteristics, including lift, drag, and pitching moment, and the phenomena of stall and its impact on flight.	PO1	C2			K3	T, F, Mid Term Exam.
CO4	Be able to **explain** aircraft performance parameters and maneuvers, gaining proficiency in flight mechanics and navigation system fundamentals.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to Aeronautical Engineering: Classification of aircraft, Different parts of aircraft (airframe, engine, avionics systems, communication systems, instrumentation and navigation systems) and their function.

Introduction to Aerodynamics: Standard atmosphere, Dimensional analysis, Bernoulli's theorem for incompressible flows and its applications in aeronautical engineering. Local and free stream characteristics.

Airfoil Classification and Characteristics: Pressure distribution over airfoil and its variation with angle of attack. Center of pressure and its movement, Forces and moments acting on airfoil, center of gravity, center of pressure and aerodynamic center concepts. Characteristics of Lift, drag and pitching moment curves. Stall and its effects.

Flight Mechanics: Aircraft engines, aircraft maneuvers- Take off, climb, cruise, glide, descend and landing. Aircraft performance parameters such as endurance, aircraft ceiling and range. Aircraft control surfaces and High lift devices.

Instrumentation: Introduction to the cockpit and its instruments; Basic 6 instruments and their functions.

Navigation systems: Fundamentals of aircraft navigation systems.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Cantered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to Aerospace Engineering.	
Class-2	Aerodynamics, Astronautics.	
Class-3	Types of aircraft	
Week 2		
Class-4	Basic forces acting on an aircraft.	
Class-5	Lift and drag, Flow over airfoils.	
Class-6	Mechanics of flight, analyze how airfoil generate lift.	
Week 3		
Class-7	Familiarization to high lifting devices.	CT2/ MID TERM
Class-8	Distinguish between different types of flaps.	
Class-9	Analyze the lift generation of different types of flaps.	
Week 4		
Class-10	Learn about parameters: endurance, aircraft ceiling and range.	
Class-11	Learn climb, descent and glide, take off, cruise, landing.	
Class-12	Analyze different phases of flight.	
Week 5		
Class-13	Aircraft basic configurations.	
Class-14	Aerospace structures – familiarization to construction of wing, fuselage, horizontal stabilizer, vertical stabilizer.	
Class-15	Aerospace structures – familiarization to construction of wing, fuselage,	
Week 6		
Class-16	Structures of fuselage and empennage.	
Class-17	Basic control surfaces.	
Class-18	Analyze the movement of aircraft.	

Week 7		
Class-19	Airfoil Nomenclature.	
Class-20	Types of airfoils.	CT2/ MID TERM
Class-21	Lift and stall angle	
Week 8		
Class-22	Drag	
Class-23	Coefficient of pressure	
Class-24	Lift and drag coefficient	
Week 9		
Class-25	Pressure distribution over airfoil and its variation with angle of attack.	
Class-26	Center of pressure and its movement	
Class-27	Forces and moments acting on airfoil.	
Week 10		
Class-28	Forces and moments acting on airfoil,	CT3
Class-29	Center of gravity	
Class-30	Center of pressure and aerodynamic center concepts.	
Week 11		
Class-31	Aircraft performance parameters	
Class-32	Endurance, aircraft ceiling and range	
Class-33	Aircraft control surfaces and High lift devices.	
Week 12		
Class-34	Introduction to Avionics Engineering.	
Class-35	Instrumentation, Introduction to the cockpit and its instruments.	
Class-36	Introduction to Basic 6 instruments and their functions.	
Week 13		
Class-37	Fundamentals of aircraft navigation system	
Class-38	Continue	
Class-39	Stages of flight, Heading, drift angle, Math.	
Week 14		
Class-40	Radio Altimeter	
Class-41	GPS	
Class-42	Velocity Triangle	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introduction to Flight -John D Anderson Jr; Tata McGraw-Hill.
2. Avionics Navigation Systems, 2nd Ed – Myron Kayton
3. Aerodynamics – Clancy
4. Flight without Formulae – Kermode

COURSE INFORMATION			
Course Code	: AE 110	Contact Hours	: 3.00
Course Title	: Aeronautical Engineering Drawing- I	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to teach the students about the basic concepts of different categories of engineering drawings and give the students some practical ideas of engineering drawing in the field of aviation.

OBJECTIVE

1. To know about different types of lines & use of different types of pencils in an engineering drawing
2. To know how to represent dimensions, letters & numbers in drawing sheet
3. To know about the projection of points, straight lines, solids etc.
4. To know about the development of different types of surfaces.
5. To learn about various engineering drawing methods.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the use of appropriate standards and conventions in drawing sheet preparation, layout, and dimensioning.	PO1	P1			K3	ASG, Q, T
CO2	Be able to **generate** orthographic, auxiliary, sectional and isometric views from practical objects.	PO3	P2			K5	ASG, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Introduction, Familiarization with drawing tools and types of projections
2.	Drawing orthographic views of simple blocks
3.	Drawing orthographic views of objects with round features
4.	Drawing orthographic views of objects with fillets, rounds
5.	Drawing sectional views
6.	Drawing auxiliary views
7.	Drawing isometric views of simple blocks
8.	Drawing an isometric circle in the correct dimensions

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction, Familiarization with drawing tools and types of projections
Week 2	Drawing orthographic views of simple blocks
Week 3	Drawing orthographic views of objects with round features.
Week 4	Drawing orthographic views of objects with fillets, rounds
Week 5	Drawing simple sectional views
Week 7	Drawing auxiliary views
Week 8	Drawing complex auxiliary views
Week 9	Drawing isometric views of simple blocks
Week 10	Drawing isometric views of blocks with round features
Week 11	Drawing isometric circles
Week 12	Lab Quiz
Week 13	Lab Test
Week 14	Viva

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><td colspan="2">Components</td><td>Grading</td><td>CO</td><td>Bloom’s Taxonomy</td></tr>
<tr><td rowspan="4">Continuous Assessment (60%)</td><td rowspan="2">Daily Assessment</td><td rowspan="2">40%</td><td>CO 1</td><td>P1</td></tr>
<tr><td>CO 2</td><td>P2</td></tr>
<tr><td rowspan="2">Lab Tests</td><td rowspan="2">35%</td><td>CO 1</td><td>P1</td></tr>
<tr><td>CO 2</td><td>P2</td></tr>
<tr><td colspan="2" rowspan="2">Lab Quiz</td><td rowspan="2">25%</td><td>CO 1</td><td>P1</td></tr>
<tr><td>CO 2</td><td>P2</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Mechanical Engineering Drawing- Dr. Md. Quamrul Islam, Dr. Amalesh Chandra Mandal
2. Engineering Drawing- N. D. Bhat.

COURSE INFORMATION			
Course Code Course Title	: AE 205 : Numerical Analysis and Applications	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code & Title:

1. Math-101 : Differential and Integral Calculus

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course will develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations and to calculate derivatives and integrals. It will also help to understand the elements of error analysis for numerical methods.

OBJECTIVE

1. To analyze appropriate numerical methods to solve algebraic and transcendental equations
2. To develop appropriate numerical methods to solve a differential equation and to evaluate a derivative at a value
3. To learn about numerical methods to solve a linear system of equations so that students are able to perform an error analysis for various numerical methods
4. To prepare for various numerical root finding methods and to derive appropriate numerical methods to calculate a definite integral
5. To compose various numerical methods in a modern computer language

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the concept of error and uncertainty in numerical computations and **apply** the knowledge to find out the root of the equation.	PO1	C3			K4	T, F, ASG.
CO2	Be able to **apply** relevant numerical techniques to determine and **analyze** the solution of linear and non-linear algebraic equations and fit the curve in the proper manner.	PO2	C4			K4	T, F, Mid Term ASG.

CO3	Be able to **apply** numerical differentiation and integration techniques to solve associated mathematical problems	PO2	C3			K4	T, F, Mid Term Exam.
CO4	Be able to **solve** ordinary and partial differential equations numerically and **compare** with analytical solution	PO2	C4			K4	T, F, Mid Term Exam.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Roots of polynomials and transcendental equations; Determinants and matrices; Eigen values and Eigen vectors; Solution of simultaneous linear equations; Solution of linear and non-linear algebraic equations; Solution of ordinary differential equations; Solution of partial differential equation; Introduction to the use of scalar, vector and matrix variables; The manipulation of matrix variables in arithmetic functions.

Interpolation methods; Numerical differentiation and integration; Solving equations by finite differences; Graph plotting and curve fitting.

Iterative solutions for non-linear problems; Use fundamental programming concepts to solve mathematical problems. Schemes to solve ordinary and partial differential equations.

Engineering analysis by using graphical tools in MATLAB.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Errors in numerical calculation**	
Class 1	Errors and their computations	
Class 2	A general Error formula	
Class 3	Error in a series of approximation	
Week 2	**Roots of polynomials and transcendental equations**	CT1
Class 4	Bisection	
Class 5	False position and Iteration method	
Class 6	Newton Raphson	
Week 3	**Interpolation methods (Finite difference interpolation method)**	
Class 7	Forward difference	
Class 8	Continue	
Class 9	Backward difference	
Week 4	**Interpolation methods (Finite difference interpolation method)**	
Class 10	Central difference	
Class 11	Continue	
Class 12	Symbolic relations and Separation of symbols	
Week 5	**Interpolation methods (Central & Divided difference interpolation method)**	CT2/ MID TERM
Class 13	Gauss Central Difference Formula	
Class 14	Continue	
Class 15	Sterling's Formula and Bessel's Formula	
Week 6	**Interpolation methods (Central & Divided difference interpolation method)**	
Class 16	Continue	
Class 17	Newton's General Interpolation Formula	
Class 18	Interpolation by Iteration	
Week 7	**Graph plotting and curve fitting**	
Class 19	Fitting a Straight Line	
Class 20	Non linear Curve Fitting	
Class 21	Continue	
Week 8	**Numerical Differentiation**	
Class 22	Errors in Numerical Differentiation	
Class 23	Continue	CT2/ MID TERM
Class 24	General Idea about Numerical Integration Method	
Week 9	**Numerical Integration**	
Class 25	Trapizoidal Rule	
Class 26	Simpsons 1/3 rule	
Class 27	Simpsons 3/8 rule	
Week10	**Numerical solution of ordinary differential equations**	
Class 28	Solution by Taylor series	
Class 29	Pieard's Method and Euler's Method	
Class 30	Runge-Kutta Method	

Week 11	**Numerical solution of partial differential equation**	CT 3
Class 31	Jacobi;s Method	
Class 32	Gauss-Seidal Method	
Class 33	Continue	
Week12	**Numerical solution of linear systems of algebraic equations**	
Class 34	Direct Method	
Class 35	Continue	
Class 36	Continue	
Week 13	**Determinants and matrices**	
Class 37	Transpose Matrix	
Class 38	Inversion Matrix	
Class 39	Continue	
Week 14	**Eigen values and Eigen vectors**	
Class 40	Eigen values of a Symmetric Tridiagonal Matrix	
Class 41	Continue	
Class 42	Review of whole Syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C3
			CO 2	C4
			CO 3	C3
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C4
			CO3	C3
Final Examination (Section A & B)		60%	CO 1	C3
			CO 2	C4
			CO 3	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Numerical Methods–S.Balachandra Rao and C.K.Shantha; Stosius Inc.
2. Numerical Methods for Engineers – Steven C. Chopra, Raymond P. Carale; Tata McGraw-Hill Publishing Company Ltd.
3. Applied Numerical Analysis– Curtis F. Gerald, Patrick O. Wheatley; Addison-Wesley Publishing Company
4. User‘s Guide for Student Edition of MATLAB – Duane Hanselman & Bruce Littlefield, Prentice Hall, NJ, 1997.

COURSE INFORMATION			
Course Code	: AE 206	Contact Hours	: 3.00
Course Title	: Numerical Analysis and Applications Sessional	Credit Hours	: 1.50

PRE-REQUISITE

Course Code & Title:
1. CSE 174: Computer Programming and Application Sessional

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn and apply numerical techniques to analyze mathematical problems by means of coding (MATLAB)

OBJECTIVE

1. To apply the theoretical knowledge of using numerical methods to solve mathematical problems by means of coding
2. To evaluate the accuracy of common numerical methods

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **write** the code for simple programs in MATLAB involving the use of matrices and vectors operations	PO5	P2			K6	T, ASG
CO2	Be able to **solve** simple mathematical problems using built-in and user defined functions in MATLAB	PO5	C4			K6	T, ASG, Q, F
CO3	Be able to **solve** problems by coding using numerical method of solution	PO5	C4			K6	T, ASG, Q, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Introduction to MATLAB
2.	Creating matrix and applying matrix operations
3.	Built-in and User Defined Functions
4.	MATLAB Plotting
5.	Using Statements and Loops
6.	Bracketing Methods of Numerical Analysis
7.	Open Methods of Numerical Analysis
8.	Solving First Order ODE
9.	Solving Higher Order ODE
10.	Application of Finite Difference Method

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction to MATLAB and creating matrix
Week 2	Matrix Operations
Week 3	Built-in and User Defined Functions
Week 4	MATLAB Plotting
Week 5	Using Statements and Loops
Week 6	Bracketing Methods
Week 7	Lab Test-1

Week 8	Open Methods of Numerical Analysis
Week 9	Solving 1st Order ODE
Week 10	Solving Higher Order ODE
Week 11	Finite Difference Method
Week 12	Finite Difference Method
Week 13	Engineering Problem Solving
Week 14	Lab Test-2

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (60%)	Daily Assessment	20%	CO1, CO2, CO3	P2, C4
	Lab test	40%	CO2, CO3	C4
Lab Quiz		40%	CO2, CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Numerical Methods for Engineers by Raymond P. Canale and Steven C. Chapra
2. Numerical Methods Using MATLAB by George Lindfield and John Penny

COURSE INFORMATION			
Course Code	: AE 213	Contact Hours	: 3.00
Course Title	: Electronics-I	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title

1. EECE 161: Electrical Circuit Analysis (DC Circuits)-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This subject is classified under the Applied Technology group and intended to teach the students the concepts, principles and working of basic electronic circuits containing BJT, MOSFET, and JFET. It is targeted to provide a foundation for technology areas like communication systems, and industrial electronics as well as instrumentation, control systems, and electronic circuit design.

OBJECTIVE

1. To provide an introduction to modern electronic circuit design and to introduce students to the concepts and simple principles of active semiconducting devices (diodes, bipolar and FET transistors, and display devices)

2. To discuss their implementation in a number of basic electronic circuits, i.e. amplifiers (single device, differential and op-amp), voltage regulators and power supplies.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the operation of semiconductor diodes, transistors and operational amplifiers in order to design basic circuits	PO1	C2			K3	T, F, ASG
CO2	Be able to **compare** and **analyze** the characteristics of different types of diodes, transistors and operational amplifiers	PO2	C4			K3	T, F, Mid Term Exam

CO3	Be able to **apply** semiconductor diodes, BJT, JFET, MOSFET and operational amplifiers to solve real world problems.	PO2	C3			K4	T, F, ASG
CO4	Be able to **identify, analyze** and **solve** mathematical and practical problems of electronic circuits	PO2	C4			K4	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Semiconductor diode, equivalent circuits; P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode; Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a zener diode, zener shunt regulator, clamping and clipping circuits. Bipolar junction transistor (BJT): BJT characteristics and regions of operation, BJT as an amplifier. Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.

Introduction to Metal-oxide-semiconductor field-effect-transistor (MOSFET), NMOS, PMOS, CMOS and Junction field-effect-transistor (JFET)

Operational amplifiers (Op-Amp): Properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits, effects of finite open loop gain and bandwidth on circuit performance, logic signal operation of Op- Amp, dc imperfections.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	The Bohr Model of Atom, Electrons and Shells, Valence Electrons, Insulators, Conductors, Semiconductors	
Class-2	Construction of semiconductors, current in semiconductors, electron and hole current	
Class-3	Continued	
Week 2		
Class-4	Intrinsic and Extrinsic materials, p-type and n-type semiconductor, Majority and Minority Carriers	
Class-5	p-n junction, Formation of Depletion Region, Barrier Potential	
Class-6	Energy Diagram of P-N Junction and Depletion Region	
Week 3		CT2/ MID TERM
Class-7	Forward bias and Reverse Bias Diode	
Class-8	Reverse Current and Reverse Breakdown Voltage, V-I Characteristic for Forward Bias and Reverse Bias Diode	
Class-9	Solving Numerical Problems, Temperature Effect on Diode, Ideal vs Practical Diode, DC and AC Resistance of Diode, Diode Equivalent Circuit	
Week 4		
Class-10	Load Line Analysis	
Class-11	Diode in series and parallel circuits and related numerical problems	
Class-12	Half wave and Full wave Rectifier	
Week 5		
Class-13	Clipper and Clapper Circuit	
Class-14	Clipper and Clapper Circuit (Cont.)	
Class-15	Clipper and Clapper Circuit (Cont.)	

Week 6		
Class-16	Construction and operation of Transistor	
Class-17	Common-base Transistor, Transistor Amplifying Action, Common Emitter Configuration	
Class-18	Common Emitter Operation, Limits of Operation, Solving Numerical Problems	
Week 7		CT2/ MID TERM
Class-19	Operating Point of a Transistor, Fixed bias Configuration, Forward Bias of Base-Emitter, Collector-Emitter Loop	
Class-20	Transistor Saturation, Load-line Analysis, Emitter bias Configuration, Base-emitter Loop, Collector-emitter Loop, Saturation Level, Load line Analysis	
Class-21	Collector Feedback Configuration, Emitter follower Configuration	
Week 8		
Class-22	Field effect transistor (FETs), Classification	
Class-23	Construction and operating principle of MOSFETs	
Class-24	Current-Voltage Characteristics of MOSFETs	
Week 9		
Class-25	Current-Voltage Characteristics of MOSFETs (Continued)	
Class-26	ID VS VDS equation derivation	
Class-27	MOSFET Symbol, analysis of electronic circuit to determine RS and RD	
Week 10		CT3
Class-28	Analysis of electronic circuit to determine RS and RD (Continued)	
Class-29	Analysis of electronic circuit to determine RS and RD (Continued)	
Class-30	Maths to determine RD	
Week 11		
Class-31	Maths to determine RD, Current mirror	
Class-32	CMOS construction, operation	
Class-33	Maths related to CMOS	
Week 12		
Class-34	NMOS, PMOS	
Class-35	Small signal operation and Models (hybrid-π, hybrid-T)	
Class-36	Common-source (CS) amplifier (Circuit, Small signal equivalent Circuit, advantage, disadvantage, Comparison)	
Week 13		
Class-37	Common drain (CD) amplifier (Circuit, Small signal equivalent Circuit, advantage, disadvantage, Comparison), Source follower/Buffer	
Class-38	Small signal equivalent circuit of MOSFETs	
Class-39	Derivation of gain, Impedance and mathematical problem	
Week 14		
Class-40	Transistor biasing	
Class-41	Construction and Operation of JFET	
Class-42	Construction and Operation of JFET (Continuation)	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 3	C3
			CO 4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C4
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C4
			CO 3	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Microelectronic Circuits – Adel S. Sedra&Keneth C. Smith; Oxford University Press.
2. A Textbook of Electrical Technology - Volume IV - BL Theraja
3. Electronic Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd.
4. Semi-Conductor Circuit Approximation - Albert P Malvino; Tata McGraw- Hill.
5. Electronic Devices and Circuits – Jacob Millman& Christos C. Halkias; Tata McGraw- Hill.
6. Micro-Electronic Circuit Analysis and Design- Donald A. Neamen; McGraw-Hill

COURSE INFORMATION

Course Code	: AE 214	Contact Hours	: 1.50
Course Title	: Electronics-I Sessional	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Students will be able to see the practical implementation of the circuit and electronic device theories that were taught to them previously. Practical means that the circuits that the students study are made up of actual electronic components. Students will also learn the practical skills required to design and troubleshoot actual electronic circuitry.

OBJECTIVE

1. To prepare and use the appropriate basic laboratory equipment for conducting circuit analysis according to common engineering practice.

2. To identify, demonstrate and measure the various types of electronic circuit with correct practice for valid outcome.

3. To measure, define and describe the characteristics of several passive and active components using standard circuit analysis.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **perform** experiments with the basic electronic components like diode, Bipolar Junction Transistor (BJT), Op-amp, digital and analog measuring equipment etc.	PO1	P2			K6	R, Q, T
CO2	Be able to **analyze** a circuit correctly and compare its theoretical performance to actual performance.	PO2	P3			K3	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Study of diode I-V characteristics.
2.	Study of diode rectifier circuits
3.	Study of npn CB (common base) transistor characteristics.
4.	Study of npn CE (common emitter) transistor characteristics.
5.	Mathematical operations using op-amp adder and subtractor.
6.	Mathematical operations using op-amp integrator circuit.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 3 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 1
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Study of diode I-V characteristics.
Week 2	Study of diode rectifier circuits.
Week 3	Study of npn CB (common base) transistor characteristics.
Week 4	Study of npn CE (common emitter) transistor characteristics
Week 5	Mathematical operations using op-amp adder and subtractor
Week 6	Mathematical operations using op-amp integrator and differentiator circuit
Week 7	Lab Test

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P2
			CO 2	P3
	Lab test	30%	CO 1	P2
			CO 2	P3
	Project and Presentation	20%	CO 1	P2
			CO 2	P3
Lab Quiz		15%	CO 1	P2
			CO 2	P3
Viva		10%	CO 1	P2
			CO 2	P3
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. Microelectronic Circuits – Adel S. Sedra &Keneth C. Smith; Oxford University Press.

2. Electronic Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd. Private Ltd

3. A Textbook of Electrical Technology - Volume IV - BL Theraja

COURSE INFORMATION			
Course Code	: AE 203	Contact Hours	: 3.00
Course Title	: Fundamentals of Fluid Mechanics	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn the concept of a fluid and hence to provide knowledge on the fundamentals of fluid flow physics

OBJECTIVE

1. To introduce the properties of fluid mechanics, hydrostatic pressure, fluid static forces.
2. To be able to determine hydrostatic pressure, center of pressure, forces, stability of immersed or floating bodies.
3. To be able to calculate the flow field for in viscid fluid flow.
4. To apply the Bernoulli equation and continuity equation for flow measurements.
5. To be able to calculate the losses in piping system and use the dimensional analysis.
6. To introduce the Rotordynamic machines (pumps).

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the basic definitions and laws used in the field of fluid mechanics	PO1	C2			K3	T, F, ASG
CO2	Be able to **determine** the pressure and velocity in a fluid using pressure measuring devices	PO1	C3			K4	T, F, ASG
CO3	Be able to **apply** continuity, momentum and energy equations to solve basic fluid flow problems and problems associated with fluid machines	PO2	C3			K4	T, F, ASG

CO4	Be able to **understand** and **apply** the concept of similarity in fluid flows	PO2	C3			K4	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

- Fundamental concept of fluid, Properties of fluid, Fluid statics; manometers, hydrostatic forces on submerged surfaces, buoyancy and stability, Fluids in rigid body motion.
- Fluid kinematics, Lagrangian and Eulerian descriptions of fluid flow, Reynolds transport theorem, Continuity, Momentum, Energy and Bernoulli's equations and their applications.
- Dimensional analysis and similitude, dimensional homogeneity, Experimental testing and modeling.
- Introduction to two dimensional incompressible flows, boundary layer, laminar and turbulent flows, losses in pipes, minor losses in pipe fittings, pressure, velocity and flow measurements.
- Introduction to the rotordynamic machines (pumps).

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Concept of fluid	
Class-2	Properties of fluid	
Class-3	Fluid Statics	
Week 2		
Class-4	Manometers	
Class-5	Mathematical problems of manometer	
Class-6	Buoyancy and stability	

Week 3		
Class-7	Fluids in rigid body motion	
Class-8	Lagrangian descriptions of fluid flow	
Class-9	Eulerian descriptions of fluid flow	
Week 4		
Class-10	Reynolds transport theorem	
Class-11	Continuity equation and its applications	
Class-12	Momentum equation and its applications	
Week 5		CT2/ MID TERM
Class-13	Energy equation and its applications	
Class-14	Bernoulli‘s equations and its applications	
Class-15	Mathematical problems	
Week 6		
Class-16	Dimensional analysis and similitude	
Class-17	Dimensional homogeneity	
Class-18	Mathematical problems	
Week 7		
Class-19	Experimental testing	
Class-20	Experimental modeling	
Class-21	Mathematical problems	
Week 8		
Class-22	Incompressible flow	
Class-23	Boundary layer	CT2/ MID TERM
Class-24	Different boundary layer formation on flat plate.	
Week 9		
Class-25	Laminar boundary layer and its characteristics	
Class-26	Turbulent boundary layer and its characteristics	
Class-27	Losses relating flow types	
Week 10		
Class-28	Different losses in pipes	
Class-29	Flow of fluid in pipes	
Class-30	Minor losses in pipe fittings	
Week 11		
Class-31	Fundamentals of measuring instruments	
Class-32	Density and different types of pressures,	
Class-33	Mathematical problem	
Week 12		
Class-34	Mathematical problem solving of dimensional analysis.	
Class-35	Mathematical problem solving of losses in pipes	CT3
Class-36	Mathematical problem solving of Flow velocity calculation	
Week 13		
Class-37	Mathematical problem solving of Continuity equation.	
Class-38	Mathematical problem solving of Energy equation	
Class-39	Mathematical problem solving of Momentum equation.	
Week 14		
Class-40	Mathematical problem solving of Bernoulli's Equation	
Class-41	Review	
Class-42	Review	

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics of Fluids – Irving H. Shames
2. Fluid Mechanics – Frank M. White
3. Fluid Mechanics – Yunus A. Cengel & John M. Cimbala
4. Fluid Mechanics – E. John Finnemore & Joseph B. Franzini

COURSE INFORMATION			
Course Code	: AE 207	Contact Hours	: 3.00
Course Title	: Thermodynamics	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:
1. PHY 119: Electricity and Magnetism, Thermal Physics and Mechanics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to introduce the fundamental concepts of energy, work and heat, as well as to provide knowledge on the thermodynamic concepts, first and second thermodynamic laws.

OBJECTIVE

1. To develop the basic concepts of Thermodynamics.
2. To describe Thermodynamics Laws.
3. To apply basic of thermodynamics to thermal equipment.
4. To determine the performance of various steam and air thermodynamics cycle

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the basic concepts of Thermodynamics.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** thermodynamic laws to derive the steady flow energy equations	PO1	C3			K3	T, F, ASG.
CO3	Be able to **understand** the concept of pure substance and entropy and **solve** associated problems	PO2	C3			K4	F, Mid Term Exam.
CO4	Be able to **determine** the performance of various steam and air thermodynamics cycle	PO2	C3			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fundamental concepts and first law: Concept of continuum, macroscopic approach, thermodynamic systems; closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics- concept of temperature and heat, internal energy, specific heat capacities, enthalpy - concept of ideal and real gases. First law of thermodynamics - applications to closed and open systems - steady flow processes.

Second law and entropy: Second law of thermodynamics; kelvin planck and clausius statements of second law. Reversibility and irreversibility - carnot theorem, carnot cycle using steam, reversed Carnot cycle, efficiency, COP - thermodynamic temperature scale - clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

Thermodynamic availability: Basics; energy in non- flow processes: expressions for the energy of a closed system – equivalence between mechanical energy forms and energy – flow of energy associated with heat flow – exergy, consumption and entropy generation - exergy in steady flow processes: expressions for exergy in steady flow processes – exergy dissipation and entropy generation.

Properties of pure substance: Properties of pure substances; thermodynamic properties of pure substances in solid, liquid and vapor phases, Use of property tables, phase rule, PVT surfaces, standard Rankine cycle.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week-1		CT1
Class-1	Concept of continuum & macroscopic approach.	
Class-2	Closed, open and isolated system.	
Class-3	Property, state, path and process.	
Week 2		
Class-4	Work, modes of work.	
Class-5	Zeroth law of thermodynamics.	
Class-6	Concept of temperature and heat.	
Week 3		
Class-7	Internal energy and specific heat capacities.	CT2/ MID TERM
Class-8	Enthalpy.	
Class-9	Concept of ideal and real gases.	
Week 4		
Class-10	First law of thermodynamics.	
Class-11	Applications to closed and open systems.	
Class-12	Steady flow processes.	
Week 5		
Class-13	Second law of thermodynamics.	
Class-14	Kelvin planck and clausius statements of second law.	
Class-15	Reversibility and irreversibility.	
Week 6		
Class-16	Carnot theorem.	
Class-17	Carnot cycle using steam.	
Class-18	Reversed Carnot cycle	
Week 7		
Class-19	Efficiency	
Class-20	COP	CT2/ MID TERM
Class-21	Thermodynamic temperature scale - clausius inequality.	
Week-8		
Class-22	Concept of entropy.	
Class-23	Entropy of ideal gas.	
Class-24	Principle of increase of entropy.	
Week 9		
Class-25	Energy in non-flow processes.	
Class-26	Expressions for the energy of a closed system.	
Class-27	Equivalence between mechanical energy forms and exergy.	
Week 10		
Class-28	Consumption and entropy generation.	CT3
Class-29	Expressions for exergy in steady flow processes.	
Class-30	Exergy dissipation and entropy generation.	
Week 11		
Class-31	Thermodynamic properties of pure substances in vapour.	
Class-32	Thermodynamic properties of pure substances in solid	
Class-33	Thermodynamic properties of pure substances in liquid	

Week 12	
Class-34	Use of property tables.
Class-35	Phase rule & PVT surfaces.
Class-36	Standard Rankine cycle.
Week 13	
Class-37	Equations of state for ideal gases and Properties of gases & vapours. Properties of atmospheric air, Non-flow and flow processes.
Class-38	Air standard cycles, Brayton cycle.
Class-39	Otto and Diesel cycles.
Week 14	
Class-40	Refrigeration cycles.
Class-41	Thermodynamic relations and equations of state.
Class-42	Mixtures of gases and vapours; Fuels and combustion.

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
			CO 4	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Thermodynamics – Yunus A. Cengel, Michael A. Boles
2. Fundamentals of Thermodynamics – R E Sonntag, C. Borgnakke, G J. Van Wylen; John Wiley & Sons, Inc, 5th edition, 2000.
3. Thermodynamics - Kenneth Wark, 6th Ed; McGraw-Hill, Singapore, 1999.
4. A Textbook of Thermal Engineering - RS Khurmi, JK Gupta

COURSE INFORMATION			
Course Code	: AE 208	Contact Hours	: 1.50
Course Title	: Thermodynamics Sessional	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to provide hands on exercises related to heat, work, and energy, psychometrics and other thermodynamic parameters.

OBJECTIVE

1. To prove the whether the laws of thermodynamics hold when determining this identity.
2. To calculate the approximate specific heat of unknown metal.
3. To evaluate the relationship between the heat that is transferred and change in temperature
4. To learn Refrigeration and Air Conditioning Unit
5. To be able to calculate calorific value and flash point.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the understanding of thermodynamic properties and application of thermodynamic tools / apparatus.	PO4	P1			K5	R, Q, T
CO2	Be able to **analyze** the concepts of air conditioning and refrigeration systems of aircraft	PO2	C4			K3	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
01	Determination of Flash Point of Liquid Fluid and Study of Sling Psychrometer
02	Study of High-Speed Diesel Engine
03	Study of Viscosity Test of Liquid Substance and Speed Measuring Instrument
04	Study of a Refrigeration and Air Conditioning Unit.
05	Determination of Calorific Value of Gaseous Fuel by Gas Calorimeter.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	05
Preparation of presentation	5
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	7
Final Quiz	1
Total	64

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Determination of Flash Point of Liquid Fluid and Study of Sling Psychrometer
Week 2	Study of High-Speed Diesel Engine
Week 3	Study of Viscosity Test of Liquid Substance and Speed Measuring Instrument
Week 4	Study of a Refrigeration and Air Conditioning Unit.
Week 5	Determination of Calorific Value of Gaseous Fuel by Gas Calorimeter.
Week 6	Lab Test-1
Week 7	Lab Quiz /Presentation on Assigned Problems

ASSESSMENT STRATEGY

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom's Taxonomy</th></tr>
<tr><td rowspan="5">Continuous Assessment (40%)</td><td rowspan="2">Lab participation and Report</td><td rowspan="2">25%</td><td>CO 1</td><td>P1</td></tr>
<tr><td>CO 1</td><td>P1</td></tr>
<tr><td rowspan="2">Report Writing/ Programming</td><td rowspan="2">15%</td><td>CO 2</td><td>C4</td></tr>
<tr><td>CO 1</td><td>P1</td></tr>
<tr><td>Mid Term Evaluation (exam/project/ assignment)</td><td>20%</td><td>CO1, CO2</td><td>P1, C4</td></tr>
<tr><td colspan="2" rowspan="2">Final Evaluation (Exam/project/assignment)</td><td rowspan="2">30%</td><td>CO 1</td><td>P1</td></tr>
<tr><td>CO 2</td><td>C4</td></tr>
<tr><td colspan="2">Viva Voce/ Presentation</td><td>10%</td><td>CO1, CO2</td><td>P1, C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Thermodynamics – Yunus A. Cengel, Michael A. Boles

2. Fundamentals of Thermodynamics – R E Sonntag, C. Borgnakke, G J. Van Wylen; John Wiley & Sons, Inc, 5th edition, 2000.

3. Thermodynamics - Kenneth Wark, 6th Ed; McGraw-Hill, Singapore, 1999.

COURSE INFORMATION

Course Code	: AE 210	Contact Hours	: 3.00
Course Title	: Aeronautical Engineering Drawing-II	Credit Hours	: 1.50

PRE-REQUISITE

Course Code & Title:
1. AE 110: Aeronautical Engineering Drawing-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to teach the students the technique of engineering graphics as a basis of engineering communication and expression of idea and thought.

OBJECTIVE

1. To create orthographic projection auxiliary, sectional views, and apply 3-D pictorials to choose the best view to present the drawings.
2. To able to use the proper and standard technique in lettering, basic geometric constructions, sketching, dimensioning methods.
3. To understand various features, sketch tools and sketch relations used in Solid Works.
4. To describe size, shape and position accurately on an engineering drawing.
5. To apply the knowledge for drawing various components of an RC aircraft and assemble them.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **imitate** the operations in the Computer Aided Design (CAD) software to make engineering drawings of different objects.	PO5	P2			K6	R, Q, T
CO2	Be able to **build** 3-D drawings of various components of an RC aircraft and assemble them.	PO2	P4			K4	R, Q, T
CO3	Be able to **perform** comprehensive skills to construct a precise 3D model of an aircraft from given design specifications.	PO5	P4			K6	Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT	
Exp No	**Exp Name**
1.	Using the Interface
2.	Design Intent, 2D Sketching and Sketch entities
3.	Conversion of sketch entities into 3D objects
4.	Creating airfoil from co-ordinates
5.	Drawing different shapes of 3D wings
6.	3-D Sketching and Reference Planes
7.	Assembly Basics
8.	Drawings Basics
9.	Fuselage drawing
10.	Engine drawing
11.	Project

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Using the Interface
Week 2	Design Intent, 2D Sketching and Sketch entities
Week 3	Conversion of sketch entities into 3D objects
Week 4	Creating airfoil from co-ordinates
Week 5	Drawing different shapes of 3D wings
Week 6	Lab Test-1

Week 7	3-D Sketching and Reference Planes
Week 8	Assembly Basics
Week 9	Drawings Basics
Week 10	Fuselage drawing
Week 11	Engine drawing
Week 12	Lab Test-2
Week 13	Project Work
Week 14	Project Demonstration

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P2
			CO 2	P4
	Lab test	30%	CO 1	P2
			CO 2	P4
	Project and Presentation	20%	CO3	P4
Lab Quiz		15%	CO 1	P2
			CO 2	P4
Project		10%	CO1, CO2, CO3	P2, P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanical Engineering Drawing – Dr. Amalesh Chandra Mandal, Dr. Md. Quamrul Islam.
2. Mastering SolidWorks - Matt Lombard
3. SOLIDWORKS 2020: A Power Guide for Beginners and Intermediate User - John Willis
4. SolidWorks Simulation 2020 Black Book - Gaurav Verma and Matt Weber

COURSE INFORMATION			
Course Code	: AE 335	Contact Hours	: 3.00
Course Title	: Applied Aerodynamics	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:
1. AE 101: Introduction to Aeronautical Engineering,
2. AE 203: Fundamentals of Fluid Mechanics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course extends fluid mechanics concepts from unified engineering to the aerodynamic performance of wings and bodies in different speed regimes.

OBJECTIVE

1. To determine aerodynamic forces and moments on airfoil, wing, and body of revolution in subsonic flow.
2. To apply the theory of 2D airfoils in low-speed flight and explain the generation and change of aerodynamic forces on finite wings.
3. To analyze the qualitative aspects of viscous flows.
4. To explain the effect of viscosity on flows around flat plate and circular cylinder sections.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **determine** aerodynamic forces and moments on airfoil, wing, and body of revolution in subsonic flow.	PO2	C3			K3	T, F, ASG.
CO2	Be able to **apply** the theory of 2D airfoils in low-speed flight	PO1	C3			K3	T, F, ASG.
CO3	Be able to **analyze** the qualitative aspects of viscous flows	PO2	C4			K4	F, Mid Term Exam.
CO4	Be able to **explain** the effect of viscosity on flows around flat plate and circular cylinder sections.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fundamental Principles:
Models of fluid flow, continuity and momentum equations applied to inviscid flows, drag momentum theory, concept of stream lines, stream tubes, streak line, path lines. Angular velocity, strain and vorticity, potential theory applied to Inviscid flows, elementary flows, their combination and applications. Solution of flows past bodies using Panel methods.

Theory of 2D airfoils:

Kutta-Joukowski theorem, Kutta condition, Kelvin circulation theorem. Classical thin airfoil theory. Types of flow separation and inviscid flow characteristics over a 2D airfoil. Inviscid & incompressible flow over finite wings, Prandtl's lifting line theory, lift distribution over finite wings, effect of aspect ratio; Different types of drags.

Viscous Flows:
Qualitative aspects of viscous flows, Navier-Stokes equations, modification N-S equation for different flows, Exact solutions of N-S equations, Aerodynamic heating, Prandtl Boundary Layer theory; Boundary Layer equations and their solutions. Skin friction and skin friction drag.

Laminar flow past flat plate. Concept free shear flows viz. jet, wake and mixing streams. Flow past cylinder and spheres and their applications. Boundary layer separation and its effects. Flow control techniques. Methods to reduce different types of drag. Introduction to turbulence, the concept of turbulence modeling, Prandtl mixing length theory.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Review of fundamental aerodynamic concepts, classification flows	
Class-2	Applied aerodynamics: aerodynamic coefficients, their magnitudes and variation	
Class-3	Review of vector relation gradient, divergence, curl, line integrals, surface integrals and volume integrals	
Week 2		
Class-4	Angular velocity, strain rate and vorticity of fluid flows	
Class-5	Circulation, stream function and velocity potential	
Class-6	Classification of rotational and irrotational flows, Fluid Stressed and strain rates	
Week 3		
Class-7	Flow analysis of Inviscid and incompressible flows, review of Bernoulli's equation and its applications	CT2/ MID TERM
Class-8	Pressure coefficient and its variation on typical airfoils	
Class-9	Elementary fluid flows. Derivation of equations of stream function velocity potential and velocity for uniform flow	
Week 4		
Class-10	Derivation of equations of stream function and velocity potential and velocity for doublet flow and vortex flow.	
Class-11	Analysis of flow past non-lifting cylinder	
Class-12	Analysis of flow past lifting cylinder, Derivation of Kutta-Joukowski theory of lift	
Week 5		
Class-13	Discussion on airfoil nomenclature and their characteristics	
Class-14	Introduction to Classical thin airfoil theory	
Class-15	Kutta condition and Kelvin's circulation theorem and starting vortex	
Week 6		
Class-16	Types of flow separation.	
Class-17	Inviscid flow characteristics over a 2D airfoil	
Class-18	Inviscid flow characteristics over a finite airfoil.	
Week 7		
Class-19	Lift distribution over finite wings.	
Class-20	Different types of drags.	CT2/ MID TERM
Class-21	Effect of aspect ratio.	
Week 8		
Class-22	Finite wing theory or Prandtl classical lifting line theory.	
Class-23	Effect of aspect ratio and physical significance	
Class-24	Elliptical lift distribution	

Week 9		
Class-25	Derivation of Navier Stokes equations: Continuity and Momentum equation	
Class-26	Derivation of Navier Stokes equations: Energy equations and different forms of N-S equation. Modification of N-S Equations for different types of flow	
Class-27	Solution method of N-S equation for simple problems: Parallel flows	
Week 10		
Class-28	Introduction to Boundary layers. Properties of B-L properties.	CT3
Class-29	Derivation of Boundary layer equations	
Class-30	Application of Boundary layer equations for laminar boundary layers and interpretation of Laminar B- L properties	
Week 11		
Class-31	Modification N-S equation for different flows, Exact solutions of N-S Equations	
Class-32	Aerodynamic heating.	
Class-33	Prandtl Boundary Layer theory	
Week 12		
Class-34	Skin friction and skin friction drag.	
Class-35	Laminar flow past flat plate	
Class-36	Concept free shear flows viz. jet, wake and mixing streams	
Week 13		
Class-37	Flow past cylinder and spheres and their applications	
Class-38	Boundary layer separation and its effects.	
Class-39	Flow control techniques	
Week 14		
Class-40	Introduction to turbulence	
Class-41	Concept of turbulence modeling	
Class-42	Prandtl mixing length theory	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C3
			CO4	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C4
Final Examination (Section A & B)		60%	CO1	C3
			CO2	C3
			CO3	C4
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of Aerodynamics - John D Anderson; McGraw-Hill.
2. Mechanics of Fluids - Irving H. Shames
3. Mechanics of Fluids - B. S. Messy
4. Aerodynamics for Engineering Students –E.L Houghton, P.W. Carpenter, S.H. Collicot and D.T. Valentine; Elsevier.
5. Computational Fluid Mechanics and Heat Transfer - Anderson.

COURSE INFORMATION			
Course Code	: AE 336	Contact Hours	: 1.50
Course Title	: Applied Aerodynamics Sessional	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students to the fundamental principles of aerodynamics involving hands-on training on subsonic wind tunnel testing and experiments.

OBJECTIVE

1. To understand the fundamental principles of incompressible aerodynamics.
2. To explain the sources of skin-friction and pressure drag, flight characteristics that relate to lift, drag and pitching moment
3. To be able to perform calculations involving lift, drag in relation to various aspects of flight and aircraft performance.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the use of theoretical characteristics of low-speed aerodynamics that can be implemented through wind tunnel operations	PO4	P2			K6	R, Q, T
CO2	Be able to **measure** the pressure and velocity distribution along the airfoil and cylinder	PO4	P3			K6	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
01	Experiment on pressure distribution around a symmetrical NACA 0012 airfoil with pressure tapping
02	Experiment on pressure distribution and coefficient of drag for a right circular cylinder
03	Experiment on Lift and Drag analysis over NACA 2412 airfoil with various Flap angles.
04	Experimental observation of boundary layer

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 05 5 05 10
Formal Assessment Continuous Assessment Final Quiz	 7 1
Total	64

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Experiment on pressure distribution around a symmetrical NACA 0012 airfoil with pressure tapping
Week 2	Experiment on pressure distribution and coefficient of drag for a right circular cylinder
Week 3	Experiment on Lift and Drag analysis over NACA 2412 airfoil with various Flap angles.
Week 4	Experimental observation of boundary layer
Week 5	Review
Week 6	Lab Test-1
Week 7	Lab Quiz

ASSESSMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Lab participation and Report	25%	CO1	P2
			CO1	P2
	Report Writing/ Programming	15%	CO2	P3
			CO1	P2
	Mid Term Evaluation (exam/project/assignment)	20%	CO1, CO2	P2, P3
Final Evaluation (Exam/project/assignment)		30%	CO1	P2
			CO2	P3
Viva Voce/ Presentation		10%	CO1, CO2	P2, P3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics of Fluids - B. S. Messy
2. Fundamentals of Aerodynamics - John D Anderson; McGrawhill.
3. Computational Fluid Mechanics and Heat Transfer – Anderson

COURSE INFORMATION			
Course Code:	AE 337	Contact Hours:	3.00
Course Title:	Aerospace Propulsion	Credit Hours:	3.00

PRE-REQUISITE

Course Code & Title:
1. AE-207 (Thermodynamics)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Students will understand and learn about the fundamentals of air breathing and non-air breathing engines and their different components.

OBJECTIVE

1. To demonstrate understanding of contemporary propulsion systems used in both air breathing and non-air breathing aircrafts. Classify Engines, Heat Engines, Air Breathing and Non –Air Breathing Engines.

2. To apply, analyze and assess the thermodynamic process occurring in various components of a gas engine which include inlets, fans, compressors, combustion chambers, turbines, afterburners and nozzles and how they interact with each other.

3. To demonstrate understanding of design variables affecting the performance of each component of an aero engine.

4. To demonstrate understanding basic aspects of rocket propulsion, propellants, rocket staging and dynamics.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** Gas Turbine Engines and **explain** thermodynamic Process of Ideal and Real Cycle	PO1	C2			K3	T, F, ASG
CO2	Be able to **explain** the construction and functioning of various components of Gas Turbine Engine and their Significance.	PO1	C2			K3	T, F, ASG

CO3	Be able to **demonstrate** Understanding of Variation types of Propelling Nozzles and basic aspects related to Rocket Propulsion and its Propellants	PO2	C3			K4	F, Mid Term Exam.
CO4	Be able to **explain** thrust augmentation, thrust reversal & aero engine control. Be able to **understand** and explain various systems related to aero engine	PO1	C2			K3	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fundamentals of air breathing engines; Operating principles of piston engines, thermal efficiency calculations, classification of piston engines, illustration of working of gas turbine engine, the thrust equation, factors affecting thrust, effect of pressure, velocity and temperature changes of air entering compressor, Propeller theory.

Inlets, nozzles and combustion chambers for jet engines ; Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternal deceleration ratio, diffuser performance, supersonic inlets, shock swallowing by area variation, real flow in nozzles and nozzle efficiency, losses in nozzles, equilibrium flow and frozen flow in nozzles, two phase flow in nozzles, ejector and variable area nozzles, interaction of nozzle flow with adjacent surfaces, thrust reversal, classification of combustion chambers, combustion chamber performance, flame stabilization.

Propulsion unit requirements for subsonic and supersonic flight. Compressors, combustion systems, turbines and after burner. Gas turbine cycles for aircraft propulsion; turbojet, turbofan, turbo shaft engines. Efficiency of components; Off-design considerations; Selection of materials for aero-engine. Aero-thermochemistry of Fuels and Propellants. Methods of thrust augmentation, Aero engine control, aero engine systems

Rocket propulsion and rocket propellants; liquid and solid rocket propulsion systems, nozzle design, rocket performance; Dynamics of rocket flight, orbital velocity; Staging; Future developments; Minimization of noise and pollution; Sub-orbital propulsion systems; Ram jet; Scram-jets; Hybrid engines.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Introduction to the Course**	CT1
Class-1	Classification of Air Breathing and Non-Air Breathing Engines	
Class-2	Compare Air Breathing and Non-Air Breathing Engines	
Class-3	Performance Characteristics of Gas Turbine Engine	
Week 2	**Thermodynamic Analysis: Gas Turbine Engine (Ideal Cycle Performance)**	
Class-4	Ideal Cycle Performance Analysis for Aircraft Propulsion: Turbojet, Turbo shaft, Turbofan engines	
Class-5	Analysis of Thermodynamic Processes: Cycle Components and Component Performance	
Class-6	Tutorial-1	
Week 3	**Thermodynamic Analysis: Gas Turbine Engine (Real Cycle Performance)**	
Class-7	Real Cycle Performance Analysis for Aircraft Propulsion: Turbojet, Turbo shaft, Turbofan engines	
Class-8	Methods of Augmenting Efficiency of Gas Turbine Engine	
Class-9	Tutorial-2	

Week 4	**Intake and Intake System**	
Class-10	Purpose of Air Intake and Types of Air Intakes	
Class-11	Aero thermodynamic Analysis of Subsonic and Supersonic Intakes	
Class-12	Performance Analysis of Air Intake	
Week 5	**Compressors**	
Class-13	Classification of Compressors, Merit & Demerit of Each type	CT2/ MID TERM
Class-14	Compressor operation, Performance, Construction	
Class-15	Vector Analysis of Airflow through Axial Flow Compressors and Compressor Flow Instability	
Week 6	**Combustion Chamber**	
Class-16	Introduction to combustion chamber	
Class-17	Classification of combustion chambers	
Class-18	Combustion chamber performance and Flame stabilization	
Week 7	**Turbine**	
Class-19	Turbine operation and Types of Turbines	
Class-20	Turbine Construction and Performance	
Class-21	Thrust Equation and Factors Affecting Thrust	
Week 8	**Exhaust Ducts or Propelling Nozzle**	
Class-22	Real flow in nozzles and nozzle efficiency, losses in nozzles.	
Class-23	Equilibrium flow and frozen flow in nozzles, two phase flow in nozzles	CT2/ MID TERM
Class-24	Ejector and variable area nozzles and Thrust Reversal	
Week 9	**Ram jet, Scram-jets, Pulse jet and Rocket**	
Class-25	Ram jet engine	
Class-26	Scram-jet engine	
Class-27	Pulsejet engine	
Week 10	**Rocket**	
Class-28	Rocket propulsion and rocket propellants	
Class-29	Liquid and solid rocket propulsion systems	
Class-30	Nozzle design and Rocket Performance	
Week 11	**Rocket (contd)&Thrust Control Method**	
Class-31	Rocket Staging and Effect of Drag on Staging	
Class-32	Methods of thrust augmentation	CT3
Class-33	Thrust Reverser	
Week 12	**Component Design, Material and Fuel**	
Class-34	Aero engine Control	
Class-35	Efficiency of components and Off-design considerations	
Class-36	Selection of materials for aero-engine	

Week 13	**Piston Engines**
Class-37	Classification of IC Engines, Classification of Piston Engines
Class-38	Operating Principles of Piston Engine and Construction
Class-39	Thermodynamic Analysis of Cycle, Performance Factors
Week 14	**Aircraft and aero engine systems**
Class-40	Lubrication system
Class-41	Fuel system
Class-42	Fire detection and prevention system

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
			CO 4	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C3
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics and thermodynamics of propulsion - Hill and Peterson, 2nd edition; Addison; Wesley, NY, 1992.
2. Gas Turbine Theory-H Cohen, GFC Rogers, HIH Saravanamuttoo
3. Rocket propulsion elements (6th edition) - George P Sutton, Oscar Biblarz, John; Wiley, NY, 1992.
4. Aero thermodynamics of Aircraft Engine Components- Oates, G.C.; AIAA Education Series
5. Aircraft Gas Turbine Engine Technology (3rd edition) - Treager.
6. The Jet Engine - Rolls Royce Limited

COURSE INFORMATION			
Course Code	: AE 338	Contact Hours	: 1.50
Course Title	: Aerospace Propulsion Sessional	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to provide the students with a hands-on experience on the various aspects of reciprocating and gas turbine engines as taught in the Aerospace Propulsion theory course

OBJECTIVE

1. To compare the structural layout of the Piston & Jet engines.

2. To practically observe the actual operation of a jet engine and match this with the theoretical knowledge.

3. To be able to apply the theoretical knowledge of basic formulas concerning the jet engine.

4. To analyze how the flow property is changed by tweaking the dimensions of the compressor & turbine section (of a jet engine).

5. To be able to evaluate various parameters of the gas turbine cycle associated with a small-scale jet engine from the practical operation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **show** the thrust & cycle efficiency of a small-scale jet engine with the parameters obtained from the practical operation.	PO4	P2			K5	R, Q, T
CO2	Be able to **analyze** the dimensional effects of compressor & turbine sections (of a jet engine) on flow properties by plotting graphs from obtained data.	PO2	C4			K4	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
01	Experiment on pressure distribution around a symmetrical NACA 0012 airfoil with pressure tapping
02	Experiment on pressure distribution and coefficient of drag for a right circular cylinder
03	Experiment on Lift and Drag analysis over NACA 2412 airfoil with various Flap angles.
04	Experimental observation of boundary layer

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	05
Preparation of presentation	5
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	7
Final Quiz	1
Total	64

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Construction of a Typical Jet Engine (WP7C Jet Engine) of a Fighter Aircraft
Week 2	Dimensional Change of Compression Section and Effects
Week 3	Dimensional Change of Turbine Section and Effects
Week 4	Ground Operation of a (Edibon) Jet Engine
Week 5	Construction of a Typical Radial Piston Engine (HUO SAI-7A Engine) of a Trainer Aircraft
Week 6	Lab Test
Week 7	Lab Quiz/Viva

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P2
			CO 1	P2
	Report Writing/ Programming	15%	CO 2	C4
			CO1	P2
	Mid Term Evaluation (exam/project/ assignment)	20%	CO1, CO2	P2, C4
Final Evaluation (Exam/project/assignment)		30%	CO 1	P2
			CO 2	C4
Viva Voce/ Presentation		10%	CO1, CO2	P2, C4
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. Aircraft Gas Turbine Engine Technology (3rd edition) - Irwin E. Treager.
2. The Jet Engine - Rolls Royce Limited.

COURSE INFORMATION			
Course Code	: AE 350	Contact Hours	: 4.00
Course Title	: Probability and Statistics for Aeronautical Engineering	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a comprehensive course designed to introduce aeronautical engineering students to essential statistical and probabilistic concepts, with a focus on real-world application within the aeronautical field. Through a blend of theoretical lessons and practical sessions, students will learn to analyze data, make informed decisions, and apply optimization techniques in engineering contexts. The curriculum progresses from fundamental statistical analysis to more advanced topics such as Regression Analysis, ANOVA, and Time Series Analysis and Forecasting, equipping students with critical analytical skills for their future careers.

OBJECTIVE

1. To integrate and apply probability and statistical methods to real-world engineering issues.
2. To utilize hypothesis testing and regression analysis for data interpretation in aeronautical contexts.
3. To proficiently use statistical software for effective data analysis and presentation.
4. To clearly synthesize and communicate statistical findings for engineering applications.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** probability theory and statistical methods to solve real-world problems, demonstrating an ability to integrate theoretical knowledge with practical applications.	PO1	C3			K3	R, Q, T
CO2	Be able to **analyze** statistical data using advanced techniques, including hypothesis testing and regression analysis, to draw meaningful conclusions from various datasets.	PO2	C4			K4	R, Q, T

CO3	Be able to **perform** data analysis using statistical software tools, showcasing proficiency in applying technology to interpret and present statistical findings effectively.	PO5	C3			K6	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Introduction to Statistics, Frequency Distribution, Measures of Central Tendency, Measures of Dispersion.
2.	Practice session
3.	Variation, Skewness, Kurtosis, Concept of Probability, Conditional Probability, Probability Distributions: Binomial, Poisson.
4.	Practice session
5.	Sampling of Mean and Standard Deviation by Normal Distribution, Chi-square and F Distributions, Sampling Theory.
6.	Practice session
7.	Estimation, Hypothesis Testing, Regression Analysis
8.	Practice session
9.	Analysis of Variance (ANOVA), Optimization Techniques.
10.	Practice session
11.	Advanced Optimization Techniques, Time Series Analysis and Forecasting
12.	Practice session

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 28 28 Total 56
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	126

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction to Statistics, Frequency Distribution, Measures of Central Tendency, Measures of Dispersion.
Week 2	Practice session
Week 3	Variation, Skewness, Kurtosis, Concept of Probability, Conditional Probability, Probability Distributions: Binomial, Poisson.
Week 4	Practice session
Week 5	Sampling of Mean and Standard Deviation by Normal Distribution, Chi-square and F Distributions, Sampling Theory.
Week 6	Practice session
Week 7	Estimation, Hypothesis Testing, Regression Analysis
Week 8	Practice session
Week 9	Analysis of Variance (ANOVA), Optimization Techniques.
Week 10	Practice session
Week 11	Advanced Optimization Techniques, Time Series Analysis and Forecasting
Week 12	Practice session
Week 13	Lab Quiz
Week 14	Lab Test

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Participation and Report	10%	CO 1	C3
			CO 2	C4
	Daily Assessment	30%	CO 1	C3
			CO 2	C4
			CO 3	C3
	Lab Test	30%	CO3	C3
Lab Quiz		30%	CO 1	C3
			CO 2	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Probability and Statistics in Aerospace Engineering by Leonard W. Howell.
2. Computational Statistics Handbook with MATLAB by Wendy L. Martinez, Angel R. Martinez
3. Introduction to Statistics (3rd edition) by Ronald E Walpole, Macmillan, 1990.
4. Probability and Statistics for Engineers by Scheaffer & McClave.
5. Statistics and Random Processes by B. Praba, Aruna Chalam and Sujatha.

COURSE INFORMATION			
Course Code	: AEAV 329	Contact Hours	: 3.00
Course Title	: Measurement and Aircraft Instruments	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

3. AEAV 223: Electronics II
4. AEAV 301: Digital Systems

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students to the fundamentals of Measurement and Aircraft Instrument System

OBJECTIVE

1. To introduce basics of Measurement.
2. To introduce working principles of basic aircraft instruments
3. Introduce to various types of transducers and signal conditioning methods
4. Introduce the signal flow through various medium including digital data bus

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the fundamentals of measurement and the operation of basic instruments in aircraft	PO1	C2			K3	T, F, ASG.
CO2	Be able to **describe the** operation of transducers and Pitot Static System	PO1	C2			K3	T, F, ASG.
CO3	Be able to **understand** the properties of Gyroscopes, Frequency, Capacitance and Temperature measurement	PO1	C2			K3	F, Mid Term Exam.
CO4	Be able to **analyze** methods of signal conditioning and digital data recording and transmission	PO2	C4			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT
Introduction to Basic Measurement principles, Generalized measurements systems, dimensions and units of measurements, causes and types of experimental errors, error and uncertainty analysis. Introduction to Aircraft Measurements, Basic layout of Instrument panels, Layout of Instruments in aircraft such as Basic 6 and Basic T, Classification of Instruments Introduction to Pitot Static Group of Instruments such as Altimeter, Air Speed Indicator, Vertical Speed Indicator, Mach Meter. Introduction to Air Data Computer (ADC) Introduction to Gyroscopic Properties and Instruments such as Attitude Indicator, Turn and Slip Indicator and Heading Indicator Introduction to Temperature Measurement and Instruments such as OAT, TGT and Cabin Temp Indicators Introduction to Fuel flow and quantity measurement: Resistive & Capacitive transducer, aircraft fuel measurement system, compensation for aircraft attitude and non-uniform tank contour. Introduction to Miscellaneous Instruments such as AoA measurement, Strain measurements, Control Surface Deflection Introduction to Data Acquisition System, Basic principles of signal conditioning: Amplification, Source of noise, noise elimination compensation, A/D and D/A converters. Introduction to Digital Data Bus such as Mil-1553 and Arinc 429

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Flight Simulator Demo

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Fundamentals of Measurement**	CT1
Class-1	Generalized measurements systems	
Class-2	Understanding Important Terms in Measurement	
Class-3	Causes and types of errors and uncertainty analysis	
Week 2	**Instrument Layout in Aircraft**	
Class-4	Layout of Analog Instruments (Basic 6 and T) and as pages in MFD	
Class-5	Types of scales (Linear, Nonlinear, Circular, Straight, Dual and Digital displays)	
Class-6	Quantitative and Qualitative displays. Scale Range and Operating range	
Week 3	**Pitot Static System**	
Class-7	Introduction to Pitot Static System	CT2/ MID TERM
Class-8	Principle of Air Pressure Measurement	
Class-9	Errors in Pitot Static System	
Week 4	**Pitot Static Group of Instruments**	
Class-10	Construction and Operating Principle of Altimeter	
Class-11	Understanding Altimeter Datum Settings QFE, QNE and QNH	
Class-12	Construction and Operating Principle of Air Speed Indicator	
Week 5	**Pitot Static Group of Instruments**	
Class-13	Understanding the different airspeeds IAS, CAS, TAS, EAS	
Class-14	Construction and Operating Principle of Vertical Speed Indicator	
Class-15	Construction and operating principle of Machmeter	
Week 6	**Introduction to Air Data Computer**	
Class-16	Working Principle of ADC	
Class-17	Construction of ADC	
Class-18	Error Compensation in Air Data Computer	
Week 7	**Gyroscopes**	
Class-19	Introduction to Gyroscopes	CT2/ MID TERM
Class-20	Properties of Gyroscope such as Rigidity and Precession	
Class-21	Errors in Gyroscopic Instruments	
Week 8	**Gyroscopic Instruments**	
Class-22	Construction and working principle of Attitude Indicator	
Class-23	Construction and working principle of Turn and Bank Indicator	
Class-24	Construction and working principle of Heading Indicator	
Week 9	**Gyroscopes in Inertial Navigation System**	
Class-25	Introduction to Inertial Navigation System	
Class-26	Working principles of INS	
Class-27	Comparison of Mechanical Gyros with Ring Laser and Fiber Optic Gyro	

Week 10	**Temperature Measurement**	
Class-28	Introduction to various Aircraft Temperature Measurement	CT3
Class-29	Temperature Sensors such as RTD, ThermoCouple,	
Class-30	Location of Temperature Sensors in aircraft	
Week 11	**Fuel Flow and Fuel Quantity Measurement**	
Class-31	Brief Introduction to Aircraft Fuel System	
Class-32	Fuel Flow measurement	
Class-33	Fuel Quantity Measurement using Capacitance Probe	
Week 12	**Engine RPM and Torque Measurement**	
Class-34	Introduction to Engine RPM measurement	
Class-35	Measurement of Engine RPM by Synchros	
Class-36	Measurement of Torque	
Week 13	**Transducers**	
Class-37	Introduction to Transducers	
Class-38	Classification of Transducers	
Class-39	Application of Transducers	
Week 14	**Data Acqusition System**	
Class-40	Introduction to Data Acquisition System	
Class-41	Elements of Signal Conditioning	
Class-42	Flight Simulator Demo	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Aircraft Instruments and integrated Systems- EHJ Pallet; Pearson Education Publishers.
2. Modern Electronic Instrumentation and Measurement Technique-Albert D Helfrick; Prentice Hall of India private Ltd.
3. Electrical Electronics Measurement and Instrumentation – AK Sawheney, Dhanpat Rai

COURSE INFORMATION			
Course Code	: AE 330	Contact Hours	: 1.50
Course Title	: Measurement and Aircraft Instruments Sessional	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to teach the students the basic concepts of measurement and analyze different functions of aircraft instruments.

OBJECTIVE

1. Conduct experiments, and then analyze and interpret results successfully
2. Demonstrate that water level and flow rate can be controlled by using feedback transducer.
3. Analyze the principle of operations of the pitot static system
4. Demonstrate that the functions of various aircraft instruments are based on the pitot static system
5. Analyze the properties, operation and construction of directional gyro.
6. Know the basic working principle of instruments using in aircraft's operation and maintenance

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the working principle of water level control and flow rate transducer	PO1	P2			K5	R, Q, T
CO2	Be able to **understand** the principle of operations of the pitot-static system and directional gyro.	PO2	P2			K5	R, Q, T
CO3	Be able to **develop** a lab module of aircraft basic instruments.	PO3	C6, A3			K5	Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Familiarization with Pressure Transducer (Strain Gauge)
2.	Flow Rate Control of Water by Feedback Transducer.
3.	Study of the pitot static system
4.	Study of the airspeed indicator (ASI)
5.	Study of the vertical speed indicator (VSI)
6.	Study of the altimeter
7.	Study of the gyroscopic equipment

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction and familiarization with the equipment.
Week 2	Familiarization with Pressure Transducer (Strain Gauge)
Week 3	Flow Rate Control of Water by Feedback Transducer.
Week 4	Study of the pitot static system
Week 5	Study of the airspeed indicator (ASI)
Week 6	Study of the vertical speed indicator (VSI)
Week 7	Study of the altimeter
Week 8	Study of the gyroscopic equipment
Week 9	Review
Week 10	Lab Test-Group 1
Week 11	Lab Test- Group 2
Week 12	Lab Quiz
Week 13	Presentation on Assigned Problems
Week 14	Project Demonstration

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom's Taxonomy</th></tr>
<tr><td rowspan="5">Continuous Assessment (40%)</td><td rowspan="2">Lab participation and Report</td><td rowspan="2">25%</td><td>CO 1</td><td>P2</td></tr>
<tr><td>CO 2</td><td>P2</td></tr>
<tr><td rowspan="2">Lab test</td><td rowspan="2">30%</td><td>CO 1</td><td>P2</td></tr>
<tr><td>CO 2</td><td>P2</td></tr>
<tr><td>Project and Presentation</td><td>20%</td><td>CO3</td><td>C6, A3</td></tr>
<tr><td colspan="2" rowspan="2">Lab Quiz</td><td rowspan="2">15%</td><td>CO 1</td><td>P2</td></tr>
<tr><td>CO 2</td><td>P2</td></tr>
<tr><td colspan="2">Viva</td><td>10%</td><td>CO1, CO2, CO3</td><td>P2, C6, A3</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Aircraft Instruments And Integration Systems- EHJ Pallet
2. Aircraft Electricity And Electronics- Thomas Eismin.

COURSE INFORMATION			
Course Code	: AE 411	Contact Hours	: 3.00
Course Title	: Control Engineering	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. Math 103: Differential Equations and Matrix
2. Math 201: Vector Analysis, Laplace Transform & Co-ordinate Geometry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course is to provide insight into basics of open and closed loop systems in classical and modern control and associated tools in time and frequency domain to analyze them.

OBJECTIVE

1. To introduce to the modeling of systems in formats to be used for analysis.
2. To introduce to Single Input Single Output system characteristics
3. To analyze systems in time and frequency domain
4. To introduce to digital control system and their characteristics

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** open and closed loop control systems in frequency and time domain.	PO1	C2			K3	T, F, ASG.
CO2	Be able **modify** complex systems to a simple one by using SFG and Mason's Rule.	PO2	C3	CP1, CP2, CP3		K4	T, F, ASG.
CO3	Be able to **determine** stability of a system using various techniques.	PO2	C5			K4	F, Mid Term Exam.
CO4	Be able to **design** analog and digital control systems via frequency response and Z-transform.	PO3	C6	CP1, CP2, CP3		K6	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to control systems: Open loop and closed loop control system**,** Transfer function, block diagram and Signal Flow Graph (SFG).

Modeling in Frequency Domain: Laplace transform review, Mechanical system transfer function, Electrical system transfer function, Electro- mechanical system transfer function.

Modeling in Time Domain: State variables**,** SFG to state variables, transfer function to state variable and state variable to transfer function.

Time Response: General first and second order system, Underdamped second order system, System response with additional poles and zeros.

Reduction of Multiple Subsystems: Signal flow graph, Masons,s rule, signal- flow graphs of state equations.

Stability: Routh- Hurwitz criterion, Root- Locus Techniques, steady- state error, design via root locus**.**

Frequency response technique: Nyquist criterion, bode plot, gain margin and phase margin via Nyquist diagram and bode plot.

Design via frequency response: Lag compensation, lead compensation, lag- lead compensation. PID controller design.

Digital control systems: Modeling the digital computer, z- transform, transfer function, sampled data systems, stability analysis in Z- domain.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Exam	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Introduction to control systems	
Class-2	Open loop and closed loop control system**,**	
Class-3	Transfer function, block diagram, Signal Flow Graph (SFG).	
Week 2		
Class-4	Laplace transform review	
Class-5	Translational Mechanical system transfer function	
Class-6	Rotational Mechanical system transfer function	
Week 3		
Class-7	Transfer function of systems with gear mechanism	CT2/ MID TERM
Class-8	Electrical system transfer function	
Class-9	Electro- mechanical system transfer function.	
Week 4		
Class-10	Basics of State Space Modeling	
Class-11	SFG to State Variables, Transfer Function to State Variable	
Class-12	State Variable to Transfer Function	
Week 5		
Class-13	General first and second order system	
Class-14	Steady- state and Transient state Response	
Class-15	Performance specifications of First Order Systems	
Week 6		
Class-16	Numerical problems: First Order Systems	
Class-17	Time Response of Second Order Systems	
Class-18	Performance specifications of second Order Systems	
Week 7		
Class-19	Underdamped second order system	
Class-20	Numerical problems: Second Order Systems	CT2/ MID TERM
Class-21	Effect of adding Pole and Zero to a system	
Week 8		
Class-22	Reduction of Multiple Subsystems via Signal flow graph	
Class-23	Masons,s Gain Formula	
Class-24	Signal- flow graphs of state equations.	
Week 9		
Class-25	Routh- Hurwitz criterion	
Class-26	Root- Locus Techniques	
Class-27	Steady- state error	
Week 10		
Class-28	Nyquist criterion	
Class-29	Bode Plot	
Class-30	Gain margin and phase margin	

Week 11		CT3
Class-31	Preliminary Considerations Of Classical Design	
Class-32	Design Of Basic Compensators	
Class-33	Lag compensation, lead compensation	
Week 12		
Class-34	Lead compensation	
Class-35	Lag- lead compensation	
Class-36	PID controller design	
Week 13		
Class-37	Modeling the digital computer	
Class-38	z- transform	
Class-39	z- transform transfer function	
Week 14		
Class-40	Controllability and observability	
Class-41	Sampled Data Systems	
Class-42	Stability Analysis In Z-Domain	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C5
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C5
			CO 4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Modern Control Systems – Richard C. Dorf and Robert H Bishop; Pearson Education Private Ltd.
2. Control System Engineering- Norman S. Nise; Wiley
3. Linear Control System Analysis and Design. - John J.D. Azzo& Constantine H. Houpis; McGraw-Hill International.
4. Modern Control Engineering - Ktsuhiko Ogata; Prentice Hall

COURSE INFORMATION			
Course Code	: AE 300	Contact Hours	: 8 Weeks
Course Title	: Industrial Training	Credit Hours	: 1.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to provide the experience for the students regarding the industrial environment and organization as well as the functionality of the engineers in industries.

OBJECTIVE

1. To be able to gain exposure to industry practices
2. To be able to understand industry standards and regulations and acquire industry-specific knowledge.
3. To be able to enhance professionalism and adaptability.
4. To be able to work in a team and manage a project within a given time frame.
5. To be able to effectively communicate solutions to problems (oral, visual, written).

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **develop** work responsibility and ethics in the working environment.	PO8	A5			K5	Pr , R
CO2	Be able to **propose** solutions to real-world problems considering societal, health, safety, legal and cultural issues based on experiences gained during the training.	PO6	A5			K7	Pr , R
CO3	Be able to effectively **communicate** with the engineering community on engineering activities within the working environment through preparing related documentation.	PO10	A2			K4	Pr , R

CO4	Be able to **apply** theoretical and academic knowledge for solving the industrial problem.	PO12	A5			K7	Pr , R
CO5	Be able to **develop** the skill to work effectively as a team member and contribute individually towards achieving the objective of the team.	PO9	A5				Pr , R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**
	Assessment Criteria	
	Attendance	10%
CO1-CO6	Industrial Performance, Observation and Presentation	90%
	Total	**100%****

COURSE INFORMATION			
Course Code	: AE 400	Contact Hours	: 12.00
Course Title	: Final Year Design and Research Project	Credit Hours	: 6.00

PRE-REQUISITE

Course Code & Title:
GERM 350: Research Methodology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The Final Year Design Project is a vital hands-on experience that equips students with practical skills essential for their transition into the industry. By engaging in real-world problem-solving, students not only apply theoretical knowledge but also develop crucial soft skills such as communication and teamwork.

OBJECTIVE

1. To learn more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
2. To contribute to research and development work.
3. To use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.
4. To plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate the work.
5. To create, analyze and critically evaluate different technical/architectural solutions.
6. To critically and systematically integrate knowledge.
7. To develop design experience through teamwork and familiarize with the project management methodology
8. To develop the ability to understand and redefine a given engineering problem, and the ability to develop a conceptual design
9. To have an idea of the professional, ethical, environmental and social impacts and responsibilities of the design project.
10. To develop the ability to communicate effectively.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** engineering knowledge to solve any complex aeronautical engineering-related problems	PO1	C3	CP1, CP2, CP3		K3, K4	APW,R
CO2	Be able to identify, formulate, review literature and **analyze** appropriate problem or topics related to aeronautical Engineering.	PO2	C4			K3, K4	PW, APW

CO3	Be able to **incorporate** the use of modern engineering tools in the **design**, **development** and **verification** process.	PO5	C6	CP1 - CP7	CA1-CA5	K6	FPr, FR
CO4	Be able to **achieve** the milestones set in the project proposal or **revises** the schedule appropriately to complete the project within the deadline	PO11	C5				FPr, FR
CO5	Be able to **value** ethical and professional responsibilities during the Final Year Design and Research Project.	PO8	A4			K7	PR, R, ASG, F
CO6	Be able to **work** effectively as an individual and as a team member towards the successful completion of the project.	PO9	A5				PW, Pr
C07	Be able to **write** professional technical document related to the topic or project and orally present the results.	PO10	A2			K4	FPr, FR
C08	Be able to **conduct** the economic analysis and estimate the cost of the final year design and research project.	PO11	C6			K7	FR, FPr
CO9	Be able to **verify** the problem in the broadest context of technological change	PO12	A5		CA1 CA4	K7	FR, FPr
CO10	Be able to **identify** and **validate** the impact of environmental considerations and the sustainability of a system/subsystem of a complete project	PO7	A4, C5		CA1, CA 4		Pr, FR, FPr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, PR – Project ; Pr – Presentation; FPr-Final Presentation; R-Report; FR-Final Report, PW-Practical Work, APW-Analysis of Previous Work)

COURSE CONTENT

Types of thesis: Students can choose topics containing theoretical, empirical and/or practical aspects. But irrespective of the topic chosen, the use of relevant theory and literature is fundamental to the thesis.
An empirical paper: The idea is to gather knowledge on a specific topic and to relate theory to empirical observations, e.g. by using existing data, by using questionnaires or experiments.
A case study: A case study approach involves an analysis of a specific occurrence or process in an actual company or another type of organization. The purpose of a case study is to provide descriptions, analyses and suggested solutions to problems in relation to the case in hand. Case studies will involve the use of quantitative and/or qualitative methods for data collection.
A theoretical paper: This type of thesis builds on a theoretical model or a generic problem. Often a theoretical thesis is based on existing literature studies in which a theoretical problem is analyzed. This type of thesis is the least common. No type of thesis is superior to others and no topics guarantee a high grade. The grade is based solely on whether the topic is thoroughly analyzed, the results clearly presented and whether you are able to demonstrate your knowledge of current theories and analyses, competent application of methods as well as independent critical judgment.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	84
Self-Directed Learning	168
Formal Assessment	11
Total	**263**

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**
	Assessment Criteria	
CO1-CO10	Seminar 1(Thesis Proposal Presentation)	10%
	Seminar 2: (Thesis Progress Presentation)	20%
	Thesis activity and oral exam	70%
	Total	**100%****

***Note: 60% of marks will be assigned to the supervisor and 40% of marks will be assigned to external board members. Thesis evaluation committee will consist of 5 members including supervisor, the head of the department, and 3 external board members.*

COURSE INFORMATION

Course Code	: AE 412	Contact Hours	: 1.50
Course Title	: Control Systems Sessional	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The goal of this course is to provide an outlook to students to see perceive most real-life system as a control system problem and use tools of Control System to analyze for finding solutions.

OBJECTIVE

1. To introduce to the modeling of real-life control systems problems.
2. To evaluate the effects of different controller in frequency and time domain.
3. To solve complex design problems digital and analog controller based on realistic aspects.
4. To develop communication and project management skills among the students through presentation and mini projects.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **analyze** the modeling of real-life control systems in various forms of working.	PO5	P3			K6	R, Q, T
CO2	Be able to **evaluate** the effects of various types of controllers on the system performance.	PO4	C4			K4	R, Q, T
CO3	Be able to **develop** a project to solve real-life problems working in a group as a member or as a leader.	PO5	P4	CP1 CP2		K6	Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Apply modeling principles in real life applications
2.	Analyzing and evaluating the effects of different kinds of controllers on system performance
3.	Experiment on water level control setup using Proportional, Integrator and Derivative Control
4.	Experiment on temperature sensing setup using proportional, integrator and derivative
5.	Experiment on speed control of motor using proportional, integrator and derivative
6.	Project

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 2.5 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 0.5
Total	56

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Apply modeling principles in real life applications
Week 2	Analyzing and evaluating the effects of different kinds of controllers on system performance
Week 3	Experiment on water level control setup using Proportional, Integrator and Derivative control
Week 4	Experiment on water level control setup using Proportional, Integrator and Derivative Control

Week 5	Experiment on temperature sensing setup using proportional, integrator and derivative
Week 6	Experiment on speed control of motor using proportional, integrator and derivative
Week 7	Project Demonstration

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P3
			CO 2	C4
	Lab test	30%	CO 1	P3
			CO 2	C4
	Project and Presentation	20%	CO3	P4
Lab Quiz		15%	CO 1	P3
			CO 2	C4
Viva		10%	CO1, CO2, CO3	P3, C4, P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Modern Control Engineering- Katsuhiko Ogata
2. Control Systems Engineering – Norman S Nise.

COURSE INFORMATION			
Course Code	: AE 447	Contact Hours	: 3.00
Course Title	: Space Engineering	Credit Hours	: 3.00

PRE-REQUISITE

None.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course offers a comprehensive overview of spacecraft dynamics, including the space environment, orbital mechanics, satellite operations, attitude dynamics and control, the legal framework governing space activities, rocket launching principles, satellite systems, and an introduction to systems engineering approaches.

OBJECTIVE

1. To explain the basic concepts of Orbital Mechanics.
2. To apply basics of Orbital Mechanics to Satellite Operations & Rocket Launching.
3. To explain the fundamentals of space environment and spacecraft operations
4. To explain the legal, engineering, and design aspects of space missions.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **calculate** spacecraft orbits and trajectories using Kepler's laws and orbital mechanics, including the calculation of position and velocity from classical orbital elements.	PO1	C3			K4	T, F, ASG.
CO2	Be able to **implement** satellite operations and attitude control strategies, incorporating geostationary orbits, transfer maneuvers, rotation matrices, Euler angles, and Euler's equations.	PO2	C3			K3	T, F, ASG.

CO3	Be able to **interpret** the knowledge of the space environment, legal standards, and systems engineering approaches to effectively plan and execute satellite missions.	PO1	C2			K3	T, F, Mid Term Exam.
CO4	Be able to **solve** detailed rocket staging calculations to optimize multi-staging strategies, for efficient satellite deployment.	PO2	C3			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction: Space environment, types of spacecrafts, present-day satellites and launch vehicles.

Orbital mechanics: Two-body Problem, Kepler's laws, geometry of orbits, Kepler's equation, classical orbital elements, orbit determination from initial conditions, position and velocity prediction from orbital elements. Satellite operations: Geostationary orbit, Hohmann transfer, inclination change maneuvers, launch windows for rendezvous missions, perturbation effects due to earth oblateness, sun synchronous orbits.

Attitude dynamics and control: rotation matrices, Euler angles, attitude kinematics, Euler’s equations for rotational dynamics, torque free motion of asymmetric and axisymmetric rigid bodies, effect of energy dissipation on stability of rotational motion, attitude control of spinning and non-spinning satellites.

Space environment, basic properties of the electro-magnetic environment in space; basic space law and legislative issues; the outer space treaty; satellite subsystems

Rocket equation, staging, multi-staging calculations, series and parallel staging, optimal staging, sensitivity ratios, vertical ascent trajectories, gravity turn trajectories.

Systems engineering process; requirements engineering; system design and integration; verification and validation; risk management; systems engineering lifecycle; project management in systems engineering; case studies in satellite systems engineering.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Two-body Problem, Kepler's laws.	
Class-2	Geometry of orbits, Kepler's equation, classical orbital elements.	
Class-3	Orbit determination from initial conditions, position, and velocity prediction from orbital elements.	
Week 2		
Class-4	The Outer Space Treaty.	
Class-5	The Outer Space Treaty.	
Class-6	The Space Activities Act Standards.	
Week 3		
Class-7	Different types of orbits.	CT2/ MID TERM
Class-8	International Space Station.	
Class-9	Hohmann transfer.	
Week 4		
Class-10	Inclination change maneuvers, launch windows for rendezvous missions.	
Class-11	Perturbation effects due to earth oblateness.	
Class-12	Sun synchronous orbit and Molniya orbit.	
Week 5		
Class-13	Rotation matrices & Euler angles.	
Class-14	Euler's equations for rotational dynamics.	
Class-15	Torque free motion of asymmetric rigid bodies.	
Week 6		
Class-16	Torque free motion of axisymmetric rigid bodies.	
Class-17	Attitude control of spinning satellites.	
Class-18	Attitude control of non-spinning satellites.	

Week 7		
Class-19	Radiation Environment & Plasma Environment.	
Class-20	Neutral Environment & Particulate Environment.	CT2/ MID TERM
Class-21	Sunspot, solar wind, corona, Solar Prominences, Solar Flares.	
Week 8		
Class-22	Structure of Sun and Earth.	
Class-23	Magnetic field of Sun and Earth.	
Class-24	Causes of Earth's magnetic field.	
Week 9		
Class-25	Mechanical structure.	
Class-26	Propulsion subsystem	
Class-27	Propulsion subsystem	
Week 10		
Class-28	Attitude and orbit control subsystem.	CT3
Class-29	Payload subsystem.	
Class-30	Antenna subsystem.	
Week 11		
Class-31	Thermal control subsystem.	
Class-32	Power supply subsystem.	
Class-33	Telemetry, tracking and command (TT&C) subsystem.	
Week 12		
Class-34	Rocket equation.	
Class-35	Multi-staging, parallel staging, optimal staging and sensitivity ratios.	
Class-36	Vertical ascent trajectories, gravity turn trajectories.	
Week 13		
Class-37	Emergence of system engineering and history.	
Class-38	Definition, Examples & Elements	
Class-39	Motivation for system engineering, Function of system engineering	
Week 14		
Class-40	Life cycle of a system. Focus and principles of system engineering.	
Class-41	Vee Model, contribution, system engineer's responsibility.	
Class-42	System engineering processes & System managements.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C3
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C3
			CO 2	C3
			CO 3	C2
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Understanding Space: An Introduction to Astronautics – Jerry Jon Sellers.
2. Elements of Spacecraft Design - Charles D. Brown
3. Satellite Technology Principles and Applications - Anil K. Maini and Varshaagrawal
4. Space Mission Analysis and Design - Wiley J. Larson and James R. Wertz
5. Spacecraft Systems Engineering- Peter Fortescue, John Stark and Graham Swinerd

5.2 Elective Courses offered in both Aerospace and Avionics Discipline

COURSE INFORMATION			
Course Code	: AEAS 315	Contact Hours	: 3.00
Course Title	: Aircraft Stability and Control	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. AEAS-335 (Applied Aerodynamics)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to demonstrate and understand the Static and Dynamic Stability and Control of the Aircraft and its use towards aircraft design to obtain expected behavior and response from the aircraft during flying.

OBJECTIVE

1. To understand the basic concept of Stability and Equilibrium
2. To understand the physics and derive mathematical expressions for various components, of aircraft towards longitudinal, lateral, and directional stability.
3. To analyze the parameters (neutral point, variation CG) and their implications on Stability.
4. To derive Equations of Rigid Aircraft Six Degrees of Freedom of Motions.
5. To demonstrate an understanding of the basic concept of AFCS, components involved in Aircraft Flight System Control (AFCS), the Principle of functioning of Autopilot, and types of Autopilots.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the basic concept of Stability & Equilibrium and **explain** the contribution of various aircraft components to Longitudinal Stability	PO1	C2			K3	T, F, ASG.
CO2	Be able to **explain** effects of Power on the Neutral Point & CG margin and **understand** the concept of Lateral-Directional Stability	PO1	C2			K3	Midterm, F, ASG.

CO3	Be able to **analyze** the six-degree equations of motion of an aircraft based on the body axis system.	PO2	C4			K4	T, F, ASG.
CO4	Be able to **understand** the Dynamic Modes, AFCS, and Principal function of Autopilot and its variants	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Importance and Significance of Flight Stability and Control: Stability and Equilibrium, Static Longitudinal, Directional, and Lateral stability concerning the aircraft axis systems; Effect of various wings design and secondary control surfaces; Origin of symmetric forces and moments; Static and maneuvering longitudinal stability, equilibrium, and control of rigid aircraft; Effects of various major components on Static Stability, Critical flight conditions, and controls requirement.

Dynamic Stability: The Axes Systems (Inertial, Body and Stability axes) and their Transformations; Treatment of Aircraft Equations of motion/linearization; Aerodynamic load effects of wings; Stability Derivatives; Aircraft Longitudinal Modes; Aircraft Longitudinal and Lateral-directional Modes.

Introduction to Automatic Flight Control System: Introduction to Aircraft Flight Control System (AFCS), Fundamentals of AFCS, Types of AFCS and Components of AFCS, Setup of the flight control system, System Performance Specification: - Requirements on flying and handling qualities and Parameters. Autopilot and its function, Types of Basic Autopilot Systems: Basic Longitudinal Autopilot and Lateral Autopilot Systems

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion Co-operative and Collaborative Method Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Introduction to the Course**	CT1
Class-1	Atmospheric Flight Mechanics and Earth Atmosphere	
Class-2	Aircraft Components and Aircraft Nomenclature	
Class-3	Basic Aerodynamics	
Week 2	**Equilibrium and Stability**	
Class-4	Equilibrium and Stability	
Class-5	Types of stability	
Class-6	Static Vs Dynamic Stability	
Week 3	**Longitudinal Static Stick Fixed Stability**	
Class-7	Criterion for Stability and Contribution of Wing	CT2/ MID TERM
Class-8	Horizontal Tail Contribution	
Class-9	Wing plus Tail Contribution	
Week 4	**Longitudinal Stability and Neutral Point**	
Class-10	Static Margin and CG Limits	
Class-11	Fuselage Contribution	
Class-12	Powerplant Contribution	
Week 5	**Longitudinal Stability and Neutral Point &Longitudinal Control**	
Class-13	Power Effects on Neutral Point	
Class-14	Elevator	
Class-15	Stick Free Stability, Most Forward CG Location	
Week 6	**Longitudinal Control & Longitudinal Maneuverability**	
Class-16	Longitudinal Stick Force per “g”, Ground Effect	
Class-17	Control requirement, Pull up Maneuver, Maneuver point	
Class-18	Elevator per “g”, Maneuver point	

Week 7	**Lateral-Directional Static Stability & Control**	
Class-19	Lateral-Directional Stability Derivates, Fuselage/Vertical Fin Contribution	
Class-20	Roll Stability, Wing Sweep Effect, Rudder	CT2/ MID TERM
Class-21	Dihedral Effect, Various Contribution	
Week 8	**Equations of Rigid Aircraft Six Degree of Freedom of Motions**	
Class-22	Power Effect, Roll Control, Aileron and Tutorial	
Class-23	Derivation of Translational Motion Equations	
Class-24	Derivation of Angular Motion Equations	
Week 9	**Equations of Rigid Aircraft Six Degree of Freedom of Motions (contd)** **&** **Perturbed(Linear) Aircraft Model**	
Class-25	Derivation of Various Forces and Moments	
Class-26	Linearization of Equation	
Class-27	Small Perturbation Method, Linearization of Equation	
Week 10	**Perturbed (Linear) Aircraft Model**	
Class-28	Aerodynamic Force and Moment Derivates	CT3
Class-29	Contribution of Aircraft Components to Aerodynamic Derivates	
Class-30	Linear Model and Aircraft Dynamic Modes	
Week 11	**Longitudinal Dynamic Modes**	
Class-31	Short period, Phugoid (Lanchester's Formulation)	
Class-32	Short Period Mode Approximation	
Class-33	Flying and handling Qualities, Cooper Harper Scale	
Week 12	**Lateral-Directional Dynamic Modes**	
Class-34	Pure Rolling Motion, Pure Yawing Motion, Spiral Approximation	
Class-35	Spiral Roll, Dutch Roll Mode Approximation	
Class-36	Lateral Flying Qualities, Routh's Stability Criterion	
Week 13	**Lateral-Directional Dynamic Modes (contd) &** **Aircraft Response to External Disturbances/Inputs**	
Class-37	Stability in Steady Roll Maneuver	
Class-38	Wind Effect on Aircraft Pure Plunging Motion	
Class-39	Wind Profiles, Longitudinal Mode, Response to Wind Shear	
Week 14	**Introduction to Aircraft Flight Control Systems**	
Class-40	Aircraft Flight Control System and Augmentation	
Class-41	Fundamentals of AFCS and Components of AFCS	
Class-42	Autopilot, Types of Autopilots	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1 CO4	C2
			CO3	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C2
			CO3	C4
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Flight Stability and Automatic Control – Robert C. Nelson
2. Automatic Flight Control – E. H. J. Pallett, Shawn Coyle
3. Fundamentals of Aerodynamics – John D. Anderson
4. Airplane Performance Stability and Control – Courtland D. Perkins and Robert E. Hage
5. Automatic Control of Aircraft and Missiles – John H. Blakelock
6. Dynamics of Flight: Stability and Control - Bernard Etkin, Lloyd Duff Reid

COURSE INFORMATION			
Course Code	: AE 419	Contact Hours	: 3.00
Course Title	: Maintenance Management and Repair of Aircraft	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn the vocabulary, practice, and technologies of Aircraft Maintenance Management.

OBJECTIVE

1. To understand the basic function of an organization/industry and the associated role of an aircraft maintenance engineer.

2. To study the concept, benefits, policies, performance indicators, methods, and techniques of different maintenance programs for proactive and cost-effective approaches to aircraft maintenance.

3. To apply aircraft maintenance principles, procedures, and airworthiness regulations to aircraft maintenance management.

4. To develop decision-making methodologies for components, systems and/ or processes to meet specified requirements, including innovative approaches to synthesis alternative solutions, concepts, and procedures.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** the basic function of Aviation Industry from an Aircraft Maintenance Engineers Perspective	PO1	C1			K3	T/ ASG, F
CO2	Be able to **illustrate** concepts, policies, and practices of Aircraft Maintenance Programs.	PO1	C2			K3	T/Mid Term Exam, F

CO3	Be able to **apply** aircraft maintenance principles, procedures, and airworthiness regulations to aircraft maintenance management.	PO2	C3			K3	T/Mid Term Exam, F
CO4	Be able to **develop** processes and frameworks for Aircraft Maintenance Management.	PO3	C6			K5	T/ ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Maintenance management principles and techniques
maintenance strategies, repair/replacement decision-making, condition monitoring, maintenance management information systems; damage assessment techniques.

Types of aircraft maintenance
Maintenance requirements for various aircraft components; Aero-engine maintenance; Engine overhaul, component life, lubrication, patches and repairs, serviceability of components.

Logistics concepts
Statistics of reliability, availability, maintainability, reparability, life-cycle costing, logistic support analysis, and supply support factors.

Repair of Structures
Practical issues in maintenance and repair of structures and systems, details of maintenance scheduling activities; Advanced methods of maintenance and repair.

Non-Destructive Testing in Aircraft Maintenance
Application of NDI for manufacture and maintenance of structural components in aircraft industry. Different structural failure modes and analysis of the causes failure.re;

Aircraft accident investigation and prevention.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Introduction of an organization**	CT1
Class-1	Organization Structure	
Class-2	Role of different directorates	
Class-3	Role of different directorates	
Week 2	**Introduction to aircraft maintenance**	
Class-4	Definition of aircraft maintenance and activities.	
Class-5	Aircraft maintenance history and objective	
Class-6	Continue	
Week 3	**Aircraft Maintenance Strategies**	CT2/ MID TERM
Class-7	Maintenance Strategies, working assumption and mathematical model	
Class-8	Conditional Maintenance Models	
Class-9	Continue	
Week 4	**Maintenance Management Information Systems**	
Class-10	Functions of Maintenance Management Information Systems	
Class-11	MMIS Structure, MMIS module (Equipment management module, work order control module)	
Class-12	MMIS module (Crafts management module, material supply and control module, performance reporting module, maintenance reporting)	
Week 5	**Aircraft Maintenance Management**	
Class-13	Primary functions of aircraft maintenance.	
Class-14	Secondary functions of aircraft maintenance	
Class-15	Local Factors of aircraft maintenance (Geographical situation, size of plant)	

Week 6	**FMEA (Failure Mode and Effect Analysis)**	
Class-16	Definition, benefits and activities of FMEA	
Class-17	Factors affecting FMEA, Tasks and Process pf FMEA	
Class-18	Evaluation criteria of FMEA with necessary examples.	
Week 7	**FADEC (Full Authority Digital Engine Control System)**	CT2/ MID TERM
Class-19	Definition of FADEC, Digital electronic control and design requirement	
Class-20	Requirement of FADEC, Location of FADEC.	
Class-21	Operation and advantages of FADEC	
Week 8	**Health Monitoring Paradigms**	
Class-22	Taxonomy of maintenance philosophies	
Class-23	Corrective and Emergency Maintenance	
Class-24	Preventive and Predictive maintenance (Condition based and reliability- based maintenance)	
Week 9	**Patches and Repair**	
Class-25	Lap or scab Patch, Flush Patch	
Class-26	Open and closed skin area repair	
Class-27	Design of a patch of different area (pressurized, unpressurized)	
Week 10	**Patches and Repair**	CT3
Class-28	Installation procedure of Rivets	
Class-29	Stresses applied to Rivet, Rivet spacing, Edge Distance of Rivet	
Class-30	Rivet Pitch, Traverse Pitch, and Rivet Layout Example	
Week 11	**NDT (Nondestructive Testing)**	
Class-31	Definition of NDT, Different types of NDT	
Class-32	Visual Inspection, Borescope and Liquid Penetrant Inspection	
Class-33	Eddy Current Inspection, Ultrasonic Inspection	
Week 12	**NDT (Nondestructive Testing)**	
Class-34	Acoustic Emission Inspection, Magnetic Particle Inspection	
Class-35	Radiographic Inspection, Inspection of Composites	
Class-36	Advantages and disadvantages of NDT	
Week 13	**Aircraft Accident Investigation**	
Class-37	Aspects of the Investigation, Group Investigation, Onsite Investigation	
Class-38	Precautionary measures for Investigation, Initial survey of site	
Class-39	Evidence collection, Photographs, Wreckage Distribution, Examination of Aircraft Structure, Power plant, Systems and Maintenance Investigation	
Week 14	**Life Cycle Costing**	
Class-40	Definition, Objective of Maintenance and Maintenance Cost	
Class-41	Maintenance Efficiency, Availability Performance and Productivity	
Class-42	Procedures for reducing maintenance failures	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom's Taxonomy</th></tr>
<tr><td rowspan="8">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO1</td><td>C1</td></tr>
<tr><td>CO3</td><td>C3</td></tr>
<tr><td>CO4</td><td>C6</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td rowspan="2">Mid-Term Assessment (Exam/Project)</td><td rowspan="2">10%</td><td>CO2</td><td>C2</td></tr>
<tr><td>CO3</td><td>C3</td></tr>
<tr style="display:none"></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO1</td><td>C1</td></tr>
<tr><td>CO2</td><td>C2</td></tr>
<tr><td>CO3</td><td>C3</td></tr>
<tr><td>CO4</td><td>C6</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Aircraft Production Technology and Management - S C Keshu and KK Ganapathi; Interline Publishing.

2. Aircraft Maintenance and Repair – kroes; Watkins Delp, McGraw Hill.

3. Aircraft Construction, Repair and Inspection - JOE Christy; Sterling Book House

COURSE INFORMATION			
Course Code	: AE 421	Contact Hours	: 3.00
Course Title	: Aviation Safety	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn about aviation safety procedures and necessary arrangements.

OBJECTIVE

1. To gain knowledge about various types of safety management programs;
2. To understand the human factors in aviation;
3. To learn about risk management and emergency planning;
4. To gain knowledge about accident prevention strategies;
5. To analyze aircraft incidents and accidents in flight for human error.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** safety management programs	PO1	C2			K3	T, F.
CO2	Be able to **plan** for risk management and emergency.	PO1	C3			K3	T, F.
CO3	Be able to **analyze** aircraft incidents and accidents in flight for human error.	PO2	C4			K3	T, F, ASG.
CO4	Be able to **recommend** proactive safety systems for the significant real-life aviation industry	PO6	C5			K7	T, F.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Safety in aviation including aircrew, aircraft, maintenance, management operations and airspace with an emphasis on human performance; Safety management programs.

Human factors in aviation, relationship between the safety and efficiency of an aviation system and the people, tasks, environment and technology - human behavior, information processing, time management and situational awareness; Judgment, decision making, the senses, human error, automation, risk management, and emergency planning.

Role of proactive safety systems – crew resource management, safety culture, operational reporting systems, safety audits, attitudinal and behavioral assessment and other metrics. Illustrate safety concepts, accident prevention strategies, safety culture and safety program evaluation methodology; Practical analysis of aircraft incidents and accidents in flight safety.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Safety in aviation**	CT1
Class-1	Safety in aviation including aircrew, aircraft	
Class-2	Safety in aviation including maintenance	
Class-3	Safety in aviation including management operations and airspace	
Week 2	**Human performance**	
Class-4	Emphasis on human performance	
Class-5	Safety issues	
Class-6	Safety management programs	
Week 3	**Human factors in aviation**	CT2/ MID TERM
Class-7	Human factors in aviation	
Class-8	Relationship between the safety and efficiency of an aviation system	
Class-9	Relationship between the safety and efficiency of the people	

Week 4	**Human behavior**	
Class-10	Environment and technology - human behavior	
Class-11	Continue	
Class-12	Information processing	
Week 5	**STIMULI**	
Class-13	Time management and situational awareness	
Class-14	Human limitations	
Class-15	Human senses	
Week 6	**Decision Making**	
Class-16	Judgment	
Class-17	Decision making	
Class-18	Continue	
Week 7	**Decision Making**	
Class-19	Human error	CT2/ MID TERM
Class-20	Continue	
Class-21	Error due to the senses	
Week 8	**Risk management**	
Class-22	Automation	
Class-23	Classification of risk	
Class-24	Risk management	
Week 9	**Emergency planning**	
Class-25	Introduction	
Class-26	Classification of emergency situation	
Class-27	Emergency planning	
Week 10	**Role of proactive safety systems**	CT3
Class-28	Details about Protective safety system	
Class-29	Crew resource management	
Class-30	Safety culture	
Week 11	**Role of proactive safety systems**	
Class-31	Operational reporting systems	
Class-32	Safety audits	
Class-33	Attitudinal and behavioral assessment and other metrics.	
Week 12	**Safety concepts**	
Class-34	Safety concepts	
Class-35	Continue	
Class-36	Analogy of safety concept.	
Week 13	**Accident prevention strategies**	
Class-37	Case study of different accidents	
Class-38	TCAS system	
Class-39	Safety culture and safety program evaluation methodology	
Week 14	**Practical analysis**	
Class-40	Practical analysis of aircraft incidents and accidents in flight safety.	
Class-41	Continue	
Class-42	Review	

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
			CO4	C5
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C3
			CO3	C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C3
			CO3	C4
			CO4	C5
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. Commercial Aviation Safety, 5th Edition by Clarence Rodrigues.
2. Beyond Aviation Human Factors by Daniel E. Maurino.
3. How Safe is Safe Enough? Leadership, Safety and Risk Management by Gregory Alston.

COURSE INFORMATION			
Course Code	: AE 423	Contact Hours	: 3.00
Course Title	: Aerospace Management	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn about how the aviation sector and related areas are coordinated and organized.

OBJECTIVE

1. To learn the basic knowledge about the airline management incorporating flight mechanics and aircraft handling.
2. To analyze the various human factors involving the aircraft flight operations.
3. To ensure the flight safety by actively considering the effect of contemporary flight regulations.
4. To analyze the associated risk and reliability in relation to airworthiness standards.
5. To incorporate emergency procedure management and risk management, accident investigation and dispatch reliability management.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the fundamental technical aspects of flight mechanics and safety management for aviation	PO1	C2			K3	T, F
CO2	Be able to **explain** flight separation for military and civil aircrafts	PO1	C2			K3	T, F

CO3	Be able to **plan** for technical crew, scheduling as well as military and civil operations	PO2	C3			K4	T, F, ASG
CO4	Be able to **recommend** proactive safety systems for significant real-life aviation industry	PO6	C5			K7	T/ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to aerospace management; Principles and practice of aviation, air traffic services and airline management incorporating flight mechanics and aircraft handling; Analysis of airline operations; Basic human factors and systematic safety issues involving aircraft accident case; Classification and use of civil and military airspace; Aspects of flight separation, aircraft performance and basic meteorology.

Civil aviation activities include engineering and maintenance, technical crew planning and scheduling; Airport and airfield planning for military and civil operations, operations control issues; Aviation regulations and safety; Flight safety and airworthiness standards; Risk and reliability management; Certification procedures and standards; Emergency procedure management and risk management, accident investigation and dispatch reliability management.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-centred Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Introduction to aerospace management**	CT1
Class-1	Organization Structure	
Class-2	Aerospace management	
Class-3	Role of different directorates	
Week 2	**Principles and practice of aviation**	
Class-4	Air traffic services	
Class-5	Airline management	
Class-6	Aircraft maintenance history and objective	
Week 3	**Airline management incorporating flight mechanics**	CT2/ MID TERM
Class-7	Maintenance Strategies, working assumption and mathematical model	
Class-8	Continue	
Class-9	Conditional Maintenance Models	
Week 4	**Airline management incorporating aircraft handling**	
Class-10	Functions of Maintenance Management Information Systems	
Class-11	Human Factors in Aviation	
Class-12	MMIS module (Crafts management module, material supply and control module, performance reporting module, maintenance reporting)	
Week 5	**Flight separation**	
Class-13	Classification and use of civil and military airspace	
Class-14	Aspects of flight separation	
Class-15	Continue	
Week 6	**Aircraft performance**	
Class-16	Aircraft performance regarding flight mechanics	
Class-17	Continue	
Class-18	Continue.	
Week 7	**Basic meteorology**	CT2/ MID TERM
Class-19	Weather condition	
Class-20	Different meteorology	
Class-21	Continue	
Week 8	**Civil aviation activities**	
Class-22	Civil aviation activities	
Class-23	Civil aviation activities including engineering	
Class-24	Risk management	
Week 9	**Civil aviation maintenance**	
Class-25	Introduction	
Class-26	Maintenance of aircraft components	
Class-27	Emergency planning	
Week 10	**Technical crew planning**	

Class-28	Technical crew planning and scheduling	CT3
Class-29	Crew resource management	
Class-30	Safety culture	
Week 11	**Airport and airfield planning for military and civil operations**	
Class-31	Airport planning for military operations	
Class-32	Airfield planning for military operations	
Class-33	Airport planning for civil operations	
Week 12	**Airport and airfield planning for military and civil operations**	
Class-34	Airfield planning for civil operations	
Class-35	Continue	
Class-36	Operations control issues	
Week 13	**Aviation regulations and safety**	
Class-37	Aviation regulations and safety	
Class-38	Flight safety and airworthiness standards	
Class-39	Risk and reliability management	
Week 14	**Management**	
Class-40	Emergency procedure management and risk management,	
Class-41	Accident investigation and dispatch reliability management.	
Class-42	Review	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C2
			CO3	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
			CO3	C3
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C2
			CO3	C3
			CO4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Commercial Aviation Safety, 5th Edition by Clarence Rodrigues.
2. Beyond Aviation Human Factors by Daniel E. Maurino.
3. How Safe is Safe Enough? Leadership, Safety and Risk Management by Gregory Alston.

COURSE INFORMATION			
Course Code Course Title	: AE 431 : Weapon Engineering	Contact Hours: Credit Hours:	3.00 3.00

PRE-REQUISITE

Course Code & Title:
1. AEAS 103 (Fundamentals of Aeronautical Engineering), AEAV 203 (Electronics-I),
2. AEAS 337 (Aerospace Propulsion)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is an Elective course but mandatory for the military student officers. This course is offered to impart knowledge on Properties, performance of explosives & explosive train used in weapon system, Warhead technologies, features of Fuses/Safety/arming devices, Theory of propulsion, Principles of missile flight & guidance, Precision guided munitions etc. are also covered.

OBJECTIVE

1. To understand properties, performance, features of explosives used in weapon system.
2. To understand and analyze anatomy of high explosive & warhead technology
3. To understand working principle of arming devices and analyze theory of propulsion applicable in weapon engineering.
4. To analyze missile flight dynamics and missile guidance techniques.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** development, properties, performance & features of explosives used in weapon system.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **understand** and **analyze** anatomy of high explosive, its structural design & modeling of warhead with its classification.	PO2	C4			K3	Mid Term, T, F.

CO3	Be able to **understand** Mechanical/ Electrical fuses used in land service & aerial weapons and to **analyze** theory of propulsion applicable in weapon engineering.	PO1	C4			K4	Mid Term, T, F.
CO4	Be able to **analyze** aerodynamics of slender bodies, wings, principles of missile flight and missile guidance phases & techniques,	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Properties & Performance of explosives: Heat & temperature of explosion, oxygen balance, Pressure of explosion, Power Index, brisance, related tests, detonation velocity, Explosive train.

Features of explosives: Compatibility, stability and their measuring tests, Sensitivity and sensitiveness of explosives.

Classification of Explosives: Initiator, Booster, Main filling, compound explosives, UN Hazard division and hazard classification.

Safe Storage of Explosives: Concept of Quantity distances, Traverses in explosive storage area.

Warhead technology: Anatomy of high explosive blast, warhead geometry, structural design & modeling.

Classification of warheads: Blast warhead, Shaped charged warhead, Kinetic Energy Rod and fragmentation warheads.

Fuzes, Safety/arming devices : Impact, Delay, Air burst, Proximity, Hydrostatic Fuses, Construction and working of different Fuses.

Theory of propulsion: Specific impulse, Classification of propellants, Gun/Rocket propellants, Solid, Liquid and hybrid propellants, Cryogenic propellants, Additives used in propellant.

Principles of missile flight & guidance: Components of a guided missile, Types of guided missile, Missile guidance phases, techniques. Homing guidance, Command guidance, Inertial Guidance, Terrain Correlation Matching (TERCOM), INS aided with GPS guidance technique.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	History & development of military explosives, Chemistry of explosives, nature of explosions.	
Class-2	Factors affecting explosion process, related definitions, application of explosives (military & industrial engineering).	
Class-3	Properties of explosives, Classification of explosives used in weapon system.	
Week 2		
Class-4	Performance of explosives, heat & temperature of explosion, oxygen balance, Pressure of explosion.	
Class-5	Power Index, brisance, related tests, rate of burning, detonation velocity & pressure.	
Class-6	Explosion process, Explosive train.	
Week 3		CT2/ MID TERM
Class-7	Features of explosives – compatibility, stability and their measuring tests.	
Class-8	Sensitivity and sensitiveness of explosives, factors affecting sensitivity of explosives.	
Class-9	Video demonstration on explosive science, generation of shock wave etc.	
Week 4		
Class-10	Initiator, Booster explosives; properties, relative comparison & examples.	
Class-11	Bursting, mixed, plastic explosives; properties, relative comparison & examples.	
Class-12	UN International classification of dangerous goods, Hazard division and hazard classification.	

Week 5		
Class-13	UN International Explosive Storage Compatibility groups and compatibility of explosives	
Class-14	Concept of Quantity distances for safe storage and operation,	
Class-15	Traverses in explosive storage area for safe storage of explosives; Types of traverses.	
Week 6		
Class-16	Warhead technology, anatomy of high explosive blast.	
Class-17	Weapon shape considerations; warhead geometry.	
Class-18	Blast analysis, structural design & modeling.	
Week 7		
Class-19	Classification of warheads, Blast warhead	CT2/ MID TERM
Class-20	Shaped charged warhead, Monroe Effect, Hollow charge principles.	
Class-21	Kinetic Energy Rod and fragmentation warheads.	
Week 8		
Class-22	Fuzes, initiators, safety/arming devices used in weapon engineering.	
Class-23	Impact, Delay, Air burst, Proximity, Hydrostatic Fuzes.	
Class-24	Construction and working of Pistol with single safety.	
Week 9		
Class-25	Construction and working of typical Fuze with more than one safety.	
Class-26	Construction and working of M-6 Mechanical nose fuze used in Mortar weapon.	
Class-27	Construction and working of Fuze AMV-AE-2 Mechanical impact Fuze with electrical initiating device used in Aircraft bomb.	
Week 10		CT3
Class-28	Theory of propulsion, Specific impulse, Parts & Types of propulsion system.	
Class-29	Classification of propellants, Gun/Rocket propellants, Solid, Homogeneous, Heterogeneous propellants	
Class-30	Liquid and hybrid propellants, Cryogenic propellants.	
Week 11		
Class-31	Additives added in the solid propellants, Stabilisers, Plasticisers, Moderants, lubricants etc.	
Class-32	Aerodynamics and dynamics of slender bodies and wings; Construction & functioning of typical rocket, Spin and fin stabilization.	
Class-33	Principles of missile flight & guidance; Components of a guided missile,	
Week 12		
Class-34	Types of guided missile on the basis of Target, launching method, guidance, trajectory, aerodynamics etc.	
Class-35	Missile guidance phases, Command guidance techniques.	
Class-36	Missile guidance-Homing guidance techniques; Active Homing Guidance system.	
Week 13		
Class-37	Semi-active Homing Guidance, Passive Homing Guidance system.	
Class-38	Inertial Guidance techniques, Inertial Navigation System (INS), Advantages, disadvantages.	
Class-39	Advanced guidance and sensor systems, Terrain Correlation Matching (TERCOM) technique, INS aided with GPS technique.	

Week 14		
Class-40	Precision Guided Munitions (PGM), Electro-Optical/TV Guided system, Laser guided system etc.	
Class-41	Basics of Electronic warfare techniques.	
Class-42	Revisions of the course contents.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO3	C4
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C4
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Brassey's Series Book on Explosives, Propellants and Pyrotechnics–A Bailey, S.G. Murray
2. Explosive Engineering–P. W Cooper.
3. Conventional Warhead Systems Physics and Engineering Design – R. M. Lloyd
4. Guided missiles – T.V. Karthikeyan and A.K. Kapoor
5. Missile Guidance and Control systems–George M Siouris.
6. Recommendations on Transport of Dangerous Goods – United Nations Orange Book

COURSE INFORMATION

Course Code	: AE 445	Contact Hours	: 3.00
Course Title	: Advanced Computational Fluid Dynamics	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. AE 325: Computational Fluid Dynamics
   Or,
2. AEAV 425: Fundamentals of Computational Fluid Dynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to equip students with a deep understanding of computational fluid dynamics (CFD), enabling them to apply numerical methods, solver development techniques, and turbulence modeling to solve complex fluid flow problems. By integrating theory with practical software applications, it prepares students to effectively analyze and interpret CFD simulations, bridging the gap between academic knowledge and real-world engineering challenges.

OBJECTIVE

1. To understand and apply foundational and advanced numerical methods, for modeling and solving CFD models.
2. To acquire and implement solver development skills, focusing on algorithm optimization and the use of parallel computing, to improve the efficiency and accuracy of CFD simulations.
3. To comprehend and articulate the principles of turbulence modeling, employing traditional, advanced, and hybrid methodologies such as RANS, LES, and DNS to simulate turbulent flows accurately.
4. To develop the competency to execute a comprehensive CFD analysis using specialized software, encompassing all steps from mesh generation and solver selection to the post-processing of results for detailed interpretation and evaluation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** numerical methods such as the Lax Method, Lax-Wendroff Method, and Crank-Nicolson Method to develop and solve computational fluid dynamics (CFD) models.	PO2	C3			K4	T, F, ASG.

CO2	Be able to **implement** solver development techniques, including algorithm optimization and parallel computing, to enhance the efficiency and accuracy of CFD simulations.	PO2	C3			K4	T, F, ASG.
CO3	Be able to **explain** turbulence modeling using traditional, advanced, and hybrid approaches, applying different methodologies such as RANS, LES, and DNS.	PO1	C2			K3	T, F, Exam.
CO4	Be able to **solve** a comprehensive CFD problem using software, integrating mesh generation, solver selection, and post-processing techniques to analyze and interpret the simulation results.	PO2	C3			K4	T, F, Mid Term, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Lax Method, Lax-Wendroff Method, ADI Method, Leapfrog Method, Crank-Nicolson Method, Dispersion and Dissipation Errors, Beam and Warming Methods, Approximate Factorization, Block Tridiagonal Matrices, Flux Vector Splitting, High-resolution Schemes: TVD and Flux Limiters, Multigrid Method, Adaptive Meshing, Solver Development Techniques: Framework Design, Algorithm Optimization, Parallel Computing for CFD, Code Validation and Verification, Introduction to Turbulence and Turbulent Flows, Traditional Turbulence Modeling, Advanced Turbulence Modeling, Hybrid Turbulence Approaches: Blending RANS and LES, Introduction to Reynolds-averaged Navier Stokes (RANS) Simulations, Large-eddy Simulation (LES), Direct Numerical Simulation (DNS) for Turbulence.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Lax Method	
Class-2	Lax-Wendroff Method	
Class-3	ADI Method	
Week 2		
Class-4	Leapfrog Method	
Class-5	Crank-Nicolson Method	
Class-6	Dispersion and Dissipation Errors	
Week 3		
Class-7	Beam and Warming Methods	CT2/ MID TERM
Class-8	Approximate Factorization	
Class-9	Block Tridiagonal Matrices	
Week 4		
Class-10	Flux Vector Splitting	
Class-11	High-resolution Schemes: TVD	
Class-12	High-resolution Schemes: Flux Limiters	
Week 5		
Class-13	Multigrid Method	
Class-14	Adaptive Meshing	
Class-15	Solver Development Techniques: Framework Design	
Week 6		
Class-16	Algorithm Optimization	
Class-17	Parallel Computing for CFD	
Class-18	Code Validation and Verification	
Week 7		
Class-19	Introduction to Turbulence and Turbulent Flows	
Class-20	Traditional Turbulence Modeling	CT2/ MID
Class-21	Advanced Turbulence Modeling	

Week 8		TERM
Class-22	Hybrid Turbulence Approaches: Blending RANS and LES	
Class-23	Introduction to RANS Simulations	
Class-24	Large-eddy Simulation (LES)	
Week 9		
Class-25	Direct Numerical Simulation (DNS) for Turbulence	
Class-26	Case Study: Applying Lax and Lax-Wendroff Methods	
Class-27	Case Study: Implementing the ADI and Leapfrog Methods	
Week 10		CT3
Class-28	Crank-Nicolson Method Application	
Class-29	Solving Dispersion and Dissipation Challenges	
Class-30	Beam and Warming Method Implementation	
Week 11		
Class-31	Developing Solvers with Approximate Factorization	
Class-32	Advanced Flux Vector Splitting Techniques	
Class-33	Implementing TVD and Flux Limiters in CFD Codes	
Week 12		
Class-34	Multigrid Method Optimization	
Class-35	Strategies for Effective Adaptive Meshing	
Class-36	Solver Development and Algorithm Optimization	
Week 13		
Class-37	Parallel Computing Techniques in CFD	
Class-38	Code Validation and Verification Processes	
Class-39	Turbulence Modeling Techniques	
Week 14		
Class-40	Hybrid Turbulence Modeling Applications	
Class-41	RANS vs. LES for Turbulence Simulation	
Class-42	Challenges in DNS for Turbulence	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C3
			CO2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO4	C3
Final Examination (Section A & B)		60%	CO1	C3
			CO2	C3
			CO3	C2
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. "Computational Fluid Dynamics: The Basics with Applications" by John D. Anderson, Jr.
2. "An Introduction to Computational Fluid Dynamics: The Finite Volume Method" by H.K. Versteeg and W. Malalasekera
3. "Numerical Heat Transfer and Fluid Flow" by Suhas V. Patankar
4. "Turbulence Modeling for CFD" by David C. Wilcox
5. "Large Eddy Simulation for Incompressible Flows: An Introduction" by P. Sagaut
6. "MATLAB Programming for Engineers" by Stephen J. Chapman

COURSE INFORMATION			
Course Code	: AE 449	Contact Hours	: 3.00
Course Title	: Advanced Space Engineering	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. AE 447: Space Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to formulate engineering views about space missions, architecture of spacecraft and evaluation and cost estimation of space missions.

OBJECTIVE

1. To identify the critical aspects of the objectives of space mission.
2. To acquire skills for designing space mission architecture.
3. To develop consciousness of launch and space environments.
4. To carry out systematic and analytic mission evaluation and cost estimation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **interpret** the critical objectives of space missions, recognizing key mission drivers and constraints.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **explain** the critical aspects of spacecraft architecture definition, including payload design and subsystem integration, and the impact of launch and space environments on mission success.	PO2	C2			K3	T, F, ASG.

CO3	Be able to **apply** systems engineering methodologies to devise conceptual designs for space missions, focusing on subsystem design across power, ADCS/GNC, communication, propulsion, CDH, thermal, and structural components.	PO2	C3			K4	T, F, Mid Term Exam.
CO4	Be able to **evaluate** the feasibility, technical requirements, and financial aspects of space missions, including conducting thorough analytic assessments of mission viability, operational risks, and cost estimations.	PO2	C5			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Basic mission objectives, principles and practical methods for mission design and operations in depth, initial requirements definition, operations concept development, architecture trade-offs, payload design, bus sizing, subsystem definition, system manufacturing, verification and operations, launch & space environments, ascent/entry, launch system services, derived requirements and critical interfaces, induced environments, spacecraft architecture definition, payload design, derived & allocated requirements, functional architecture, current technologies subsystem design (power, ADCS/GNC, comm, propulsion, CDH, thermal, structures/configuration), system realization, mission evaluation, technical risk assessment and cost estimation.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - - Total 42
Self-Directed Learning	
Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.	

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Basic mission objectives.	
Class-2	Principles and practical methods for mission design.	
Class-3	Operations in depth.	
Week 2		
Class-4	Initial requirements definition.	
Class-5	Operations concept development.	
Class-6	Architecture trade-offs.	
Week 3		CT2/ MID TERM
Class-7	Payload design.	
Class-8	Bus sizing.	
Class-9	Subsystem definition.	
Week 4		
Class-10	System manufacturing.	
Class-11	Verification and operations.	
Class-12	Launch & space environments.	
Week 5		
Class-13	Ascent/entry, launch system services.	
Class-14	Continue	
Class-15	Continue	
Week 6		
Class-16	Derived requirements and critical interfaces.	
Class-17	Continue	
Class-18	Continue	
Week 7		
Class-19	Radiation environment & plasma environment.	
Class-20	Induced environments	
Class-21	Continue	

Week 8		CT2/ MID TERM
Class-22	Induced environments.	
Class-23	Spacecraft architecture definition.	
Class-24	Continue	
Week 9		
Class-25	Payload design, derived & allocated requirements.	
Class-26	Continue	
Class-27	Continue	
Week 10		CT3
Class-28	Functional architecture.	
Class-29	Continue	
Class-30	Continue	
Week 11		
Class-31	Current technologies subsystem design (power, adcs/gnc, comm).	
Class-32	Continue	
Class-33	Continue	
Week 12		
Class-34	Propulsion, cdh.	
Class-35	Thermal structures/configuration.	
Class-36	System realization.	
Week 13		
Class-37	Mission evaluation.	
Class-38	Technical risk assessment.	
Class-39	Cost estimation.	
Week 14		
Class-40	Review	
Class-41	Continue	
Class-42	Continue	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C2
			CO3	C3
			CO4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS
1. Elements of Spacecraft Design - Charles D. Brown 2. Satellite Technology Principles and Applications - Anil K. Maini and Varshaagrawal 3. Space Mission Analysis and Design - Wiley J. Larson and James R. Wertz 4. Spacecraft Systems Engineering- Peter Fortescue, John Stark and Graham Swinerd

COURSE INFORMATION			
Course Code	: AE 455	Contact Hours	: 3.00
Course Title	: Human Performance and Limitations	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn about Human Performance and Limitations in order to improve Safety Standards.

OBJECTIVE

1. To learn about some historic aircraft accidents and associated Human Factors
2. To understand the factors affecting Human Performance.
3. Understanding how Engineers work as a Part of the technical and Social Ecosystem.
4. To identify potential risks and hazards and improve Safety Standards.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **identify** human factors and its associated models	PO1	C1			K3	T, F, ASG
CO2	Be able to **interpret** the limitations and affecting factors of human performance	PO1	C2			K3	T, F, ASG
CO3	Be able to **label** various sorts of human errors in the workplace for avoiding them	PO1	C1			K3	T, F, ASG

CO4	Be able to **organize** work and organizational environments for identifying hazards and safety risks	PO2	C4			K3	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fundamental Human Factors Concept: Understand the term human factor, the need take human factors into account, incidents attributable to human factors/human error, human factors applications in aviation operations.

Human performance and limitation: Vision, Hearing, Information and protection, memory, claustrophobia and physical access.

Social Psychology & Responsibilities: Individual and group, motivation and de-motivation, peer pressure, culture issues, team working, management, supervision and leadership.

Factors affecting performance: Fitness/health, Stress: domestic and works related, time pressure and deadline, workload, overload, sleep and fatigue, shift work, alcohol, medication, drug use, use of psychoactive, substances, restriction on exercising privileges of license/ authorization under influence psychoactive substance (reference ANO D.3)

Physical Environment, Management and Organization: Noise and fumes, illumination, climate and temperature, motion and vibration, working environment, management‘s contribution to safety, allocation of resources, safe and unsafe organization. Takes: physical work, repetitive tasks, visual inspection, and complex systems.

Communication: Within and between teams, work logging and recording, keeping up to date, currency, dissemination of information, terms and organizational issues in aircraft maintenance.

Human Error: Error models including the SHEL and Reason models, and theories, Murphy‘s law, human error in aircraft maintenance inspection including selected case studies, implications of error, error prevention considerations and strategies, avoiding and managing errors.

Hazards in workplace: Recognizing and avoiding hazards, dealing with emergencies.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	1 Meaning Of Human Factors 1.2 Scope Of Human Factors And Error Management 1.3 Human Factors Models	
Class-2	1.4 Human Factors In Aviation 1.5 Origins Of Human Factors In Aviation 1.6 The Relationship Between Human Factors And Ergonomics.	
Class-3	1.7 The Importance Of Human Input Into Aircraft Maintenance Activities 1.8 The Importance Of An Effective Human Factors Program In A Maintenance Organisation. 1.9 An Integrated Approach To Human Factors And Safety	
Week 2		
Class-4	1.10 The Cost Effectiveness of Implementing HF Programs In Organisations. 1.11 Regulatory Aspects Of Human Factors In Aviation Engineering 1.12 The Importance Of Training In Reducing Maintenance Errors	
Class-5	2.0 Introduction 2.1 Human Factors Behind Accidents/Incidents: Some Statistics	
Class-6	2.2 An Outline of Incidents/Accidents Attributable To Human Factors / Human Errors 2.3 Appreciation Of Human Factors Behind Accidents And Incidents	
Week 3		CT2/ MID TERM
Class-7	3.0 Introduction 3.1 Human In The HF Model 3.2 Human Performance As Part Of The Maintenance Engineering System	

Class-8	3.3 Vision 3.4 Hearing 3.3 Listening Process	
Class-9	3.6 Information Processing 3.7 Claustrophobia, Physical Access And Fear of Heights 3.8 Performance Shaping Factors	
Week 4		
Class-10	4.1 Introduction 4.2 The Social Environment 4.3 Responsibility: Individual And Group	
Class-11	4.4 Motivation And De Motivation 4.5 Peer Pressure	
Class-12	4.6 Culture Issues 4.7 Team Working	
Week 5		
Class-13	4.8 Management, Supervision And Leadership 4.9 Maintenance Resource Management	
Class-14	5.0 Introduction 5.1 Fitness And Health	
Class-15	5.2 Stress: Domestic And Work Related 5.3 Time Pressure And Deadlines	
Week 6		
Class-16	5.4 Workload-Overload and Underload 5.5 Sleep, Fatigue and Shift Work 5.6 Alcohol, Medication and Drug Abuse	
Class-17	6.0 Introduction 6.1 Noise	
Class-18	6.2 Fumes 6.3 Illumination	
Week 7		
Class-19	6.4 Climates and Temperature	
Class-20	6.5 Motion and Vibration	
Class-21	6.6 Working Environment	
Week 8		
Class-22	7.0 Introduction 7.1 Physical Work	
Class-23	7.2 Repetitive Tasks 7.3 Visual Inspection	CT2/ MID TERM
Class-24	7.4 Complex Systems	
Week 9		
Class-25	8.0 Introduction 8.1 Process of Communication	
Class-26	8.2 Modes of Communication	
Class-27	8.3 Communication Within and Between Teams	
Week 10		
Class-28	8.4 Communication Problems	
Class-29	8.5 Work Logging and Recording	
Class-30	8.6 Keeping Up-To-Date	
Week 11		CT3
Class-31	8.7 Dissemination of Information	
Class-32	9.0 Introduction 9.1 Error Models and Theories	

Class-33	9.2 Types of Error In Maintenance Tasks	
Week 12		
Class-34	9.3 IMPLICATIONS OF ERRORS (I. E. ACCIDENTS)	
Class-35	9.4 Avoiding and Managing Errors	
Class-36	Continue.	
Week 13		
Class-37	10.0 Introductions 10.1 Potential Hazards in Aircraft Maintenance Engineering	
Class-38	10.2 Relevant Legislation and The Maintenance Organization's Responsibilities	
Class-39	10.3 Engineer's Individual Responsibilities 10.4 Dealing with Emergencies	
Week 14		
Class-40	11.0 Introduction	
Class-41	11.1 Situation Awareness in Workplace	
Class-42	Review Of Whole Syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1
			CO2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C1
Final Examination (Section A & B)		60%	CO1	C1
			CO2	C2
			CO3	C1
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Human Factors for Aviation Maintenance - An EASA Part 66/147 approved manual on Human Factors; Aircraft Technical Book Co.
2. Human Performance and Limitations - Trevor Thom
3. Human Performance and Limitations in Aviation – R. D. Campbell, Michael Bagshaw

COURSE INFORMATION			
Course Code	: AE 457	Contact Hours	: 3.00
Course Title	: Airworthiness Legislation	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn about aircraft licensing and certifications.

OBJECTIVE

1. To Know about the legislative and regulatory framework of national and international aviation authorities and the relationship between them.
2. To Understand the role of Part-66 and Part-145 guidance material and their use in complying with the airworthiness requirements and maintenance regulations of EASA.
3. To Understand aircraft operation and certification requirements and the associated documentation.
4. To Analyze the applicable National and International requirements and the EASA Part-M regulation for the continued airworthiness and maintenance of aircraft.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** the legislative and regulatory framework of national and international aviation authorities and the relationship between them.	PO1	C1			K3	T, F.
CO2	Be able to **explain** the role of Part-66 and Part-145 guidance material and their use in complying with the airworthiness requirements and maintenance regulations of EASA.	PO1	C2			K3	T, F, Mid Term Exam.

CO3	Be able to **explain** aircraft operation, certification requirements and the associated documentation.	PO1	C2			K3	F, Mid Term Exam.
CO4	Be able to **analyze** the applicable National and International requirements and the EASA Part-M regulation for the continued airworthiness and maintenance of aircraft.	PO2	C4			K3	T, F.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Regulatory Framework:
Role of International Civil Aviation Organization; Articles, Annexes & SARPS,
Role of CAAB and general understanding of civil aviation regulations;
Civil Aviation Rules 1984;
Air Navigation Orders (Airworthiness Requirements);
Relationship between PART-145, PART-66, PART-147 and PART-M,

Certifying Staff- Maintenance:
Detailed understanding of PART-66.

Approved Maintenance Organizations:
Detailed understanding of PART-145 and Part-M Subpart F.

Air Operations:
Air Operators Certificates;
Operators Responsibilities; in particular regarding continuing airworthiness and maintenance;
Aircraft Maintenance Programmed;
MEL/CDL
Documents to be Carried on board,
Aircraft Placarding (Markings);

Certification of Aircraft, parts and appliances
(a) General:
Certification rules: Type Certification; Supplemental Type Certification;
Design standards,
Certificate of Type Approval.
(b) Documents:
Certificate of Airworthiness; Certificate of Registration; Noise Certificate;
Weight Schedule; Flight Manual; Radio Station Licence and Approval.

Continuing Airworthiness:
Detail understanding of design certification provisions to continuing airworthiness.
Detailed understanding of PART-M.

Other Applicable Requirements for
(a) Maintenance Programs, Maintenance checks and inspections;
Master Minimum Equipment Lists, Minimum Equipment List, Dispatch Deviation Lists;
Mandatory Aircraft Equipment, Airworthiness Directives;
Service Bulletins, manufacturers service information;
Modifications and repairs; Maintenance documentation: maintenance manuals, structural repair manual, illustrated parts catalogue, etc.;
Only for A to B2 licences:
Master Minimum Equipment Lists, Minimum Equipment List, Dispatch, Deviation Lists;
(b) Continuing airworthiness;
Minimum equipment requirements - Test flights;
Only for B1 and B2 licences: ETOPS, maintenance and dispatch requirements;
All Weather Operations, Category 2/3 operations.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Regulatory Framework**	
Class-1	Role of International Civil Aviation Organization; Articles, Annexes & SARPS,	
Class-2	Role of CAAB and general understanding of civil aviation regulations;	
Class-3	Civil Aviation Rules 1984;	

Week 2	**Civil Aviation Rules 1984**	CT1
Class-4	Rules of the Air Aviation Meteorology Aeronautical Charts Units of Measurement Operation of Aircraft Registration and Marking of Aircraft	
Class-5	Airworthiness Requirements Facilitation Aeronautical Telecommunications Air Traffic Services Search and Rescue Aerodromes and Airports	
Class-6	Aeronautical Information Services Aircraft Noise Safeguard Against Acts of Unlawful Interference	
Week 3	**Air Navigation Orders (Airworthiness Requirements)**	CT2/ MID TERM
Class-7	Relationship between PART-145, PART-66, PART-147 and PART-M,	
Class-8	Certifying Staff- Maintenance	
Class-9	Detailed understanding of PART-66	
Week 4	**Approved Maintenance Organizations**	
Class-10	Detailed understanding of PART-145	
Class-11	Detailed understanding of PART-145	
Class-12	Detailed understanding of Part-M Subpart F	
Week 5	**Air Operations:**	
Class-13	Air Operators Certificates;	
Class-14	Operators Responsibilities; in particular regarding continuing airworthiness and maintenance;	
Class-15	Aircraft Maintenance Programmed;	
Week 6	**Air Operations:**	
Class-16	MEL/CDL	
Class-17	Documents to be Carried on board	
Class-18	Aircraft Placarding (Markings);	
Week 7	**Certification of Aircraft, parts and appliances**	
Class-19	a) General: Certification rules: Type Certification; Supplemental Type Certification;	CT2/ MID TERM
Class-20	Design standards, Certificate of Type Approval.	
Class-21	b) Documents: Certificate of Airworthiness; Certificate of Registration;	
Week 8	**Certification of Aircraft, parts and appliances**	
Class-22	Noise Certificate; Weight Schedule;	
Class-23	Flight Manual;	
Class-24	Radio Station License and Approval.	

Week 9	**PART 66- Aircraft Maintenance License** **PART 145- Approved Maintenance Organization**	
Class-25	Chapter 2: Procedures for Competent Authority & Acceptable Means of Compliance (Section B)	
Class-26	Part 145-Chapter 1: Regulations & Acceptable Means of Compliance (Section A)	
Class-27	Chapter 2: Procedures for Competent Authority & Acceptable Means of Compliance (Section B)	
Week 10	**PART 147- Approved Maintenance Training Organizations**	CT3
Class-28	Chapter 1: Regulations	
Class-29	Chapter 2: Acceptable Means of Compliance to Part-147	
Class-30	Chapter 3: Guidance Material to Part-147, Chapter 4: National Variants	
Week 11	**Continuing Airworthiness:**	
Class-31	Detail understanding of design certification provisions to continuing airworthiness.	
Class-32	Detailed understanding of PART-M.	
Class-33	Detailed understanding of PART-M.	
Week 12	**Other Applicable Requirements for**	
Class-34	(a) Maintenance Programs, Maintenance checks and inspections;	
Class-35	Master Minimum Equipment Lists, Minimum Equipment List, Dispatch Deviation Lists;	
Class-36	Mandatory Aircraft Equipment, Airworthiness Directives;	
Week 13	**Other Applicable Requirements for**	
Class-37	Service Bulletins, manufacturers service information;	
Class-38	Modifications and repairs; Maintenance documentation: maintenance manuals, structural repair manual, illustrated parts catalogue, etc.;	
Class-39	Only for A to B2 licenses: Master Minimum Equipment Lists, Minimum Equipment List, Dispatch, Deviation Lists;	
Week 14	**Other Applicable Requirements for**	
Class-40	(b) Continuing airworthiness; Minimum equipment requirements - Test flights;	
Class-41	Only for B1 and B2 licenses: ETOPS, maintenance and dispatch requirements; All Weather Operations, Category 2/3 operations.	
Class-42	Review	

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1
			CO2	C2
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2 CO3	C2
Final Examination (Section A & B)		60%	CO1	C1
			CO2	C2
			CO3	C2
			CO4	C4
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. ANO (Air Navigation Order) (Updated by CAAB)
2. CAR (Civil Aviation Rules) 1984

COURSE INFORMATION			
Course Code	: AE 459	Contact Hours	: 3.00
Course Title	: Entrepreneurship Development	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn how to Start, Organize and successfully Manage a new Business Venture.

OBJECTIVE

1. To be able to learn and apply skills and managerial quality needed for entrepreneurship.
2. To use the knowledge of market research to investigate the opportunities to nurture a new business idea.
3. To be able to plan effectively for financial and human resource development in order to solidify the newly started business.
4. To be able to analyze Business Performance.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** understanding of Entrepreneurial Concepts and its roles in Business	PO11	C3			K7	T/ ASG, F
CO2	Be able to **apply** market research knowledge to investigate new opportunities for Business.	PO11	C3			K7	T/Mid Term Exam, F
CO3	Be able to **plan** the Financial and Operational framework of the business	PO11	C6			K7	T/Mid Term Exam, F

CO4	Be able to **analyze** business performance by using managerial skills.	PO11	C4			K7	T/ ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Entrepreneurship: definition and importance and its role; Characteristics and skills of entrepreneurs; Entrepreneurial process; Self-assessment; Managers, leader, innovators and entrepreneurs.

Small Business: nature and importance, methods for generating ideas, creativity process, product planning and development process; Merger, acquisition & joint venture; Business plan; Marketing plan; Market research; Financial plan; Organizational and human resource plan; Production plan; Financing the business, Managing early operations and growth.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Entrepreneurship**	
Class-1	definition and importance and its role; Characteristics and skills of entrepreneurs; Entrepreneurial process; Self-assessment; Managers, leader, innovators and entrepreneurs	
Class-2	importance	
Class-3	importance	CT 1

Week 2	**Entrepreneurship**	
Class-4	importance	
Class-5	roles	
Class-6	roles	
Week 3	**Entrepreneurship**	
Class-7	entrepreneurs	
Class-8	Characteristics	
Class-9	Characteristics	
Week 4	**Entrepreneurship**	
Class-10	Skills	
Class-11	Skills	
Class-12	Entrepreneurial process	
Week 5	**Entrepreneurship**	CT2/ MID TERM
Class-13	Entrepreneurial process	
Class-14	Entrepreneurial process	
Class-15	Self-assessment	
Week 6	**Entrepreneurship**	
Class-16	Self-assessment	
Class-17	Managers, leader, innovators and entrepreneurs.	
Class-18	Managers, leader, innovators and entrepreneurs.	
Week 7	**Small Business**	
Class-19	nature and importance	
Class-20	methods for generating ideas	
Class-21	creativity process	
Week 8	**Small Business**	
Class-22	product planning and development process	
Class-23	product planning and development process	CT2/ MID TERM
Class-24	Merger	
Week 9	**Small Business**	
Class-25	acquisition & joint venture	
Class-26	Business plan	
Class-27	Business plan	
Week 10	**Market research**	
Class-28	Market research	
Class-29	Market research	
Class-30	Financial plan	
Week 11	**Financial plan**	
Class-31	Financial plan	
Class-32	Organizational and human resource plan	
Class-33	Organizational and human resource plan	
Week 12	**Financing the business**	CT3
Class-34	Production plan	
Class-35	Production plan	
Class-36	Production plan	
Week 13	**Financing the business**	
Class-37	Financing the business	
Class-38	Financing the business	
Class-39	Financing the business	

Week 14	**Managing early operations and growth.**	
Class-40	Managing early operations and growth.	
Class-41	Managing early operations and growth.	
Class-42	Managing early operations and growth.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C3
			CO2	C3
			CO3	C6
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment	10%	CO2	C3
			CO3	C6
Final Examination (Section A & B)		60%	CO1	C3
			CO2	C3
			CO3	C6
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Entrepreneurship 6th Edition; Robert D. Hisrich, Michael P Peters, Dean AShepherd.
2. Entrepreneurship Strategies and Resources 3rd Edition; Marc J. Dollinger –Pearson Education.
3. New Venture Creation: Entrepreneurship for the 21st Century 5th Edition;Jeffrey A. Timmons – McGraw Hill.

COURSE INFORMATION			
Course Code	: AE 499	Contact Hours	: 3.00
Course Title	: Quadrotor Dynamics	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. Math 201: Vector analysis, Laplace Transform and Coordinate Geometry
2. AE 205: Numerical Analysis
3. ME 249: Engineering Mechanics (Statics and Dynamics)
4. Math 215: Complex Variable, Harmonic Analysis and Fourier Transformation
5. AE 315: Aircraft Stability and Control
6. AE 335: Applied Aerodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course objective is to cover the principles and equations of motion and mathematical modelling of UAV quadcopter drone. The course relies heavily on state-space equations, Newton-Euler 6 DOF dynamic equations of motion and Model Predictive Control. mathematical modelling of a UAV quadcopter drone

OBJECTIVE

1. To develop Newton-Euler 6 DOF dynamic equations of motion with rotating frames.
2. To apply Model Predictive Control algorithm to the UAV.
3. To develop mathematical modelling of a UAV quadcopter drone.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the equations of motion with rotating frames	PO1	C2			K3	T, F, ASG
CO2	Be able to **describe and compare** different control system for UAV.	PO1	C4			K3	T, F, Mid Term Exam
CO3	Be able to **explain** UAV specific state-space equations.	PO1	C2			K3	T, F, ASG

CO4	Be able to **develop** modelling of a UAV quadcopter drone.	PO3	C6			K5	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Mathematical modelling of a UAV quadcopter drone.

Obtaining kinematic equations: Rotation & Transfer matrices.

Obtaining Newton-Euler 6 DOF dynamic equations of motion with rotating frames.

Development of state-space equations UAV

Gyroscopic effect & its application to the UAV model

Application of Runge-Kutta integrator to the UAV model

Application of Model Predictive Control algorithm to the UAV

Application of feedback linearization controller to the UAV

Combining Model Predictive Control and feedback linearization

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Drone architecture from Control System point of view**	CT1
Class-1	Inertial frame and Body frame	
Class-2	6 DOF of a quadcopter	
Class-3	Quadcopter rotation and vector direction	
Week 2	**Fundamental kinematics and dynamics for a 6 DOF System**	
Class-4	UAV position and attitude	
Class-5	2D and 3D rotation matrix formulation	
Class-6	Orthonormal matrix	
Week 3	**Rotation Matrix**	CT2/ MID TERM
Class-7	Rotation Matrix Conventions	
Class-8	Continue	
Class-9	Rotation Matrix application in UAV	
Week 4	**Transfer Matrix**	
Class-10	Transfer Matrix for quadcopter modeling	
Class-11	Transfer Matrix derivation	
Class-12	Continue	
Week 5	**Mass Moment Inertia**	
Class-13	Introduction to Mass Moment Inertia	
Class-14	Mathematical formulas of mass moments of inertia	
Class-15	Mathematical formulas of products of inertia	
Week 6	**Translational Motion**	
Class-16	Translational Motion in inertial frame	
Class-17	Translational Motion in body frame	
Class-18	Continue	
Week 7	**Rotational Motion**	CT2/ MID TERM
Class-19	Dynamics of Rotational Motion	
Class-20	Continue	
Class-21	Continue	
Week 8	**UAV Plant Model**	
Class-22	6 DOF Newton-Euler to state-space conversion	
Class-23	Effect of gravity force to the UAV Plant Model	
Class-24	Control Inputs for the UAV Plant Model	
Week 9	**Gyroscopic effect on a UAV**	
Class-25	Gyroscopic effect on a UAV	
Class-26	Continue	
Class-27	Continue	
Week 10	**Runge - Kutta integrator**	CT3
Class-28	Runge - Kutta integrator for UAV plant Model	
Class-29	Continue	
Class-30	Continue	
Week 11	**Control Inputs and Rotor Angular Velocities**	
Class-31	Control Inputs and Rotor Angular Velocities	
Class-32	Continue	
Class-33	Continue	

Week 12	**Control Inputs and Rotor Angular Velocities**
Class-34	Continue
Class-35	Continue
Class-36	Continue
Week 13	**Global Control Architecture for UAV**
Class-37	Global Control Architecture scheme
Class-38	Elements of the sequential/cascaded controller
Class-39	Effect of the control inputs on future states
Week 14	**MPC Attitude Controller and Feedback Control**
Class-40	Conversion of State Space equations into Linear format
Class-41	Cost Function and Future States
Class-42	Differential Equations & the control law

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO3	C2
			CO4	C6
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C4
			CO3	C2
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introduction to Multicopter Design and Control by Quan Quan

2. FPV Flight Dynamics - Mastering Acro on High-Performance Drones by Christian M. Mollica

3. Build a Drone (A Step-by-Step Guide to Designing, Constructing, and Flying Your Very Own Drone) by Barry Davies

4. Make Drones: Teach an Arduino to Fly by David McGriffy

5. Applied Control Systems 1: autonomous cars: Math + PID + MPC by Mark Misin

6. Applied Control Systems 2: autonomous cars (360 tracking) by Mark Misin

7. Applied Control Systems 3: UAV drone (3D Dynamics & control) by Mark Misin

5.3 Compulsory Courses Offered in Aerospace Discipline

COURSE INFORMATION			
Course Code	AEAS 205	Contact Hours	3.00
Course Title	Mechanics of Solids	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. ME 249: Engineering Mechanics (Statics and Dynamics)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to enhance student knowledge of the basic principles of solid mechanics and design problem solutions.

OBJECTIVE

1. To evaluate stress and deformation of simple deformable structural under shear, flexure and torsional loadings.
2. To analyze statically indeterminate structure.
3. To analyze the deflection of beam and shaft.
4. To establish the stress transformation equations and determine the absolute maximum normal and shear stress.
5. To analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.
6. To evaluate stresses & strains for Column

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the concepts and perform calculations, relative to the strength and stability of structures and mechanical components.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **evaluate** the deflection at any point on a beam subjected to diverse loads.	PO2	C5			K3	T, F, ASG.
CO3	Be able to **analyze** various structural members subjected to combined stresses by application of Mohr's circle of stress.	PO2	C4			K4	F, Mid Term Exam.

CO4	Be able to **evaluate** stresses & strains for Column.	PO2	C5			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Stress analysis: Stress-strain concept and their inter-relationship, axially loaded member, Shearing and Bearing Stress thermal and centrifugal stresses; Stresses in thin and thick-walled cylinders and spheres.
Beams: Interpretation of Vertical Shear and Bending Moment, Relations among Load, Shear and Moment, Moving Loads
Forces under different loading conditions and its effect on the resisting member; Shear force and bending moment diagrams; Various types of stresses i.e., bending, torsion, shear etc. in beams; Flexure formula; Deflection analysis of beams: integration and area moment methods; Introduction to reinforced concrete beams and slabs.
Torsion: Torsion formula; Angle of twist; Modulus of rupture
Combined stresses: Variation of Stress with inclination of element. Variation of Stress at a point: Analytical Derivation principal stress, Mohr's Circle. Failure Theories.
Columns: Euler 's formula, intermediate column formulas, the Secant formula; Flexure formula of curved beams; Problem-based applications in aerospace engineering.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Stress analysis**	
Class-1	Stress-strain concept and their inter-relationship	CT1
Class-2	Axially loaded member	
Class-3	Shearing and Bearing Stress	

Week 2	**Stress Analysis**	
Class-4	Thermal and centrifugal stresses	
Class-5	Stresses in thin and thick walled cylinders and spheres	
Class-6	Numerical	
Week 3	**Stresses in Beams**	
Class-7	Interpretation of Vertical Shear and Bending Moment	CT2 / Mid Term Exam
Class-8	Relations among Load, Shear and Moment	
Class-9	Moving Loads	
Week 4	**Beam Deflections**	
Class-10	Forces under different loading conditions	
Class-11	Force effect on the resisting member	
Class-12	Moment Diagrams by part	
Week 5	**Beam Deflections (Continued)**	
Class-13	Shear force diagram	
Class-14	Bending moment diagram	
Class-15	Examples	
Week 6	**Beam Deflections (Continued)**	
Class-16	Integration and area moment methods	
Class-17	Deflections of Simply Supported Beams	
Class-18	Deflections of Cantilever Beams	
Week 7	**Beam Deflections (Continued)**	
Class-19	Mid Span deflections	
Class-20	Bending, torsion, shear etc. in beams	CT2 / Mid Term Exam
Class-21	Flexure formula and numerical	
Week-8	**Introduction to reinforced concrete beams and slabs.**	
Class-22	Introduction	
Class-23	Effect of loading	
Class-24	Numerical	
Week 9	**Torsion**	
Class-25	Derivation of Torsion Formula	
Class-26	Terminologies (Modulus of rupture, Angle of twist)	
Class-27	Numerical	
Week 10	**Combined stress**	
Class-28	Variation of Stress with inclination of element	CT3
Class-29	Variation of Stress at a point: Analytical Derivation	
Class-30	Numerical	
Week 11	**Combined stress (Continued)**	
Class-31	Mohr's Circle	
Class-32	Application of Mohr's Circle to combined loadings	
Class-33	Numerical	
Week 12	**Combined stress (Continued)**	
Class-34	Absolute maximum shearing stress	
Class-35	Transformation of Strain Components	
Class-36	Failure Theories	
Week 13	**Column**	
Class-37	Eulers Formula	
Class-38	Buckling	
Class-39	Numerical;	

Week 14	**Column**	
Class-40	The Secant formula; intermediate column formulas	
Class-41	Flexure formula of curved beam	
Class-42	Review Class	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 CO 4	C5
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 3	C4
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C5
			CO 3	C4
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Strength of Materials – James M. Gere & Barry Goodno.
2. Strength of Materials (4t h edition) – Andrew Pytel, Ferdinand L. Singer.
3. Strength of materials (4t h edition) -William Nash; McGraw-hill International Editions, Schaum's Outline Series.
4. Mechanics of Materials – Beer and John Stone

COURSE INFORMATION			
Course Code	AEAS 225	Contact Hours	3.00
Course Title	Aircraft Systems	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AE 101: Introduction to Aeronautical Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn the basics of different systems of aircraft and their inter-relation for safe operation

OBJECTIVE

1. To be able to understand the importance of different systems for aircraft safe operations
2. To describe avionics systems associated with aircraft control and navigation
3. To understand various features of the systems and subsystems for further courses like aerospace vehicle design.
4. To understand the inter-relation of different systems for safe operation

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the working principles of hydraulic and pneumatic systems of an aircraft	PO1	C2			K3	T, F, ASG
CO2	Be able to **explain** different types of control systems of an aircraft	PO1	C2			K3	T, F, ASG
CO3	Be able to **understand** the working mechanism of aircraft engine systems, air conditioning and pressurization systems	PO1	C2			K3	T, F, ASG
CO4	Be able to **understand** electrical and avionics systems and **determine** the necessary electrical loads in an aircraft	PO2	C3			K4	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Hydraulic systems: Study of typical workable systems, components, hydraulic systems controllers, modes of operation.
Pneumatic systems, working principles–typical pneumatic power system, brake system, components, anti-skidding, landing gear systems, classifications, shock absorbers.
Airplane control systems: push pull rod system, operating principles, Cable and pulley system, Power assisted and fully powered flight controls, digital fly by wire systems.
Engine systems: Starting and ignition systems, Fuel systems of piston and jet engine, multi-engine fuel systems, Fuel system operating modes.
Air conditioning and pressurizing system: Basic air cycle systems, Oxygen systems, Deicing and anti- icing system.
Electrical Systems: AC and DC power generations and supply in aircraft, aircraft batteries, external power supplies, Auxiliary Power Unit (APU), Components of power distribution, safety requirements, aircraft electrical wiring and lighting.
Avionics Systems: Flight data recording system, cockpit voice recording system, Cockpit Display System, Glass Cockpit, HUD, HDD, HMD, Warning Systems, Fire detection and suppression, Emergency power sources, Emergency landing, Full Authority Digital Engine Control (FADEC) System.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Types of Systems	
Class-2	Aviation authorities	
Class-3	Importance of systems	
Week 2		

Class-4	Basic control systems	
Class-5	Open and close loop control systems	
Class-6	Elements of basic control system	
Week 3		
Class-7	Various control surfaces	CT2 / Mid Term Exam
Class-8	Conventional control systems	
Class-9	Different control systems	
Week 4		
Class-10	Pascals law and applications	
Class-11	Power assisted and fully powered control systems	
Class-12	Power assisted and fully powered control systems	
Week 5		
Class-13	Basic fly by wire systems	
Class-14	Operating principle and factors	
Class-15	Types of fly by wire	
Week 6		
Class-16	Importance , Basic operation	
Class-17	Different functions of auto pilot	
Class-18	Modes of operation, basic gyroscope	
Week 7		
Class-19	Basic air cycle systems	
Class-20	Basic Oxygen systems	CT2 / Mid Term Exam
Class-21	Principle of operation and safety precautions	
Week 8		
Class-22	Causes of fire in aircraft	
Class-23	Types of fire protection systems	
Class-24	Basic deicing and anti- icing system.	
Week 9		
Class-25	Types of ice & Principle of ice detection	
Class-26	Types of ice & Principle of ice detection	
Class-27	Types of ice & Principle of ice detection	
Week 10		
Class-28	Aircraft electrical systems	CT3
Class-29	Power generation, Primary power distribution	
Class-30	Power conversion and energy storage	
Week 11		
Class-31	Principle of operation of both systems	
Class-32	Modes of operation, advantages and disadvantages	
Class-33	Application in aircraft, sources of power, safety precautions	
Week 12		
Class-34	Different types of engine, thrust generation	
Class-35	Principle of operation of jet engines, components	
Class-36	Different types of jet engines	
Week 13		
Class-37	Aircraft instrumentation	
Class-38	Basic six instruments	
Class-39	Principle of ASI, VSI, altimeter	

Week 14		
Class-40	Flight data recording system, operation and survival test	
Class-41	cockpit voice recording system, operation, data	
Class-42	Review of whole Syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C2
			CO3	C2
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Aircraft Power Plants- Mekinley, J.L. and R.D. Bent; McGraw Hill 1993.
2. Aircraft Systems (3rd edition) -- Ian Moir, Allan Seabridge; WILEY Publications.
3. Aircraft Fuel Systems—Roy Langton, Chuck Clark, Martin Hewitt, Lonnie Richards; WILEY Publications.

COURSE INFORMATION			
Course Code	AEAS 206	Contact Hours	3.00
Course Title	Mechanics of Solids Sessional	Credit Hours	1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to apply the concept of Mechanics of Solids and determine the internal forces and deformations in common structural members.

OBJECTIVE

1. To demonstrate the knowledge of stress, strain and bucking in different experiments.
2. To evaluate the mechanical properties of materials and design of the structural members.
3. To analyze the performances of different materials under different loading.
4. To learn the strength, stiffness and stability design and construction requirements.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the knowledge of stress, strain and buckling in different experiments using tools	PO1	P1			K4	R, Q, T
CO2	Be able to **implement** the concept of solid mechanics for testing materials	PO1	P2			K3	R, Q, T
CO3	Be able to **show** the failure patterns of testing materials	PO2	P3			K3	Pr, R, T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Tension Test of Mild Steel Specimen
2.	Hardness Test on Metal Specimen
3.	Compression Test of Timber Specimen
4.	Izod And Charpy Impact Test of Metal Specimen
5.	Rockwell Hardness Test of Metal Specimens
6.	Brinell Hardness Test of Metal Specimens
7.	Torsion Test of Mild Steel Specimen
8.	Basics of Shear Force and Bending Moment Diagram
9.	Deflection Test on Cantilever Beam
10.	Compression Test on Open Coil Helical Spring

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Tension Test of Mild Steel Specimen
Week 2	Hardness Test on Metal Specimen
Week 3	Compression Test of Timber Specimen
Week 4	Izod And Charpy Impact Test of Metal Specimen
Week 5	Rockwell Hardness Test of Metal Specimens
Week 6	Brinell Hardness Test of Metal Specimens
Week 7	Torsion Test of Mild Steel Specimen
Week 8	Basics of Shear Force and Bending Moment Diagram
Week 9	Deflection Test on Cantilever Beam
Week 10	Compression Test on Open Coil Helical Spring
Week 11	Lab Test-1
Week 12	Lab Test-2
Week 13	Lab Quiz
Week 14	Presentation on Assigned Problems

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment	Lab participation and Report	15%	CO 1	P1
			CO 2	P2

	Lab test	25%	CO 1	P1
			CO 2	P2
Lab Quiz	Mid Term Evaluation (exam/project/assignment)	20%	CO3	P3
	Final Evaluation (Exam/project/assignment)	30%	CO1, CO2, C03	P1, P2, P3
Viva Voce/ Presentation		10%	CO1, CO2, C03	P1, P2, P3
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. Strength of Materials – James M. Gere & Barry Goodno.
2. Strength of Materials (4t h edition) – Andrew Pytel, Ferdinand L. Singer.
3. Strength of materials (4t h edition) -William Nash; Mcgraw-hill International Editions, Schaum’s Outline Series.
4. Strength of Materials – Beer and John Stone.

COURSE INFORMATION			
Course Code	AEAS 204	Contact Hours	1.50
Course Title	Fundamentals of Fluid Mechanics Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is intended to teach the students basic concepts and principles of experimental fluid mechanics

OBJECTIVE

1. To develop an understanding of hydrostatic law.
2. To imbibe basic laws and equations used for the analysis of fluid flow.
3. To inculcate the importance of fluid flow measurement and its applications in industries.
4. To determine the losses in a flow system and flow through pipes.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **imitate** the experimental procedure for determining the center of pressure of an object	PO4	P2			K5	ASG, R, Q
CO2	Be able to experimentally **measure** the fluid flow rate using flow measuring devices	PO4	P3			K5	ASG, R, Q
CO3	Be able to **measure** the effect of friction in fluids flowing through a pipe	PO4	P3			K5	ASG, R, Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Determination of Center of Pressure of a Submerged Surface
2.	Proof of Bernoulli's Equation
3.	Flow Through a Venturi Meter
4.	Flow Through an Orifice
5.	Fluid Friction in a Pipe

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical	14
Self-Directed Learning	
Preparation of Lab Reports	5
Preparation of Lab Quiz	5
Preparation of Lab Viva	5
Formal Assessment	
Continuous Assessment	7
Final Quiz	1
Total	44

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Determination of Center of Pressure of a Submerged Surface
Week 2	Proof of Bernoulli's Equation
Week 3	Flow Through a Venturi Meter
Week 4	Flow Through an Orifice
Week 5	Fluid Friction in a Pipe
Week 6	Lab Quiz
Week 7	Viva Voce

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (30%)	Lab Report	30%	CO1, CO2, CO3	P2, P3
Lab Quiz		50%	CO1, CO2, CO3	P2, P3
Viva Voce		20%	CO1, CO2, CO3	P2, P3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics of Fluids - Irving H. Shames
2. Fluid Mechanics - Frank M. White
3. Fluid Mechanics - Yunus A. Cengel; John M. Cimbala
4. Fluid Mechanics - E. John Finnemore; Joseph B. Franzini

COURSE INFORMATION			
Course Code	AEAS 301	Contact Hours	3.00
Course Title	Heat Transfer	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AE 207: Thermodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course provides an introduction to heat transfer and introduces practical application in industry

OBJECTIVE

1. To apply principles of heat and mass transfer to basic engineering systems
2. To explain heat transfer by conduction, convection
3. To analyze and design heat exchangers
4. To analyze diffusion processes and calculate the flux in a diffusion process
5. To describe the fundamental principles of radiative emission and absorption

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the different heat transfer mechanisms in detail	PO1	C2			K3	T, F, ASG
CO2	Be able to **determine** the mathematical model and the solution of heat transfer problems which involve conduction, convection and radiation using relevant techniques	PO2	C3			K4	T, F, ASG
CO3	Be able to **identify** and **explain** the different stages of boiling and condensation heat transfer	PO1	C2			K3	T, F, ASG
CO4	Be able to **familiarize** with the engineering applications of heat transfer devices	PO2	C3			K4	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Basic modes of heat transfer; General conduction equations; Steady state conduction in different geometries and composite structures; Effect of variable thermal conductivity; Heat transfer from extended surfaces.
Mechanism of convective heat transfer; General methods for estimation of convective heat transfer coefficient; Heat and momentum transfer associated with laminar and turbulent flow of fluids in forced convection; Free convection from exterior surfaces of common geometrics.
Mechanism and laws of radiation heat transfer; Blackbody and gray body emission; Radiative properties of surfaces.
Boiling and condensation; pool boiling, forced convection boiling, film condensation, dropwise condensation, condensation number
Heat exchanger: basic types, LMTD, exchanger effectiveness-NTU relations; Techniques of heat transfer augmentation; Heat exchanger devices.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Conduction, convection, Radiation.	
Class-2	General conduction equations,	
Class-3	Steady state conduction in different geometrics and composite structures.	
Week 2		
Class-4	Conduction related problems.	
Class-5	Effect of variable thermal conductivity	
Class-6	Heat transfer from extended surfaces.	

Week 3		
Class-7	Mechanism of convective heat transfer	CT2 / Mid Term Exam
Class-8	General methods for estimation of convective heat transfer coefficient	
Class-9	Related mathematical problems.	
Week 4		
Class-10	Heat and momentum transfer associated with laminar and turbulent flow of fluids in forced convection.	
Class-11	Equation of Heat and momentum transfer associated with laminar flow.	
Class-12	Equation of Heat and momentum transfer associated with turbulent flow of fluids in forced convection	
Week 5		
Class-13	Free convection from exterior surfaces of common geometrics	
Class-14	Mathematical problems relating forced convection.	
Class-15	Mathematical problems relating free convection.	
Week 6		
Class-16	Mechanism and laws of radiation heat transfer	
Class-17	Blackbody emission	
Class-18	Gray body emission	
Week 7		
Class-19	Radiative properties of surfaces.	
Class-20	Radiation equation,	CT2 / Mid Term Exam
Class-21	Spectrum analysis.	
Week 8		
Class-22	Pool boiling,	
Class-23	Forced convection boiling,	
Class-24	Mathematical Problems.	
Week 9		
Class-25	Film condensation	
Class-26	Dropwise condensation	
Class-27	Condensation number	
Week 10		
Class-28	Types of Heat exchanger,	CT3
Class-29	Fundamentals of Heat exchanger,	
Class-30	Principles of Heat exchanger.	
Week 11		
Class-31	LMTD relation analysis.	
Class-32	Heat exchanger performance,	
Class-33	Mathematical Problems.	
Week 12		
Class-34	NTU relations	
Class-35	Techniques of heat transfer augmentation	
Class-36	Mathematical problems.	
Week 13		
Class-37	Heat Transfer Applications	
Class-38	Heat Transfer Applications	
Class-39	Heat Transfer Applications	

Week 14		
Class-40	Heat Transfer Applications	
Class-41	Heat Transfer Applications	
Class-42	Syllabus Review	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO3	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C3
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C3
			CO3	C2
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Heat Transfer - J. P. Holman
2. Heat & Mass Transfer - Yunus A. Cengel, Afshin J. Ghajar
3. Principles of Heat Transfer - F. Kreith, Mark S. Bohn
4. Heat Transfer - Binay K. Dutta
5. Heat Transfer – A basic approach by M. Necati Ozisik

COURSE INFORMATION			
Course Code	AEAS 331	Contact Hours	3.00
Course Title	Materials Science and Aerospace Materials	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic properties of different materials and to familiarize with the methods to produce composite materials with new properties using the basic properties.

OBJECTIVE

1. To instill understanding of materials' atomic and crystal structures affecting aerospace performance.
2. To equip students with skills to select aerospace materials based on mechanical properties and application needs.
3. To grasp concepts of corrosion mechanisms and heat treatment principles for aerospace material maintenance.
4. To introduce composite materials and nanotechnology's impact on aerospace material innovation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the fundamental properties and structures of aerospace materials, including atomic and crystal structures, imperfections in crystals, and the significance of phase diagrams in material science.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **describe** the process and implications of corrosion and heat treatment on metals and alloys used in aerospace.	PO2	C2			K3	T, F, ASG.

CO3	Be able to **apply** knowledge of material selection principles for aerospace applications, including the mechanical behavior of materials and the use of non-destructive testing methods to evaluate material suitability.	PO1	C3			K3	T, F, Mid Term Exam.
CO4	Be able to **explain** the basics and applications of composite materials and nanotechnology in aerospace engineering, including the fabrication processes involved in alloys and composites and the role of nanoscience in advancing aerospace material technology.	PO2	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to Aerospace Materials: Elements of aerospace materials, Structure of solid materials, Atomic structure of materials, crystal structure, miller indices, density, packing factor, space lattices, imperfection in crystals, physical metallurgy, Phase diagram including the Fe-FeC_3 equilibrium diagram, requirements of materials for aerospace applications.
Material Selection For Aerospace Applications: Mechanical behavior of materials, Linear and nonlinear elastic properties, Yielding, strain hardening, fracture, Bauchinger‘s effect, Notch effect testing and flaw detection of materials and components, creep and fatigue, Comparative study of metals, ceramics plastics and composites, Introduction to destructive and non-destructive tests.
Corrosion & Heat Treatment: Corrosion & heat treatment of metals and alloys, Types of corrosion, effect of corrosion on mechanical properties, stress corrosion cracking, Corrosion resistant materials used for space vehicles, heat treatment of carbon steels, aluminum alloys, magnesium alloys and titanium alloys, effect of alloying treatment, heat resistance alloys, tool and die steels, magnetic alloys.
Introduction to Composite Materials and Nanotechnology: Introduction to powder metallurgy, modern ceramic materials, cermet, glass ceramic, plastics and rubber, carbon/carbon composites, fabrication processes involved in metal matrix composites, polymer matrix composites, shape memory alloys, applications in aerospace vehicle design, Basic concepts of Nanoscience and Nanotechnology.
High Temperature Materials: High temperature materials, Characterization, classification, production and characteristics, methods and testing, determination of mechanical and thermal properties of materials at elevated temperatures, super alloys, high temperature material applications.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	Elements Of Aerospace Materials	CT1
Class-1	Engineering Materials Modern Materials' Needs	
Class-2	Modern Materials' Needs Structure of Crystalline Solids	
Class-3	Structure of Crystalline Solids	
Week 2	Elements Of Aerospace Materials (Continued)	
Class-4	Face-Centered & Body-Centered Cubic Crystal Structure	
Class-5	Imperfections in Solids	
Class-6	Hexagonal Close-Packed (HCP) Crystal Structure	
Week 3	Crystallographic Points, Directions, and Planes	CT2 / Mid Term Exam
Class-7	Elements Of Aerospace Materials	
Class-8	Equilibrium Diagram	
Class-9	Iron-Carbon Diagram, Lead–Tin Phase Diagram, Copper–Silver Phase Diagram	
Week 4	Material Selection for Aerospace Applications	
Class-10	Material Selection Criteria	
Class-11	Material Types	
Class-12	Material Forms	
Week 5	Corrosion And Heat Treatment of Metals and Alloys	
Class-13	Corrosion of Metals and Its Prevention	
Class-14	Factors That Control the Corrosion Rate	
Class-15	How to Keep Aircraft Safe from corrosion	
Week 6	Corrosion And Heat Treatment of Metals and Alloys	
Class-16	Main objectives of heat treatment (heat treatment processes)	
Class-17	Types of Heat Treatment	
Class-18	Typical Design Guidelines in Heat Treatment	

Week 7	Ceramics And Glass	
Class-19	Classification of Ceramics, General Properties of Ceramics, Common Ceramics	CT2 / Mid Term Exam
Class-20	Shaping Methods for Glass	
Class-21	Glass working Processes	
Week 8	Processing Of Plastics	
Class-22	Types of Processing of Plastics	
Class-23	Extrusion, Lamination (Calendaring)	
Class-24	Thermoforming, Casting	
Week 9	Processing Of Plastics	
Class-25	Molding	
Class-26	Expansion, Foaming	
Class-27	Spinning, Solid-Phase Forming	
Week 10	Composite Materials	CT3
Class-28	Introduction	
Class-29	Components of Composite Materials	
Class-30	Types and General Characteristics of Composite Materials	
Week 11	Composite Materials	
Class-31	Polymer Matrix Composites (PMC)	
Class-32	Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC)	
Class-33	Advantages & Disadvantages of Composites	
Week 12	Non-Destructive Testing (NDT)	
Class-34	Introduction	
Class-35	Uses of NDT Methods	
Class-36	NDT methods using time	
Week 13	Nanotechnology	
Class-37	Introduction to Nanoscience and Nanotechnology	
Class-38	Fabrication and Characterization Techniques for Nanomaterials	
Class-39	Fabrication and Characterization Techniques for Nanomaterials	
Week 14	Nanotechnology and Revision	
Class-40	Applications of Nanotechnology in Aerospace	
Class-41	Nanotechnology and Revision	
Class-42	Nanotechnology and Revision	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C3
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Materials Science and Engineering: An Introduction - David G. Rethwisch and William Callister
2. Aircraft Materials and Processes- Titterton.G.; Pitman Publishing Co.
3. Introduction to Physical Metallurgy (2nd edition) -Sidney H Avner; Tata McGraw – Hill Edition.
4. Engineering Materials, Their properties and Applications- Martin, J.W.; Wykedham Publications (London) Ltd.

COURSE INFORMATION			
Course Code	AEAS 302	Contact Hours	1.50
Course Title	Heat Transfer Sessional	Credit Hours	0.75

PRE-REQUISITE

Course Code & Title:

1. AEAS 301: Heat Transfer

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course provides an introduction to heat transfer and introduces practical application in industry

OBJECTIVE

1. To apply principles of heat and mass transfer to basic engineering systems
2. To analyze heat transfer by conduction, convection
3. To analyze and design heat exchangers
4. To analyze diffusional processes and calculate the flux in a diffusion process
5. To understand the fundamental principles of radiative emission and absorption

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **match** the instructions given in the lab manual and carry out the experiments relating to heat transfer processes.	PO1	P2			K3	R,Q,T
CO2	Be able to **analyze** the results obtained from the experiments.	PO2	C4			K4	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ;PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Determination of Thermal Conductivity of a Metal by Steady State Method
2.	Determination of Thermal Contact Conductance
3.	(A) Inverse Square Law for Light Radiation. (B) Lamberts Cosine Law for Light
4.	Study of a Free Convection of Fin/ Flat Plate/ Pipe Bundle
5.	Force Convection Heat Transfer in a Flat Plate
6.	Study of Heat Exchanger
7.	Study of Heat Transfer by Radiation

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
Total	21

Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 10 05 05 10
Formal Assessment Continuous Assessment Final Quiz	 06 1
Total	63

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method

COURSE SCHEDULE

Week 1	Determination of Thermal Conductivity of a Metal by Steady State Method
Week 2	Determination of Thermal Contact Conductance
Week 3	(A) Inverse Square Law for Light Radiation. (B) Lamberts Cosine Law for Light
Week 4	Study of a Free Convection of Fin/ Flat Plate/ Pipe Bundle, Force Convection Heat Transfer in a Flat Plate
Week 5	Study of Heat Exchanger
Week 6	Study of Heat Transfer by Radiation
Week 7	Lab Quiz and Lab Viva

ASSESSMENT STRATEGY

Components	**Grading**	CO	Bloom's Taxonomy
Conduct Lab Test/ Class Performance	25%	CO 1	P2
		CO 2	C4
Report Writing	15%	CO 1	P2
		CO 2	C4
Mid Term Evaluation (exam/project/assignment)	20%	CO 1	P2
		CO 2	C4
Final Evaluation (Exam/project/assignment)	30%	CO 1	P2
		CO 2	C4
Viva Voce/ Presentation	10%	CO 1	P2
		CO 2	C4
Total Marks		100%	

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Principles of Heat Transfer - F. Kreith, Mark S. Bohn
2. Heat Transfer - Binay K. Dutta

COURSE INFORMATION			
Course Code	AEAS 332	Contact Hours	1.50
Course Title	Materials Science and Aerospace Materials Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course provides the necessary knowledge about metallurgy and phase diagrams.

OBJECTIVE

1. To learn the basic classification of steel based on the percentage of Carbon present in it and their properties.
2. To visualize the phase diagram of different types of steel in the microscope and analyze the different regions.
3. To be able to explain the use of materials of different properties in order to make alloys of a new property.
4. To gain knowledge about the heat treatment method used in making steel of different properties

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **prepare** metal specimen in order to view the microstructure under a light microscope.	PO5	P1			K6	R, Q
CO2	Be able to **analyze** the phase diagram of different materials used in making of alloys.	PO2	C4			K3	R, Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Sample Preparation by hand method using different polishing and etching and analysis of it in microscope.
2.	Study of Phase diagram including the Fe-FeC3 equilibrium diagram
3.	Study of Crystal structure of different types of cast iron
4.	Study of Crystal structure of different types of Steel
5.	Heat treatment of carbon steels, aluminum alloys, magnesium alloys and titanium alloys

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 7 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 5 5 5 5 10
Formal Assessment Continuous Assessment Final Quiz	 7 1
Total	59

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method

COURSE SCHEDULE

Week 1	Sample Preparation by hand method using different polishing.
Week 2	Etching and analysis of metal Sample in microscope.
Week 3	Study of Phase diagram including the Fe-FeC3 equilibrium diagram
Week 4	Study of Crystal structure of different types of cast iron
Week 5	Study of Crystal structure of different types of Steel
Week 6	Heat treatment of carbon steels, aluminum alloys, magnesium alloys and titanium alloys
Week 7	Lab Quiz and Viva

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment	Conduct Lab Test/ Class Performance	25%	CO1	P1
	Report Writing	15%	CO2	C4
Lab Quiz	Mid Term Evaluation (exam/project/assignment)	20%	CO1, CO2	P1
	Final Evaluation (Exam/project/assignment)	30%	CO1, CO2	C4
Viva		10%	CO1, CO2	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Aircraft Materials and Processes- Titterton.G.; Pitman Publishing Co.
2. Introduction to Physical Metallurgy (2nd edition) -Sidney H Avner; Tata McGraw – Hill Edition.
3. Engineering Materials, Their properties and Applications- Martin, J.W.; Wykedham Publications (London) Ltd.
4. Composite Materials for Aircraft Structures (2nd edition)- Allan Baker, Stuart Dutton, Donald Kelly; AIAA Education Series
5. Engineering Metallurgy (Part I & II) (6th edition) – Raymond A. Huggins; Viva Books Private Ltd.
6. Materials Science and Engineering: An Introduction – W D Callister, Jr.; John Wiley and Sons, Inc (4th edition) 1997
7. A Text Book of Nano-science and Nanotechnology- T.Pradeep; Tata McGraw Hill.

COURSE INFORMATION			
Course Code	AEAS 317	Contact Hours	4.00
Course Title	Mechanics of Structure, Structural Vibration and Aero Elasticity	Credit Hours	4.00

PRE-REQUISITE

Course Code & Title:

1. ME 249: Engineering Mechanics (Statics and Dynamics)
2. AEAS 205: Mechanics of Solids

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to provide with the knowledge of relative motion between the various parts of a machine, forces which act on them and analysis of vibration. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine

OBJECTIVE

1. To introduce the approaches and mathematical models used in kinematic and dynamic analysis of machinery.
2. To understand techniques for studying motion of machines and their components.
3. To give basic knowledge on kinematic and dynamic design of machinery.
4. To give basic knowledge on different types mechanical vibrations.
5. To be able to construct turning moment diagram.
6. To be able to calculate balancing mass and its position.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** graphical and analytical methods to study the motion of a simple mechanism.	PO1	C3			K4	T, F
CO2	Be able to **analyze** the motions of gear trains and flywheels.	PO2	C4			K4	T, F, ASG.
CO3	Be able to **explain** mechanical vibrations in detail.	PO1	C2			K3	T, F, Mid Term Exam
CO4	Be able to **determine** and **solve** the mathematical model of vibrating mechanical systems using appropriate techniques.	PO1	C3			K4	T, F, ASG, Mid Term Exam

CO5	Be able to **analyze** problems associated with engineering applications of vibrations and mass balancing.	PO2	C4			K4	F, ASG
CO6	Be able to **explain** various aeroelastic phenomena and their preventions in detail.	PO1	C2			K3	F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Mechanics of Structure

Mechanisms; Displacement, velocity and acceleration; Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Study of gears and gears trains; Static and dynamic balancing: reciprocating and rotating parts.

Structural Vibration

Free vibrations with one and two degrees of freedom; Longitudinal, transverse and torsional vibrations; Damped free and forced vibrations with single degrees of freedom; Whirling of shafts and rotors; Vibration absorption and isolation; Vibration measuring instruments; Methods of determining natural frequencies: matrix methods; Continuous systems: lateral vibrations of beams; Introduction to Lagrangian methods.

Aero Elasticity

Introduction to aero elasticity, load distribution, concepts of divergence, control effectiveness and reversal.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	56
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 56
Self-Directed Learning	
Non-face-to-face learning	56
Revision of the previous lecture at home	28
Preparation for final examination	28
Formal Assessment	
Continuous Assessment	3
Final Quiz	3
Total	174

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Kinematics of motion**	CT1
Class-1	Linear displacement, velocity and acceleration	
Class-2	Properties of fluid	
Class-3	Fluid Statics	
Class-4	Numerical	
Week 2	**Simple Mechanisms**	
Class-5	Kinematic link or element, types of link	
Class-6	Kinematic pair, classification of kinematic pairs	
Class-7	Kinematic chain, types of joints in a chain	
Class-8	Mechanism	
Week 3	**Velocity in Mechanisms (Instantaneous Centre Method)**	
Class-9	Methods for determining the velocity of a point on a link	CT2
Class-10	Properties and number of Instantaneous centers in a mechanism	
Class-11	Types and location of instantaneous centers	
Class-12	Method of locating instantaneous centers in a mechanism	
Week 4	**Velocity in Mechanisms (Relative Velocity Method)**	
Class-13	Relative velocity of two bodies moving in straight lines	
Class-14	Velocity of a point on a link	
Class-15	Velocities in a slider crank mechanism	
Class-16	Rubbing velocity at a pin joint	
Week 5	**Gear Trains**	
Class-17	Introduction and types of gear trains	
Class-18	Simple and compound gear train	
Class-19	Design of spur gears	
Class-20	Epicyclic gear train	
Week 6	**Turning Moment Diagram and Flywheel**	
Class-21	Turning moment diagram for a single cylinder double acting steam Engine	
Class-22	Turning moment diagram for a four-stroke cycle IC engine	
Class-23	Fluctuation of energy, maximum fluctuation of energy and coefficient of fluctuation of energy	
Class-24	Energy stored in a flywheel	
Week 7	**Balancing of rotating and reciprocating masses**	
Class-25	Balancing of rotating masses	CT3/ Mid Term Exam
Class-26	Balancing of rotating masses	
Class-27	Balancing of reciprocating masses (cont’d)	
Class-28	Balancing of reciprocating masses (cont’d)	
Week 8	**Introduction to structural vibration**	
Class-29	Definition and causes of vibration	
Class-30	Modeling of vibration and important terminologies	
Class-31	Types of vibration	
Class-32	Concepts of resonance, degrees of freedom	
Week 9	**Determination of natural frequency and equations of motion**	
Class-33	Natural frequency of free longitudinal vibration	
Class-34	Natural frequency of free transverse vibration	CT3/

Class-35	Equations of motion of single degree of freedom systems	Mid Term Exam
Class-36	Equations of motion of multi degrees of freedom systems	
Week 10	**Damped Free Vibration and Forced Underdamped Vibration**	
Class-37	Damped Free Vibration	
Class-38	Related numerical	
Class-39	Forced Underdamped Vibration	
Class-40	Related numerical	
Week 11	**Vibration Isolation and Vibration Measuring Instruments**	
Class-41	Definition, types of vibration isolation and transmissibility ratio	
Class-42	Related numerical	
Class-43	Quantifying vibration level, considerations in choosing acceleration, velocity or displacement parameters	
Class-44	Piezoelectric transducer	
Week 12	**Natural frequency of multi-degrees of freedom systems**	
Class-45	Lagrange's method	
Class-46	Numerical related to Lagrange's method and Dunkerly's formula	
Class-47	Determination of natural frequency and mode shapes using Matrix Method	
Class-48	Numerical related to matrix method	
Week 13	**Vibration of continuous media**	
Class-49	Transverse vibration of a string	
Class-50	Longitudinal vibration of a rod	
Class-51	Torsional vibration of a shaft	
Class-52	Lateral vibration of beams	CT4
Week 14	**Aeroelasticity**	
Class-53	Introduction and types of aeroelasticity	
Class-54	Static aeroelastic phenomenon	
Class-55	Dynamic aeroelastic phenomenon	
Class-56	Avoiding aeroelastic phenomena	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-4	20%	CO 1	C3
			CO 2	C4
			CO 3	C2
			CO 4	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
			CO 4	C3
Final Examination (Section A & B)		60%	CO 1	C3
			CO 2	C4
			CO 3	C2
			CO 4	C3
			CO 5	C4
			CO 6	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Theory of Machines (S. I. Units) – R. S. Khurmi, J. K. Gupta; Eurasia Publishing House (Pvt.) Ltd.
2. Mechanical Vibrations-S.S. Rao
3. Theory of Vibration with Application - William T Thomson

COURSE INFORMATION			
Course Code	AEAS 319	Contact Hours	3.00
Course Title	Machine Design	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. ME 249: Engineering Mechanics (Statics & Dynamics)
2. AEAS 205: Mechanics of Solids

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is aimed to design, analyze and selection of commonly used mechanical components subject to static and dynamic loads.

OBJECTIVE

1. To calculate various loads as applied to shaft, and specify appropriate design stresses for shaft.
2. To specify suitable keys and couplings for shaft and other type of machine elements.
3. To analyze and design spur gear, helical gear and bevel gear.
4. To analyze and design of sliding bearings.
5. To analyze and design of clutches, brakes, power screws and springs.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** the theories relating to power screws, shaft, keys, springs, bearings, gears, brakes and clutches.	PO1	C1			K3	T, F, ASG.
CO2	Be able to **explain** the design requirements of various engineering machines.	PO1	C2			K3	T, F, ASG.
CO3	Be able to **apply** the knowledge to **design** machine parts like power screws, shaft, keys, springs, bearings, gears, brakes and clutches.	PO3	C6	CP1, CP2, CP3		K6	T, F, Mid Term Exam.
CO4	Be able to **analyze** the design parameters of various aircraft parts.	PO3	C4	CP1, CP2, CP3		K6	T, F, ASG, Mid Term Exam.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT
Introduction to design; Stress analyses; Deflection and stiffness considerations; Shock and impact; Statistical considerations; Design for static strength; Design for fatigue strength; Fracture mechanics in design. Design of basic machine elements like power screws, solid shafts and hollow shaft systems, keys, rivets, mechanical springs, roiling contact bearings, journal bearings, gears, brakes and clutches. Design with composite materials. Part design for manufacturing aircraft parts.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Simple Stresses in Machine Parts**	CT1
Class-1	Load, Stress, Strain, Tensile Stress and Strain, Compressive Stress and	
Class-2	Strain, Young's Modulus or Modulus of Elasticity, Shear Stress and Strain.	
Class-3	Stress-strain Diagram, Working Stress, Factor of Safety.	
Week 2	**Shafts**	
Class-4	Shafts Subjected to Fluctuating Loads, Shafts Subjected to Axial Load in addition to Combined Torsion and Bending Loads.	
Class-5	Design of Shafts on the Basis of Rigidity.	
Class-6	Mathematical Problems.	
Week 3	**Shafts**	
Class-7	Material Used for Shafts, Manufacturing of Shafts, Types of shafts, Standard Sizes of Transmission Shafts.	CT2/ Mid Term Exam
Class-8	Stresses in Shafts, Maximum Permissible Working Stresses for Transmission Shafts, Design of Shafts, Shafts Subjected to Twisting Moment Only.	

Class-9	Shafts Subjected to Bending Moment Only, Shafts Subjected to Combined	
Week 4	**Keys**	
Class-10	Types of Keys, Sunk Keys, Saddle Keys, Tangent Keys, Round Keys, Splines, Forces acting on a Sunk Key.	
Class-11	Strength of a Sunk Key, Effect of Keyways.	
Class-12	Mathematical Problems.	
Week 5	**Power Screws**	
Class-13	Types of Screw Threads used for Power Screws, Multiple Threads, Torque, Required to Raise Load by Square Threaded Screws.	
Class-14	Torque Required to Lower Load by Square Threaded Screws, Efficiency of Square Threaded Screws, Maximum Efficiency of Square Threaded Screws, Efficiency vs. Helix Angle.	
Class-15	Overhauling and Self-locking Screws, Efficiency of Self-Locking Screws, Coefficient of Friction, Acme or Trapezoidal Threads.	
Week 6	**Power Screws**	
Class-16	Stresses in Power Screws.	
Class-17	Design of Screw Jack, Differential and Compound Screws.	
Class-18	Mathematical Problems.	
Week 7	**Springs**	
Class-19	Types of Springs, Material for Helical Springs, Standard Size of Spring, Wire, Terms used in Compression Springs.	
Class-20	End Connections for Compression Helical Springs, End Connections for Tension Helical Springs, Stresses in Helical Springs of Circular Wire.	CT2/ Mid Term Exam
Class-21	Deflection of Helical Springs of Circular Wire, Eccentric Loading of Springs.	
Week 8	**Springs**	
Class-22	Buckling of Compression Springs, Surge in Springs, Energy Stored in Helical Springs of Circular Wire.	
Class-23	Stress and Deflection in Helical Springs of Non-circular Wire, Helical Springs Subjected to Fatigue Loading.	
Class-24	Springs in Series, Springs in Parallel, Concentric or Composite Springs, Helical Torsion Springs, Flat Spiral Springs.	
Week 9	**Clutches**	
Class-25	Types of Clutches, Positive Clutches, Friction Clutches.	
Class-26	Material for Friction Surfaces, Considerations in Designing a Friction Clutch, Types of Friction Clutches.	
Class-27	Single Disc or Plate Clutch, Design of a Disc or Plate Clutch, Multiple Disc Clutch and Cone Clutch.	
Week 10	**Brakes**	
Class-28	Energy Absorbed by a Brake, Heat to be Dissipated during Braking.	CT3
Class-29	Materials for Brake Lining, Types of Brakes.	
Class-30	Single Block or Shoe Brake, Pivoted Block or Shoe Brake, Double Block or Shoe Brake, Simple Band Brake, Differential Band Brake.	
Week 11	**Spur Gears**	
Class-31	Friction Wheels, Advantages and Disadvantages of Gear Drives.	
Class-32	Classification of Gears, Terms used in Gears, Condition for Constant Velocity Ratio of Gears–Law of Gearing.	
Class-33	Forms of Teeth, Cycloidal Teeth, Involute Teeth, Comparison	

	Between Involute and Cycloidal Gears.	
Week 12	**Spur Gears**	
Class-34	Systems of Gear Teeth, Standard Proportions of Gear Systems, Interference in Involute Gears.	
Class-35	Minimum Number of Teeth on the Pinion in order to Avoid Interference, Gear Materials, Design Considerations for a Gear Drive.	
Class-36	Beam Strength of Gear Teeth-Lewis Equation, Permissible Working Stress for Gear Teeth in Lewis Equation, Dynamic Tooth Load.	
Week 13	**Bearings**	
Class-37	Classification of Bearings, Types of Sliding Contact Bearings, Hydrodynamic Lubricated Bearings, Assumptions in Hydrodynamic, Lubricated Bearings.	
Class-38	Important Factors for the Formation of Thick Oil Film in Hydrodynamic Lubricated Bearings.	
Class-39	Wedge Film Journal Bearings, Squeeze Film Journal Bearings, Properties of Sliding Contact Bearing Materials, Materials used for Sliding Contact Bearings.	
Week 14	**Bearings**	
Class-40	Properties of Lubricants, Terms used in Hydrodynamic Journal Bearings, Bearing Characteristic Number and Bearing Modulus for Journal Bearings, Coefficient of Friction for Journal Bearings	
Class-41	Mathematical Problems.	
Class-42	Review.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C1
			CO 2	C2
			CO 4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam)	10%	CO 3 CO 4	C6, C4
Final Examination (Section A & B)		60%	CO 1	C1
			CO 2	C2
			CO 3	C6
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. A Textbook of Machine Design - R. S. Khurmi, J. K. Gupta.
2. Fundamentals of Machine Component Design - Robert C Juvinall.
3. Design of Machine Elements (4th Ed) - Virgil Moring Faires.
4. Mechanical Engineering Design (11th Edition) - Joseph E Shigley, Charles R Mischke & Richard G Budynas.

COURSE INFORMATION			
Course Code	AEAS 325	Contact Hours	3.00
Course Title	Computational Fluid Dynamics	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AE 205: Numerical Analysis and Applications
2. AE 335: Applied Aerodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students to the fundamental principles of Computational Fluid Dynamics (CFD) for understanding fluid flow and fluid properties based on computational method.

OBJECTIVE

1. To explain the methods of fluid flow analysis i.e. theoretical, experimental and computational.
2. To describe the concept of potential theory and its application to incompressible and inviscid flows.
3. To apply the numerical methods for solution of flow situations.
4. To describe implications errors and stability analysis of numerical methods.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** computational fluid dynamics (CFD) fundamentals, including governing equations and their applications.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **implement** equation discretization and grid generation techniques for CFD analyses.	PO2	C3			K4	T, F, ASG.
CO3	Be able to **apply** numerical methods to **solve** and **interpret** diffusion and fluid flow problems.	PO2	C3			K4	T, F, Mid Term Exam.
CO4	Be able to **analyze** the accuracy and stability for various CFD techniques.	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to computational fluid dynamics and its application. Review of governing equations, their forms (conservative and non-conservative formulations) and variants. Boundary conditions. Classification of Partial Differential Equations and their effects on CFD problem setup and solutions.

Concept of equation discretization using finite difference methods, Explicit and implicit methods of formulations and solutions. Domain discretization. Algebraic grid generations, stretched grids, staggered grids, elliptic grid generation techniques.

CFD techniques for Finite Difference Methods; Lax-Wendroff technique, MacCormack's Technique, under relaxation and over relaxation techniques. Errors, Consistency and stability analysis, numerical dispersion and artificial viscosity.

Finite volume techniques for diffusion problems, convection-diffusion problems. Algorithms for pressure- velocity coupling in steady flows (SIMPLE, SIMPLER, SIMPLEC, PISO). Solution of discretized equations (TDMA, point iterative, line iterative and ADI techniques). Concept of turbulence models. Post processing techniques in CFD.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to computational fluid dynamics	
Class-2	Review of governing equations, their forms (conservative and non-conservative)	
Class-3	Boundary Conditions	
Week 2		
Class-4	Classification of Partial Differential Equations	
Class-5	Classification of Partial Differential Equations	
Class-6	Effects of Partial Differential Equations on CFD problem setup and solutions.	

Week 3		
Class-7	Explicit methods of formulations and solutions	CT2 / Mid Term Exam
Class-8	Domain discretization	
Class-9	Algebraic grid generations	
Week 4		
Class-10	Implicit methods of formulations and solutions	
Class-11	Domain discretization	
Class-12	Algebraic grid generations	
Week 5		
Class-13	Stretched grids	
Class-14	Staggered grids	
Class-15	Elliptic grid	
Week 6		
Class-16	CFD techniques for Finite Difference Methods	
Class-17	Lax-Wendroff technique	
Class-18	MacCormack's Technique,	
Week 7		
Class-19	Consistency and stability analysis	
Class-20	Numerical dispersion and artificial viscosity.	CT2 / Mid Term Exam
Class-21	Errors	
Week 8		
Class-22	Finite volume method	
Class-23	Finite volume method	
Class-24	Finite volume method	
Week 9		
Class-25	Convection-diffusion problems	
Class-26	Solved out examples	
Class-27	Solved out examples	
Week 10		
Class-28	SIMPLE	CT3
Class-29	SIMPLER	
Class-30	SIMPLEC, PISO	
Week 11		
Class-31	Discretization equations	
Class-32	Discretization techniques	
Class-33	TDMA	
Week 12		
Class-34	Discretization techniques	
Class-35	TDMA	
Class-36	Solved out examples	
Week 13		
Class-37	Turbulence flow	
Class-38	Turbulence flow modeling	
Class-39	Turbulence flow modeling using CFD techniques	
Week 14		
Class-40	Post processing techniques in CFD.	
Class-41	Post processing techniques in CFD.	
Class-42	Revision class	

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C4
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. Computational Fluid Dynamics – John D. Anderson.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method – H. Versteeg.
3. Fundamentals of Aerodynamics - John D Anderson; McGrawhill.
4. Aerodynamics for Engineering Students –E.L Houghton, P.W. Carpenter, S.H. Collicot and D.T. Valentine; Elsevier.
5. Computational Fluid Mechanics and Heat Transfer - Pletcher.

COURSE INFORMATION			
Course Code	AEAS 326	Contact Hours	1.50
Course Title	Computational Fluid Dynamics Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students with the fundamental principles of ANSYS Fluent module for understanding fluid flow and fluid properties based on computational method.

OBJECTIVE

1. To place CFD in the context of a useful design tool for industry and a vital research tool for fluid research.
2. To familiarize students with the basic steps and algorithms associated with CFD.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **identify** practical physical problems in computational domain with ANSYS software.	PO5	C1			K6	R, Q
CO2	Be able to **solve** the problems and **interpret** the obtained result from CFD analysis using ANSYS.	PO5	C5			K6	R, T, Pr, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	**Exp Name**
1.	Introduction to CFD and ANSYS Fluent
2.	Numerical solution of practical CFD problems
3.	Defining a CFD problem and creating geometry and mesh
4.	Flow over a cylinder using ANSYS- FLUENT
5.	Flow over an aerofoil using ANSYS -FLUENT
6.	Post Processing – analysis of results; validation and verification

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21

Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz	 10 08 10 07
Formal Assessment Continuous Assessment Final Quiz	 06 01
Total	63

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Introduction to CFD and ANSYS Fluent
Week 2	Numerical solution of practical CFD problems
Week 3	Defining a CFD problem and creating geometry and mesh
Week 4	Flow over a cylinder using ANSYS- FLUENT
Week 5	Flow over an aerofoil using ANSYS -FLUENT
Week 6	Post Processing – analysis of results; validation and verification
Week 7	Lab Quiz + Viva

ASSESSMENT STRATEGY

Components	**Grading**	CO	Bloom’s Taxonomy
Class Performance	15%	CO1	C1
		CO2	C5
Report Writing	15%	CO1	C1
		CO2	C5
Lab Quiz	20%	CO1	C1
Lab Test	30%	CO2	C5
Viva Voce/ Presentation	20%	CO2	C5
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Computational Fluid Dynamics: A Practical Approach 3rd Edition by Jiyuan Tu
2. Computational Fluid Dynamics 1st Edition by John Anderson.

COURSE INFORMATION			
Course Code	AEAS 320	Contact Hours	1.50
Course Title	Machine Design Sessional	Credit Hours	0.75

PRE-REQUISITE

Course Code & Title:
1. ME 249: Engineering Mechanics (Statics and Dynamics)
2. AEAS 205: Mechanics of Solids

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is intended to teach the students to design, analysis and selection of commonly used mechanical components of aircraft subject to static and dynamic loads.

OBJECTIVE

1. To calculate various loads as applied to shaft, and specify appropriate design stresses for shaft used in aircraft.
2. To specify suitable keys and couplings for shaft and other type of machine elements used in aircraft.
3. To analyze and design spur gear, helical gear and bevel gear subjected to aircraft.
4. To analyze and design of sliding bearings clutches, brakes, power screws and springs subjected to aircraft.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** the knowledge to **design** machine parts like power screws, shaft, keys, springs, bearings, gears, brakes and clutches.	PO3	C6	CP1, CP2, CP3		K6	T, R, Q
CO2	Be able to **analyze** the design parameters of various aircraft parts.	PO2	C4	CP1, CP2, CP3		K6	T, R, Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Study of fatigue strength; Fracture mechanics in aircraft design.
2.	Design of solid shafts and hollow shaft systems used in aircraft.
3.	Design of keys, springs, roiling contact bearings, journal bearings used in aircraft.
4.	Design of gears, brakes and clutches used in aircraft.
5.	Design with composite materials. Part design for manufacturing aircraft parts.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 7 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 5 5 5 5 10
Formal Assessment Continuous Assessment Final Quiz	 7 1
Total	59

TEACHING METHODOLOGY
Lecture followed by numerical and discussion, Co-operative and Collaborative Method.

COURSE SCHEDULE	
Week 1	Study of fatigue strength; Fracture mechanics in aircraft design.
Week 2	Design of solid shafts and hollow shaft systems used in aircraft.
Week 3	Design of keys, springs, roiling contact bearings, journal bearings used in aircraft.
Week 4	Design of gears, brakes and clutches used in aircraft.
Week 5	Design with composite materials. Part design for manufacturing aircraft parts.
Week 6	Review Assessment of Aircraft part designs.
Week 7	Lab Quiz and Viva.

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom’s Taxonomy
Continuous Assessment	Conduct Lab Test/ Class Performance	25%	CO1	C6
	Report Writing	15%	CO2	C4
Lab Quiz	Mid Term Evaluation (exam/project/assignment)	20%	CO1	C6
	Final Evaluation (Exam/project/assignment)	30%	CO2	C4
Viva		10%	CO1, CO2	C6, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)
REFERENCE BOOKS
1. A Textbook of Machine Design - R. S. Khurmi, J. K. Gupta. 2. Fundamentals of Machine Component Design - Robert C Juvinall. 3. Design of Machine Elements (4th Ed) - Virgil Moring Faires. 4. Mechanical Engineering Design (11th Edition) - Joseph E Shigley, Charles R Mischke & Richard G Budynas.

COURSE INFORMATION			
Course Code	AEAS 405	Contact Hours	3.00
Course Title	Aerospace Vehicle Design	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AE 210: Aeronautical Engineering Drawing II
2. ME 249: Engineering Mechanics (Statics and Dynamics)
3. AEAS 307: Aircraft Loading and Structure Analysis
4. AE 315: Aerospace Vehicle Stability and Control
5. AE 335: Applied Aerodynamics
6. AE 337: Aerospace Propulsion

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is intended to teach students the methodology and decision making involved in the process of designing aircraft.

OBJECTIVE

1. To describe an aircraft design phase like conceptual, preliminary and detail.
2. To generate a first estimation of the new aircraft weight.
3. To analyze the critical performance parameters for the new aircraft.
4. To generate the configuration layout for the new aircraft.
5. To understand the detail design phase and analyzing the wing design, tail design, fuselage design, and propulsion system design.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the concept of design of an aerospace system, mission, or vehicle.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** the conceptual design phase, design layout and design analysis for various types and categories of aircraft, requirement of teamwork and engineering projects.	PO2	C3	CP1, CP2, CP3		K4	T, F, ASG.
CO3	Be able to **analyze** the preliminary design phase and find out the Max take-of weight (MTOW), wing area & engine sizing.	PO2	C4	CP1, CP2, CP3, CP4		K5	F, Mid Term Exam, T.

CO4	Be able to **evaluate** the different design parameters like wing, tail, fuselage, landing gear, and propulsion system.	PO3	C5	CP1, CP2, CP3, CP4, CP5, CP7		K6	T, F.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to conceptual design; Design layout and design analysis - various types and categories of aircraft, requirement of teamwork for complex engineering projects. Aircraft design methods; Techniques for selecting, sizing and stressing components; Regulatory requirements for certification; Off-design requirements; Construction tolerances.
Aircraft preliminary design; Configuration design - performance, propulsion, weight and balance; Aerodynamics design – lift, drag, stability and control, structures and loads; Structural design – payload considerations, center of gravity requirements and materials; Philosophies of design and analysis.
Aircraft detailed design; System design –System design procedures; Systems integration; Test procedures; Fatigue and damage tolerance; the art of design and trade studies.
Investigation of a typical aircraft configuration; Component layout; Alternate configurations; weight penalties or gains; requirements for ancillary equipment. Engine and propeller selection.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction**	CT1
Class-1	Introduction to Design	
Class-2	Engineering Design	
Class-3	Feasibility Analysis	

Week 2	**Systems Engineering Approach**	
Class-4	Fundamentals of Systems Engineering	
Class-5	Design Requirements	
Class-6	Design Review, Evaluation, and Feedback	
Week 3	**Aircraft Conceptual Design**	
Class-7	Primary Functions of Aircraft Components	CT2/ Mid Term Exam
Class-8	Aircraft Configuration Alternatives	
Class-9	Aircraft Classification and Design Constraints	
Week 4	**Preliminary Design**	
Class-10	Maximum Take-Off Weight Estimation	
Class-11	Wing Area and Engine Sizing	
Class-12	Design Examples &Problems	
Week 5	**Wing Design**	
Class-13	Airfoil Section	
Class-14	Airfoil Selection	
Class-15	High-Lift Device	
Week 6	**Wing Design**	
Class-16	High-Lift Device	
Class-17	Wing Design Steps	
Class-18	Wing Design Steps	
Week 7	**Tail Design**	
Class-19	Tail Configuration	
Class-20	Tail Configuration	CT2/ Mid Term Exam
Class-21	Horizontal Tail Parameters	
Week 8	**Tail Design**	
Class-22	Horizontal Tail Parameters	
Class-23	Vertical Tail Design	
Class-24	Vertical Tail Design	
Week 9	**Fuselage Design**	
Class-25	Cockpit Design	
Class-26	Optimum Length-to-Diameter Ratio	
Class-27	Fuselage Design Steps	
Week 10	**Propulsion System Design**	
Class-28	Engine Type Selection	CT3
Class-29	Engine Installation	
Class-30	Engine Performance	
Week 11	**Landing Gear Design**	
Class-31	Landing Gear Configuration	
Class-32	Landing Gear Geometry	
Class-33	Landing Gear and Aircraft Centre of Gravity	
Week 12	**Weight of Components**	
Class-34	Sensitivity of Weight Calculation	
Class-35	Aircraft Major Components	
Class-36	Weight Calculation Technique	
Week 13	**Aircraft Weight Distribution**	
Class-37	Aircraft Centre of Gravity Calculation	
Class-38	Centre of Gravity Range	
Class-39	Weight Distribution Technique	

Week 14	**Design of Control Surfaces**	
Class-40	Aileron Design	
Class-41	Elevator Design	
Class-42	Rudder Design	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
			CO4	C5
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2, CO3	C3, C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C3
			CO3	C4
			CO4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Aircraft Design: A systems of Engineering Approach- Mohammad H. Sadraey
2. Aircraft Design: A Conceptual Approach - Raymer, 3rd Ed; AIAA Virginia, 1999.
3. Airplane Design: John Roskam, Parts: I-VIII

COURSE INFORMATION			
Course Code	AEAS 406	Contact Hours	1.50
Course Title	Aerospace Vehicle Design Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is intended to teach the students to apply all the design phases & structural layout for aircraft design.

OBJECTIVE

1. To describe an aircraft design phase like conceptual, preliminary and detail.
2. To generate a first estimation of the new aircraft weight.
3. To analyze the critical performance parameters for the new aircraft.
4. To generate the configuration layout for the new aircraft.
5. To understand the detail design phase and analyzing the wing design, tail design, fuselage design, and propulsion system design.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** the conceptual design phase, design layout and design analysis for various types and categories of aircraft, requirement of teamwork and engineering projects.	PO1	C3			K3	R, Q, T
CO2	Be able to **analyze** the preliminary design phase and find out the Max take-of weight (MTOW), wing area & engine sizing.	PO2	C4	CP1, CP2, CP3		K4	R, Q, T
CO3	Be able to **design** and **investigate** the various aircraft's components like wing, tail, fuselage, landing gear, and propulsion system.	PO4	C6	CP1, CP2, CP3, CP4, CP5, CP7		K8	Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Conceptual design report, depending on the mission profile: • Development of system operational requirement, • Selection of configuration from different alternative using Figure of Merit.

2.	Preliminary design report: • Numerical problems on maximum take-off weight estimation, wing area &engine sizing.
3.	Detail design report: • Wing design: Selection of aero foil, determination of wing parameters using Geometric and Trigonometric method. • Tail design: determination of tail parameters. • Fuselage Design: determination of fuselage parameters • Propulsion System Design: determination of propulsion system parameters • Landing Gear Design: determination of landing gear parameters • Weight of Components & Weight Distribution: Estimation of component's weight and distribution of center of gravity
4.	Individual project on specified Aircraft Design.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 7 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of presentation Engagement in Individual Design	 15 5 10
Formal Assessment Continuous Assessment	 05
Total	56

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Introduction to design sessional and providing mission profiles
Week 2	Conceptual design phase
Week 3	Preliminary design phase
Week 4	Preliminary design phase
Week 5	Detail design phase
Week 6	Detail design phase
Week 7	Individual project on specified Aircraft Design.

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	15%	CO 1	C3
			CO 2	C4
	Report Writing	25%	CO 1	C3
			CO 2	C4
			CO 3	C6

Final Evaluation (Exam/project/assignment)	50%	CO1, CO2, CO3	C3, C4, C6
Viva Voce/ Presentation	10%	CO1, CO2, CO3	C3, C4, C6C6
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Aircraft Design: A systems of Engineering Approach- Mohammad H. Sadraey
2. Aircraft Design: A Conceptual Approach - Raymer, 6th Ed; AIAA Virginia, September 30, 2018.
3. Airplane Design: John Roskam, Part: I – VIII

COURSE INFORMATION			
Course Code:	AEAS 439	Contact Hours:	3.00
Course Title:	Rotor Dynamics and Aircraft Performance	Credit Hours:	3.00

PRE-REQUISITE

Course Code & Title

1. AE 335: Applied Aerodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is intended to teach the students about Helicopter aerodynamics and understand & analyze various aircraft performance parameters

OBJECTIVE

1. To explain the blade momentum and element theory for lift generation in helicopters.
2. To understand the performance of helicopter in different phases of flight.
3. To analyze the performance of fixed wing aircraft.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the basic concepts of momentum theory as applied to rotary wing aircraft.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **understand** blade element theory and different performance parameters of helicopter.	PO1	C2			K3	T, F, ASG.
CO3	Be able to **analyze** the components of drag for fixed wing aircraft and engine performance.	PO2	C4			K4	F, Mid Term Exam.
CO4	Be able to **analyze** performance of a fixed wing aircraft	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

1.<u>Rotary-Wing Aircraft Performance</u>: Introduction to rotor dynamics, momentum theory, Vertical climb and descent, Autorotation, Ground effect, Rotor mechanisms, Introduction to rotor aerodynamics and aerodynamic design, Rotorcraft performance, rotorcraft in vertical and forward flight, rotorcraft maneuver, Rotorcraft mission analysis, V/STOL performance; Noise performance.

2. **Performance of Fixed-Wing Aircraft**: Introduction, the aircraft and its environment, weight performance, Aerodynamic performance, Engine performance. Flight envelopes, take-off and landing, climb and gliding, cruise performance; Maneuver performance.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to Helicopter dynamics**	CT1
Class-1	Helicopter History and advantages of helicopters over fixed wing aircraft	
Class-2	Helicopter configurations, their working principles	
Class-3	Basic control mechanisms of helicopter, degrees of freedom and pilot controls	
Week 2	**Momentum theory in Rotor dynamics**	
Class-4	Introduction to momentum theory as applied to rotor dynamics. Simplifying assumptions	
Class-5	Analysis of vertical flight: Hover using momentum theory	
Class-6	Dependence of parameters for hover flight	
Week 3	**Momentum theory application to Rotor dynamics: Vertical Flight**	
Class-7	Analysis of vertical flight: Climb using momentum theory	CT2/ Mid Term
Class-8	Analysis of vertical flight: Climb using momentum theory	
Class-9	Analysis of vertical flight: Descending flight using momentum theory	
Week 4	**Momentum theory application to Rotor dynamics: Vertical Flight**	
Class-10	Applicability of momentum theory and discussion on turbulent wake state and windmill braking	
Class-11	Auto rotation and Ideal auto rotation	
Class-12	In ground effect and out of ground effect. Brown out and vortex structures of vertical flight	
Week 5	**Blade elementary theory and non-uniform flows**	
Class-13	Application of Blade elementary theory for vertical flight.	

Class-14	Correlation between pilot pitch input and variation in thrust coefficient, power coefficient	
Class-15	Introduction to non-uniform flows	
Week 6	**Forward flight concept and Helicopter performance**	
Class-16	Introduction to forward flight and its dynamics, construction of articulated blades.	
Class-17	Analysis of forward flight using momentum theory, blade elementary Theory. Induced power in forward flight	
Class-18	Performance of Helicopter in vertical flight: Hover, climb and descend flights;	
Week 7	**Helicopter performance and stability analysis**	
Class-19	Helicopter performance in forward flight, limiting factors of forward speed.	
Class-20	Static stability analysis of helicopters	
Class-21	Longitudinal and lateral dynamic stability analysis for helicopters	
Week 8	**Introduction to Aircraft Performance**	
Class-22	Aviation history (Pre Wright era, Era of Strut & Wire Biplanes)	
Class-23	Aviation history (Era mature Propeller Driven Airplane, Era of Jet Propelled Airplane)	CT2/ Mid Term
Class-24	Unconventional Designs (Innovative Concepts)	
Week 9	**Aerodynamics of the Airplane**	
Class-25	Aerodynamic Centre	
Class-26	Lift and Drag Buildup	
Class-27	Drag Polar	
Week 10	**Engine Performance**	
Class-28	Thrust and Efficiency	
Class-29	Variation of power and specific fuel consumption with velocity and altitude.	
Class-30	Variation of thrust and specific fuel consumption with velocity and altitude.	
Week 11	**Airplane Performance: Steady Flight**	
Class-31	Equations of motion for steady and level flight.	
Class-32	Thrust required	
Class-33	Aerodynamic relations associated with Maximum C_L/C_D, $C_L3/2/C_D$, $C_L1/2/C_D$	
Week 12	**Airplane Performance: Steady Flight**	
Class-34	Thrust available and the maximum velocity of propeller driven aircraft.	CT3
Class-35	Thrust available and the maximum velocity of jet propelled aircraft.	
Class-36	Power required and power available.	
Week 13	**Airplane Performance: Steady Flight**	
Class-37	Rate of climb, time to climb.	
Class-38	Service Ceiling & Absolute ceiling.	
Class-39	Range and Endurance.	
Week 14	**Airplane Performance: Accelerated Flight**	
Class-40	Level Turn, Pull up and pull down maneuver.	
Class-41	V-n Diagram and energy concept.	
Class-42	Takeoff and landing performance.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2, CO4	C2, C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C2
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Performance of Fixed and Rotary Wing Aircraft - Antonio Filippone
2. Aerodynamics of the helicopter - Alfred Gessow/ Garry C. Myers Jr.
3. Basic Helicopter Aerodynamics - John Seddon/Simon Newman.
4. The Art of the Helicopter - John Watkinson.
5. Aircraft Performance and Design - John D. Anderson; WCB McGrawhill.

COURSE INFORMATION			
Course Code:	AEAS 407	Contact Hours:	3.00
Course Title:	Turbomachinery	Credit Hours:	3.00

PRE-REQUISITE

Course Code & Title:
1. AE-207 (Thermodynamics)
2. AEAS-301 (Heat Transfer)
3. AE-337 (Aerospace propulsion)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Students will be able to understand, analyze and learn about the details of turbo machines and their working principles.

OBJECTIVE

1. To know the classification and applications of different turbo machines.
2. To develop the basic concepts of thermodynamic analysis of diffusers, nozzles.
3. To analyze the Thermodynamic and Aerodynamic behavior of Axial and Radial Flow Compressors and Turbines.
4. To demonstrate understanding of instabilities in compressor operations and methods to arrest instabilities.
5. To identify performance parameters influencing the operation of turbo machines.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the functioning of turbo machines and **explain** aero thermodynamic process of Nozzle and Stator	PO1	C2			K3	T, F, ASG.
CO2	Be able to **predict** the Performance of turbo machines by Dimensional Analysis techniques and **calculate** aerodynamic forces on blades by understanding flow through Cascades	PO1	C3			K3	T, F, ASG.
CO3	Be able to **compare** Aero thermodynamic analysis of flow through Axial Flow Turbines and Axial Flow Compressors and **analyze** parameters affecting their performance	PO2	C4			K4	F, Mid Term Exam.

CO4	Be able to **analyze** Aero thermodynamic flow through Centrifugal compressors and Radial Turbines and also **Predict** design and Off design performance of Gas Turbines	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Mechanics and thermodynamics of diffusers, nozzles, compressors and turbines; Dimensional Analysis,
Energy Transfer in turbo-machines, Stage dynamics and performance of axial flow compressor and turbine, centrifugal compressors and radial turbines, stage velocity triangles.
Theories of cascades. Axial compressor and turbine blade design considerations. Prediction of design and off design performance of Gas Turbines; Gas turbine component matching; Transient behavior of Gas turbines.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	**CT**
Week 1	**Introduction to Turbo-machines**	CT1
Class-1	Historical review of evolution of turbo-machines	
Class-2	Introduction to Turbo-machines, classification of turbo-machines	
Class-3	Essential Components and advantages of turbo-machines over positive displacement machines	

Week 2	**Thermodynamic laws**	
Class-4	Review of thermodynamic laws	
Class-5	Thermodynamic analysis of flow through nozzles for large pressure ratios and small pressure ratios	
Class-6	Thermodynamic analysis of flow through diffusers for large pressure ratios and small pressure ratios	
Week 3	**Introduction to aerodynamics analysis**	
Class-7	Work and efficiency definitions of turbines and compressors	CT2/ Mid Term
Class-8	Discussion on stage efficiencies, polytrophic efficiencies applied to turbine and compressors	
Class-9	Introduction to aerodynamics analysis of flow through the turbo-machines	
Week 4	**Dimensional analysis**	
Class-10	Introduction to Dimensional analysis, Buckingham's π -theorem	
Class-11	Dimensional analysis applied to incompressible and compressible turbo- machines	
Class-12	Performance characteristics of turbines, compressors, fans and blowers	
Week 5	**2D Flow Through Cascades**	
Class-13	Introduction to 2D flow through cascades	
Class-14	Aerodynamic analysis of compressor and turbine cascade and efficiency of cascades	
Class-15	Performance of cascades	
Week 6	**Axial flow compressor**	
Class-16	Thermodynamic analysis of axial flow compressor. Multi-staging effects and its analysis. Infinitesimal staging and its effects. Stage-wise performance analysis	
Class-17	Variation of thermodynamic properties of air in multistage compressors	
Class-18	Performance of axial flow compressors, Flow coefficient, degree of reaction, diffusion etc.	
Week 7	**Velocity Triangles**	
Class-19	Discussions on velocity triangles, work done by compressor, change in properties across the compressor stages	
Class-20	Efficiencies of axial flow compressors.	CT2/ Mid Term
Class-21	Performance of axial flow compressors, Flow coefficient, degree of reaction, diffusion etc.	
Week 8	**Surge**	
Class-22	Axial flow compressor losses and its effects	
Class-23	Unstable operations of axial flow compressor	
Class-24	Rotating stall and Surge. Detection of onset of rotating stall and surge	
Week 9	**Axial Flow Turbines**	
Class-25	Thermodynamic analysis of axial flow turbines	
Class-26	Aerodynamic analysis of axial flow turbines	
Class-27	Multi-staging and multi pooling requirements of turbines	
Week 10	**Stage velocity triangles**	
Class-28	Stage velocity triangles	CT3
Class-29	Effect of degree of reaction and velocity triangles for different values of degree of reactions	

Class-30	Losses and efficiencies of axial flow turbines	
Week 11	**Performance**	
Class-31	Performance of axial flow turbines	
Class-32	Introduction of centrifugal and radial machines	
Class-33	Enthalpy and conservation of Enthalpy across rotors	
Week 12	**Centrifugal compressors**	
Class-34	Comparison of centrifugal compressors with axial flow compressors, advantages and applications	
Class-35	Velocity triangles, analysis of work, efficiencies. Variation of fluid property in centrifugal compressors	
Class-36	Comparison of radial turbines with axial turbines, advantages and applications	
Week 13	**Radial Flow Turbines**	
Class-37	Velocity triangles, work done, efficiency of radial flow turbines. Various Configurations and constructions of radial flow turbines	
Class-38	Axial compressor and turbine blade design considerations	
Class-39	Blade cooling techniques in turbines	
Week 14	**Design Performance**	
Class-40	Prediction of design and off design performance of Gas Turbines	
Class-41	Gas turbine component matching	
Class-42	Transient behavior of Gas turbines	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C3
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics and Thermodynamics of Propulsion - Hill & Peterson.
2. Fluid Mechanics, Thermodynamics of Turbo-machinery - S L Dixon; Pergamon
3. Fundamentals of Turbomachinery- BK Venkanna
4. Gas Turbine Theory-H Cohen, GFC Rogers, HIH Saravanamuttoo
5. Principles of Turbo-machinery - Seppo A. Korpela; WILEY Publications.
6. Turbines Compressors and Fans-S M Yahya.

COURSE INFORMATION			
Course Code	AEAS 413	Contact Hours	3.00
Course Title	High Speed Aerodynamics	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AE 203: Fundamentals of Fluid Mechanics
2. AE 335: Applied Aerodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the theories of compressible flow involving subsonic and supersonic cases.

OBJECTIVE

1. To define the fundamental aspects of compressible flow.
2. To solve simple problems related to shock and expansion (Prandtl-Meyer) waves phenomena.
3. To solve problems related to adiabatic flow.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the concept of compressible flows and shock waves	PO1	C2			K3	T, F, ASG
CO2	Be able to mathematically **analyze** the influence of shock and expansion waves	PO2	C4			K4	T, F, ASG
CO3	Be able to **apply** the knowledge of shock wave theories to address problems of supercritical airfoils and fluid friction	PO1	C3			K4	T, F, ASG
CO4	Be able to **determine** the effect of compressibility and moving shocks mathematically	PO2	C3			K4	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT
Basic equations of compressible flow, wave propagation in compressible media; velocity of sound, subsonic and supersonic flows, Mach number, isentropic flow, stagnation properties, flow through convergent-divergent nozzle. Normal shock waves, oblique shock and expansion waves, Prandatl-Mayer expansion fans, shock expansion theory, linearized flow theory. Flow with friction and heat transfer, moving shock wave, shock tube flow, transonic flow, and measurements in compressible flow.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Bernoulli's Equation, Low-speed wind tunnel.	
Class-2	Pitot tube: measurement of airspeed, pressure coefficient.	
Class-3	Governing equation for Inviscid, Compressible flow.	
Week 2		
Class-4	Aspects of subsonic flow,	
Class-5	Aspects of supersonic flow: shock wave	
Class-6	Types of flow: subsonic, supersonic and hypersonic.	
Week 3		
Class-7	Definition of total (stagnation) condition.	CT2 / Mid Term Exam
Class-8	Speed of sound	
Class-9	Sound formation and propagation in air.	
Week 4		
Class-10	Special forms of Energy equation	
Class-11	Prandlt-Glauert compressibility correction	
Class-12	Drag divergence mach number, critical mach number	

Week 5		
Class-13	Governing Equation for Quasi-one-dimensional flow.	
Class-14	Nozzle flows, diffusers, subsonic wind tunnel, CD nozzle.	
Class-15	Supersonic wind tunnel and related math.	
Week 6		
Class-16	The basic normal shock equations.	
Class-17	Calculation of normal shock waves.	
Class-18	Related mathematics.	
Week 7		
Class-19	Oblique shock relations	
Class-20	Supersonic flow over wedges and cones	CT2 / Mid Term Exam
Class-21	Detached shock wave in front of a blunt body	
Week 8		
Class-22	Prandatl-Mayer expansion waves	
Class-23	Continue	
Class-24	Mathematical problem.	
Week 9		
Class-25	Shock expansion theory: application to supersonic airfoils	
Class-26	Continue	
Class-27	Mathematical problem	
Week 10		
Class-28	Derivation of the Linearized Supersonic pressure coefficient formula	CT3
Class-29	Application to supersonic airfoils	
Class-30	Super critical airfoils and related problems	
Week 11		
Class-31	Explain basic equations and formulae	
Class-32	Mathematical problem solve	
Class-33	Mathematical problem solve	
Week 12		
Class-34	Introduction to moving shock wave	
Class-35	Equations of moving shock wave	
Class-36	Shock tube flow	
Week 13		
Class-37	Transonic flow	
Class-38	Subsonic flow	
Class-39	Supersonic flow	
Week 14		
Class-40	Equations of motion for compressible flow	
Class-41	Energy equation for compressible flow	
Class-42	Problem solving and review	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C4
	Class Performance	5%		
	Class Attendance	5%		

	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C4
			CO3	C3
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of Aerodynamics- John D. Anderson; McGraw Hill.
2. Aerodynamics for Engineering Students, 5th Edition-E. L. Houghton & P. W. Carpenter
3. Gas Dynamics, 3rd Edition-James E. A. John and Theo G. Keith
4. Gas Dynamics- E. Rathakrishna.

COURSE INFORMATION			
Course Code	AEAS 408	Contact Hours	1.50
Course Title	Turbomachinery Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to apply the theoretical knowledge of different types of compressors and turbines in practical cases.

OBJECTIVE

1. To determine the thermodynamic properties of flow inside the diffusers, nozzles, compressors and turbines.
2. To compile and analyze the various properties of flow and check whether the laws of thermodynamics hold.
3. To determine the performance of different types of compressors and turbines.
4. To analyze the design considerations required for different types of working conditions.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the working principle of turbomachines.	PO1	C2			K3	R, Q, T
CO2	Be able to **analyze** Stage Velocity triangles of Compressor and Turbine, **investigate** performance of Turbomachines.	PO4	C4, P2			K5	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
01	Determination of pressure and temperature of the flow inside compressors and turbines
02	Determination of the performance of different types of compressors and turbines.
03	Representation of stage velocity triangles calculated from different parameters
04	Predict performance of turbomachines and Calculation of energy transfer in turbo-machines

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21

Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	05
Preparation of presentation	5
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	7
Final Quiz	1
Total	64

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Familiarization with types of turbomachines and Construction of turbomachines.
Week 2	Thermodynamic Cycle Analysis of Axial Flow Compressors and Turbines
Week 3	Aero-thermodynamic Analysis of Axial Flow Compressors and Turbines.
Week 4	Familiarization with Wind Tunnel Set-up for Cascade flow Analyze the Stage Velocity triangles of Axial Flow Compressors and Turbines
Week 5	Perform experiment in 2D Wind Tunnel for Compressor Blade Rows. Perform experiment in 2D Wind Tunnel for Turbine Blade Rows
Week 6	Lab Test
Week 7	Lab Quiz/Viva

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation	25%	CO 1	C2
			CO 2	C4, P2
	Report Writing	25%	CO 1	C2
			CO 2	C4, P2
	Mid Term Evaluation (exam/project/ assignment)	20%	CO 1	C2
Final Evaluation (Exam/project/assignment)		40%	CO 1	C2
			CO 2	C4, P2
Viva Voce/ Presentation		10%	CO1, CO2	C2, C4, P2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Mechanics and Thermodynamics of Propulsion - Hill & Peterson.
2. Fluid Mechanics, Thermodynamics of Turbo-machinery - S L Dixon.
3. Fundamentals of Turbomachinery- BK Venkanna
4. Gas Turbine Theory-H Cohen, GFC Rogers, HIH Saravanamuttoo
5. Principles of Turbo-machinery - Seppo A. Korpela; WILEY Publications.
6. Turbines Compressors and Fans-S M Yahya.

COURSE INFORMATION			
Course Code	AEAS 414	Contact Hours	1.50
Course Title	High Speed Aerodynamics Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This subject is intended to teach the students basics, concepts, principles and working mechanisms of supersonic wind tunnel.

OBJECTIVE

1. To learn about the working principle of a supersonic wind tunnel
2. To visualize the flow analysis and shock wave characteristics of different objects.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **familiarize** with the operation of a supersonic wind tunnel	PO1	P2			K3	R, Q, T
CO2	Be able to **investigate** the flow properties and shock wave characteristics of different objects	PO2	C4			K4	R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Familiarization with Supersonic Wind Tunnel
2.	Visualization of Shock Wave in a Supersonic Wind Tunnel
3.	Determination of Pressure Distribution along a C-D nozzle
4.	Effect of angle of attack on the flow deflection angle of wedges having different geometries
5.	Determination of Pressure Distribution around a Double-Wedged Airfoil on Supersonic Flow

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
	Total 42

Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Familiarization with experimental apparatus and datasets.
Week 2	Familiarization with Supersonic Wind Tunnel
Week 3	Visualization of Shock Wave in a Supersonic Wind Tunnel
Week 4	Determination of Pressure Distribution along a C-D nozzle
Week 5	Effect of angle of attack on the flow deflection angle of wedges having different geometries
Week 6	Determination of Pressure Distribution around a Double-Wedged Airfoil on Supersonic Flow
Week 7	Lab Test & Lab Quiz

ASSESSMENT STRATEGY

Components	**Grading**	CO	Bloom's Taxonomy
Lab participation and Report	25%	CO 1	P2
		CO 2	C4
Lab Test	40%	CO 1	P2
		CO 2	C4
Lab Quiz	35%	CO 1	P2
		CO 2	C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of Aerodynamics- John D. Anderson; McGraw Hill.
2. Aerodynamics for Engineering Students, 5th Edition-E. L. Houghton & P. W. Carpenter
3. Gas Dynamics- E. Rathakrishna
4. General Theory of High Speed Aerodynamics- Textbook by William R. Sears

5.5 Elective Courses Offered in Aerospace Discipline

COURSE INFORMATION

Course Code	: AEAS 307	Contact Hours	: 3.00
Course Title	: Aircraft Loading and Structural Analysis	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. AEAS 205: Mechanics of Solids

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides an in-depth understanding of aircraft structures and the principles of loading analysis. Emphasis will be placed on developing skills in structural analysis techniques, including failure theories and stress analysis. Upon completion of the course, students will be equipped with the knowledge and tools necessary to evaluate aircraft structures' integrity and performance under different loading conditions.

OBJECTIVE

1. To get an introduction of design philosophies like damage tolerance, and fail-safe principle.
2. To get introduction of the aircraft data requirements and description of the critical airloads used in the design and analysis of aircraft structures.
3. To get introduction of the aero-elastic stability design constraint.
4. To get an overview of the role and lay-out of main structural members used in aircraft structures.
5. To understand fatigue failure consideration and its relation with design philosophies, fatigue loads in aircraft operations and fatigue life analysis methods.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the theory of elasticity in the solution of engineering problems	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** the energy methods to solve idealized aircraft structural components	PO2	C3			K3	T, F, ASG.
CO3	Be able to explain the concept of shear flow and shear center, and its implication in aircraft structures	PO1	C2			K3	F, Mid Term Exam.

CO4	Be able to interpret the basic theories of plate and other major aircraft components and solve relevant problems	PO2	C5			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fundamental equations of elasticity and their applications, stress and deformation in elemental structures/components; General equations and solution techniques;
Energy methods in structural analysis: Principles of virtual work and total potential and complementary energies.
Bending of beams with unsymmetrical cross-sections; Basic principles and theory of stressed-skin structural analysis; Determination of direct stresses and shear flows in arbitrary thin-walled beams: unsymmetrical sections, open and closed sections, tapered sections, continuous and idealized sections.
The fundamental theory of plates, including in-plane and bending loads as well as buckling and shear instabilities; Solution techniques for plate problems including Navier's solutions for rectangular plates; Energy methods for plate bending and plate buckling. Analysis of common aircraft components including fuselages, wings, skin-panels, spar, stringers, ribs, frames and longerons.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week-1	**Theory of Elasticity**	CT1
Class-1	Review of basic concepts: Stress, strain.	
Class-2	Stress-strain relationship : Hook's law in 1-D and 3-D.	
Class-3	Related Numerical.	

Week 2	**Theory of Elasticity (Continued)**	
Class-4	Strain-displacement relations.	
Class-5	Volumetric strain and determination of limiting value of Poisson's ratio.	
Class-6	Related Numerical.	
Week 3	**Conditions for Equilibrium and Two Dimensional Elasticity**	
Class-7	Derivation of equilibrium equations in Elasticity and related numerical	
Class-8	Introduction to two dimensional elasticity and plane stress condition	
Class-9	Related Numerical.	
Week 4	**Two Dimensional Elasticity**	
Class-10	Plane strain condition	
Class-11	Solution of 2-D problems: Derivation of compatibility equations.	
Class-12	Related Numerical.	
Week 5	**Stress Function Formulation and Energy Methods in Structural Analysis**	CT2/ MID TERM
Class-13	Airy's stress function.	
Class-14	. Related Numerical.	
Class-15	Strain energy and complementary energy.	
Week 6	**Energy Methods in Structural Analysis**	
Class-16	Expression for strain energy for a solid bar under various types of loading	
Class-17	Related Numerical.	
Class-18	Castigliano's theorem and related numerical	
Week 7	**Energy Methods in Structural Analysis (cont'd) and Beams**	
Class-19	Minimum potential energy method and related numerical.	
Class-20	Types of beams and differential equation governing deflection of beam.	
Class-21	Boundary conditions	
Week-8	**Shearing stresses in beams**	
Class-22	Shear stress distribution and concept of shear flow.	
Class-23	Shear flow in I-section, Channel section and Split tube section.	CT2/ MID TERM
Class-24	Shear center and numerical related to shearing stresses in beams.	
Week 9	**Determination of direct stresses and shear flows in arbitrary thin-walled beams**	
Class-25	Unsymmetrical sections.	
Class-26	Open and closed sections.	
Class-27	Tapered sections, continuous and idealized sections.	
Week 10	**Plate Theory and Applications**	
Class-28	Fundamental theory of plates, bending of thin plates.	
Class-29	Displacement, stress and strain field for thin plates.	
Class-30	Equilibrium equations for thin plates.	
Week 11	**Plate Theory and Applications (cont'd)**	
Class-31	Solution techniques for plate problems including Navier's solutions for rectangular plates.	CT3
Class-32	End conditions for plates	
Class-33	Related numerical.	
Week 12	**Plate Theory and Applications (cont'd)**	
Class-34	Energy methods for plate bending.	

Class-35	Plate Buckling
Class-36	Numerical
Week 13	**Analysis of common aircraft components**
Class-37	Analysis of fuselage.
Class-38	Analysis of wings.
Class-39	Analysis of skin-panels.
Week 14	**Analysis of common aircraft components (cont'd)**
Class-40	Analysis of spar, stringers.
Class-41	Analysis of ribs, frames and longerons.
Class-42	Numerical

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
			CO 4	C5
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C2
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Aircraft Structures for Engineering Students- T.H.G Megson
2. Aircraft Structure –David & Perez; Publisher – McGraw-Hill.
3. Strength of Materials (4th edition) – AndrewPytel, Ferdinand L. Singer.
4. Strength of Materials –Beer and Johnston.

COURSE INFORMATION			
Course Code	: AEAS 427	Contact Hours	: 3.00
Course Title	: Noise Control and Vibration	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn about aviation safety procedures and necessary arrangements.

OBJECTIVE

1. To gain knowledge about sound transmission, its level and effect on human health.
2. To understand the mathematical perspective of sound/vibration propagation.
3. To evaluate various properties in relation to controlling noise.
4. To understand about how vibration from vibrating machinery affects the surrounding environment.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the mathematical perspective of sound/vibration propagation	PO1	C2			K4	T, F.
CO2	Be able to **evaluate** various properties in relation to controlling noise.	PO2	C5			K4	T, F.
CO3	Be able to **list** different preventive measures to cancel out harmful vibrations in aircraft and helicopters.	PO1	C1			K3	T/ASG, F
CO4	Be able to **assess** the effects of vibrating machinery to surrounding environment.	PO2	C5			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Sound waves; Sound sources; Sound transmission through walls and structures; sound pressure level; psychological response to sound; threshold of hearing and threshold of pain, maximum permissible levels of sound exposure; Sound transmission inside the aircraft; Mechanism of sound absorption; Sound control inside the aircraft.
Physical acoustics: The wave equation, solution of the wave equation, comparison with vibration having finite degrees of freedom; Acoustics of large and small rooms; Mechanism of sound absorption; Design of silencers.
Noise attenuation and control; Statistical properties of noise; response of systems to noise, correlation functions and transfer; Frequency response functions.
Vibration isolation, machine foundation design; Generation of vibration in machines, acceptable levels and methods of control; Vibration absorption; Random vibration; Beam and plate vibrations; Radiation of sound from vibrating machinery
Importance of vibration in aircraft and helicopters; Vibration identification and preventive measures in aircraft and helicopters

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Sound waves**	CT1
Class-1	Sound sources	
Class-2	Sound transmission through walls and structure	
Class-3	Sound pressure level	
Week 2	**Psychological response to sound**	
Class-4	Threshold of hearing	
Class-5	Threshold of pain	
Class-6	Maximum permissible levels of sound exposure	

Week 3	**Sound transmission inside the aircraft**	
Class-7	Mechanism of sound absorption	CT2/ MID TERM
Class-8	Sound control inside the aircraft	
Class-9	Continue	
Week 4	**Physical acoustics**	
Class-10	The wave equation	
Class-11	Solution of the wave equation	
Class-12	Continue	
Week 5	**Vibration and degrees of freedom**	
Class-13	Comparison with vibration having finite degrees of freedom	
Class-14	Acoustics of large and small rooms	
Class-15	Continue	
Week 6	**Sound absorption**	
Class-16	Mechanism of sound absorption	
Class-17	Design of silencers	
Class-18	Continue	
Week 7	**Noise**	
Class-19	Noise attenuation and control	
Class-20	Statistical properties of noise	CT2/ MID TERM
Class-21	Continue	
Week 8	**Systems to noise**	
Class-22	Response of systems to noise	
Class-23	Continue	
Class-24	Correlation functions and transfer	
Week 9	**Frequency response**	
Class-25	Frequency response functions.	
Class-26	Continue	
Class-27	Continue	
Week 10	**Vibration isolation**	
Class-28	Introduction to vibration isolation	CT3
Class-29	Machine foundation design	
Class-30	Generation of vibration in machines	
Week 11	**Vibration levels and methods of control**	
Class-31	Acceptable levels and methods of control	
Class-32	Vibration absorption	
Class-33	Random vibration control	
Week 12	**Vibrations on Bodies**	
Class-34	Beam and plate vibrations	
Class-35	Radiation of sound from vibrating machinery.	
Class-36	Continue	
Week 13	**Vibration in aircraft and helicopters**	
Class-37	Importance of vibration in helicopters	
Class-38	Importance of vibration in aircraft	
Class-39	Continue	
Week 14	**Vibration identification and prevention**	
Class-40	Vibration identification systems	
Class-41	Preventive measures in aircraft and helicopters.	
Class-42	Review of whole Syllabus	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO 1</td><td>C2</td></tr>
<tr><td>CO 2</td><td>C5</td></tr>
<tr><td>CO4</td><td>C5</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO2, CO3</td><td>C5, C1</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO 1</td><td>C2</td></tr>
<tr><td>CO 2</td><td>C5</td></tr>
<tr><td>CO 3</td><td>C1</td></tr>
<tr><td>CO 4</td><td>C5</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Fundamentals of Noise and Vibration – F. J. Fahy, J. G. Walker; Spon Press; 1998
2. Active control of Noise and Vibration – Colin Snyder Hansen – C. H. Hansen, Scott Snyder; Spon Press, 1st edition, 1996.
3. Mechanical Vibrations (3rd edition) - Singiresu S Rao; Addison-Wesley, Massachusetts, 1995

COURSE INFORMATION			
Course Code Course Title	: AEAS 429 : Rotorcraft Performance	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code & Title:
1. AE 207: Thermodynamics,
2. AE 337: Aerospace Propulsion.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn the various factors in designing the different components of the aircraft.

OBJECTIVE

1. To Gain knowledge about various types of rotorcraft flight conditions.
2. To Understand the performance of rotors and engines in the presence of a helicopter fuselage and other rotors
3. To Evaluate various control settings and actuator forces for trim in hover, forward and climbing flight.
4. To Gain knowledge about various types of flight tests in relation to rotorcrafts.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** various types of rotorcraft flight conditions.	PO1	C2			K3	T, F.
CO2	Be able to understand the performance of rotors and engines in the presence of a helicopter fuselage and other rotors.	PO1	C2			K3	T, F.
CO3	Be able to **evaluate** various control settings and actuator forces for trim in hover, forward and climbing flight.	PO2	C5			K3	T, F, ASG.
CO4	Be able to **analyze** various types of flight tests in relation to rotorcrafts and know about design	PO2	C4			K4	T/ASG, F

	components of rotorcrafts considering fail-safe and safe life concepts.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Examine the performance of rotorcraft in hover, forward and climbing flight; Methods for estimating the performance of rotors and engines in the presence of a helicopter fuselage and other rotors; Calculate the control settings and actuator forces for trim in hover, forward and climbing flight at various center of gravity locations for a real helicopter.
Helicopter dynamics and proceeds to derive stability augmentation and flight control system design; Rotorcraft flight test engineering including the use of dimensional analysis; Design regulations and considerations relating to rotor induced vibration, ground resonance and fatigue; Emphasis on design for crash worthiness; Fail safe and safe life concepts.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Performance of rotorcraft in hover**	CT1
Class-1	Examine the performance of rotorcraft in hover	
Class-2	Continue	
Class-3	Continue	
Week 2	**Forward and climbing flight**	
Class-4	Forward flight	
Class-5	Climbing flight	
Class-6	Continue	
Week 3	**Methods for estimating the performance of rotors in the presence of a helicopter fuselage and other rotors**	

Class-7	Methods for estimating the performance of rotors in the presence of a helicopter fuselage	CT2/ MID TERM
Class-8	Continue	
Class-9	Methods for estimating the performance of rotors in the presence of other rotors	
Week 4	**Methods for estimating the performance of engines in the presence of a helicopter fuselage and other rotors**	
Class-10	Methods for estimating the performance of engines in the presence of a helicopter fuselage	
Class-11	Continue	
Class-12	Methods for estimating the performance of engines in the presence other rotors	
Week 5	**Control settings and actuator forces for trim in hover**	
Class-13	Calculate the control settings and actuator forces for trim in hover	
Class-14	Continue	
Class-15	Continue	
Week 6	**Control settings and actuator forces for trim in forward flight**	
Class-16	Calculate the control settings and actuator forces for trim in forward flight	
Class-17	Continue	
Class-18	Continue	
Week 7	**Control settings and actuator forces for trim in climbing flight**	
Class-19	Calculate the Control settings and actuator forces for trim in climbing flight	
Class-20	Continue	CT2/ MID TERM
Class-21	Continue	
Week 8	**Helicopter dynamics**	
Class-22	Introduction to Helicopter dynamics	
Class-23	Continue	
Class-24	Continue	
Week 9	**Stability augmentation and flight control system design**	
Class-25	Derivation of stability augmentation and flight control system design	
Class-26	Continue	
Class-27	Continue	
Week 10	**Rotorcraft flight test**	
Class-28	Rotorcraft flight test engineering	CT3
Class-29	Continue	
Class-30	Use of dimensional analysis	
Week 11	**Design regulations and considerations relating to rotor induced vibration**	
Class-31	Introduction	
Class-32	Design regulations and considerations	
Class-33	Continue	
Week 12	**Design regulations and considerations relating to ground resonance**	
Class-34	Introduction	
Class-35	Design regulations and considerations	
Class-36	Continue	

Week 13	**Design regulations and considerations relating to rotor induced fatigue**	
Class-37	Introduction	
Class-38	Design regulations and considerations	
Class-39	Continue	
Week 14	**Emphasis on design for crash worthiness**	
Class-40	Emphasis on design for crash worthiness	
Class-41	Continue	
Class-42	Fail safe and safe life concepts	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2, CO3	C2, C5
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C5
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Rotary Wing aerodynamics - W.Z. Stepniewski and C.N. Keys;
2. Theory of Flight (AP 3456A) - Royal Air Force Manual.
3. Helicopter Flight Dynamics - Gareth D. Padfield.

COURSE INFORMATION			
Course Code	: AEAS 433	Contact Hours	: 3.00
Course Title	: Computational Structural Analysis	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:
1. ME 249: Engineering Mechanics (Statics & Dynamics)
2. AE 205: Numerical Analysis and Applications
3. AEAS 205: Mechanics of Solids
4. AEAS 317: Mechanics of Structure, Structural Vibration and Aeroelasticity

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course intends to develop the ability to solve structural problems using numerical methods and analyze the obtained solution

OBJECTIVE

1. To appreciate the necessity of computational methods in the solution of engineering problems
2. To apply numerical techniques to solve structural problems in engineering

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the types of structural problems and the basic outline of the corresponding numerical solving techniques	PO1	C2			K3	T, F, ASG
CO2	Be able to solve initial value structural problems using relevant numerical methods	PO2	C3			K4	T, F, ASG
CO3	Be able to apply finite difference method to solve structural problems and compare with available analytical solution	PO2	C4			K4	T, F, ASG
CO4	Be able to apply finite element method to determine the solution of various structural problems in engineering	PO2	C3			K4	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

- Classification of the solution types of engineering problems
- Initial and Boundary Value Problems
- Basic Outline of R-K Method (4th order)
- Application of 4th order R-K method to solve structural IVPs
- Finite Difference Discretization of differential equations
- Outline of finite difference method
- Application of finite difference method to solve structural IVPs and BVPs and compare with corresponding analytical solution
- Potential Energy Method of solution
- Finite Element Method basics
- Application of FEM to the solution of bar, shaft, truss and beam problems

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Classification of the solution types of engineering problems	
Class-2	Initial and Boundary Value Problems	
Class-3	Basic Outline of R-K Method (4th order)	
Week 2		
Class-4	Application of 4thorder R-K method to solve structural IVPs	
Class-5	Application of 4th order R-K method to solve structural IVPs	
Class-6	Application of 4th order R-K method to solve structural IVPs	
Week 3		
Class-7	Finite Difference Discretization of differential equations	CT2/ MID TERM
Class-8	Finite Difference Discretization of differential equations	
Class-9	Outline of finite difference method for solving structural problems	

Week 4		
Class-10	Application of finite difference method to solve beam problems	
Class-11	Application of finite difference method to solve beam problems	
Class-12	Application of finite difference method to solve beam problems	
Week 5		
Class-13	Application of finite difference method to solve column problems	
Class-14	Application of finite difference method to solve column problems	
Class-15	Application of finite difference method to solve beam-column problems	
Week 6		
Class-16	Application of finite difference method to solve beam-column problems	
Class-17	Application of finite difference method to solve vibration problems	
Class-18	Application of finite difference method to solve vibration problems	
Week 7		
Class-19	Introduction to Finite Element Method	
Class-20	Difference between FEM and FDM; advantages and disadvantages	CT2/ MID TERM
Class-21	Basic outline of applying FEM to solve engineering problems	
Week 8		
Class-22	Bar Element	
Class-23	Application of FEM to solve bar problems	
Class-24	Application of FEM to solve bar problems	
Week 9		
Class-25	Application of FEM to solve bar problems	
Class-26	Truss Element	
Class-27	Application of FEM to solve truss problems	
Week 10		
Class-28	Outline of Potential Energy Method to solve structural problems	CT3
Class-29	Application of Potential Energy Method to solve structural problems	
Class-30	Application of Potential Energy Method to solve structural problems	
Week 11		
Class-31	Shape Functions in FEM	
Class-32	Shape Functions in FEM	
Class-33	Shape Functions in FEM	
Week 12		
Class-34	Developing stiffness matrix of beam element	
Class-35	Developing stiffness matrix of beam element	
Class-36	Solving beam problems by FEM	
Week 13		
Class-37	Solving beam problems by FEM	
Class-38	Solving beam problems by FEM	
Class-39	Types of 2D and 3D finite elements	
Week 14		
Class-40	Types of 2D and 3D finite elements	
Class-41	Review	
Class-42	Review	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="5">Continuous Assessment (40%)</td><td rowspan="2">Class Test/ Assignment 1-3</td><td rowspan="2">20%</td><td>CO1</td><td>C2</td></tr>
<tr><td>CO2</td><td>C3</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO3</td><td>C4</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO1</td><td>C2</td></tr>
<tr><td>CO2</td><td>C3</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td>CO4</td><td>C3</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Computational Structural Analysis and Finite Element Methods by A. Kaveh
2. Introduction to Finite Element Analysis and Design by Nam H. Kim. Bhavani V. Sankar and Ashok V. Kumar
3. An Introduction to Finite Element Method by J.N. Reddy
4. Finite Element Procedures by Klaus-Jürgen Bathe

COURSE INFORMATION			
Course Code	: AEAS 435	Contact Hours	: 3.00
Course Title	: Aircraft Structural Design	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:
1. ME 249: Engineering Mechanics (Statics and Dynamics),
2. AEAS 205: Mechanics of Solids,
3. AE 315: Aerospace Vehicle Stability and Control,
4. AEAS 319: Machine Design,
5. AEAS 317: Mechanics of Structure, Structural Vibrations and Aero Elasticity.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the various factors in designing the different components of the aircraft.

OBJECTIVE

1. To learn what an engineer should consider as a responsibility during the design phase of an aircraft.
2. To be able to explain the contemporary requirements and trends for designing various components of an aircraft.
3. To be able to evaluate the different types of loads acting on the aircraft and their possible effect in its structural integrity.
4. To evaluate the advantages and disadvantages of basic contemporary configurations of different aircraft components.
5. To be able to ensure the safety of designed components based on structural integrity.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to understand an engineer's responsibility in relation to designing various components of an aircraft.	PO1	C2			K3	T, F.
CO2	Be able to understand the basic contemporary factors for designing various components of an aircraft.	PO1	C2			K3	T, F.
CO3	Be able to evaluate various types of loads acting on the aircraft.	PO2	C5	CP1, CP2, CP3		K4	T, F, ASG
CO4	Be able to analyze about various contemporary configurations of different aircraft components.	PO2	C4			K4	T/ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to Aircraft Structural Design;
Design for Manufacturing: Engineer's Responsibility, Producibility, Maintainability, Tooling, Other Considerations
Aircraft Loads: Review of Aero-elasticity, Flight Maneuvers, Wing Design Loads, Empennage Loads, Fuselage Loads, Propulsion Loads, Landing Gear Loads, Miscellaneous Loads, and Example of an Airplane Load Calculation
Buckling and Stability of Structures: Columns and Beam Columns, Crippling Stress, Buckling of Thin Sheets, Thin Skin-Stringer Panel – Compression, Skin-Stringer Panel – General, Integrally Stiffened Panel,
Wing Design: Wing Box Structure, Wing Box Design, Wing Covers, Spars, Ribs and Bulkheads, Wing Root Joints, Variable Swept Wings, Wing Fuel Tank Design, Wing Leading and Trailing Edges, Wing Control Surfaces, Fixed Leading and Trailing Edges, Design Considerations
Empennage Design: Horizontal Stabilizer, Vertical Stabilizer (Fin), Elevator and Rudder Fuselage Design: Introduction, Fuselage Configuration, Fuselage Detail Design, Forward Fuselage, Wing and Fuselage Intersection, Stabilizer and Aft Fuselage Intersection, Fuselage Opening
Landing Gear: Introduction, Development and Arrangements, Stowage and Retraction, Selection of Shock Absorbers, Wheels and Brakes
Engine Mounts: Propeller-Driven Engine Mounts, Inlet of Jet Engine (Fighter), Wing-Pod (Pylon) Mounts, Rear Fuselage Mount and Tail Mount, Fuselage Mount (for Fighters).

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Introduction to Aircraft Structural Design**	CT1
Class-1	Design for Manufacturing	
Class-2	Engineer's Responsibility,	
Class-3	Producibility, Maintainability, Tooling, Other Considerations	
Week 2	**Aircraft Loads**	
Class-4	Review of Aero-elasticity	
Class-5	Flight Maneuvers	
Class-6	Continue	
Week 3	**Aircraft Loads (Continued)**	
Class-7	Wing Design Loads, Empennage Loads	CT2/ MID TERM
Class-8	Continue	
Class-9	Fuselage Loads, Propulsion Loads	
Week 4	**Aircraft Loads (Continued)**	
Class-10	Landing Gear Loads, Miscellaneous Loads	
Class-11	Continue	
Class-12	Example of an Airplane Load Calculation	
Week 5	**Buckling and Stability of Structures**	
Class-13	Columns and Beam Columns	
Class-14	Crippling Stress	
Class-15	Buckling of Thin Sheets	
Week 6	**Buckling and Stability of Structures (Continued)**	
Class-16	Thin Skin-Stringer Panel – Compression	
Class-17	Continue	
Class-18	Continue	
Week 7	**Buckling and Stability of Structures (Continued)**	
Class-19	Skin-Stringer Panel – General	
Class-20	Integrally Stiffened Panel	CT2/ MID TERM
Class-21	Continue	
Week 8	**Wing Design**	
Class-22	Wing Box Structure, Wing Box Design	
Class-23	Wing Covers, Spars, Ribs and Bulkheads	
Class-24	Wing Root Joints, Variable Swept Wings	
Week 9	**Wing Design (Continued)**	
Class-25	Wing Fuel Tank Design	
Class-26	Continue	
Class-27	Wing Leading and Trailing Edges	
Week 10	**Wing Design (Continued)**	
Class-28	Wing Control Surfaces	CT3
Class-29	Fixed Leading and Trailing Edges	
Class-30	Design Considerations	
Week 11	**Empennage Design**	
Class-31	Horizontal Stabilizer	
Class-32	Vertical Stabilizer (Fin)	
Class-33	Elevator and Rudder	
Week 12	**Fuselage Design**	
Class-34	Introduction, Fuselage Configuration	

Class-35	Fuselage Detail Design, Forward Fuselage, Wing and Fuselage Intersection	
Class-36	Stabilizer and Aft Fuselage Intersection, Fuselage Opening	
Week 13	**Landing Gear**	
Class-37	Introduction, Development and Arrangements	
Class-38	Stowage and Retraction, Selection of Shock Absorbers	
Class-39	Wheels and Brakes	
Week 14	**Engine Mounts**	
Class-40	Propeller-Driven Engine Mounts, Inlet of Jet Engine (Fighter)	
Class-41	Wing-Pod (Pylon) Mounts, Rear Fuselage Mount and Tail Mount	
Class-42	Fuselage Mount (for Fighters)	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
			CO 4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3, CO 4	C4, C5
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C5
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Airframe Structural Design by Michael Chung-Yung Niu, Practical Design Information and Data on Aircraft Structures (2006).
2. Airframe Stress Analysis and Sizing 3rd edition by Michael C. Niu (2011).
3. Aircraft Structures for engineering students 7th Edition by T. H. G. Megson (2021)
4. Aircraft Structures By G. Lakshmi Narasaiah. (2016)
5. Understanding Aircraft Structures, 4th Edition by John Cutler, Jeremy Liber. (2006)

COURSE INFORMATION			
Course Code	: AEAS 443	Contact Hours	: 3.00
Course Title	: Pressurization and Air Conditioning Systems	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn about the pressurization and air conditioning system in an aircraft.

OBJECTIVE

1. To learn the fundamental principles of pressurization and air conditioning.
2. To understand basic pressurization and air conditioning systems and their equipment.
3. To familiarize with Aerospace applications of pressurization and air conditioning systems.
4. To understand load calculations and perform basic design of pressurization and air conditioning systems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** the working principles of pressurization and air conditioning.	PO1	C1			K3	T, F, ASG.
CO2	Be able to explain the components of pressurization and air conditioning systems.	PO1	C2			K3	T, F, ASG.
CO3	Be able to solve the critical problems of pressurization and air conditioning systems.	PO2	C3			K4	F, Mid Term Exam.
CO4	Be able to analyze the critical components of pressurization and air conditioning systems.	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

a) Main Contents: Pressurization and air conditioning system

b) Detail Contents:

Pressurization

Concept of pressurization and its applications in the cockpit; Study of pressurization system and different components related to cockpit pressurization.

Refrigeration

Concept of refrigeration and its applications; Different refrigeration methods; Analysis of vapor compression refrigeration, absorption refrigeration and air-cycle refrigeration systems; Refrigerants; Refrigeration equipment: compressors, condensers, evaporators, expansion devices, other control and safety devices; Multi-evaporator, multi-compressor systems; Low temperature refrigeration.

Air conditioning

Concept of air conditioning and its uses; Cooling load calculation; Psychometric analysis; Air conditioning systems; Air distribution systems; Duct design methods; Air conditioning equipment; Application criteria; Control systems.

Fire Hazard

Fire hazard and firefighting equipment.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week-1	**Pressurization**	CT1
Class-1	Concept of pressurization	
Class-2	Pressurization applications in the cockpit	
Class-3	Pressurization applications in the cabin	
Week 2	**Study of pressurization system**	
Class-4	Study of pressurization system	
Class-5	Different components	
Class-6	Cockpit pressurization	

Week 3	**Refrigeration**	
Class-7	Concept of refrigeration and its applications	CT2/ MID TERM
Class-8	Different refrigeration methods	
Class-9	Continue	
Week 4	**Vapor compression refrigeration**	
Class-10	Analysis of vapor compression refrigeration	
Class-11	Continue	
Class-12	Absorption refrigeration and air-cycle refrigeration systems	
Week 5	**Refrigerants**	
Class-13	Classification and use of Refrigerants	
Class-14	Refrigeration equipment	
Class-15	Continue	
Week 6	**Refrigeration equipment**	
Class-16	Compressors	
Class-17	Condensers	
Class-18	Evaporators	
Week 7	**Refrigeration equipment**	
Class-19	Multi-evaporator	
Class-20	Multi-compressor systems	CT2/ MID TERM
Class-21	Low-temperature refrigeration	
Week-8	**Air conditioning**	
Class-22	Introduction	
Class-23	Concept of air conditioning and its uses	
Class-24	Continue	
Week 9	**Cooling load calculation**	
Class-25	Mathematical problem	
Class-26	Cooling load calculation of different air conditioning cycle	
Class-27	Continue	
Week 10	**Cooling load calculation**	
Class-28	Mathematical problem	CT3
Class-29	Cooling load calculation of different air conditioning cycle	
Class-30	Continue	
Week 11	**Psychometric analysis**	
Class-31	Psychometric analysis	
Class-32	Psychometric chart interpolation	
Class-33	Mathematical problem-related Psychometric analysis	
Week 12	**Air conditioning systems**	
Class-34	Air conditioning systems	
Class-35	Continue	
Class-36	Air distribution	
Week 13	**Air distribution systems**	
Class-37	Duct design methods	
Class-38	Air conditioning equipment	
Class-39	Application criteria	
Week 14	Fire hazard Management	
Class-40	Fire hazard and firefighting equipment	
Class-41	Continue.	
Class-42	Review	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO 1</td><td>C1</td></tr>
<tr><td>CO 2</td><td>C2</td></tr>
<tr><td>CO 4</td><td>C4</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO3</td><td>C3</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO 1</td><td>C1</td></tr>
<tr><td>CO 2</td><td>C2</td></tr>
<tr><td>CO 3</td><td>C3</td></tr>
<tr><td>CO 4</td><td>C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Modern Refrigeration and Air-conditioning – A D. Althause, C. H. Turnquist,
2. A.F. Bracciano; The Goodheant Wilcox Company, Inc. 1982.
3. Heating cooling of Building, Design for Efficiency – J. F. Kreidev, A. Raldl;

COURSE INFORMATION			
Course Code	: AEAS 451	Contact Hours	: 3.00
Course Title	: Avionics Technology	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course offers knowledge about communication, navigation and guidance systems of an aircraft for their proper implementation in future workplace or studies.

OBJECTIVE

1. To provide a fundamental understanding and knowledge of conventional and modern design and working principles of radar, guidance and navigation for air vehicles.
2. To provide the basic mathematical concepts of radar, navigation by NDB, VOR, GPS and Inertial Navigation approaches, and guidance laws.
3. To provide an expansive view into the technological trends of future aircraft navigation and guidance systems designs.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the air navigation, navigation parameters and principle of different types of navigation.	PO1	C2			K3	T, F, ASG.
CO2	Be able to explain Hyperbolic Navigation, Doppler Navigation, Satellite Navigation, Automatic Direction Finder (ADF), VHF Omni-directional Range (VOR), Distance Measuring Equipment (DME), Instrumental Landing System (ILS).	PO1	C2			K3	T, F, ASG.
CO3	Be able to explain basic principles & fundamental elements, Amplitude modulation-demodulation,	PO1	C2			K3	T, F, Mid Term Exam.

	frequency modulation (FM)-demodulation, Radar Principle, Radar range equation, Doppler Effect- Continuous wave radars, moving target indicator, Radar antenna- Antenna parameters.						
CO4	Be able to **explain** Transformer- Ideal transformer, transformation ratio, no- load and load vector diagrams; DC generator- Types, no load voltage characteristic, effect of speed on no-load and load characteristics and voltage regulation, DC motor- Torque, Three Phase Alternator.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to Navigation: Block diagram of navigation system, Types of navigation, Coordinate Frames, Coordinate transformation, Frame of Reference.
Methods of navigation: Dead Reckoning (DR) Computation, Inertial Navigation System (INS), Hyperbolic Navigation, Air Data Navigation, Doppler Navigation, Satellite Navigation, Automatic Direction Finder (ADF), VHF Omni-directional Range (VOR), Distance Measuring Equipment (DME), Instrumental Landing System (ILS).
Communication: Overview of communication systems: Basic principles & fundamental elements. Continuous wave modulation: Amplitude modulation-demodulation, frequency modulation (FM)- demodulation.
Radar Systems: Radar Principle, Functional block diagrams, Radar range equation, Factors affecting radar performance; Doppler Effect- Continuous wave radars, moving target indicator and phase-Doppler radars; Radar antenna- Antenna parameters, radiation pattern and aperture distribution.
Electro-mechanical System: Transformer- Ideal transformer, transformation ratio, no-load and load vector diagrams; DC generator- Types, no load voltage characteristic, effect of speed on no-load and load characteristics and voltage regulation; DC motor- Torque, counter emf, torque-speed characteristics, starting and speed regulation; Three Phase Alternator: Overview, Principle of operation.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Quiz	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	Air Navigation	CT1
Class-1	Introduction to Air Navigation, Phases of flight	
Class-2	Basic navigation and navigation parameters.	
Class-3	Continue	
Week 2	Wind Triangle Analysis	
Class-4	Wind Triangle Analysis theory	
Class-5	Wind Triangle Analysis problem solving	
Class-6	Coordinate Frames, Frame of Reference	
Week 3	Coordinate transformation	
Class-7	Coordinate transformation from 2D to 3D	CT2/ MID TERM
Class-8	Continue.	
Class-9	Angular transformation	
Week 4	Types of navigation	
Class-10	Classification of different Types of navigation with block diagram	
Class-11	Visual Flight Rules	
Class-12	Instrument Flight Rules	
Week 5	Visual Flight Rules	
Class-13	Navigation by Pilotage	
Class-14	Celestial Navigation	
Class-15	Continue	
Week 6	Instrument Flight Rules	
Class-16	Radio Navigation, Doppler Navigation	
Class-17	Dead Reckoning (DR) Computation	
Class-18	Different Types of Navigation Techniques	

Week 7	Navigation Techniques	
Class-19	Inertial Navigation System (INS), Sensors- Accelerometers, Gyroscopes	
Class-20	Inertial measurement unit (IMU).	CT2/ MID TERM
Class-21	Air Data Navigation	
Week 8	Navigational Equipment	
Class-22	Automatic Direction finder (ADF)	
Class-23	VHF Omnidirectional Range (VOR)	
Class-24	Distance Measuring Equipment (DME)	
Week 9	Navigational Equipment	
Class-25	Instrumental Landing System (ILS)	
Class-26	Basic-6 and Basic-T aircraft instrument	
Class-27	Continued	
Week 10	Instrumentation and Measurement	
Class-28	Basic-6 and Basic-T aircraft instrument	CT3
Class-29	Continued	
Class-30	Continued	
Week 11	Radar System	
Class-31	Radar principle and operation	
Class-32	Different terminologies related to Radar system	
Class-33	Numerical problems related to radar design	
Week 12	Communication System	
Class-34	Basic principles & fundamental elements	
Class-35	Modulation	
Class-36	Antenna	
Week 13	Electro-mechanical System	
Class-37	Introduction of transformer	
Class-38	Basics of generators	
Class-39	Basics of motors	
Week 14	Electro-mechanical System:	
Class-40	Three Phase Alternator	
Class-41	Overview of principle of operation.	
Class-42	Review of whole Syllabus	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Avionics Fundamentals- Jeppesen; High flyn.
2. Avionics Navigation Systems – Myron Kayton; Wiley-Interscience
3. Elements of Electronic Navigation- N S Nagaraja; McGraw-Hill.
4. A Text Book of Electrical Technology (Volume-II)- B L Theraja and A K Theraja; S. Chand & Company Ltd.
5. Introduction to RADAR systems - M. Skolnik; McGraw-Hill International.
6. Modern Digital & Analog Communication System - B. P. Lathi; Oxford University Press

COURSE INFORMATION			
Course Code	: AEAS 461	Contact Hours	: 3.00
Course Title	: Advanced Materials Processing Technologies	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. AEAS 331: Materials Science and Aerospace Materials
2. AEAS 332: Materials Science and Aerospace Materials Sessional

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn about Advanced Materials Processing Technologies.

OBJECTIVE

1. To understand the common failure mechanisms of engineering materials.
2. To Study the internal structure of each major class of engineering material.
3. To understand the principal concerns of common materials processing techniques.
4. To Analyze and identify machining requirements.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the common mechanisms by which engineering materials fail	PO1	C2			K3	T, F, ASG
CO2	Be able to explain the general internal structure of each major class of engineering material	PO1	C2			K3	T, F, Mid Term
CO3	Be able to identify the principal concerns of common materials processing techniques	PO1	C1			K3	T, F, Mid Term, ASG
CO4	Be able to analyze and identify machining requirements.	PO2	C4			K4	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Overview of Advanced Materials Processing Technologies: Outline of advanced materials processing techniques: Precision Materials Removal Processes; Precision Forming; Microwave Technology; Advanced Surface Engineering Processes; Joining Technologies.

Precision Removal Processes: Ultra-precision machining, theories, principles and applications. Micro Electro-discharge machining. Physio-chemical machining, Surface Metrology of machined components.
Laser Materials Processing: Fundamentals of industrial lasers. Laser materials interaction theories. Laser processing for various industries such as metals, non-metals, photovoltaic, bio-medical applications.
Nontraditional Machining: Principles, equipment, process variables and applications – surface engineering – concept of CIM and FMS – additive manufacturing – advanced manufacturing techniques.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Overview of Advanced Materials Processing Technologies**	CT1
Class-1	Advanced Materials	
Class-2	Materials Processing	
Class-3	Materials Processing	
Week 2	**Advanced Materials Processing Technologies**	
Class-4	Materials Processing Technologies	
Class-5	Outline	
Class-6	Precision Materials Removal Processes	
Week 3	**Materials Processing Technologies**	
Class-7	Precision Materials Removal Processes	CT2/ MID TERM
Class-8	Precision Forming	
Class-9	Precision Forming	
Week 4	**Microwave Technology**	
Class-10	Microwave Technology	
Class-11	Microwave Technology	
Class-12	Microwave Technology	
Week 5	**Advanced Surface Engineering Processes**	
Class-13	Advanced Surface Engineering Processes	

Class-14	Advanced Surface Engineering Processes	
Class-15	Advanced Surface Engineering Processes	
Week 6	**Joining Technologies**	
Class-16	Precision Removal Processes	
Class-17	Ultra-precision machining	
Class-18	Ultra-precision machining	
Week 7	**Laser Materials Processing**	
Class-19	Fundamentals of industrial lasers.	
Class-20	Fundamentals of industrial lasers.	Mid Term
Class-21	Fundamentals of industrial lasers.	
Week 8	**Laser Materials Processing**	
Class-22	Laser materials interaction theories.	
Class-23	Laser materials interaction theories.	
Class-24	Laser materials interaction theories.	
Week 9	**Laser Materials Processing**	
Class-25	Laser processing for various industries -metal	
Class-26	Laser processing for various industries- non metal	
Class-27	Laser processing for various industries-photovolatic	
Week 10	**Laser Materials Processing**	
Class-28	Laser processing for various industries	CT2/ MID TERM
Class-29	bio-medical applications.	
Class-30	bio-medical applications.	
Week 11	**Nontraditional Machining**	
Class-31	Principles, equipment, process variables and applications – surface engineering – concept of CIM and FMS – additive manufacturing – advanced manufacturing techniques.	
Class-32	Continue	
Class-33	Continue	
Week 12	**Nontraditional Machining**	
Class-34	Principles, equipment	
Class-35	process variables and applications –	
Class-36	surface engineering	
Week 13	**Nontraditional Machining**	
Class-37	concept of CIM and FMS	
Class-38	additive manufacturing	
Class-39	additive manufacturing	
Week 14	**Nontraditional Machining**	
Class-40	Advanced manufacturing techniques.	
Class-41	Advanced manufacturing techniques.	
Class-42	Advanced manufacturing techniques.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
			CO 3	C1
			CO 4	C4

	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment	10%	CO2	C2
			CO3	C1
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C1
			CO 4	C4
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

REFERENCE BOOKS

1. Aerospace Materials Handbook- Editors: Sam Zhang, Dongliang Zhao
2. Manufacturing Technology for Aerospace Structural Materials- F.C. Campbell; Elsevier

COURSE INFORMATION			
Course Code	: AEAS 463	Contact Hours	: 3.00
Course Title	: Fluid Power and Control	Credit Hours	: 3.00

PRE-REQUISITE

Course Code &Title:

1. AE 203: Fundamentals of Fluid Mechanics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to learn and familiarize with the details of fluid power and control.

OBJECTIVE

1. To understand the role of hydraulic and pneumatic system.
2. To analyze hydraulic and pneumatic system and identify basic components.
3. To trace and describe the flow of energy in a fluidic system.
4. To be able to Understand hazards of hydraulic and pneumatic circuits and be able to work safely.
5. To perform and be familiar with troubleshooting techniques of pneumatic and hydraulic systems.
6. To understand and perform work in accordance with fluid power safety rules and procedures
7. To Understand the concepts of fluid statics and dynamics as applied to commercial and industrial control.
8. To Recognize standard schematic symbols for common fluid power components.
9. To Understand the operation, application, and maintenance of common fluid power components such as pumps, compressors, valves, cylinders, motors etc .

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the basic components of hydraulic and pneumatic systems	PO1	C2			K3	T, F, ASG.
CO2	Be able to understand the concept of controlling the basic fluid power system components	PO1	C2			K3	T, F, Mid Term ASG.
CO3	Be able to apply the concepts of fluid power for modeling various fluid power components	PO2	C3			K3	T, F, Mid Term Exam.

CO4	Be able to analyze the hydraulic and pneumatic circuits properly and be able to work safely.	PO2	C4			K4	T, F, Mid Term Exam.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fluid Power Industrial Applications, Leakage testing machine, Pneumatic industrial tools, Friction losses, Conceptual modelling of a transfer function, Linear modelling of a piston, Linear modelling of rotating elements, Non-linear modeling, Servo Control systems, Fluid power symbols, Hydraulic Circuits Design and Analysis, Hydraulic motor braking system, Air over oil system, Pneumatic Circuits Design and Analysis, Control of air motor, Deceleration of a pneumatic cylinder, Pneumatic logic control, Fluid Power ComponentsFluid Power and Control

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction**	CT1
Class 1	Leakage testing machine	
Class 2	Pneumatic industrial tools	
Class 3	Continue	
Week 2	**Fundamentals of Fluid Power**	
Class 4	Power transmission methods	
Class 5	Continue	
Class 6	Continue	

Week 3	**Basic theories**	
Class 7	Newton's laws of motion	CT2/ MID TERM
Class 8	Bernoulli's equation of energy	
Class 9	Continue	
Week 4	**Friction losses**	
Class 10	Friction losses in hydraulic systems	
Class 11	Continue	
Class 12	Friction losses in pneumatic systems	
Week 5	**Modelling of Fluid Power Systems**	
Class 13	Block diagrams	
Class 14	Conceptual modelling of a transfer function	
Class 15	Continue	
Week 6	**Modelling of Fluid Power Systems**	
Class 16	Linear modelling of a piston	
Class 17	Linear modelling of rotating elements	
Class 18	Continue	
Week 7	**Modelling of Fluid Power Systems**	
Class 19	Modelling of control valves	
Class 20	Non-linear modelling	CT2/ MID TERM
Class 21	Continue	
Week 8	**Control of Fluid Power Systems**	
Class 22	Servo Control systems	
Class 23	Valve operated servo control	
Class 24	Pump operated servo control	
Week 9	**Hydraulic Circuits Design and Analysis**	
Class 25	Single-acting hydraulic cylinder	
Class 26	Application and analysis	
Class 27	Continue	
Week10	**Hydraulic Circuits Design and Analysis**	
Class 28	Double-acting hydraulic cylinder	CT 3
Class 29	Application and analysis	
Class 30	Continue	
Week 11	**Hydraulic Circuits Design and Analysis**	
Class 31	Double-pump hydraulic system	
Class 32	Counter balance hydraulic system	
Class 33	Continue	
Week12	**Pneumatic Circuits Design and Analysis**	
Class 34	Single-acting pneumatic cylinder	
Class 35	Application and analysis	
Class 36	Continue	
Week 13	**Pneumatic Circuits Design and Analysis**	
Class 37	Double-acting pneumatic cylinder	
Class 38	Application and analysis	
Class 39	Cycle timing of pneumatic cylinder	
Week 14	**Fluid Power Components**	
Class 40	Compressors, Actuators,Valves	
Class 41	Hydraulic transmission pipelines	
Class 42	Review	

ASSESSMENT STRATEGY				
Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
			CO 3	C3
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
			CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fluid power control –Ahmed Abu hanieh.
2. Fundamentals of Fluid power control –John Watton.
3. Aircraft Gas Turbine Engine Technology (3rd edition) - Treager.
4. Fluid power Engineering- M Galal Rabie

COURSE INFORMATION			
Course Code	: AEAS 465	Contact Hours	: 3.00
Course Title	: Composite Materials	Credit Hours	: 3.00

PRE-REQUISITE

Course Code &Title:

1. AEAS 331: Materials Science and Aerospace Materials
2. AEAS 307: Aircraft Loading and Structural Analysis

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course provides a detailed understanding of the mechanics of composite materials

OBJECTIVE

1. To understand the definition and classification of composite materials
2. To understand the mechanics of composites
3. To apply the knowledge of mechanics of composites to various problems of composite structures

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the classification of composite materials and **define** important associated terminologies	PO1	C2			K3	T, F, ASG
CO2	Be able to derive the stress-strain relationships for composite structures considering varying planes of symmetry	PO1	C3			K4	T, F, ASG
CO3	Be able to carry out the micromechanical analysis of a composite structure	PO2	C4			K4	T, F, ASG
CO4	Be able to carry out the macromechanical analysis of a composite structure	PO2	C4			K4	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

- Introduction to Composite Materials
- Macromechanical Analysis of a Composite Lamina
- Micromechanical Analysis of a Composite Lamina
- Introduction to Laminated Composites

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to Composite Materials	
Class-2	Classification of Composites	
Class-3	Mechanics Terminology	
Week 2		
Class-4	Hooke's Law for Different Types of Materials	
Class-5	Hooke's Law for Different Types of Materials	
Class-6	Hooke's Law for Different Types of Materials	
Week 3		
Class-7	Hooke's Law for a Two-Dimensional Unidirectional Lamina	CT2/ MID TERM
Class-8	Hooke's Law for a Two-Dimensional Unidirectional Lamina	
Class-9	Hooke's Law for a Two-Dimensional Unidirectional Lamina	
Week 4		
Class-10	Hooke's Law for a Two-Dimensional Angle Lamina	
Class-11	Hooke's Law for a Two-Dimensional Angle Lamina	
Class-12	Hooke's Law for a Two-Dimensional Angle Lamina	
Week 5		
Class-13	Strength Failure Theories of an Angle Lamina	
Class-14	Strength Failure Theories of an Angle Lamina	
Class-15	Strength Failure Theories of an Angle Lamina	

Week 6		
Class-16	Hygrothermal Stresses and Strains in a Lamina	
Class-17	Hygrothermal Stresses and Strains in a Lamina	
Class-18	Volume and Mass Fractions, Density, and Void Content of Composite	
Week 7		
Class-19	Volume and Mass Fractions, Density, and Void Content of Composite	
Class-20	Evaluation of the Four Elastic Moduli	CT2/ MID TERM
Class-21	Evaluation of the Four Elastic Moduli	
Week 8		
Class-22	Evaluation of the Four Elastic Moduli	
Class-23	Ultimate Strengths of a Unidirectional Lamina	
Class-24	Ultimate Strengths of a Unidirectional Lamina	
Week 9		
Class-25	Coefficient of Thermal Expansion	
Class-26	Coefficient of Moisture Expansion	
Class-27	Practice of Related Mathematics	
Week 10		
Class-28	Practice of Related Mathematics	CT3
Class-29	Practice of Related Mathematics	
Class-30	Practice of Related Mathematics	
Week 11		
Class-31	Multiphysics Mathematical Modeling of Composite Lamina	
Class-32	Multiphysics Mathematical Modeling of Composite Lamina	
Class-33	Multiphysics Mathematical Modeling of Composite Lamina	
Week 12		
Class-34	Solution of Multiphysics Problems of Composite Lamina	
Class-35	Solution of Multiphysics Problems of Composite Lamina	
Class-36	Solution of Multiphysics Problems of Composite Lamina	
Week 13		
Class-37	Introduction to Laminated Composites	
Class-38	Classification of Laminated Composites	
Class-39	Laminate Code	
Week 14		
Class-40	Review	
Class-41	Review	
Class-42	Review	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO4	C4

<table>
<tr><td rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO1</td><td>C2</td></tr>
<tr><td>CO2</td><td>C3</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td>CO4</td><td>C4</td></tr>
<tr><td>Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="4">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
<tr><td colspan="4">REFERENCE BOOKS</td></tr>
<tr><td colspan="4">1. Mechanics of Composite Materials by Autar K. Kaw
2. Mechanics of Composite Materials by Robert M. Jones</td></tr>
</table>

5.5 Compulsory Courses Offered in Avionics Discipline

COURSE INFORMATION			
Course Code	AEAV 211	Contact Hours	3.00
Course Title	Electrical Circuit Analysis-II	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. EECE 161: Electrical Circuit Analysis-I,
2. EECE 162: Electrical Circuit Analysis-I Sessional

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on the basics of AC circuit (single-phase, three-phase), methods of solving AC circuits and working principle & application of different types Passive Filters, Magnetically coupled circuits etc.

OBJECTIVE

1. To find out various parameters of AC Circuits and their effect on RLC circuits.
2. To apply appropriate method to solve different types of AC circuits.
3. To understand and analyze different types of passive filters and understand their frequency response.
4. To understand the fundamentals and features of magnetically coupled circuits.
5. To understand the basics of 3-phase circuits and apply the knowledge to determine various parameters of the circuit.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the concept of sinusoid & phasors & fundamental parameters of AC Circuits.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** various techniques to solve AC Circuits and **find out** various Power related parameters in them.	PO2	C3			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **understand** the fundamentals of Passive Filters and Magnetically Coupled Circuits and **apply** that knowledge to design passive filters & analyze magnetic circuits.	PO2	C3			K4	T/ Mid Term Exam, F, ASG.

CO4	Be able to **understand** fundamentals of three-phase circuit and **apply** that knowledge to solve various parameters of three-phase circuits.	PO2	C3			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Sinusoidal functions

Instantaneous current, voltage, power, Effective current and voltage, average power, Phases and complex quantities, impedance, real and reactive power, power factor.

Single-phase AC circuits

Series and parallel RL, RC and RLC circuits, nodal and mesh analysis, application of network theorems in AC circuits, circuits with non-sinusoidal excitations, transients in ac circuits.

AC frequency analysis and Passive Filters

Frequency response of AC circuits, Transfer function, Bode plot, Series and parallel resonance, Quality Factor, Low pass filter, High pass filter, Band pass filter, Band stop filter.

Magnetically coupled circuits

Mutual Inductance, Energy in a Coupled Circuit, Linear Transformers.

Three-phase circuits

Impedance, Voltage, Current of three phase circuit, Y-Y, Y-Δ, Δ-Y, Δ-Δ Connections & associated mathematical problems, Power Calculation (P, Q, S etc.) of balanced three phase circuit, Unbalanced three phase circuits.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Faraday's law of electromagnetic induction; Lenz's law	
Class-2	Alternating voltage generation	
Class-3	Application of AC voltage in aircraft	
Week 2		
Class-4	Details of Sinusoidal functions & its different terminology	
Class-5	Effective voltage & current	
Class-6	Average value	
Week 3		
Class-7	Phase relation and complex quantities	
Class-8	Phase relation and complex quantities	
Class-9	Impedance function	
Week 4		CT2/ MID TERM
Class-10	Impedance & phase calculation	
Class-11	Impedance & phase calculation	
Class-12	Impedance, phase, power, average power & energy calculation	
Week 5		
Class-13	Impedance, phase, power, average power & energy calculation	
Class-14	Analysis of single-phase AC circuits	
Class-15	Nodal Analysis in AC circuit	
Week 6		
Class-16	Mesh Analysis in AC circuit	
Class-17	Application of network theorems in AC circuits	
Class-18	Application of network theorems in AC circuits	
Week 7		
Class-19	Introduction to Resonant circuits	
Class-20	Series Resonance in AC circuits	
Class-21	Application of resonance	
Week 8		CT2/ MID TERM
Class-22	Basics of Passive filter	
Class-23	Low pass filter	
Class-24	High pass filter	
Week 9		
Class-25	Band pass filter	
Class-26	Band stop filter	
Class-27	Continue with Mathematical practice	
Week 10		
Class-28	Self & Mutual Inductance	
Class-29	Dot Convention in mutually coupled circuit	
Class-30	Continue with Mathematical practice	
Week 11		CT3
Class-31	Energy in a Coupled Circuit	
Class-32	Linear Transformer	
Class-33	Continue with Mathematical practice	

Week 12		
Class-34	Impedance, Voltage, Current of three phase circuit	
Class-35	Y-Y Connection of three phase circuit	
Class-36	Y-Δ Connection of three phase circuit,	
Week 13		
Class-37	Δ-Y Connection of three phase circuit	
Class-38	Δ-Δ Connection of three phase circuit	
Class-39	Numerical Analysis & Mathematical practice	
Week 14		
Class-40	Power Calculation of three phase circuit	
Class-41	Continue with Mathematical practice	
Class-42	Review of the Syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 / CO 3	C3
			CO 4	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 / CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
2. Fundamentals of Electric circuits- Charles K. Alexander & Matthew N. O. Sadiku
3. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd.
4. A Text Book of Electrical Technology- B L Theraja and A K Theraja; S.Chand & Company Ltd.

COURSE INFORMATION			
Course Code	AEAV 212	Contact Hours	1.50
Course Title	Electrical Circuits Analysis – II Sessional	Credit Hours	0.75

PRE-REQUISITE

Course Code & Title:
1. EECE 161: Electrical Circuit Analysis-I,
2. EECE 162: Electrical Circuit Analysis-I Sessional

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Students will be able to understand about the fundamentals of AC circuits and utilize that knowledge to design different passive circuit.

OBJECTIVE

1. To deduce various parameters of AC circuit using appropriate theorems and methods.
2. To understand frequency response of AC circuits & design different passive filter.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **measure** different parameters of single-phase altering current in different RLC circuits.	PO1	P3			K6	R, Q, T
CO2	Be able to **construct** different types of passive filters and analyze their frequency response.	PO2	P2			K6	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp. No	Exp. Name
1.	Familiarization with Alternating Current (AC) waves.
2.	Study of R-L-C series circuit.
3.	Different types of filters and its characteristics with different input frequency.
4.	Series Resonance and Parallel Resonance.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21

Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 2.5 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 1
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Introduction
Week 2	Familiarization with alternating current (AC) waves.
Week 3	Study of R-L-C series circuit
Week 4	Different types of filters and its characteristics with different input frequency
Week 5	Series Resonance and Parallel Resonance
Week 6	Lab Quiz
Week 7	Lab Test

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (30%)	Lab participation	20%	CO 1	P3
			CO 2	P2
	Report Writing	10%	CO 1	P3
			CO 2	P2
Lab Quiz		30%	CO 1	P3
			CO 2	P2
Lab Test		30%	CO 1	P3
			CO 2	P2
Viva		10%	CO 1	P3
			CO 2	P2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
2. Fundamentals of Electric circuits- Charles K. Alexander & Matthew N. O. Sadiku
3. A Text Book of Electrical Technology- B L Theraja and A K Theraja; S.Chand & Company Ltd.

COURSE INFORMATION			
Course Code	AEAV 223	Contact Hours	3.00
Course Title	Electronics-II	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. EECE 161: Electrical Circuit Analysis-I
2. AE 213: Electronics-I.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This subject focuses on how to create electronic systems with 'building block' circuits using bipolar transistors and FETs, and looks at the use and operation of amplifiers. It also looks at how to design feedbacks to systems, and interface with sensors.

OBJECTIVE

1. To classify different types of FETs and demonstrate feedback amplifiers, OP-AMPs, and oscillator circuits.
2. To compute and characterization of feedback amplifiers, OP-AMPs, and oscillator circuits.
3. To understand familiarity with basic electronic components and use them to design simple electronic circuits.
4. To analyze basic forms of power supply filters and determine their filtering performance and performance of basic class-A, class-B, class-C, class-AB power amplifiers.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** analog and digital electronic circuits from a circuit and monolithic (integrated circuit) implementation point of view.	PO1	C2			K3	T, F, ASG
CO2	Be able to **explain** the design of elements in Bipolar and CMOS-based op amps, feedback, power supplies, linear and non-linear applications circuits with the op amp as the basic building block, and transistor circuits for realizing basic digital circuits.	PO1	C2			K3	T, F, Mid Term Exam

CO3	Be able to **apply** the concepts of basic electronic devices to design, fabricate and test small electronic circuit.	PO2	C3			K4	T, F, ASG
CO4	Be able to **analyze** the design, operation, and troubleshooting of electronic systems.	PO2	C4			K4	T/ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Frequency response of amplifiers: Poles, zeros & Bode plots, amplifier transfer function, techniques of determining 3 dB frequencies of amplifier circuits, frequency response of single- stage and cascade amplifiers, frequency response of differential amplifiers.
MOSFET: Structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.
JFET: Structure & operation of JFET, transistor characteristics, and pinch-off voltage.
Differential and multistage amplifiers: Description of differential amplifiers, small signal operation, differential and common mode gains, RC coupled mid-band frequency amplifier.
Op-Amp: General purpose Op-Amp: DC analysis, small-signal analysis of different stages, and gain and frequency response of 741 Op-Amp.
Negative feedback: Properties, basic topologies, feedback amplifiers with different topologies, stability, frequency compensation. Active filters: Different types of filters and specifications, transfer functions, realization of first and second order low, high and band pass filters using Op- Amps.
Signal generators: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, LC & crystal oscillators. Power Amplifiers: Classification of output stages: class A, B and AB.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Basic of Op-Amp and Circuit Symbol, Classification, Ideal Op- Amp Characteristics	
Class-2	Buffer/ Source Follower, Non Ideal Effects	
Class-3	Integrator(Non-inverting), Differentiator	
Week 2		
Class-4	Inverting Integrator, Inverting Differentiator, Weighted Summer, Subtractor	
Class-5	Zero Crossing Detector, Voltage level Detector(Comparator), Smoke Detector	
Class-6	Schmitt Trigger, Practical Op-Amp Amplifiers	
Week 3		CT2/ MID TERM
Class-7	AC performance (Frequency Response/ Slew rate), Current Compensation	
Class-8	Input Resistance of feedback Op-Amp, Frequency Response Analysis, Semi-Logarithmic Graph Paper Scaling	
Class-9	Output Resistance Feedback Op-Amp, Bode Plot (Magnitude Plotting)	
Week 4		
Class-10	Bode Plotting (Phase plotting, magnitude plotting)	
Class-11	Stability from Bode Plot	
Class-12	Bode Plot Practice Examples, Phase Margin and Gain Margin	
Week 5		
Class-13	Stability	
Class-14	Pole-Zero Plot	
Class-15	Stability from Pole-Zero Plot	
Week 6		
Class-16	Frequency Band, Gain Bandwidth Product, Cut-off frequency	
Class-17	Low Frequency Response, High Frequency Response	
Class-18	Active Filter, Classification of Active Filter	
Week 7		CT2/ MID TERM
Class-19	LPF, HPF, BPF, BRF/ Notch	
Class-20	LPF, HPF, BPF, BRF/ Notch -Continued	
Class-21	Cut-Off Frequency of LPF, HPF, BPF, BRF/Notch	
Week 8		
Class-22	Filter Design	
Class-23	Filter Design -Continued	
Class-24	Oscillator	
Week 9		
Class-25	Phase-Shift Oscillator, Oscillator Design	

Class-26	The Colpitts Oscillator, Wein bridge Oscillator	
Class-27	Feedback Amplifier, Classification of Amplifier	
Week 10		CT3
Class-28	Gain with feedback	
Class-29	Advantages of feedback	
Class-30	Advantages of feedback -Continued	
Week 11		
Class-31	Voltage series feedback	
Class-32	Current series feedback	
Class-33	Voltage shunt feedback	
Week 12		
Class-34	Related Math problems of feedback	
Class-35	Current-Shunt feedback	
Class-36	Method of Analysis of Current-shunt Amplifier	
Week 13		
Class-37	Power Amplifier	
Class-38	Classification of Power Amplifier	
Class-39	Advantages of Power Amplifier	
Week 14		
Class-40	Crossover distortion of Power Amplifier	
Class-41	Efficiency of Power Amplifiers	
Class-42	Efficiency of Power Amplifiers –Continued	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 3	C3
			CO 4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
			CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. **Electronic Devices and circuit –** Jacob Millman& Christos C. Halkias;
2. **Micro-Electronic Circuit Analysis and Design-** Donald A. Neamen.
3. **Operational Amplifier and Linear Integrated Circuit** –RamakantGayakwad.

COURSE INFORMATION			
Course Code	AEAV 224	Contact Hours	1.50
Course Title	Electronics-II Sessional	Credit Hours	0.75

PRE-REQUISITE

Course Code & Title:
1. AE 213: Electronics I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Students will be able to see the practical implementation of the circuit and electronic device theories that were taught to them previously. Practical means that the circuits that the students study are made up of actual electronic components. Students will also learn the practical skills required to design and troubleshoot actual electronic circuitries.

OBJECTIVE

1. To prepare and use the appropriate basic laboratory equipment for conducting circuit analysis according to common engineering practice.
2. To identify, demonstrate and measure the various types of filter, oscillator and power amplifiers correct practice for valid outcomes.
3. To measure, define and describe the characteristics of several passive and active components using standard circuit analysis.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **perform** experiments with the basic active filters, oscillators, and power amplifiers.	PO1	P2			K5	R, Q, T
CO2	Be able to **analyze** a circuit correctly and compare its theoretical performance to actual performance.	PO2	C4			K5	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Determining the Frequency response curve of low pass, and high pass filters using OP-Amp.
2.	Determining the Frequency response curve of band pass, and band stop filter using OP-Amp.
3.	Study of Phase Shift Oscillator.
4.	Study of Wien Bridge Oscillator.
5.	Study of Power Amplifier.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 3 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 1
Total	57

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	Introduction
Week 2	Determining the Frequency response curve of low pass, and high pass filters using OP-Amp.
Week 3	Determining the Frequency response curve of band pass, and band stop filter using OP-Amp.
Week 4	Study of Phase Shift Oscillator.
Week 5	Study of Wien Bridge Oscillator..
Week 6	Study of Power Amplifier
Week 7	Lab Test

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P2
			CO 2	C4
	Lab test	30%	CO 1	P2
			CO 2	C4
	Project and Presentation	20%	CO 1	P2
			CO 2	C4
Lab Quiz		15%	CO 1	P2
			CO 2	C4

Viva	10%	CO 1	P2
		CO 2	C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. **Semi-Conductor Circuit Approximation -** Albert P Malvino;
2. **Electronic Devices and circuit –** Jacob Millman& Christos C. Halkias;
3. **Micro-Electronic Circuit Analysis and Design-** Donald A. Neamen.
4. **Operational Amplifier and Linear Integrated Circuit** –RamakantGayakwad.

COURSE INFORMATION			
Course Code	AEAV 217	Contact Hours	3.00
Course Title	Aircraft Electrical system	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. EECE 161: Electrical Circuit Analysis I
2. AEAV 211: Electrical Circuit Analysis-II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on basics and application of different electro-mechanical systems including DC/AC motor, Generators; basics of Aircraft Electrical system including AC/DC Power generation in aircraft, Power distribution system in aircraft, wiring, Bus- bar system, starting system, electrical loads in aircraft etc.

OBJECTIVE

1. To learn the basics of Electro-Mechanical system including Ideal transformer, transformation ratio, losses of transformer etc.
2. To understand the construction and operation of DC motor, DC generator, AC motor and Alternator.
3. To learn the basics of AC and DC power generations, Power supply system, electrical wiring in aircraft.
4. To understand the functioning of Power distribution system in aircraft, Bus-bar system, electrical starting system of aircraft engine, electrical loads etc.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the working principle of Transformers, DC Generators, Alternators, DC and AC motors and **solve** associated problems.	PO2	C3			K4	T, F, ASG.
CO2	Be able to **analyze** the working principles of any electrical machine under loaded and unloaded conditions.	PO2	C4			K3	T, F, ASG.
CO3	Be able to **explain** the basics of AC and DC power generations, Power supply systems, Electrical Wiring in aircraft.	PO1	C2			K3	F, Mid Term Exam.

CO4	Be able to **summarize** the functioning of aircraft Power distribution system, Bus-bar system, Starting system and Electrical loads.	PO1	C2			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Electro-Mechanical System: Transformer: Ideal transformer, transformation ratio, no-load and load vector diagrams, transformer test, tosses of transformer, eddy current loss, hysteresis loss.
Generator: Excitation systems, equivalent circuit, vector diagrams at different loads, factor.
DC generator: Types, no load voltage characteristic, effect of speed on no-load and load characteristics and voltage regulation.
Three Phase Alternator: Overview, Principle of operation.
DC motor: Torque, counter emf, speed, torque-speed characteristics, starting and speed regulation.
AC and DC Power Generation System in aircraft: AC/DC Electrical Power generation system, Aircraft batteries used in different types of aircraft, Frequency wild & Constant frequency system, Voltage regulation, Paralleling & Load sharing etc.
Aircraft Power Distribution System: Aircraft Power distribution system, Bus-bar system used in different aircraft, Electrical wiring system, Electrical starting system of aircraft, Auxiliary Power Unit (APU), Ground Power Unit (GPU), Electrical loads in aircraft, Aircraft lighting system.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Test	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	What is Transformer, construction, application.	
Class-2	Ideal transformer & it's working principle.	
Class-3	Transformer test and losses of transformer.	
Week 2		
Class-4	Transformation ratio, no-load and load vector diagrams.	
Class-5	Eddy current loss, hysteresis loss.	
Class-6	Continue	
Week 3		
Class-7	Excitation systems, Equivalent circuit.	CT2/ MID TERM
Class-8	Vector diagrams at different loads.	
Class-9	Generator Factors.	
Week 4		
Class-10	Continue with generator.	
Class-11	Introduction to DC motor, Torque.	
Class-12	Counter EMF, Speed regulation.	
Week 5		
Class-13	Torque-speed characteristics.	
Class-14	Starting and speed regulation.	
Class-15	Mathematical problems.	
Week 6		
Class-16	Introduction to Three phase alternator & construction.	
Class-17	Working Principle of Three Phase alternator.	
Class-18	Principle of operation of Three Phase alternator.	
Week 7		
Class-19	Principle of operation of Three Phase alternator.	
Class-20	Mathematical problems.	CT2/ MID TERM
Class-21	Overview of syllabus of Section A.	
Week 8		
Class-22	Introduction to Aircraft Electrical System; Syllabus,	
Class-23	Power sources, Power distribution systems.	
Class-24	AC Power Supply systems.	
Week 9		
Class-25	Frequency wild & Constant frequency system.	
Class-26	DC Power Supply systems.	
Class-27	Voltage regulation, Paralleling & Load sharing.	
Week 10		
Class-28	Lead Acid Batteries.	CT3
Class-29	Nickel-Cadmium Batteries.	
Class-30	Typical Battery system in a Turbo-prop ac; Lithium	
Week 11		
Class-31	Characteristics of Aircraft Electrical Wire, Wire Size.	
Class-32	Electric Conduit, Terminals, Bonding, Grounding.	
Class-33	Identification of Wire & Cable.	

Week 12		
Class-34	Busbar, Bus-ties, typical & Simplified Aircraft Bus-bar System.	
Class-35	Electrical power distribution systems of typical transport	
Class-36	Static & Rotary Converting Unit, Transformer Rectifier Unit.	
Week 13		
Class-37	Auxiliary Power Unit for starting of aircraft engines.	
Class-38	Ground Power System: DC System.	
Class-39	Ground Power System: AC System.	
Week 14		
Class-40	Electrical Loads, Exterior Lighting: Navigation, Anti-collision, Landing & Taxing Lighting system.	
Class-41	Interior Lighting: Cockpit, Cabin & Emergency Lighting system.	
Class-42	Overview of syllabus of Section B.	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C4
			CO 3	C2
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Electric Machine and Transformers – Irving L. Kosow; Prentice Hall of India.
2. Aircraft Electrical and Electronic Systems - Mike Tooley
3. A Text Book of Electrical Technology (Volume-II)- B L Theraja.
4. Aircraft Electrical Systems- EHJ Pallet; Pearson Education
5. Aircraft Electricity & Electronics- Thomas K Eismin, Tata McGraw-Hill
6. Electric Machinery Fundamental - Stephan J. Chapman; McGraw-Hill

COURSE INFORMATION			
Course Code	AEAV 218	Contact Hours	1.50
Course Title	Aircraft Electrical System Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Students will be able to understand about the learn basics of electro-mechanical components like transformer, DC generator, DC motor, alternator and their operations.

OBJECTIVE

1. To learn the basics of transformers.
2. To study the working principle & properties of motors and generators.
3. To be able to understand the basics of Alternator.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **practice** the fundamentals of electromagnetics using a transformer.	PO1	P2			K6	R, Q, T
CO2	Be able to **practice** the working principle of different linear electric machines.	PO1	P2			K6	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp. No	Exp. Name
1.	Regulation of the Transformer in various loads.
2.	Study the properties of DC Separately Excited Shunt Generator.
3.	Study the properties of DC Self-Excited Shunt Generator.
4.	Study the properties of DC Shunt Motor
5.	Study the properties of Three-Phase Alternator in various loads.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21

Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 2.5 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 1
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Introduction
Week 2	Regulation of the Transformer in various loads.
Week 3	Study the properties of DC Separately Excited Shunt Generator.
Week 4	Study the properties of DC Self-Excited Shunt Generator.
Week 5	Study the properties of DC Shunt Motor
Week 6	Study the properties of Three-Phase Alternator in various loads.
Week 7	Lab Quiz

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (30%)	Lab participation	25%	CO 1	P2
			CO 2	P2
	Report Writing	15%	CO 1	P2
			CO 2	P2
Lab Quiz		50%	CO 1	P3
			CO 2	P2
Viva		10%	CO 1	P3
			CO 2	P2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Electric Machine and Transformers – Irving L. Kosow; Prentice Hall of India.
2. A Text Book of Electrical Technology (Volume-II)- B L Theraja and A K Theraja.
3. Electric Machinery Fundamental - Stephan J. Chapman; McGraw-Hil.

COURSE INFORMATION			
Course Code	AEAV 301	Contact Hours	3.00
Course Title	Digital Systems	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course offers a comprehensive exploration of digital logic design, starting with number systems and progressing through the analysis and synthesis of digital circuits, including both combinational and sequential logic. Students will delve into the intricacies of multiplexers, demultiplexers, programmable logic devices, memory structures, and gain foundational knowledge of microprocessor architecture, specifically the Intel 8086, covering its architecture, addressing modes, and instruction sets.

OBJECTIVE

1. To instill understanding of materials' atomic and crystal structures affecting aerospace performance.
2. To equip students with skills to select aerospace materials based on mechanical properties and application needs.
3. To grasp concepts of corrosion mechanisms and heat treatment principles for aerospace material maintenance.
4. To introduce composite materials and nanotechnology's impact on aerospace material innovation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** knowledge of number systems and codes to analyze and synthesize basic digital logic circuits using Boolean algebra and combinational logic.	PO2	C3			K3	T, F, ASG.
CO2	Be able to **apply** complete logic circuits to develop combinational circuits that can contribute to different applications.	PO2	C3			K3	T, F, Mid Term, ASG.

CO3	Be able to **apply** sequential logic circuit principles to **design** and implement functional flip-flops, counters, and shift registers for specific applications.	PO3	C6			K5	T, F, ASG.
CO4	Be able to **explain** the architecture of 8086 microprocessor, addressing modes, instruction set and its application.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Digital System: Introduction to number systems and codes. Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic circuits, minimization of combinational logic. Modular combinational circuit, Multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, Introduction to programmable logic devices. Sequential circuits: Different types of latches, flip-flops. Shift registers, counters, and their applications. Introduction to memory devices and their structure. Microprocessor: Introduction to microprocessors. Intel 8086 microprocessor: Architecture, addressing modes, instruction sets.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Concept of digital and analog systems, advantages and disadvantages of digital system.	
Class-2	Decimal, Binary, Octal & Hexadecimal number system	
Class-3	Signed number, Gray Code, Parity method of error detection, ASCII, Binary addition, division, subtraction, multiplication	
Week 2		
Class-4	Operations, truth table and logic symbol of AND, OR, NAND, NOR, exclusive-OR, exclusive-NOR gate	
Class-5	Pulsed operation of different logic gates	
Class-6	Practical problem-solving using logic gates	
Week 3		CT2/ MID TERM
Class-7	Laws of Boolean Algebra	
Class-8	DeMorgan's Theorem	
Class-9	Simplify expression by using laws and rules of Boolean algebra	
Week 4		
Class-10	Sum of Product and Product of Sum	
Class-11	Karnaugh Map to simplify Boolean expression	
Class-12	Application of Boolean algebra and the Karnaugh map method to a system operation	
Week 5		
Class-13	Basic combinational logic circuits	
Class-14	Design a combinational logic circuit for a truth table and vice versa	
Class-15	Practical problem solving using combinational logic circuits	
Week 6		
Class-16	The half adder, the full adder, parallel binary adders	
Class-17	Continue	
Class-18	Comparators (magnitude and cascaded comparators)	
Week 7		
Class-19	Operation, truth table and logic symbol of basic decoders	CT2/ MID TERM
Class-20	Application example of decoder (BCD to decimal and BCD to 7 segment decoder)	
Class-21	Operation, truth table and logic symbol of basic encoders	
Week 8		
Class-22	Code Converters (BCD to Binary, Binary to Gray and Gray to Binary)	
Class-23	Operation of multiplexers (74LS151 and 74HC157A multiplexers)	
Class-24	Operation of demultiplexers (74HC154 multiplexers)	
Week 9		
Class-25	Operation of S-R, D and J-K flip-flop, truth table, logic symbols	
Class-26	Continue	
Class-27	Application examples of different flip-flops.	
Week 10		CT3
Class-28	Asynchronous Counter operation	
Class-29	Application of Asynchronous Counter	
Class-30	Synchronous Counter operation	

Week 11	
Class-31	Application of Synchronous Counter
Class-32	Up/ down Synchronous Counter
Class-33	Design of a Synchronous Counter
Week 12	
Class-34	Operation of shift registers, serial in/ serial out shift registers
Class-35	Mathematical problems
Class-36	Serial in- parallel out shift registers, parallel in-serial out shift registers, parallel in-parallel out shift registers
Week 13	
Class-37	Mathematical problems
Class-38	Bidirectional shift registers, shift register counters
Class-39	Continue
Week 14	
Class-40	Introduction to Microprocessor
Class-41	The architecture of 8086 microprocessor, addressing modes, instruction set.
Class-42	Continue

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C3
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C6
Final Examination (Section A & B)		60%	CO 1	C3
			CO 2	C3
			CO 3	C6
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Digital Logic and Computer Design- M Morris Mano;
2. Digital Fundamentals - Floyd; Prentice Hall International, Inc.
3. Microprocessor and Interfacing - Douglas V. Hall; Tata McGraw-Hill.

COURSE INFORMATION			
Course Code	AEAV 302	Contact Hours	3.00
Course Title	Digital Systems Sessional	Credit Hours	1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This subject is intended to teach the students basics, concepts, principles and working of digital circuits putting forth the use of a transistor as a switch, number systems, Boolean Algebra, logic gates, counters, timers and so on.

OBJECTIVE

1. To learn about combinational digital circuits.
2. To learn about sequential digital circuits.
3. To solve complex design problems regarding digital electronics based on realistic aspects.
4. To develop communication and project management skills among the students through presentation and mini projects.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the use of standard electronic test equipment such as logic gates, digital multi-meters, power supplies and other digital equipment to test, and implement digital circuits.	PO2	P2			K4	R, Q, T
CO2	Be able to **analyze** a circuit correctly and compare its theoretical performance to actual performance.	PO2	C4			K4	R, Q,T
CO3	Be able to **design and validate** a digital circuit to solve real life problems.	PO3	C6	CP1, CP2, CP3		K5	R, Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Familiarization and use of truth table of basic logic Gates.
2.	De Morgan's Laws using the Logic Gates
3.	Truth tables and simplification using Boolean algebra
4.	Design of Adder & Subtraction circuits using basic gates

5.	Design and implement of encoder and decoder circuits
6.	Design and implement of BCD to seven-segment decoder circuit using logic gates.
7.	Design and implement of Multiplexer & De-multiplexer circuit using logic gates
8.	Design and implement of various types of clocked flip-flop circuits using logic gates
9.	Design and implement of up and down counters
10.	Project

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Familiarization and use of truth table of basic logic Gates.
Week 2	De Morgan's Laws using the Logic Gates
Week 3	Truth tables and simplification using Boolean algebra
Week 4	Design of Adder & Subtraction circuits using basic gates
Week 5	Design and implement of encoder and decoder circuits
Week 6	Design and implement of BCD to seven-segment decoder circuit using logic gates.
Week 7	Design and implement of Multiplexer & De-multiplexer circuit using logic gates
Week 8	Design and implement of various types of clocked flip-flop circuits using logic gates.
Week 9	Design and implement of up and down counters
Week 10	Review
Week 11	Lab Test-1

Week 12	Lab Quiz
Week 13	Presentation on Assigned Problems
Week 14	Project Demonstration

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P2
			CO 2	C4
	Lab test	30%	CO 1	P2
			CO 2	C4
	Project and Presentation	20%	CO3	C6
Lab Quiz		15%	CO 1	P2
			CO 2	C4
Viva		10%	CO1, CO2, C03	P2, C4, C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Digital Logic and Computer Design- M Morris Mano
2. Digital Fundamentals - Floyd; Prentice Hall International, Inc.
3. Pulse, Digital and Switching waveforms - Jacob Millman & Herbert Taub;
4. Microprocessor and Interfacing - Douglas V. Hall; Tata McGraw-Hill.
5. Microprocessor and Microprocessor Based System Design - Dr M. Rafiquzzaman;

COURSE INFORMATION			
Course Code	AEAV 303	Contact Hours	3.00
Course Title	Signal and Systems	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on the basics of electrical signals as well as the analysis and design of systems.

OBJECTIVE

1. To describe signals mathematically and perform mathematical operations on signals.
2. To familiarize with commonly used signals and learn their application on systems.
3. To describe systems using differential equations & analyze their response.
4. To identify various system properties and their implication on practical systems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the classification of different types of signals & systems.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** appropriate theorem and method to analyze time domain LTI systems.	PO2	C3			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **apply** appropriate method to analyze the frequency response of various signals and systems.	PO2	C3			K4	T/ Mid Term Exam, F, ASG.
CO4	Be able to **find** different systems characteristics using appropriate technique.	PO2	C3			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

<u>Classification of signals and systems</u>

Signals - classification, basic operation on signals, elementary signals, representation of signals using impulse function; systems – classification.

Properties of Linear Time Invariant (LTI) systems
Linearity, causality, time invariance, memory, stability, inevitability.
Time domain analysis of LTI systems
Differential equations - system representation, order of the system, solution techniques, zero state and zero input response, system properties; impulse response - convolution integral, determination of system properties; state variable - basic concept, state equation and time domain solution.
Frequency domain analysis of LTI systems
Fourier series- properties, harmonic representation, system response, frequency response of LTI systems.
Fourier transformation
Properties, system transfer function, system response and distortion-less systems. Applications of time and frequency domain analyses: solution of analog electrical and mechanical systems, amplitude modulation and demodulation, time-division and frequency-division multiplexing.
Laplace transformation
Properties, inverse transform, solution of system equations, system transfer function, system stability and frequency response and application.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to signal and system**	CT1
Class-1	Signals - classification	
Class-2	Elementary signals	
Class-3	Periodic vs aperiodic signals, Continuous vs discrete signals	

Week 2	**Transformation of independent variable**	
Class-4	Basic operation on signals: types	
Class-5	The shifting operation	
Class-6	Reflection operation, Time scaling operation	
Week 3	**Properties of Linear Time Invariant (LTI) systems**	
Class-7	Linear and nonlinear systems	
Class-8	Time varying and time invariant systems	
Class-9	System with and without memory	
Week 4	**Properties of Linear Time Invariant (LTI) systems**	CT2/ MID TERM
Class-10	Causal and non-causal systems	
Class-11	Convolution integral	
Class-12	Graphical interpretation of Convolution	
Week 5	**Time domain analysis of LTI systems**	
Class-13	Differential equations - system representation, system properties	
Class-14	Zero state and zero input response	
Class-15	impulse response - convolution integral	
Week 6	**State variable - basic concept**	
Class-16	Determination of system properties	
Class-17	State equation	
Class-18	Time domain solution	
Week 7	**Frequency domain analysis of LTI systems: system response, frequency response of LTI systems.**	
Class-19	Introduction to Fourier series	
Class-20	Dirichlet Condition and orthogonality	
Class-21	Properties of Fourier series	
Week 8	**Types of Fourier Series**	CT2/ MID TERM
Class-22	Basic concept of trigonometric Fourier series	
Class-23	Problem solving techniques	
Class-24	Effect of Symmetry	
Week 9	**Fourier Series**	
Class-25	Exponential Fourier Series	
Class-26	Convolution of two signals	
Class-27	Systems with periodic inputs	
Week 10	**Fourier Transformation**	
Class-28	Properties	
Class-29	system transfer function	
Class-30	Problem solving on basic properties	
Week 11	**Fourier Transformation**	CT3
Class-31	Convolution of signals	
Class-32	Energy of aperiodic signals	
Class-33	Problem solving	
Week 12	**Applications of Fourier transformation**	
Class-34	Amplitude modulation	
Class-35	Demodulation	
Class-36	time-division and frequency-division multiplexing	
Week 13	**Laplace transformation**	
Class-37	Properties	
Class-38	Inverse transform	

Class-39	Problem solving on system equations	
Week 14	**System equations**	
Class-40	System stability	
Class-41	System transfer function	
Class-42	Frequency response and application.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 / CO 3	C3
			CO 4	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 / CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Signals and Systems, 2nd Edition- Simon Haykin, Barry Van Veen
2. Signal Processing and Linear Systems, 1st Edition- B.P. Lathi
3. Continuous and Discrete Signals & Systems - S.S. Soliman & M. D. Srinath
4. Signal and System (Continuous & Discrete) - R.E. Ziemer
5. Feedback Control System - Phillips & Horbour
6. Signals and Systems- Alan V. Oppenheim and Alan S. Willsky

COURSE INFORMATION			
Course Code	AEAV 305	Contact Hours	3.00
Course Title	Communication Engineering	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 303: Signals and Systems

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course objective is to cover the principles of analog and digital communication systems involving different modulation and demodulation technique.

OBJECTIVE

1. To develop and compare the functional blocks of coding/modulation and demodulation/decoding for analog and digital communication systems.
2. To analyze the analog-to-digital conversion process with emphasis on Nyquist Sampling Criteria, line coding, pulse shaping and optimum detection functions.
3. To analyze different parameters of analog and digital communication techniques.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** the fundamental principles of communication systems, noises, information theory and application of modulations in aircraft communication system	PO1	C2			K3	T, F, ASG
CO2	Be able to **describe and compare** different types of amplitude modulations, demodulations, applications, advantages and limitations.	PO1	C4			K3	T, F, Mid Term Exam
CO3	Be able to **explain** the fundamentals of angle modulation, demodulation and its application in communication system.	PO1	C3			K3	T, F, ASG

CO4	Be able to **describe** the basic concepts of analog to digital signal conversion, digital modulation and demodulation techniques.	PO2	C4			K4	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Overview of communication systems: Basic principles & fundamental elements; Noise: Sources & characteristics.
Information theory: Measure of information, channel capacity of a continuous system.
Communication systems: Analog and digital.
Continuous wave modulation: Transmission types, Amplitude modulation: Introduction, double side band, single side band, vestigial side band, quadrature, spectral analysis of each type, envelope and synchronous detection.
Angle modulation: Instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM. Pulse modulation: Sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling. Pulse amplitude modulation: Principle, bandwidth requirements.
Pulse code modulation (PCM): Quantization principle, quantization noise, non-uniform quantization, signal to quantization error ratio, differential PCM, demodulation of PCM.
Delta modulation (DM): Principle, adaptive DM, line coding – formats and bandwidths.
Digital modulation: ASK, PSK, FSK.
Multiplexing: Time division multiplexing (TDM) - principle, receiver synchronization, frame synchronization, TDM of multiple bit rate systems, frequency division multiplexing - principle, de-multiplexing, wavelength-division multiplexing.
Aircraft Communication System: Intercommunication System, VHF/UHF Communication, HF Communication, Satellite Communication.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Information Theory	
Class-2	Shanon's information capacity theorem	
Class-3	Basic communication block diagram	
Week 2		
Class-4	DSB-SC modulation	
Class-5	Tone Modulation	
Class-6	Multiplier Modulator, Non-Linear Modulator, Switch Modulator, Ring Modulator	
Week 3		CT2/ MID TERM
Class-7	Coherent and Non-coherent Demodulation	
Class-8	Sigle Sideband Modulation	
Class-9	Numerical Problem	
Week 4		
Class-10	Vestigial Sideband Modulation and Demodulation	
Class-11	Quadrature Amplitude Modulation and Demodulation	
Class-12	Applications of Modulations	
Week 5		
Class-13	Angle Modulation	
Class-14	Relationship between phase and frequency modulation	
Class-15	Generation of Frequency Modulation	
Week 6		
Class-16	Pulse modulation: Sampling theorem Definition, Principle	
Class-17	Nyquist criterion Aliasing	
Class-18	Bandwidth requirements and application	
Week 7		CT2/ MID TERM
Class-19	Definition of Pulse code Modulation, quantization & quantization principle	
Class-20	Quantization noise, non-uniform quantization	
Class-21	Signal to quantization error ratio and math	
Week 8		
Class-22	Time Division Multiplexing	
Class-23	TDM: Receiver synchronization, frame synchronization	
Class-24	Frequency Division Multiplexing	
Week 9		
Class-25	DPCM (transmitter, receiver)	
Class-26	Continue	
Class-27	ADPCM &Demodulation of PCM	
Week 10		CT3
Class-28	Continue	

Class-29	TDM of multiple bit rate systems	
Class-30	Delta modulation (DM): Principle, transmitter & receiver	
Week 11		
Class-31	Continue	
Class-32	Adaptive DM: (transmitter and receiver)	
Class-33	Continue	
Week 12		
Class-34	DM: Threshold of coding and overloading	
Class-35	Digital modulation: Amplitude-shift keying	
Class-36	Phase-shift keying (PSK):	
Week 13		
Class-37	BPSK & QPSK	
Class-38	Frequency-shift Keying (FSK)	
Class-39	Line coding and its properties	
Week 14		
Class-40	Aircraft Communication	
Class-41	HF Communication	
Class-42	VHF Communication	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 3	C3
			CO 4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C4
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C4
			CO 3	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Digital and Analog Communication System - Leon W. Couch; Pearson Education.
2. Communication System - Somon Haykin; John Wiley & Sons, Inc.
3. Modern Digital & Analog Communication System - B. P. Lathi;
4. Telecommunication Switching Systems and Networks – Thiagarajan Viswanathan;
5. Electronic Communication Systems-Kennedy & Davis; Tata McGraw Hill

COURSE INFORMATION			
Course Code	AEAV 306	Contact Hours	1.50
Course Title	Communication Engineering Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This sessional is intended to teach the students the basics of communication as well as the analysis and implementation of various communication methods.

OBJECTIVE

1. To explain the basic theory of different types modulation techniques of communication
2. To apply the basic theory of modulation using different engineering equipment
3. To compare the numerical results with software results to design a communication system as per requirement
4. To analyze the effect of noise by analyzing different communication techniques

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the use of appropriate tools and construct the circuit for implementing basic processes of different types of modulation schemes.	PO1	P2			K4	R, Q, T
CO2	Be able to **construct** and **analyze** various parameters of the circuit for implementing basic processes of modulation and demodulation.	PO2	C4			K4	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	AM Modulation by Transistor and Demodulation by Diode detector
2.	FM Modulation and FM Demodulation
3.	DSB-SC and SSB Modulation and Demodulation.
4.	Delta Modulation and Demodulation.
5.	ASK/ PSK/ FSK Modulation and Demodulation.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of viva Preparation of Quiz	 06 06 06 06
Formal Assessment Continuous Assessment Final Quiz Final Lab test Final viva	 07 01 02 01
Total	56

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method.

COURSE SCHEDULE	
Week 1	AM Modulation by Transistor and Demodulation by Diode detector
Week 2	FM Modulation and FM Demodulation
Week 3	DSB-SC and SSB Modulation and Demodulation.
Week 4	Delta Modulation and Demodulation.
Week 5	ASK/ PSK/ FSK Modulation and Demodulation.
Week 6	Final Lab test
Week 7	Final Quiz and viva

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	30%	CO 1	P2
			CO 2	C4
	Lab test	40%	CO 1	P2
			CO 2	C4
Lab Quiz		20%	CO 1	C3
			CO 2	P3
Viva		10%	CO1, CO2	P3, C3,
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Digital and Analog Communication System - Leon W. Couch; Pearson Education.
2. Communication System –Somon Haykin; John Wiley & Sons, Inc.
3. Modern Digital & Analog Communication System - B. P. Lathi; Oxford University Press.
4. Telecommunication Switching Systems and Networks – ThiagarajanViswanathan; Prentice Hall of India Private Ltd.
5. Electronic Communication Systems-Kennedy & Davis; Tata McGraw Hill

COURSE INFORMATION			
Course Code	AEAV 307	Contact Hours	3.00
Course Title	Electro-magnetic Field Theory	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on the basics of electromagnetism and electromagnetic waves.

OBJECTIVE

1. To learn the basics of static electric field and magnetic field.
2. To learn the basic of time varying fields.
3. To learn the basic of planar electromagnetic wave.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the fundamentals of electrostatics and **apply** that knowledge to find out various parameters in steady electric fields.	PO2	C3			K4	T, F, ASG.
CO2	Be able to **explain** the fundamentals of magnetostatics.	PO1	C2			K3	T / Mid Term Exam, F, ASG.
CO3	Be able to **derive** the fundamentals of time varying fields.	PO2	C3			K4	T/ Mid Term Exam, F, ASG.
CO4	Be able to **understand** the fundamentals of plane electromagnetic waves.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Electromagnetics

Fields, EM Source, Electrical quantities, Applications.

Electrostatics

Fundamental postulates of static Electric field, Coulomb's law, Gauss law and applications, Electric potentials, material media in Electric field, Electric flux density, dielectric strength, boundary conditions for Electrostatics, Electric dipole, Capacitances, Electrostatics energy, Boundary value problem, Poisson's and Laplace equation, Image theory.

Steady Electric currents
Current density and ohm's law, equation of continuity, Power dissipation and Joules law, Governing equations for steady current and boundary conditions.

Magnetostatics
Fundamental postulates of magnetostatics, Vector magnetic potentials, Biot-savart law, magnetic dipole, magnetic field intensity and permeability, magnetic materials, boundary conditions, Inductances, magnetic stored energy, magnetic force and torque.

Time varying Fields and Maxwell's equation
Faraday's law of EM induction, Maxwell's equations (differential, integral and phasor form), Potentials functions, Time harmonics fields, Helmholtz's wave equations.

Plane electromagnetic waves
Plane waves in lossless media, Doppler effect, TEM wave, Polarization of plane waves, plane wave in lossy media, lowloss dielectric, good conductors, Phase velocity and group velocity, EM power flow and Poynting vector, Instantaneous EM power in a good conductor and lossy dielectric, Normal incidence of plane wave at plane boundaries

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to Electromagnetics**	CT1
Class-1	Fundamentals Quantities of Electromagnetics	
Class-2	Co-ordinate Transformation	

Class-3	Fundamentals postulates of Electrostatics	
Week 2	**Law's of Electrical Field**	
Class-4	Coulomb's law of Electric Field, Guass Law	
Class-5	Ring Charge, Surface Charge and related problems	
Class-6	Surface Charge using Guass Law	
Week 3	**Electric Field and related terms**	
Class-7	Electric Scalar Potential and related problems	
Class-8	Electric Dipole, Material in a static Electric Field	
Class-9	Electric Field Intensity and relative permittivity and related problems	
Week 4	**Capacitance and Energy**	CT2/ MID TERM
Class-10	Capacitance of a capacitor, Capacitance of Cylinder	
Class-11	Electric Store Energy, Poisson's and Laplace Equation with boundary conditions	
Class-12	Image Theory/ Method of Image	
Week 5	**Energy and Power related terms**	
Class-13	Image Theory Method of Image	
Class-14	Line Charge, Steady Current, Convection/Conduction Current Density	
Class-15	Resistance calculation, Power Dissipation	
Week 6	**Magneto statics**	
Class-16	Governing and boundary equations for current density and related problems	
Class-17	Equivalent RC circuits, Magneto statics	
Class-18	Fundamental postulates of Magneto statics	
Week 7	**Magnetic Characteristics**	
Class-19	Biot-Savart Law, Magnetic Dipole	
Class-20	Boundary Conditions and Related Problems	
Class-21	Classification of Magnetic material	
Week 8	**Magnetic Properties**	CT2/ MID TERM
Class-22	Inductance of an Inductor, Inductance of a co-axial cable	
Class-23	Magnetic Store Energy, Magnetic Store energy for a co-axial cable	
Class-24	Magnetic Force and related problems	
Week 9	**Time Varying Electromagnetics and Wave equation**	
Class-25	Time Varying Electro magnetics, Fundamental Postulates and related problems	
Class-26	Time Varying Potentials and Maxwell's equations	
Class-27	Time Harmonic Electro magnetics, Wave equation fro electric and magnetic field	
Week 10	**Plane Wave Polarization**	
Class-28	Plane Wave, Polarization. Uniform Plane Wave	
Class-29	Doppler Effect and problems	
Class-30	Plane Wave in a Lossy media	
Week 11	**Plane wave propagation and power flow**	CT3
Class-31	Plane wave propagating through a good conductor	
Class-32	Skin Depth/ Depth of Penetration	
Class-33	Electromagnetics Power Flow	
Week 12	**Pointing vector and Average power density**	
Class-34	Continued and related math problems	

Class-35	Pointing vector and Average Power density	
Class-36	Instantaneous expression of pointing vector and average power density	
Week 13	**Plane wave and co-efficient**	
Class-37	Group Velocity and Phase Velocity	
Class-38	Nominal incidence of a plane wave at plane boundary	
Class-39	Refection Coefficient, Transmission co-efficient, Standing wave ratio	
Week 14	**Problems Analysis**	
Class-40	Continued and Related Mathematical Problems	
Class-41	Normal Incidence of plane wave on a good conductor	
Class-42	Problem analysis and solving method	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 / CO 3	C3
			CO 4	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 / CO3	C3
Final Examination (Section A & B)		60%	CO 1	CO 1
			CO 2	CO 2
			CO 3	CO 3
			CO 4	CO 4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Fundamentals of Engineering Electromagnetic - D.K. Cheng.
2. Engineering Electromagnetics – W. H. HaytJr& John A. Buck.
3. Fields and Waves in Communication Electronics - Simon Ramo.

COURSE INFORMATION			
Course Code	AEAV 313	Contact Hours	3.00
Course Title	Digital Signal Processing	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 303: Signals and Systems

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge of the discrete signals and systems and designing various filters.

OBJECTIVE

1. To study the properties of discrete time signals and systems
2. To study the properties of digital signal processing
3. To analyze different discrete systems
4. To understand the frequency response of different systems
5. To study the design techniques for FIR and IIR digital filters

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the basics of discrete signals & systems.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** various modeling techniques to **analyze** various systems.	PO2	C4			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **apply** Fourier Transform to study the frequency response of different systems.	PO2	C3			K4	T/ Mid Term Exam, F, ASG.
CO4	Be able to **design** digital various filters with given specifications.	PO3	C6			K5	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

<u>Introduction to digital signal processing</u>

Sampling, quantization and signal reconstruction.

<u>Analysis of discrete-time system in the time domain</u>

Impulse response model, difference equation model. Correlation: power signal, energy signal, applications. Z-transform and analysis of LTI systems.

Frequency analysis of discrete-time signals

Discrete Fourier series and discrete-time Fourier transform (DTFT). Frequency analysis of LTI systems. Discrete Fourier transform (DFT) and fast Fourier transform (FFT). Minimum phase, maximum phase and all pass systems. Calculation of spectrum of discrete-time signals.

Digital filter design

Linear phase filters, specifications, design using window, optimal methods; IIR filters-specifications, design using impulse invariant, bi-linear z- transformation, least-square methods.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to digital signal processing (DSP)**	CT1
Class-1	Discrete-time signals and systems	
Class-2	Types of signals	
Class-3	Analog and digital systems	
Week 2	**Conversion of signals**	
Class-4	Basic sampling theorem	
Class-5	Quantization, Digitization, Aliasing	
Class-6	Signal Reconstruction	
Week 3	**Properties of digital signals**	
Class-7	Linearity & time variant properties	
Class-8	Static, dynamic and system stability	
Class-9	Causal, non-causal and basic theory of convolution	
Week 4	**Impulse response**	CT2/ MID TERM
Class-10	Significance	
Class-11	Finite impulse response (FIR)	

Class-12	Infinite impulse response (IIR)	
Week 5	**Difference equation model**	
Class-13	Solution technique of difference equation	
Class-14	Homogenous solution: theory & problem solving	
Class-15	Particular solution: theory & problem solving	
Week 6	**Structures of LTI systems**	
Class-16	Direct form 1: theory & problem solving	
Class-17	Direct form 2: theory & problem solving	
Class-18	Problem solving	
Week 7	**Discrete transformations**	
Class-19	Discrete-time Fourier series	
Class-20	Properties of discrete-time Fourier series	
Class-21	Analytical problems on DTFS	
Week 8	**Z transform**	CT2/ MID TERM
Class-22	Significance & advantages	
Class-23	Properties of Z transform	
Class-24	Problem solving on various properties	
Week 9	**Inverse Z transform**	
Class-25	Inverse Z transform by expansion	
Class-26	Analysis of LTI systems in Z-domain	
Class-27	One sided Z transform	
Week 10	**Fourier transform (DFT)**	
Class-28	Properties	
Class-29	Frequency-Domain Characteristics of Linear Time-Invariant Systems	
Class-30	Inverse fast Fourier transform	
Week 11	**Discrete Fourier Transform**	CT3
Class-31	Properties	
Class-32	Multiplication of Two DFTs	
Class-33	Circular Convolution	
Week 12	**Fast Fourier Transform**	
Class-34	Direct Computation of the DFT	
Class-35	Radix-2 FFT Algorithms	
Class-36	Problem solving	
Week 13	**Filter design**	
Class-37	Theory of filter design	
Class-38	Design technique of FIR filters	
Class-39	Filter design using window method	
Week 14	**Design of IIR filters**	
Class-40	Theory of IIR filter design	
Class-41	Impulse invariance method	
Class-42	Bilinear transformation method	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 / CO 3	C3

			CO 4	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 / CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Digital Signal Processing: A Practical Approach by Emmanuel Ifeachor , Barrie Jervis
2. Digital Signal Processing by John Proakis, Dimitris Manolakis
3. Signal Processing and Linear Systems 1st Edition by B. P. Lathi

COURSE INFORMATION			
Course Code	AEAV 314	Contact Hours	1.50
Course Title	Digital Signal Processing Sessional	Credit Hours	0.75

PRE-REQUISITE

Course Code & Title:

1. AEAV 303: Signals and Systems

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to familiarize the basics of digital signals and designing & analyze various filters.

OBJECTIVE

1. To study the fundamentals of discrete time signals and systems using MATLAB
2. To analyze discrete time signals and systems in time and frequency domain using MATLAB
3. To study the design techniques for digital filters in MATLAB.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **analyze** discrete time signals and systems in both time and frequency domain using MATLAB.	PO5	C4			K6	R, Q, T
CO2	Be able to **design** various digital filters in MATLAB.	PO5	C6	CP1, CP2, CP7.		K6	R, Q,T, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp. No	Exp. Name
1.	Study of sampling, quantization and encoding.
2.	Time domain analysis of discrete time signals and systems.
3.	Z-transform and Its Application.
4.	Frequency Domain Analysis of discrete time signals and systems.
5.	Filter Design.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21

Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 05 05 2.5 05 10
Formal Assessment Continuous Assessment Final Quiz	 07 1
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Introduction.
Week 2	Study of sampling, quantization and encoding.
Week 3	Time domain analysis of discrete time signals and systems.
Week 4	Z-transform and Its Application.
Week 5	Frequency Domain Analysis of discrete time signals and systems.
Week 6	Filter Design.
Week 7	Lab Test.

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (30%)	Lab participation	20%	CO 1	C4
			CO 2	C6
	Report Writing	10%	CO 1	C4
			CO 2	C6
Lab Test		30%	CO 1	CO 1
			CO 2	CO 2
Project		30%	CO 2	CO 2
Viva		10%	CO 1	CO 1
			CO 2	CO 2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Digital Signal Processing – John G.Proakis & Dimitris Manolakis.
2. Digital Signal Processing Using MATLAB - Vinay K. Langle.
3. Digital Signal Processing-A practical approach– Emmanuel C. Ifeachor.

COURSE INFORMATION			
Course Code	AEAV 401	Contact Hours	3.00
Course Title	Microwave Engineering	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 307: Electro-Magnetic field theory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on the basics of electrical, thermal, dielectric and magnetic properties of the materials.

OBJECTIVE

1. To understand the fundamentals of transmission line, waveguides, resonators.
2. To learn the working principle of various microwave antennas.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the fundamentals of transmission lines and **apply** that knowledge to find out various parameters.	PO2	C3			K4	T, F, ASG.
CO2	Be able to **determine** various parameters of different waveguides.	PO2	C3			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **derive** the fundamental properties of various resonators.	PO2	C3			K3	T/ Mid Term Exam, F, ASG.
CO4	Be able to **explain** the working principles of different types of antennas.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Transmission lines

Voltage and current in ideal transmission lines, reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching and lossy transmission lines.

Waveguides

General formulation, modes of propagation and losses in parallel plate, rectangular and circular waveguides. Micro strips: Structures and characteristics.

Rectangular resonant cavities
Energy storage, losses and Q.
Radiation
Small current element, radiation resistance, radiation pattern and properties, Hertzian and half wave dipoles.
Antennas
Monopole, horn, rhombic and parabolic reflector, array, and Yagi- Uda antenna.
Microwave devices
Microwave oscillators and amplifiers, Klystron, Magnerton, TWT, Twystron.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to Microwave Engineering**	CT1
Class-1	EM Spectrum	
Class-2	Mode of Propagation, Transmission Line	
Class-3	Telegrapher's Equation, Travelling Wave Equation	
Week 2	**Transmission Line**	
Class-4	Loss-less Transmission line theory	
Class-5	Distortion less transmission line and related mathematical problems.	
Class-6	Termination of Transmission Line	
Week 3	**Transmission Line**	
Class-7	Termination of Transmission Line	
Class-8	Time Average Power Flow on TL's	
Class-9	Voltage standing Wave Ratio, Input Impedance of Transmission Line	
Week 4	**Insertion Loss and Transmission Co efficient**	CT2/ MID
Class-10	VSWR, ISWR, Insertion Loss	

Class-11	Related mathematical problems regarding last topic	TERM
Class-12	Introduction to Smith Chart	
Week 5	**Smith Chart**	
Class-13	Introduction to Smith Chart and related Problems	
Class-14	Location Determination of Voltage Maximum and Minimum from Load	
Class-15	Problem Analysis and Solving	
Week 6	**Waveguides**	
Class-16	Introduction to Waveguides	
Class-17	Mode of Propagation	
Class-18	General solutions to Maxwell's Equations for different modes	
Week 7	**Rectangular Waveguide**	
Class-19	Introduction to Rectangular Waveguide	
Class-20	Equations for rectangular waveguide, Dominant Mode	
Class-21	Boundary Condition of Rectangular waveguide and mathematical Problems	
Week 8	**Resonant Cavity**	CT2/ MID TERM
Class-22	Introduction to Resonant Cavity, Advantages, Disadvantages and Uses	
Class-23	Characteristics of Cavity Resonator	
Class-24	Cavity Resonator for different modes	
Week 9	**Quality factor of a resonator**	
Class-25	Determination of Quality Factor	
Class-26	Time Average Magnetic Stored Energy	
Class-27	Power Loss	
Week 10	**Micro strip Line and Antenna**	
Class-28	Micro strip Structure and Modes of Micro strip Line	
Class-29	Introduction to Antenna	
Class-30	Basic Equation, Antenna region, Antenna Parameter	
Week 11	**Antenna**	CT3
Class-31	Radiation Pattern, Power Pattern, Beam Area	
Class-32	Radiation intensity, Directive gain and related mathematical Problems	
Class-33	FRIIS Transmission Formula, Radar Equation and related problems	
Week 12	**Different Types of Antenna**	
Class-34	Half-Wave Dipole Antenna Equation	
Class-35	Hertizian Dipole Antenna	
Class-36	Half Wave Dipole Antenna and Hertizian Dipole Antenna related problems	
Week 13	**Magnetic Dipole Antenna**	
Class-37	Magnetic Dipole Antenna and radiation and power intensity	
Class-38	Klystron's Amplifier and their mechanism	
Class-39	S-Parameter and related mathematical problems	
Week 14	**Problems Analysis**	
Class-40	Continued and Related Mathematical Problems	
Class-41	Revision	
Class-42	Revision	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><td colspan="2">Components</td><td>Grading</td><td>CO</td><td>Blooms Taxonomy</td></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO 1</td><td>C3</td></tr>
<tr><td>CO 2 / CO 3</td><td>C2</td></tr>
<tr><td>CO 4</td><td>C2</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO 2 / CO3</td><td>C2</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO 1</td><td>C3</td></tr>
<tr><td>CO 2</td><td>C2</td></tr>
<tr><td>CO 3</td><td>C2</td></tr>
<tr><td>CO 4</td><td>C2</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
2. Foundations for Microwave Engineering - E. Colliong; McGraw-Hill International.
3. Microwave Engineering - M.Pozar; Addision Wesley Publishing Company.
4. Antenna Theory Analysis and Design - C.A. Balanis; John Wile.

COURSE INFORMATION			
Course Code	AEAV 402	Contact Hours	1.50
Course Title	Microwave Engineering Sessional	Credit Hours	0.75

PRE-REQUISITE

Course Code & Title:

1. AEAV 306: Communication Engineering Sessional
2. AEAV 307: Electro-Magnetic Field Theory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The goal of this sessional is to introduce students with microwave components, circuits, circuit criteria so that student is able to design any microwave circuits and understand microwave working principles.

OBJECTIVE

1. To get familiar with microwave components
2. Analyzing circuits in terms of scattering parameters, electrical characteristics of waveguides and transmission lines through electromagnetic field analysis
3. To learn about applications of microwaves
4. Determine the wavelengths and wave impedances using different waveguide

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the practical hands-on use of various microwave sources & devices and digital modulation and communication schemes.	PO2	P2			K3	R, Q, T
CO2	Be able to **analyze** Microwave signal such as its patterns, beam width, directionality and basic concept of polarization and its properties.	PO2	C4			K4	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Familiarization with Microwave Training System
2.	Study of Microwave Signal: Radiation pattern, Beam width and Directionality

3.	Study of polarization of microwave signal
4.	Measurement of wavelength, VSWR, reflection coefficient and transmission coefficient (T) using a slotted coaxial transmission line and a microwave generator
5.	Study of reflection of microwaves & application of reflection of microwave
6.	Measurement of wavelengths and wave impedance by slotted waveguide section

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of viva Preparation of Quiz	 06 06 06 06
Formal Assessment Continuous Assessment Final Quiz	 07 01
Final Lab test	02
Final Viva	01
Total	56

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Familiarization with Microwave Training System
Week 2	Study of Microwave Signal: Radiation pattern, Beam width and Directionality
Week 3	Study of polarization of microwave signal
Week 4	Measurement of wavelength, VSWR, reflection coefficient and transmission coefficient (T) using a slotted coaxial transmission line and a microwave generator
Week 5	Study of reflection of microwaves & application of reflection of microwave
Week 6	Measurement of wavelengths and wave impedance by a slotted waveguide section
Week 7	Lab Test, Lab Quiz and Viva

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
	Lab participation and Report	30%	CO 1	P2
			CO 2	C4

<table>
<tr><td rowspan="2">Continuous Assessment (40%)</td><td rowspan="2">Lab test</td><td rowspan="2">40%</td><td>CO 1</td><td>P2</td></tr>
<tr><td>CO 2</td><td>C4</td></tr>
<tr><td colspan="2" rowspan="2">Lab Quiz</td><td rowspan="2">20%</td><td>CO 1</td><td>P2</td></tr>
<tr><td>CO 2</td><td>C4</td></tr>
<tr><td colspan="2">Viva</td><td>10%</td><td>CO1, CO2</td><td>P2, C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
2. Foundations for Microwave Engineering - E. Colliong; McGraw-Hill International.
3. Microwave Engineering - M.Pozar; Addision Wesley Publishing Company.
4. Antenna Theory Analysis and Design - C.A. Balanis; John Wiley & Sons.

COURSE INFORMATION			
Course Code	AEAV 407	Contact Hours	3.00
Course Title	Radar Engineering	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 307: Electro-Magnetic Field Theory
2. AEAV 401: Microwave Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is an introduction to radar. It is designed to develop the primary knowledge and techniques necessary to analyze the performance of radar systems so that the student are able to specify the subsystem performance requirements in a radar system design.

OBJECTIVE

1. To explain the principle involved in radar system
2. To know the various types of radar and areas of applications
3. To determine various radar parameters
4. To learn about radar transmitter, receiver and antennas.
5. To describe the principle of electronic counter an counter- counter measure.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** theoretical principles of radar system and different types of radar with their applications.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **determine** various radar parameters that affect radar performance.	PO2	C3			K4	T, F, ASG.
CO3	Be able to **describe** the construction and working principle of radar transmitters, receivers and antennas.	PO1	C2			K4	F, Mid Term Exam.
CO4	Be able to **summarize** the role of radar in electronic warfare including different jamming techniques and airborne radar.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to Radar: Radar Principle, Functional block diagrams, Radar range equation, Radar frequencies, Pulse repetition frequency and Range ambiguity, Minimum detectable signal.
Radar cross-section of targets: Detection and tracking, jamming techniques.
Doppler Effect: Continuous wave and frequency modulation radars, moving target indicator and phase-Doppler radars.
Radar transmitter: Magnetron oscillator, klystron amplifier and traveling wave tube amplifier.
Radar antenna: Antenna parameters, radiation pattern and aperture distribution.
Radar receivers: Displays and duplexers.
Electronic Warfare: Electronic counter measures, electronic counter- counter measures. Introduction to Airborne Radar.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to Radar and application in aviation sector and course objectives.	
Class-2	Radar basic working principle, radar functional block diagram	
Class-3	Radar range equation, mathematical problems.	
Week 2		
Class-4	Radar frequencies, Pulse repetition frequency and Range ambiguity, Minimum detectable signal.	

Class-5	Radar cross-section of targets: What is radar cross section, types of radar cross section (3 types with descriptions).	
Class-6	RCS regions, examples and mathematical problems.	
Week 3		
Class-7	Radar Resolution: What is Radar resolution, range resolution.	CT2/ MID TERM
Class-8	Angle resolution, Doppler resolution, mathematical problems.	
Class-9	Probability density function: types of pdf, probability of detection, false alarm.	
Week 4		
Class-10	Integration of radar pulses: integration of radar pulses types and mathematical problems.	
Class-11	Moving target Indicator (MTI): MTI block diagram,	
Class-12	MTI limitations, delay line cancellers, staggered prf techniques.	
Week 5		
Class-13	Continuous wave radar, CW radar block diagram, frequency modulated radar and their differences.	
Class-14	Doppler effect: What is Doppler effect, derivation of Doppler radar frequency equation	
Class-15	Phased Doppler radar , mathematical problems.	
Week 6		
Class-16	Detection and tracking: Tracking radar, tracking types, radar tracking techniques.	
Class-17	Angle tracking and range tracking techniques and advantages, disadvantages,	
Class-18	Monopulse tracking, conical scan, sequential lobing, tracking radar limitations, low angle tracking.	
Week 7		
Class-19	Clutter: what is clutter, airborne clutter and ground clutter	
Class-20	cutter attenuation factor, clutter RCS, mathematical problems	CT2/ MID TERM
Class-21	Receiver noise, noise figure, detection of radar signals in noise	
Week 8		
Class-22	Solid state amplifier, magnetron,	
Class-23	klystron amplifier and traveling wave tube amplifier.	
Class-24	klystron amplifier and traveling wave tube amplifier	
Week 9		
Class-25	Radar Receivers and duplexers.	
Class-26	Radar receiver, superheterodyne receiver and duplexers	
Class-27	Automatic detection, mathematical problems	
Week 10		
Class-28	Radar jamming: radar jamming, jamming fundamentals and jamming techniques.	CT3
Class-29	Noise jamming and its types.	
Class-30	Radar antenna: functions of radar antenna, antenna parameters,	
Week 11		
Class-31	Antenna radiation pattern and aperture, mathematical problems.	
Class-32	Parabolic Antenna: Working Principle, Numerical Problem	
Class-33	Parabolic Antenna: Working Principle	
Week 12		
Class-34	Array antenna: types of array antenna	
Class-35	Electronic Warfare, ESM, ECM, ECCM	

Class-36	Radar Jamming, Fundamentals of radar noise jamming	
Week 13		
Class-37	Different types of radar noise jamming	
Class-38	Different types of radar deception jamming	
Class-39	Introduction to airborne radar	
Week 14		
Class-40	Airborne Weather radar	
Class-41	Synthetic Aperture Radar	
Class-42	Side Looking Airborne Radar	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introduction to RADAR systems - M. Skolnik; McGraw-Hill International.
2. Principle of Radar - Tomay; Prentice Hall of India.
3. Radar design, principles, signal processing and the environment - Fred E Nathanson, Prentice Hall of India Private Ltd.
4. Introduction to Electronic Defense System- FlippoNeri; Artech House Publishers

COURSE INFORMATION			
Course Code	AEAV 408	Contact Hours	1.50
Course Title	Radar Engineering Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to provide the students with an understanding of the fundamental principles, design of radar system and analysis of radar signals by the means of practical demonstration of different radars.

OBJECTIVE

1. To become familiar with fundamentals of Radar and gain in depth knowledge about the different types of Radar and their operation.
2. To learn about signal detection in Radar and various Radar signal detection techniques.
3. To determine the effect of different radar parameters on radar performance.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **modify** the Radar signal for the detection of various stationary and moving objects in the Radar Toolset.	PO5	C4, P2			K6	R, Q, T
CO2	Be able to **analyze** Radar signal by using various parameters for observing the radar performance.	PO2	C4			K3	R, Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Detection of stationary targets using parabolic antenna and study the influence of Sensitivity Time Control (STC) on display.
2.	Detection of moving targets using parabolic antenna and estimation of beam-width.
3.	Detection of moving targets using patch antenna.
4.	Study of the effect of short pulses on range.
5.	Study of the effect of long pulses on range.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 07 14 Total 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of viva Preparation of Quiz	 06 06 06 06
Formal Assessment Continuous Assessment Final Quiz Final Lab test Final viva	 07 01 02 01
Total	56

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method.

COURSE SCHEDULE	
Week 1	Familiarization and use Didactical Primary Radar tool set and different antennas.
Week 2	Detection of stationary targets using parabolic antenna and study the influence of Sensitivity Time Control (STC) on display.
Week 3	Detection of moving targets using parabolic antenna and estimation of beam- width.
Week 4	Detection of moving targets using patch antenna.
Week 5	Study of the effect of short pulses on range.
Week 6	Study of the effect of long pulses on range.
Week 7	Lab Test and Lab Quiz

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	30%	CO 1	C4, P2
			CO 2	C4
	Lab test	40%	CO 1	C4, P2
			CO 2	C4
Lab Quiz		20%	CO 1	CO 1
			CO 2	CO 2
Viva		10%	CO1, CO2	CO1, CO2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introduction to RADAR systems - M. Skolnik; McGraw-Hill International.
2. Principle of Radar - Tomay; Prentice Hall of India.
3. Radar design, principles, signal processing and the environment - Fred E Nathanson, Prentice Hall of India Private Ltd.

COURSE INFORMATION			
Course Code	AEAV 443	Contact Hours	4.00
Course Title	Aircraft Communication and Navigation	Credit Hours	4.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students to the fundamental principles of Aircraft Navigation and the various types of Navigation aids used in a Modern aircraft.

OBJECTIVE

1. To understand the basic principles of Aircraft Navigation and the terminology used.
2. To study the different types of Dead Reckoning and Position Fixing navigation systems.
3. To understand the principle of Primary and Secondary Radar and analyse various Radio Navigational Aids
4. To understand the requirement of VHF, UHF and HF communication systems.
5. To Understand INS, GNSS and Area Navigation Systems (RNAV)

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the Principle of Aircraft Navigation and difference between Dead Reckoning and Position Fixing type of navigation systems	PO1	C2			K3	T, F, ASG.
CO2	Be able to **explain** and compare different airborne and Ground based Radio and Radar Navigational Aids used in aviation.	PO1	C2			K3	T, F, ASG.
CO3	Be able to **understand** the basic principles of Inertial Navigation System and Global Navigation Satellite System (GNSS)	PO1	C2			K3	F, Mid Term Exam.

CO4	Be able to **describe** the basics of Aircraft Communication System both Air-Air and Air-Ground communication	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to the basic aircraft Navigation terminology, Form of the Earth, Imaginary lines on the earth, Units of measurement, Direction, Position, Maps, Navigation planning
Understanding the various airborne and ground based Navigational Aids available such as NDB, RMI, VOR, ILS, , DME, TACAN, , IFF, TCAS, Radar Navigation etc
Introduction to Basic Aircraft Radio, Radio signal Propagation and Properties. Various Communication Systems used in Aircraft such as VHF, UHF, HF and SATCOM.
Understanding the Principles of Inertial Navigation System (INS), Global Navigation Satellite System (GNSS) and Hybrid Navigation Systems and Area Navigation System (RNAV)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	56
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 56
Self-Directed Learning	
Non-face-to-face learning	56
Revision of the previous lecture at home	28
Preparation for final examination	28
Formal Assessment	
Continuous Assessment	3
Final Quiz	3
Total	174

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Demo on the Flight Simulator.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to Aircraft Navigation**	CT1
Class-1	Introduction to Aircraft Navigation	
Class-2	Form of the Earth, Distance and Direction.	
Class-3	Position on Earth and Navigation Planning	

Week 2	**Radio Navigational Aids**	
Class-4	Non Directional Beacon (NDB)	
Class-5	Non Directional Beacon (NDB)	
Class-6	Radio Direction Finding, Radio Magnetic Indicator (RMI)	
Week 3	**Radio Navigational Aids**	
Class-7	VHF Omnidirectional Range (VOR) Operation	
Class-8	VHF Omnidirectional Range (VOR) Airborne and Ground Station	
Class-9	Distance Measuring Equipment (DME)	
Week 4	**Radio Navigational Aids**	
Class-10	Instrument Landing System (ILS) Operation	
Class-11	Instrument Landing System (ILS) Equipment	
Class-12	ILS Ground based facilities	CT2/ MID TERM
Week 5	**Radio Navigational Aids**	
Class-13	Introduction to Secondary Radar	
Class-14	Identification of Friend or Foe (IFF) Operation and Modes	
Class-15	IFF equipment	
Week 6	**Aircraft Communication System**	
Class-16	Introduction to Aircraft Communication System	
Class-17	VHF, UHF and HF Radio Equipment	
Class-18	SATCOM	
Week 7	**Inertial Navigation System**	
Class-19	Introduction to INS	CT2/ MID TERM
Class-20	Basic Principles of INS	
Class-21	Platform Stabilisation and Mounting Mechanical Gyroscopes	
Week 8	**Inertial Navigation System**	
Class-22	Correction of Inertial Sensors	
Class-23	INS Alignment methods	
Class-24	INS Errors	
Week 9	**Inertial Navigation System**	
Class-25	Kalman Filtering	
Class-26	Ring Laser Gyroscopes	
Class-27	Fiber Optic Gyroscopes	
Week 10	**Global Navigation Satellite Systems**	
Class-28	Introduction to GNSS	
Class-29	Principle of GNSS	
Class-30	Principle of GNSS	
Week 11	**Global Navigation Satellite Systems**	
Class-31	Global Positioning System	
Class-32	Segments of GPS	
Class-33	Levels of Service provided by GPS	
Week 12	**Global Navigation Satellite Systems**	CT3
Class-34	GPS Receivers	
Class-35	GPS Errors	
Class-36	Other Satellite Systems	
Week 13	**Global Navigation Satellite Systems**	
Class-37	Differential GPS	
Class-38	Hybrid Navigation System INGPS,	
Class-39	Use of GNSS	

Week 14	**Area Navigation Systems (RNAV)**	
Class-40	Introduction to RNAV	
Class-41	Use of RNAV	
Class-42	Demo of Navigation using Flight Simulator	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-4	20%	CO 1	C2
			CO 2	C2, C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	15%	CO3	C4
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C4
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Avionics Navigation Systems – Myron Kayton: Wiley Interscience
2. Principles of Avionics - Albert Helfrick; Avionics Communication
3. Avionics Fundamentals- Jeppesen; Highflyn
4. Digital Avionics Systems Principles and Practice - R. Spitzer; The Blackburn Press
5. Elements of Electronic Navigation- N S Nagaraja; McGraw-Hill
6. Understanding GPS – Elliot Kaplan & Christopher Hegarty; Artech House.

COURSE INFORMATION			
Course Code	AEAV 444	Contact Hours	1.50
Course Title	Aircraft Communication and Navigation Sessional	Credit Hours	0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This subject aims at providing a basic understanding of navigation guidance and communication, with special attention to the signal processing aspect and overall system integration for further workplace.

OBJECTIVE

1. To demonstrate knowledge and understanding of various communication equipment.
2. Fundamentals of the various navigation and guidance techniques and their properties.
3. Position and attitude estimation.
4. Examples of current and planned implementations and applications of navigation instruments and their working mechanism.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the use of aircraft communication equipment (RADAR), navigation equipment (DME, ILS, VOR, Radio Altimeter) and controlling equipment (Autopilot).	PO5	P2			K6	R, Q, T
CO2	Be able to **develop** a model of aircraft navigational equipment	PO3	C6			K5	R, PR
CO3	Be able to **demonstrate** the ability to work in a group as a member or as a leader.	PO11	A3			-	R, PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Familiarization with DME operation and its terminologies using a DME trainer set.
2.	Familiarization with ILS operation and terminologies used in ILS.
3.	Familiarization with Radio Altimeter and simulating a return signal through a

	test set.
4.	Familiarization with autopilot operation and its terminologies and autopilot Testing using a Trainer set.
5.	Familiarization with GPS operation and terminologies and GPS Receiver Testing using a GPS Simulator test set.
6.	Project

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
	Total 21
Self-Directed Learning	
Preparation of Lab Reports	05
Preparation of Lab Test	05
Preparation of presentation	2.5
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	07
Final Quiz	0.5
Total	56

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method

COURSE SCHEDULE

Week 1	Familiarization with DME operation and its terminologies using a DME trainer set.
Week 2	Familiarization with ILS operation and terminologies used in ILS.
Week 3	Familiarization with Radio Altimeter and simulating a return signal through a test set.
Week 4	Familiarization with autopilot operation and its terminologies and autopilot Testing using a Trainer set.
Week 5	Familiarization with GPS operation and terminologies and GPS Receiver Testing using a GPS Simulator test set.
Week 6	Lab quiz & viva
Week 7	Project Demonstration

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Lab participation and Report	25%	CO 1	P2
			CO 2	C6
	Lab test	30%	CO 1	P2
			CO2, CO3	C6, A3
	Project and Presentation	20%	CO2, CO3	C6, A3

Lab Quiz	15%	CO 1	P2
Viva	10%	CO1, CO2, CO3	P2, C6, A3
Total Marks	100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)			

REFERENCE BOOKS

1. Avionics Fundamentals- Jeppesen; Highflyn.
2. Principles of Avionics - Albert Helfrick; Avionics Communication.
3. Digital Avionics Systems Principles and Practice - R. Spitzer; The Blackburn Press.
4. Antennas and Wave propagation- 4th Edition, John D Kraus, Ronald J Marhefka; McGraw-Hill
5. Avionics Navigation Systems – Myron Kayton; Wiley-Interscience.
6. Elements of Electronic Navigation- N S Nagaraja; McGraw-Hill.

5.6 Elective Courses Offered in Avionics Discipline

COURSE INFORMATION			
Course Code	AEAV 309	Contact Hours	3.00
Course Title	Aircraft Avionics Systems	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 215: Electronics II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize with the basics of various Avionic Systems and Man Machine Interface to understand the Avionics Architecture and Data bus operation.

OBJECTIVE

1. To understand the various Avionics Systems and the associated HMI, Layout of Displays in the Cockpit and Concept of Glass Cockpit.
2. To analyze and compare the various Avionics Systems such as HUD, HMD, HDD.
3. To understand the function of Stability Augmentation Systems (SAS), Auto stabilizers, Autopilot, FBW, SSFDR, FMS etc.
4. To understand the Avionics Architecture, Data bus such as Mil-1553, ARINC 429.
5. To understand the System Requirements, Design and Certification of Avionics.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **express** the role and importance of Avionics Systems	PO1	C2			K3	T, F, ASG.
CO2	Be able to **compare** the concept of various Avionic System and their HMI	PO1	C2			K3	T, F, ASG.
CO3	Be able to **understand** the operation of Autopilot, auto stabilizers, FADEC	PO1	C2			K3	F, Mid Term Exam.
CO4	Be able to **understand** the Avionics architecture and the design of Mil-1553 and Arinc 429 data bus	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Aircraft Electrical Systems: AC and DC power generations and supply in aircraft, bus bar, generator, alternator, fuses and circuit breakers in aircraft power supply, Concept of emergency power supply, aircraft batteries, types, capacity etc. external power supplies, Auxiliary Power Unit (APU), Components of power distribution, safety requirements, aircraft electrical wiring and lighting.
Aircraft Electronic Systems: Integrated Cockpit Display System: Introduction, Cockpit Display System, Glass Cockpit, Display Unit, HUD, HDD, HMD, IEEE smart sensors.
Engine Control and Monitoring System: Principles of Operation, Engine Indications and Monitoring, Full Authority Digital Engine Control (FADEC) System.
Emergency Systems: Warning Systems, Fire Detection and Suppression, Emergency Oxygen, Passenger Evacuation, Cockpit Voice Recorder & Flight Data Recording System, Ice & Rain Protection System, Emergency power sources, Emergency landing.
Airplane control systems: Push pull rod system, operating principles, Cable and pulley system, Power assisted and fully powered flight controls, digital fly by wire systems. Introduction to Hydraulic systems, Pneumatic systems, brake system, anti-skidding, landing gear systems, Engine Fuel systems, Air conditioning and pressurizing system, deicing and anti- icing system.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Demo on the Flight Simulator (Avionics and Gnd Electronics Lab)

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction to Avionics Systems**	CT1
Class-1	Introduction to Avionics Systems	
Class-2	Role of Avionics in modern Aircraft	
Class-3	Cockpit Layout and concept of Glass Cockpit	

Week 2	**Head Up Display (HUD)**	
Class-4	Head Up Display Operation	
Class-5	Basic Design of HUD	
Class-6	Difference between Civil and Military HUDs	
Week 3	**Helmet Mounted Display (HMD)**	
Class-7	Helmet Mounted Display Operation	
Class-8	Basic Design of HMD	
Class-9	Difference between HUDs and HMDs	
Week 4	**Control and Data Entry**	
Class-10	Introduction to Control and Data Entry and HMI	CT2/ MID TERM
Class-11	Tactile Control Panels, Speech Systems and Display Integration	
Class-12	Direct Voice Input and Eye Trackers	
Week 5	**Stability Augmentation Systems**	
Class-13	Introduction to Stability Augmentation Systems	
Class-14	Limited Authority Stability Augmentation Systems	
Class-15	Full Authority Stability Augmentation Systems	
Week 6	**Fly by Wire Control System**	
Class-16	Introduction to FBW System	
Class-17	Control Laws	
Class-18	Redundancy and Failure Survival	
Week 7	**Autopilots System**	
Class-19	Introduction to Autopilots	CT2/ MID TERM
Class-20	Autopilot Modes	
Class-21	Integration with other systems such as ILS, Auto landing, Autothrottle	
Week 8	**Flight Management System**	
Class-22	Introduction to FMS	
Class-23	FMS Architecture	
Class-24	FMS Operation Modes	
Week 9	**Solid State Flight Data Recorder (SSFDR)**	
Class-25	Introduction to SSFDR	
Class-26	Principle of Flight Data Acquisition System	
Class-27	Data Recording, extraction and Telemetry	
Week 10	**Avionics System Architecture**	
Class-28	Introduction to Avionics System Architecture	CT3
Class-29	Integrated and Modular Avionics Architecture	
Class-30	Redundancy in design	
Week 11	**Digital Data Bus Mil -1553**	
Class-31	Introduction to Mil-1553 Data Bus	
Class-32	Command, Data and Status Word format	
Class-33	Mil-1553 Architecture	
Week 12	**Digital Data Bus Arinc-429**	
Class-34	Introduction to ARINC Data Bus	
Class-35	Word format	
Class-36	ARINC Data bus Architecture	
Week 13	**Avionics System Implementation**	
Class-37	Fault Tolerant Avionics	
Class-38	Advanced Distributed Architecture	
Class-39	New Avionics System	

Week 14	**Avionics Operations**	
Class-40	Understanding Avionics in Operations	
Class-41	Demo Class using Flight Simulator	
Class-42	Demo Class using Flight Simulator	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 3	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. The Avionics Handbook Edited by Cary R. Spitzer
2. Introduction to Avionics Systems RPG Collinson

COURSE INFORMATION			
Course Code	AEAV 403	Contact Hours	3.00
Course Title	Electric and Magnetic Properties of Materials	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on the basics of electrical, thermal, dielectric and magnetic properties of the materials.

OBJECTIVE

1. To understand the fundamentals of various material properties.
2. To learn different electrical and magnetic behavior of materials.
3. To learn the fundamentals of superconductivity and meta-materials.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** various types of crystal structures & their effect on material properties.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **apply** different theories of materials to find out different properties of materials.	PO2	C3			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **compare** different dielectric and magnetic properties of materials.	PO2	C3			K4	T/ Mid Term Exam, F, ASG.
CO4	Be able to **describe** the fundamentals of superconductivity and meta materials.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

<u>Crystal structures</u>

Types of crystals, lattice and basis, Bravais lattice and Miller indices.

<u>Classical theory of electrical and thermal conduction</u>

Scattering, mobility and resistivity, temperature dependence of metal resistivity, Mathiessen's rule, Hall effect and thermal conductivity.

Introduction to quantum mechanics
Wave nature of electrons, Schrodinger's equation, one-dimensional quantum problems-infinite quantum well, potential step and potential barrier; Heisenbergs's uncertainty principle and quantum box, Electron in a 3D box. Hydrogen Atom.
Band theory of solids
Band theory from molecular orbital, Bloch theorem, Kronig-Penny model, Brillouin zone, effective mass, density-of-states. Carrier statistics: Maxwell-Boltzmann and Fermi-Dirac 155 distributions, Fermi energy. Modern theory of metals: Determination of Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat.
Dielectric properties of materials
Dielectric constant, polarization- electronic, ionic, orientational and interfacial; internal field, Clausius-Mosotti equation, spontaneous polarization, frequency dependence of dielectric constant, dielectric loss, piezoelectricity, ferroelectricity, pyroelectricity.
Magnetic properties of materials
Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains.
Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density. BCS theory. Magnetic recording materials, Josephson theory.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Crystal Structures**	CT1
Class-1	Crystals, Types Of Crystals, Lattice And Basis	
Class-2	Lattice And Basis	
Class-3	Bravais Lattice And Miller Indices	

Week 2	**Classical Theory Of Electrical And Thermal Conduction**	
Class-4	Scattering, Mobility And Resistivity	
Class-5	Temperature Dependence Of Metal Resistivity, Mathiessen's Rule	
Class-6	Hall Effect And Thermal Conductivity	
Week 3	**Introduction To Quantum Mechanics**	
Class-7	Wave Nature Of Electrons, Schrodinger's Equation	
Class-8	One-Dimensional Quantum Problems- Infinite Quantum Well	
Class-9	Potential Step And Potential Barrier	
Week 4	**Uncertainty Principle**	
Class-10	Heisenbergs's Uncertainty Principle And Quantum Box,	
Class-11	Electron In A 3D Box	
Class-12	Hydrogen Atom	
Week 5	**Band Theory Of Solids**	
Class-13	Band Theory From Molecular Orbital, Bloch Theorem	
Class-14	Kronig-Penny Model, Brillouin Zone	
Class-15	Effective Mass, Density-Of-States. Carrier Statistic	CT2/ MID TERM
Week 6	**Band Theory Of Solids**	
Class-16	Maxwell-Boltzmann And Fermi- Dirac Distributions	
Class-17	Fermi Energy	
Class-18	Fermi- Dirac Distributions	
Week 7	**Modern Theory Of Metals**	
Class-19	Determination Of Fermi Energy And Average Energy Of Electrons	
Class-20	Average Energy Of Electrons	
Class-21	Classical And Quantum Mechanical Calculation Of Specific Heat	
Week 8	**Dielectric Properties Of Materials**	
Class-22	Dielectric Constant, Polarization Electronic	
Class-23	Ionic, Orientational And Interfacial	
Class-24	Internal Field, Clausius-Mosotti Equation	
Week 9	**Dielectric Properties Of Materials**	
Class-25	Spontaneous Polarization	CT2/ MID TERM
Class-26	Frequency Dependence Of Dielectric Constant, Dielectric Loss	
Class-27	Piezoelectricity, Ferro Electricity, Pyro Electricity	
Week 10	**Magnetic Properties Of Materials**	
Class-28	Magnetic Moment, Origin Of Ferromagnetism And Magnetic Domains.	
Class-29	Magnetization And Relative Permittivity	
Class-30	Different Types Of Magnetic Materials	
Week 11	**Magnetic Properties Of Materials**	
Class-31	Origin Of Ferromagnetism And Magnetic Domains	
Class-32	Zero Resistance	
Class-33	Meissner Effect	
Week 12	**Introduction To Superconductivity**	
Class-34	Type I Superconductors	CT3
Class-35	Critical Current Density	
Class-36	Type II Superconductors	
Week 13	**Introduction To Superconductivity**	
Class-37	Magnetic Recording Materials,	
Class-38	Continue	

Class-39	Josephson Theory	
Week 14	**Introduction To Meta-Materials**	
Class-40	Meta-Materials	
Class-41	Revision	
Class-42	Review Of The Syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 / CO 3	C3
			CO 4	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 / CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Electrical Properties of Materials- Laszlo Solymar, Donald Walsh.
2. Introduction to Magnetic Materials- B. D. Cullity, C. D. Graham.
3. Introduction to Magnetism and Magnetic Materials- David Jiles.

COURSE INFORMATION			
Course Code	AEAV 409	Contact Hours	3.00
Course Title	Microprocessor and Embedded Systems	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 301: Digital Systems

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to provide the students' knowledge of microprocessor circuit and interface networks in various project design.

OBJECTIVE

1. 1Illustrate the architecture, programming and operating principle of an ARM microprocessor.
2. Introduce Microprocessor design using Verilog HDL.
3. Interpret assembly language programs by executing ARM instruction sets.
4. Introduce design of embedded systems and RTOS.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the architecture, instruction set, memory and input/output interface of an ARM Microprocessor	PO1	C2			K3	T, F, ASG
CO2	Be able to **develop** Embedded Systems solutions with relevant appropriate consideration	PO2	C3			K4	Mid Term Exam, F
CO3	Be able to **Illustrate** emerging technologies and trends in Microprocessor design to recognize the need to always learn the state-of-the art	PO1	C2			K3	Mid Term Exam, F, ASG

CO4	Be able to **analyze** the performance &design variables for each component of a microprocessor	PO2	C4			K3	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Fundamentals of microprocessor and computer design: processor data path, architecture, microarchitecture, complexity, metrics, and benchmark; Instruction Set Architecture, introduction to CISC and RISC, Instruction-Level Parallelism, pipelining, pipelining hazards and data dependency, branch prediction, exceptions and limits, super-pipelined vs superscalar processing

Memory hierarchy and management: Direct Memory Access, Translation Lookaside Buffer; cache, cache policies, multi-level cache, cache performance; Multicore computing, message passing, shared memory, cache-coherence protocol, memory consistency, paging Vector Processor, Graphics Processing Unit, IP Blocks, Single Instruction Multiple Data and SoC with microprocessors. Simple Arm/RISC-V based processor design with VerilogHDL

Introduction to embedded systems design: software concurrency and Realtime Operating Systems, Arm Cortex M / RISC-V microcontroller architecture, registers and I/O, memory map and instruction sets, endianness and image, Assembly language programming of Arm Cortex M / RISC-V based embedded microprocessors (jump, call-return, stack, push and pop, shift, rotate, logic instructions, port operations, serial communication and interfacing), system clock, exceptions and interrupt handling, timing analysis of interrupts, general purpose digital interfacing, analog interfacing, timers: PWM, real-time clock, serial communication, SPI, I2C, UART protocols, Embedded Systems for Internet of Things (IoT).

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Introduction**	CT1
Class-1	Fundamentals of microprocessor and computer design	
Class-2	Processor data path, architecture, microarchitecture	
Class-3	introduction to CISC and RISC, complexity, metrics, and benchmark	
Week 2	**Assembly Language**	
Class-4	Introduction to Assembly Language	
Class-5	Assembly Language for microprocessor	
Class-6	Continue	
Week 3	**Assembly Language Programming**	CT2/ MID TERM
Class-7	Assembly Language Programming	
Class-8	Continue	
Class-9	Continue	
Week 4	**Machine Language**	
Class-10	Introduction to Machine Language	
Class-11	Machine Language Compiling	
Class-12	Assembling	
Week 5	**Multi Cycle Processor**	
Class-13	Performance analysis of Multi Cycle Processor	
Class-14	Signal Cycle of Multi Cycle Processor	
Class-15	Continue	
Week 6	**Microarchitecture**	
Class-16	Pipelining, Hazards in Microarchitecture	
Class-17	Advanced Microarchitecture	
Class-18	Continue	
Week 7	**Memory Systems**	CT2/ MID TERM
Class-19	Introduction to Memory Systems	
Class-20	Cache and Virtual Memory	
Class-21	Continue	
Week 8	**Embedded System**	
Class-22	Introduction to Embedded System Design	
Class-23	Introduction to IOT	
Class-24	Introduction to Arm Cortex m4	
Week 9	**General Purpose Input Output**	
Class-25	Introduction to General Purpose Input Output	
Class-26	Continue	
Class-27	Continue	
Week 10	**General Purpose Timer**	CT3
Class-28	Introduction to General Purpose Timer	
Class-29	Continue	
Class-30	Continue	

Week 11	**Interrupts**	
Class-31	Introduction to Interrupts	
Class-32	Significance of Interrupts in Microprocessor	
Class-33	Continue	
Week 12	**ADC and DAC**	
Class-34	Analog to Digital Conversion	
Class-35	Digital to Analog Conversion	
Class-36	Continue	
Week 13	**Serial Communication**	
Class-37	Introduction to Serial Communication	
Class-38	Serial Communication in Microprocessor	
Class-39	Continue	
Week 14	**Review**	
Class-40	Review	
Class-41	Review	
Class-42	Review	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 3	C3
			CO 4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C3
			CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Semi-Conductor Circuit Approximation - Albert P Malvino; Tata McGraw- Hill.
2. Electronic Devices and circuit – Jacob Millman& Christos C. Halkias; Tata Mc GrawHill.
3. Micro-Electronic Circuit Analysis and Design- Donald A. Neamen; McGraw-Hill.
4. Operational Amplifier and Linear Integrated Circuit –RamakantGayakwad

COURSE INFORMATION			
Course Code	AEAV 413	Contact Hours	3.00
Course Title	Mobile Cellular Communications	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AEAV 305: Communication Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

By the end of the course, the student will be able to analyze and design wireless and mobile cellular systems and work in advanced research wireless and mobile cellular programs

OBJECTIVE

1. To understand the basic cellular system concepts.
2. To have an insight into the various propagation models and the speech coders used in mobile communication.
3. To understand the multiple access techniques and interference education techniques in mobile communication.
4. To enable the student to synthesis and analyze wireless and mobile cellular communication systems over a stochastic fading channel
5. To provide the student with an understanding of diversity reception techniques

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** cellular radio concepts and various propagation effects	PO1	C1			K3	T, Q, ASG, F
CO2	Be able to **relate** to the mobile system specifications.	PO1	C2			K3	T, Q, ASG, F
CO3	Be able to **classify** multiple access techniques in mobile communication.	PO1	C2			K3	T, Q, ASG, F
CO4	Be able to **analyze** various methodologies to improve the cellular capacity	PO2	C4			K4	T, Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction: Concept, evolution and fundamentals. Analog and digital cellular systems.

Cellular Radio System: Frequency reuse, co-channel interference, cell splitting and components.

Mobile radio propagation: Propagation characteristics, models for radio propagation, antenna at cell site and mobile antenna. Frequency Management and Channel Assignment: Fundamentals, spectrum utilization, fundamentals of channel assignment, fixed channel assignment, non-fixed channel assignment, traffic and channel assignment. Handoffs and Dropped Calls: Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate. Diversity Techniques: Concept of diversity branch and signal paths, carrier to noise and carrier to interference ratio performance. Digital cellular systems: Global system for mobile, time division multiple access and code division multiple access.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Introduction**	CT1
Class-1	Concept evolution and fundamentals	
Class-2	Analog and digital cellular systems	
Class-3	Analog and digital cellular systems	
Week 2	**Cellular Radio System**	
Class-4	Syst Frequency reuse em Technologies principles	
Class-5	co-channel interference	
Class-6	cell splitting and components	

Week 3	**Mobile Radio Propagation**	CT2/ MID TERM
Class-7	Propagation characteristics	
Class-8	models for radio propagation	
Class-9	Continue	
Week 4	**Antenna cell**	
Class-10	antenna at cell site	
Class-11	Mobile antenna	
Class-12	mobile antenna types	
Week 5	**Frequency Management**	
Class-13	Fundamentals	
Class-14	spectrum utilization	
Class-15	Continue	
Week 6	**Airborne EW**	
Class-16	Airbrone EW familiarization	
Class-17	Technology evolution	
Class-18	Advanced EW technical approaches	
Week 7	**Radar Bands**	CT2/ MID TERM
Class-19	EW and radar bands	
Class-20	Anti-radiation missiles	
Class-21	Advanced threat radars and missile systems	
Week 8	**Missile System**	
Class-22	Countering missile systems	
Class-23	Countering missile systems	
Class-24	Maneuverability and speed	
Week 9	**RF and IR seekers**	
Class-25	dropped call rate	
Class-26	Dropped Calls	
Class-27	Continue	
Week 10	**Diversity Techniques**	CT3
Class-28	Concept of diversity branch	
Class-29	signal paths	
Class-30	carrier to noise	
Week 11	**Directed energy weapons**	
Class-31	carrier to interference ratio	
Class-32	Performance	
Class-33	Continue	
Week 12	**Digital cellular systems**	
Class-34	Global system for mobile	
Class-35	time division multiple access	
Class-36	Continue	
Week 13	**Code division multiple access.**	
Class-37	Phase and amplitude modulation	
Class-38	Continue	
Class-39	Continue	
Week 14	**Revision**	
Class-40	Revision	
Class-41	Revision	
Class-42	Revision	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><td colspan="2">Components</td><td>Grading</td><td>CO</td><td>Bloom’s Taxonomy</td></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO 1</td><td>C1</td></tr>
<tr><td>CO 3</td><td>C2</td></tr>
<tr><td>CO 4</td><td>C4</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO2</td><td>C2</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO 1</td><td>C1</td></tr>
<tr><td>CO 2</td><td>C2</td></tr>
<tr><td>CO 3</td><td>C2</td></tr>
<tr><td>CO 4</td><td>C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Mobile Cellular Telecommunication (Analog Digital Systems) - William C.Y Lee; McGraw-Hill.
2. Mobile & Personal Communication System & Series - Raj Pandya; IEEE Press, Prentice Hall of India.
3. Wireless Digital Communications - Dr. KamiloFeher; Prentice Hall of India.
4. Mobile Communication satellites theory and application - Ton Logadon; McGraw-Hill International

COURSE INFORMATION			
Course Code	AEAV 415	Contact Hours	3.00
Course Title	Satellite Communications	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AE 447: Space Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge of satellite communication technology to the students.

OBJECTIVE

1. To study the orbital mechanics of satellite
2. To study the subsystems of satellites
3. To analyze the link budget of satellites and inter-satellite links
4. To study the earth station of satellite
5. To study various multiple access techniques

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** the basics of orbital mechanics and various subsystems in satellite.	PO1	C3			K3	T, F, ASG.
CO2	Be able to **calculate** the link budget for various satellites.	PO2	C3			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **understand** the basics of earth station and inter satellite links.	PO1	C2			K3	T/ Mid Term Exam, F, ASG.
CO4	Be able to **explain** various multiple access techniques.	PO1	C2			K3	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Orbital Mechanics

Orbital parameter, Look angles, Coverage angles, Orbital Perturbations.

Satellite Subsystems

Mechanical structure, Propulsion subsystem, Thermal control subsystem, Power supply subsystem, Telemetry, tracking and command (TT&C) subsystem, Attitude and orbit control subsystem, Payload subsystem, Antenna subsystem.

Satellite Link Design

Satellite link parameters, Propagation consideration, Noise considerations, Interference effect, Link budget.

Earth Station

Earth Station Architecture, Key Performance Parameters, Antennas, Amplifiers, Tracking.

Inter-satellite Link

Maximum line of sight distance, Lead-ahead angle.

Multiple Access Techniques

Transponder Assignment, TDMA, FDMA, CDMA, SDMA.

Communication Satellites

Basic elements, Transponders, Design consideration, Typical Satellite TV Network.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to satellite Communications	
Class-2	Advantages of satellite Communication	
Class-3	Different types of orbits	
Week 2		
Class-4	Orbital Parameters	
Class-5	Look Angles	
Class-6	Look Angles	
Week 3		
Class-7	Problems on look Angles	

Class-8	Coverage angle	
Class-9	Orbital Perturbations	
Week 4		CT2/ MID TERM
Class-10	Satellite Subsystems	
Class-11	Mechanical Structures, Propulsion subsystems	
Class-12	Thermal Control subsystem, Power Supply Subsystem	
Week 5		
Class-13	Attitude and Orbit Control, Attitude Sensors	
Class-14	Attitude Stabilization	
Class-15	Attitude Control, TT&C	
Week 6		
Class-16	Satellite link fundamentals	
Class-17	Satellite Link Parameters	
Class-18	Propagation considerations	
Week 7		
Class-19	Noise considerations	
Class-20	Noise of Cascaded systems	
Class-21	Problems on noise calculation	
Week 8		CT2/ MID TERM
Class-22	Interference	
Class-23	Overall system noise temperature	
Class-24	Satellite link budget	
Week 9		
Class-25	Problems on link budget	
Class-26	Earth Station	
Class-27	Earth Station Architecture	
Week 10		
Class-28	Earth station key parameters	
Class-29	Satellite antennas	
Class-30	Amplifiers, converters	
Week 11		CT3
Class-31	Inter-satellite links	
Class-32	Lead ahead angle	
Class-33	Problems on lead ahead angle	
Week 12		
Class-34	Multiple access techniques	
Class-35	FDMA	
Class-36	TDMA	
Week 13		
Class-37	CDMA	
Class-38	SDMA	
Class-39	Comparison between different techniques	
Week 14		
Class-40	Communication satellite, elements	
Class-41	Design considerations	
Class-42	Typical Satellite TV network	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO 1</td><td>C3</td></tr>
<tr><td>CO 2 / CO 3</td><td>C3/ C2</td></tr>
<tr><td>CO 4</td><td>C2</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO 2 / CO3</td><td>C3/ C2</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO 1</td><td>C3</td></tr>
<tr><td>CO 2</td><td>C3</td></tr>
<tr><td>CO 3</td><td>C2</td></tr>
<tr><td>CO 4</td><td>C2</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Satellite Technology: Principles and Applications by Anil K. Maini,
2. Satellite Communications Systems: Systems, Techniques and Technology by Gerard Maral, Michel Bousquet.
3. Satellite Communications by Timothy Pratt.

COURSE INFORMATION			
Course Code	AEAV 417	Contact Hours	3.00
Course Title	Optoelectronics	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. AE 213: Electronics- I
2. AEAV 215: Electronics- II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to provide the students' knowledge of Optoelectronics and apply those in various project design.

OBJECTIVE

1. To provide knowledge of Optical properties in semiconductor.
2. To learn Properties of light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.
3. To be able to design and interrupt different systems.
4. To understand Modulation of light: Phase and amplitude modulation, electro-optic effect, acousto-optic effect and magneto optic devices.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** optical properties of semiconductor; direct and indirect band-gap materials, luminescence and quantum efficiency in radiation.	PO1	C2			K3	T, F, ASG
CO2	Be able to **illustrate** the properties of light, particle and wave nature of light, polarization, interference, diffraction.	PO1	C2			K3	T, F, ASG
CO3	Be able to **analyze** various light emitting diode, materials for visible and infrared LED, structure and coupling to optical fibers.	PO2	C4			K4	T, Mid Term Exam, F

CO4	Be able to **examine** variables for stimulated emission	PO2	C4			K4	T, Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Optical properties in semiconductor: Direct and indirect band-gap materials, radiate and nonradioactive recombination, optical absorption, photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation.
Properties of light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.
Light emitting diode (LED): Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers.
Stimulated emission and light amplification: Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions.
Semiconductor Lasers: Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, hetero-junction lasers, optical and electrical confinement. Introduction to quantum well lasers.
Photo-detectors: Photoconductors, junction photo-detectors, PIN detectors, avalanche photodiodes and phototransistors.
Solar cells: Solar energy and spectrum, silicon and Schottkey solar cells.
Modulation of light: Phase and amplitude modulation, electro-optic effect, acousto-optic effect and magneto optic devices. Introduction to integrated optics.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1	**Optical Properties In Semiconductor**	CT1
Class-1	Direct And Indirect Band-Gap Materials	
Class-2	Direct And Indirect Band-Gap Materials	
Class-3	Radiative And Non-Radiative Recombination	
Week 2	**Optical Properties In Semiconductor**	
Class-4	Radiative And Non-Radiative Recombination	
Class-5	Optical Absorption	
Class-6	Optical Absorption	
Week 3	**Optical Properties In Semiconductor**	CT2/ MID TERM
Class-7	Photo-Generated Excess Carriers	
Class-8	Photo-Generated Excess Carriers	
Class-9	Minority Carrier Life Time	
Week 4	**Optical Properties In Semiconductor**	
Class-10	Minority Carrier Life Time	
Class-11	Luminescence And Quantum Efficiency In Radiation	
Class-12	Luminescence And Quantum Efficiency In Radiation	
Week 5	**Properties Of Light**	
Class-13	Particle And Wave Nature Of Light	
Class-14	Particle And Wave Nature Of Light	
Class-15	Polarization, Interference, Diffraction And Blackbody Radiation	
Week 6	**Properties Of Light**	
Class-16	Polarization, Interference,	
Class-17	Diffraction And Blackbody Radiation	
Class-18	Continue	
Week 7	**Light Emitting Diode (LED)**	CT2/ MID TERM
Class-19	Principles, Materials For Visible And Infrared LED	
Class-20	Internal And External Efficiency, Loss Mechanism	
Class-21	Structure And Coupling To Optical Fibers	
Week 8	**Stimulated Emission And Light Amplification**	
Class-22	Spontaneous And Stimulated Emission	
Class-23	Einstein Relations	
Class-24	Population Inversion	
Week 9	**Stimulated Emission And Light Amplification**	
Class-25	Absorption Of Radiation	
Class-26	Optical Feedback	
Class-27	Threshold Conditions	
Week 10	**Semiconductor Lasers**	CT3
Class-28	Population Inversion In Degenerate Semiconductors, Laser Cavity	
Class-29	Operating Wavelength, Threshold Current Density, Power Output	
Class-30	Hetero-Junction Lasers, Optical And Electrical Confinement	
Week 11	**Photo-Detectors**	
Class-31	Photoconductors, Junction Photo-Detectors	
Class-32	PIN Detectors	
Class-33	Avalanche Photodiodes And Phototransistors.	

Week 12	**Solar Cells**
Class-34	Solar Energy And Spectrum
Class-35	Silicon
Class-36	Schottkey Solar Cells
Week 13	**Modulation Of Light**
Class-37	Phase And Amplitude Modulation
Class-38	Electro-Optic Effect
Class-39	Acousto-Optic Effect And Magneto Optic Devices
Week 14	**Introduction To Integrated Optics**
Class-40	Introduction To Integrated Optics.
Class-41	Review
Class-42	Review

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
			CO 3	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
			CO3	C4
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C4
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Optoelectronics – an Introduction - J. Wilson, J.F.B. Hawkes; Prentice Hall of India Private Ltd.
2. Optical Electronics in Modern Communications - AmnonYariv;
3. Optical Fiber Communications: Principles & Practice - John M. Senior;
4. Introduction to optical Electronics – A. Jones; Harper & Row

COURSE INFORMATION			
Course Code	AEAV 419	Contact Hours	3.00
Course Title	Electronic Warfare	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The purpose of electronic warfare is to deny the opponent the advantage of and ensure friendly unimpeded access to, the EM spectrum.

OBJECTIVE

1. To understand about joint electromagnetic spectrum operations.
2. To know about the electromagnetic operational environment.
3. To learn about electromagnetic battle management.
4. To understand about joint electromagnetic spectrum management operations.
5. To be able to electronic warfare's (EW's) relationship to irregular warfare, EW's relationship to space operations, EW's relationship to cyberspace operations, and EW's relationship to navigation warfare.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** modern electronic warfare systems, architecture, types and technology.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **describe** various role of expendables, chaff and decoys, comparing EW receiver capabilities.	PO1	C2			K3	T, F, ASG.
CO3	Be able to **illustrate** EW and radar bands, anti- radiation missiles, advanced threat radars and missile systems.	PO1	C2			K3	F, Mid Term Exam.

CO4	Be able to **analyze** digital RF memory, camouflage jamming, search radar jamming, high ERP generation.	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Modern electronic warfare (EW) systems: Architecture, types and technology. EW signal processing: Modern EW operation, software control of EW sets.
Role of expendables: Chaff and decoys. Comparing EW receiver capabilities.
Airborne EW: Technology evolution. Advanced EW technical approaches, EW and radar bands, anti- radiation missiles, advanced threat radars and missile systems, countering missile systems, maneuverability and speed considerations.
RF and IR seekers: digital RF memory, camouflage jamming, search radar jamming, high ERP generation, directed energy weapons and stealth technology, countering stealth technology, high power microwave weapons, propagation limitations, high energy lasers and charged particle beam weapons.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	**CT**
Week 1	**Modern electronic warfare (EW) systems**	CT1
Class-1	warfare (EW) systems: Architecture	
Class-2	System types	
Class-3	System Technologies Familiarization	

Week 2	**Modern electronic warfare (EW) systems**	
Class-4	System Technologies principles	
Class-5	System Technologies use	
Class-6	Warfare architecture total connectivity	
Week 3	**EW signal processing**	
Class-7	Luminescence and quantum efficiency in radiation.	CT2/ MID TERM
Class-8	Modern EW operation	
Class-9	software control of EW sets	
Week 4	**Role of expendables**	
Class-10	Polarization and interference,	
Class-11	Chaff	
Class-12	Decoys	
Week 5	**Role of expendables**	
Class-13	Comparing EW receiver capabilities	
Class-14	Internal and external efficiency	
Class-15	Loss mechanism	
Week 6	**Airborne EW**	
Class-16	Airborne EW familiarization	
Class-17	Technology evolution	
Class-18	Advanced EW technical approaches	
Week 7	**Radar Bands**	
Class-19	EW and radar bands	
Class-20	Anti-radiation missiles	CT2/ MID TERM
Class-21	Advanced threat radars and missile systems	
Week 8	**Missile System**	
Class-22	Countering missile systems	
Class-23	Countering missile systems	
Class-24	Maneuverability and speed	
Week 9	**RF and IR seekers**	
Class-25	Digital RF memory	
Class-26	Camouflage jamming	
Class-27	Search radar jamming	
Week 10	**High ERP generation**	
Class-28	Photo-detectors	CT3
Class-29	Photoconductors	
Class-30	Junction photo-detectors	
Week 11	**Directed energy weapons**	
Class-31	Stealth technology	
Class-32	Interfaces require	
Class-33	Interface familiarization	
Week 12	**High power microwave weapons**	
Class-34	Avalanche photodiodes and phototransistors	
Class-35	Interfaces require	
Class-36	Interface familiarization	
Week 13	**Propagation limitations**	
Class-37	Phase and amplitude modulation	
Class-38	Electro effect	
Class-39	Requirement descriptions	

Week 14	**High energy lasers and charged particle beam weapons.**	
Class-40	Acousto-optic effect and magneto devices.	
Class-41	Introduction to integrated	
Class-42	Review of whole syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Electronic Defense Systems - FilippoNeri; Artech House Publishers.
2. Electronic warfare in Information Age - D. Curtis Schleher;
3. Electronic Warfare - JPR Browne; Brassey's London

COURSE INFORMATION			
Course Code	AEAV 421	Contact Hours	3.00
Course Title	Optical Fiber Communications	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AEAV 305: Communication Engineering,

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course discussed component and system concepts in optical communications and its application and to give students and understanding of the theory of optical devices and systems and their application in optical communication networks.

OBJECTIVE

1. To discuss the importance of optical fiber communication
2. To introduce optical fiber communication system
3. To describe the principle of LED
4. To describe the principle of laser
5. To illustrate light propagation in optical fiber.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** step index, graded index fibers and characteristics of optical sources and detectors.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **explain** characteristics transmission characteristics, fiber joints and fiber couplers, light emitting diodes and laser diodes.	PO1	C2			K3	T, F, ASG.
CO3	Be able to **describe** PIN photo-detector and avalanche photo-detectors, direct detection and coherent detection, noise and limitations.	PO1	C2			K3	F, Mid Term Exam.

CO4	Be able to **analyze** Laser and fiber amplifiers, applications and limitations, multi-channel optical system.	PO2	C4			K4	T, F, ASG.
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)							

COURSE CONTENT

Introduction to Optical Fiber Communication.
Light propagation through optical fiber: Ray optics theory and modern theory.
Optical fiber: Types and characteristics transmission characteristics, fiber joints and fiber couplers.
Light sources: Light emitting diodes and laser diodes.
Detectors: PIN photo-detector and avalanche photo-detectors.
Receiver analysis: Direct detection and coherent detection, noise and limitations.
Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises.
Optical amplifier: Laser and fiber amplifiers, applications and limitations.
Multi-channel optical system: Frequency division multiplexing, wavelength division multiplexing and optical CDMA. Radio on fiber technology, Fiber optic access networks.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to Optical Fiber Communication.	
Class-2	Light propagation	
Class-3	Continue	

Week 2		
Class-4	Optical fiber	
Class-5	Ray optics theory	
Class-6	Mode theory	
Week 3		
Class-7	Types	CT2/ MID TERM
Class-8	transmission characteristics	
Class-9	Continue	
Week 4	**Optical Fiber**	
Class-10	fiber couplers	
Class-11	fiber joints	
Class-12	Continue	
Week 5	**Light sources**	
Class-13	Fundamentals	
Class-14	Light emitting diodes	
Class-15	laser diodes	
Week 6	**Detectors**	
Class-16	Fundamentals	
Class-17	PIN photo-detector	
Class-18	avalanche photo-detectors	
Week 7	**Receiver Analysis**	
Class-19	Direct detection	
Class-20	Coherent detection	CT2/ MID TERM
Class-21	Noise and limitations	
Week 8	**Dispersion**	
Class-22	Transmission limitations	
Class-23	Chromatic dispersion	
Class-24	Nonlinear refraction	
Week 9	Types	
Class-25	transmission characteristics	
Class-26	Continue	
Class-27	**Optical Fiber**	
Week 10	fiber couplers	
Class-28	Laser	CT3
Class-29	Fiber amplifiers	
Class-30	Applications	
Week 11	**Multi-channel Optical System**	
Class-31	Frequency division multiplexing imitations	
Class-32	wavelength division multiplexing	
Class-33	Continue	
Week 12	**Optical CDMA**	
Class-34	Fiber optic access networks	
Class-35	CDMA	
Class-36	Application	
Week 13	**Radio on Fiber Technology**	
Class-37	Fiber technology	
Class-38	Continue	
Class-39	Continue	

Week 14	**Revision**
Class-40	Revision
Class-41	Review
Class-42	Review

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Optical Fiber Communications: Principles & Practice - John M. Senior
2. Fiber Optic Communication System - Gerd Keiser; McGraw-Hill International.
3. Optical Communication System - John Gower; Prentice Hall of India.

COURSE INFORMATION			
Course Code	AEAV 425	Contact Hours	3.00
Course Title	Fundamentals of Computational Fluid Dynamics	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AE 205: Numerical Analysis and Applications
2. AE 335: Applied Aerodynamics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course introduces the students to the fundamental principles of Computational Fluid Dynamics (CFD) for understanding fluid flow and fluid properties based on computational method.

OBJECTIVE

1. To explain the methods of fluid flow analysis i.e. theoretical, experimental and computational.
2. To describe the concept potential theory and its application to incompressible and inviscid flows.
3. To apply the numerical methods for solution of flow situations.
4. To describe implications errors and stability analysis of numerical methods.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** computational fluid dynamics (CFD) fundamentals, including governing equations and their applications.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **implement** equation discretization and grid generation techniques for CFD analyses.	PO2	C3			K3	T, F, ASG.
CO3	Be able to **apply** numerical methods to solve and interpret diffusion and fluid flow problems.	PO2	C3			K4	T, F, Mid Term Exam.
CO4	Be able to **analyze** the accuracy and stability for various CFD techniques.	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Introduction to computational fluid dynamics and its application. Review of governing equations, their forms (conservative and non-conservative formulations) and variants. Boundary conditions. Classification of Partial Differential Equations and their effects on CFD problem setup and solutions.
Concept of equation discretization using finite difference methods, Explicit and implicit methods of formulations and solutions. Domain discretization. Algebraic grid generations, stretched grids, staggered grids, elliptic grid generation techniques.
CFD techniques for Finite Difference Methods; Lax-Wendroff technique, MacCormack's Technique, under relaxation and over relaxation techniques. Errors, Consistency and stability analysis, numerical dispersion and artificial viscosity.
Finite volume techniques for diffusion problems, convection-diffusion problems. Algorithms for pressure- velocity coupling in steady flows (SIMPLE, SIMPLER, SIMPLEC, PISO). Solution of discretized equations (TDMA, point iterative, line iterative and ADI techniques). Concept of turbulence models. Post processing techniques in CFD.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Introduction to computational fluid dynamics	
Class-2	Review of governing equations, their forms (conservative and non-conservative)	
Class-3	Boundary Conditions	

Week 2		
Class-4	Classification of Partial Differential Equations	
Class-5	Classification of Partial Differential Equations	
Class-6	Effects of Partial Differential Equations on CFD problem setup and solutions.	
Week 3		
Class-7	Explicit methods of formulations and solutions	CT2/ MID TERM
Class-8	Domain discretization	
Class-9	Algebraic grid generations	
Week 4		
Class-10	Implicit methods of formulations and solutions	
Class-11	Domain discretization	
Class-12	Algebraic grid generations	
Week 5		
Class-13	Stretched grids	
Class-14	Staggered grids	
Class-15	Elliptic grid	
Week 6		
Class-16	CFD techniques for Finite Difference Methods	
Class-17	Lax-Wendroff technique	
Class-18	MacCormack's Technique,	
Week 7		
Class-19	Consistency and stability analysis	
Class-20	Numerical dispersion and artificial viscosity.	CT2/ MID TERM
Class-21	Errors	
Week 8		
Class-22	Finite volume method	
Class-23	Finite volume method	
Class-24	Finite volume method	
Week 9		
Class-25	Convection-diffusion problems	
Class-26	Solved out examples	
Class-27	Solved out examples	
Week 10		
Class-28	SIMPLE	CT3
Class-29	SIMPLER	
Class-30	SIMPLEC, PISO	
Week 11		
Class-31	Discretization equations	
Class-32	Discretization techniques	
Class-33	TDMA	
Week 12		
Class-34	Discretization techniques	
Class-35	TDMA	
Class-36	Solved out examples	
Week 13		
Class-37	Turbulence flow	
Class-38	Turbulence flow modeling	

Class-39	Turbulence flow modeling using CFD techniques	
Week 14		
Class-40	Post processing techniques in CFD.	
Class-41	Post processing techniques in CFD.	
Class-42	Revision class	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Computational Fluid Dynamics – John D. Anderson.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method – H. Versteeg.
3. Fundamentals of Aerodynamics - John D Anderson; McGrawhill.
4. Aerodynamics for Engineering Students –E.L. Houghton, P.W. Carpenter, S.H. Collicot and D.T. Valentine; Elsevier.
5. Computational Fluid Mechanics and Heat Transfer - Pletcher.

COURSE INFORMATION			
Course Code	AEAV 427	Contact Hours	3.00
Course Title	VLSI Circuits and Design	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:
1. AE 213: Electronics-I
2. AEAV 215: Electronics-II
3. AEAV 301: Digital Systems

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is provided to impart knowledge on the basics of design techniques of Very Large Scale Integrated Circuits.

OBJECTIVE

1. To teach the elementary Fabrication steps and working principle of different circuit families to implement logic functions.
2. To familiarize students with edge times, delay and power calculation of MOS circuits.
3. To impart the knowledge of Layout, Design Rules of Layout to the students.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the steps of Fabrication, implement any logic function using NMOS, CMOS and other circuit families.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **understand** non-ideal characteristics of MOS devices and **apply** this knowledge in **analyzing** performances of amplifiers and logic gates.	PO2	C4			K4	T / Mid Term Exam, F, ASG.
CO3	Be able to **compute** power & delay of MOS circuits and **implement** MOS circuits for desired power delay performance.	PO2	C3			K4	T/ Mid Term Exam, F, ASG.
CO4	Be able to **design** Stick Diagram and Layout maintaining the lambda-based Design Rules, design Subsystems, Memory Cells.	PO3	C6			K5	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

VLSI technology
Top-down design approach, technology trends and design styles.

Review of MOS transistor theory
Threshold voltage, body effect, I-V equations and characteristics, latch-up problems, NMOS inverter, CMOS inverter, pass-transistor and transmission gates.

CMOS circuit characteristics and performance estimation
Resistance, capacitance, rise and fall times, delay, gate transistor sizing and power consumption

CMOS circuit and logic design
Layout design rules and physical design of simple logic gates. CMOS subsystem design: Adders, multiplier and memory system, arithmetic logic unit. Programmable logic arrays. I/O systems. VLSI testing.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Brief History	
Class-2	Integrated Circuits Trends, Choice of Technology and Various Design Approaches	
Class-3	nMOS Fabrication & CMOS Fabrication	
Week 2		
Class-4	Thermal Aspects of Processing	
Class-5	BiCMOS technology	
Class-6	Production of E-beam Masks	

Week 3		
Class-7	MOS Capacitor	
Class-8	MOS Device Design Equations	
Class-9	MOS Transconductance	
Week 4		CT2/ MID TERM
Class-10	Nonlinear Behavior of MOS Device, Mobility Degradation,Velocity Saturation	
Class-11	Channel Length Modulation, Threshold Voltage Effect	
Class-12	Leakage, Pass Transistor and Pass Gate	
Week 5		
Class-13	MOS Layers	
Class-14	Stick Diagrams	
Class-15	Design Rules and Layout, Examples & Summary	
Week 6		
Class-16	Lambda-Based Design and Other Rules	
Class-17	Layout Diagrams	
Class-18	Basic Physical Design of Simple Logic Gates	
Week 7		
Class-19	MOS Biasing	
Class-20	CS Stage with Diode Connected Load	
Class-21	MOS Device as Current Source	
Week 8		CT2/ MID TERM
Class-22	CS Stage with Current-Source Load	
Class-23	CS Stage with Degeneration	
Class-24	Source Follower (Common-Drain), Common-Gate Stage	
Week 9		
Class-25	Architectural Issues	
Class-26	Switch Logic, Pull up and Pull down Network	
Class-27	Gate Logic, Compound Logic	
Week 10		
Class-28	Clocked Circuits	
Class-29	ALU Subsystem, Adders, Multipliers, Memory Arrays	
Class-30	Examples & Summary	
Week 11		CT3
Class-31	DC Response for Resistive load, Saturated Load, and Linear Load Inverter	
Class-32	DC Response of CMOS Inverter, NAND, NOR	
Class-33	Noise Margin and Beta Ratio Effects	
Week 12		
Class-34	Transient Response and Delay Estimation	
Class-35	Elmore Delay and Delay Estimation Using Elmore Delay	
Class-36	Examples & Summary	
Week 13		
Class-37	Power in Circuit Elements	
Class-38	Switching Power	
Class-39	Power Dissipation Sources	
Week 14		
Class-40	Dynamic Power and Dynamic Power Reduction	

Class-41	Activity Factor Estimation	
Class-42	Stack Effect and Power Gating, Examples & Summary	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2 / CO 3	C4, C3
			CO 4	C6
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 / CO3	C4, C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C4
			CO 3	C3
			CO 4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Basic VLSI Design by Douglas A. Pucknell; Prentice Hall of India private Ltd.
2. CMOS VLSI Design - A Circuits and System Perspective by N. H. E. Weste and D. Harris.
3. Fundamentals of Microelectronics by Behzad Razavi, MacGraw Hill International.

COURSE INFORMATION			
Course Code	AEAV 435	Contact Hours	3.00
Course Title	Computer Networks	Credit Hours	3.00

PRE-REQUISITE

Course Code & Title:

1. CSE 173: Computer Programming and Application

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Resource sharing is the main objective of the computer network. The goal is to provide all the program, date and hardware is available to everyone on the network without regard to the physical location of the resource and the users.

OBJECTIVE

1. To provide the high Reliability. It is achieved by replicating the files on two or more machines, so in case of unavailability (due to fail of hardware) the other copies can be used.
2. To install interconnected microcomputer connected to the mainframe computer.
3. To increase system performance as the work load increases (load balancing).
4. To increase security as only authorized user can access resource in a computer network.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.	PO1	C2			K3	T, F, ASG.
CO2	Be able to **identify** difficulties in existing protocols, and then go onto **formulate** new and better protocols.	PO2	C6			K4	T, F, ASG.
CO3	Be able to **understand** the issues surrounding Mobile and Wireless Networks.	PO1	C2			K3	F, Mid Term Exam.

CO4	Be able to **analyze** the requirements for a given organizational structure and select the most appropriate networking architecture.	PO2	C4			K4	T, F, ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Switching and multiplexing: ISO, TCP-IP and ATM reference models. Different data communication services: Physical layer wired and wireless transmission media. Cellular radio: Communication satellites; data link layer: Elementary protocols. Sliding window protocols. Error detection and corrections. HDLC.DLLL of Internet. DLLL of ATM: Multiple Access protocols. IEECE.802 Protocols for LANs and MANs. Switches. Hubs and bridges. High speed LAN Network Layer: Routing, congestion control, internetworking. Network layer in internet: IP protocol, IP addresses. ARP; NI in ATM transport layer, transmission control protocol. UDP.ATM adaptation layer, application layer, network security, email, domain name system. Simple network management protocol, HTTP and World Wide Web.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		
Class-1	Switching	CT1
Class-2	Multiplexing	
Class-3	Continue	

Week 2		
Class-4	Iso	
Class-5	Tcp-Ip	
Class-6	Atm	
Week 3		
Class-7	Physical Layer Wired	CT2/ MID TERM
Class-8	Wireless Transmission Media	
Class-9	Cellular Radio	
Week 4		
Class-10	Transmission	
Class-11	Communication Satellites	
Class-12	Data Link Layer	
Week 5		
Class-13	Elementary Protocols	
Class-14	Sliding Window Protocols	
Class-15	Error Detection And Corrections	
Week 6		
Class-16	Fundamentals	
Class-17	PIN Photo-Detector	
Class-18	Avalanche Photo-Detectors	
Week 7		
Class-19	Wireless Transmission Media	
Class-20	Corrections	CT2/ MID TERM
Class-21	Hdlc	
Week 8		
Class-22	DLLL Of ATM	
Class-23	Access	
Class-24	Ieece.802	
Week 9		
Class-25	Protocols For Mans	
Class-26	Routing	
Class-27	Switches. Hubs And Bridges.	
Week 10		
Class-28	Congestion Control	CT3
Class-29	Internetworking	
Class-30	Network Layer In Internet	
Week 11		
Class-31	IP Addresses	
Class-32	Control Protocol	
Class-33	Arp	
Week 12		
Class-34	High Speed LAN Network Layer	
Class-35	IP Protocol	
Class-36	HTTP And World Wide Web.	
Week 13		
Class-37	Udp	
Class-38	ATM Adaptation Layer	
Class-39	Application	

Week 14		
Class-40	Network Security	
Class-41	Email	
Class-42	Domain Name System	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C6
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO3	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C6
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Computer Network- Andrew S. Tanenbaum; Prentice Hall of India Private Ltd.
2. Data and Computer Communications – William Stallings; Prentice Hall of India.
3. Computer Network and Distributed Processing – James Martin; Prentice Hall of India Private Ltd.
4. Data Communication and Distributed Network – Uyless D. Black; Prentice Hall of India Private Ltd.

CHAPTER 6

DETAIL OUTLINE OF UNDERGRADUATE COURSES OFFERED BY OTHER DEPARTMENTS TO AE STUDENTS

6.1 Science and Humanities Department Courses:

COURSE INFORMATION			
Course Code	: PHY 117	Contact Hours	: 3.00
Course Title	: Waves and Oscillations, Optics, and Structure of Matter	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the basics of physics in the fields of waves and oscillations, optics, and structure of matter. The course will emphasize the basic concepts, theories, and solving quantitative problems that can be applicable in a wide spectrum of engineering disciplines.

OBJECTIVE

1. To define the different parameters, concepts, logical and critical thinking with scientific knowledge of waves and oscillations, optics, and structure of matter.
2. To explain the basic theories and laws of waves and oscillations, optics, and structure of matter.
3. To solve numerical and analytical problems regarding waves and oscillations, optics, and structure of matter.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** different basic laws and parameters in the field of waves and oscillations, optics and structure of matters such as simple harmonic motion, damped oscillations, interference, diffraction, polarization, crystal structure, crystal defects, etc.	PO1	C1	-	-	K1	T, MT, F

CO2	**Explain** different basic theories in the field of waves and oscillations, optics and structure of matters such as the SHM, damped motion, wave motion, interference, diffraction, polarization, Bragg's law, bonding energy, etc	PO1	C2	-	-	K1	T, MT, F
CO3	**Solve** quantitative problems in the field of waves and oscillations, optics and structure of matters such as SHM, damped motion, wave motion, interference, diffraction, polarization, packing factor, Miller indices, etc.	PO1	C3	-	-	K2	T, ASG, MT, F

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- MID TERM Exam, F – Final Exam)

COURSE CONTENT

Waves and Oscillations: Simple Harmonic Motion (SHM) and its properties, differential equation of a SHM and its solution, total energy and average energy of a body executing SHM, simple pendulum, torsional pendulum, spring-mass system, LC oscillatory circuit, two body oscillation and reduced mass, Composition of SHM, Damped oscillations, and its different condition, forced oscillations and its different condition, resonance, Wave motion : expression for a plane progressive wave, differential equation of wave motion, energy density of wave motion, average kinetic and potential energy of wave motion, Stationary wave.

Optics: Combination of lens, equivalent lens and power, Defects of images and different aberrations, Interference of light, Young's double slit experiment, interference in thin films, Newton's ring, Diffraction of light, Fraunhofer and Fresnel diffraction, diffraction by single slit and double slit, diffraction grating, Fraunhofer diffraction at a circular aperture, resolving power of optical instrument, Polarization of light, Brewster's law, Malus law, polarization by double refraction, Nicole prism, optical activity and polarimeters, Laser: spontaneous and stimulated emission.

Structure of matter : Crystalline and non-crystalline solids, single crystal and poly-crystal solids, unit cell, crystal systems, co-ordinations number, crystal planes and directions, NaCl and CsCl structure, packing factor, Miller indices, relation between inter-planar spacing and Miller indices, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns; defects in solids: point defects, line defects, surface defects, bonds in solids, band theory of solids: distinction between metal, semiconductor

and insulator, inter-atomic distances, calculation of cohesive and bonding energy.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Quiz	3
Total	132

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT-1
Class-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	
Class-2	Periodic motion, oscillatory motion, simple harmonic motion (SHM), properties of SHM, differential equations, general solution of SHM, graphical representation of SHM	
Class-3	Velocity, acceleration, phase and epoch, time period, frequency and angular frequency of SHM	
Week 2		
Class-4	Total energy and average energy of SHM, problems	
Class-5	Simple pendulum, torsional pendulum, spring-mass system	
Class-6	LC oscillatory circuit, two body oscillations, reduced mass	
Week 3		
Class-7	Composition of SHM	
Class-8	Composition of SHM, problems	
Class-9	Damped oscillations and its differential equation	
Week 4		
Class-10	Displacement equation of damped oscillations and its different conditions, electric damped oscillatory circuit	CT-2 /MID TERM
Class-11	Forced oscillations and its differential equation, displacement equation of forced oscillations, resonance	
Class-12	Wave motion: expression for a plane progressive wave, differential equation of wave motion, particle velocity, wave velocity	

Week 5		
Class-13	Energy density of a plane progressive wave, average energy in a plane progressive wave, problems	
Class-14	Stationary wave: node, anti-node, problems	
Class-15	Lens and combination of lenses, equivalent lens, power of lens, cardinal points	
Week 6		
Class-16	Defects of images and different aberrations	
Class-17	Defects of images and different aberrations	
Class-18	Interference of light, young's double slit experiment	
Week 7		
Class-19	Analytical treatment of interference, energy distribution	
Class-20	Interference fringes, interference in thin films	
Class-21	Newton's ring, Interferometer	
Week 8		
Class-22	Diffraction: Fresnel & Fraunhofer diffraction, diffraction by single slit	
Class-23	Diffraction by double slit, diffraction gratings	
Class-24	Fraunhofer diffraction at a circular aperture, resolving power of optical instrument	
Week 9		CT2/ MID TERM
Class-25	Polarization of light, Brewster's law, Malus' law	
Class-26	Polarization by double refraction, Nicol prism: Polarizer and analyzer	
Class-27	Optical activity: specific rotation, polarimeters	
Week 10		
Class-28	Laser: spontaneous and stimulated emission, applications of laser	
Class-29	Classification of solids, types of crystalline solids, crystal, lattice, basis, crystal structure, plane lattice, space lattice, Bravais and non-Bravais lattices	
Class-30	Unit cell, lattice parameters, primitive and non-primitive cells and their distinctions, lattice symbols, crystal structure of NaCl and CsCl	
Week 11		
Class-31	Unit face, axial units: linear and numerical parameters and, Miller indices	
Class-32	Atomic radius, packing factor and coordination number for different structures	
Class-33	Relation between lattice constant and density of solids and related numerical problems	
Week 12		
Class-34	Inter-planer spacing, relation between inter-planar spacing and Miller indices, problems	
Class-35	X-ray diffraction, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns, problems	CT 3
Class-36	Defects in solids: point defects, line defects, surface defects	
Week 13		
Class-37	Defects in solids: point defects, line defects, surface defects	
Class-38	Atomic arrangement in solid: different types of bonds in solids	
Class-39	Band theory of solids : valence band, conduction band, energy gap, distinction between metal, semiconductor and insulator	

Week 14		
Class-40	Potential, cohesive energy, binding energy, Madelung constant, inter-atomic distance, calculation of total potential energy of a pair of atoms	
Class-41	Calculation of total potential energy at the equilibrium separation of an ionic crystal, problems	
Class-42	Review of the syllabus	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C1
			CO 2	C2
			CO 3	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam)	10%	CO 1 CO 2 CO 3	C1, C2, C3
Final Examination (Section A & B)		60%	CO 1	C1
			CO 2	C2
			CO 3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)

REFERENCE BOOKS

1. Physics for Engineers : Part-I and Part-II : Dr Giasuddin Ahmad
2. Physics, Volume I and Volume II **:** Resnick and Halliday
3. Fundamentals of Physics : Halliday, Resnick and Walker
4. Physics for Scientists and Engineers: Serway and Jewett
5. Waves and Oscillations : Brij Lal and Subramannyam
6. The Physics of Vibrations and Waves: H. J. Pain
7. Fundamental of Optics: Francis A. Jenkins and Harvey E.White
8. Fundamental Optical Design: Michael J. Kidger

COURSE INFORMATION			
Course Code	: PHY 119	Contact Hours	: 3.00
Course Title	: Electricity and Magnetism, Thermal Physics, and Mechanics	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is one of the basic physics in the field of electricity and magnetism, thermal physics and mechanics. The course will emphasize the basic concepts, theories, and solving quantitative problems that can be applicable in a wide spectrum of engineering disciplines.

OBJECTIVE

1. To define the different parameter and concepts of electricity and magnetism, thermal physics, and mechanics.
2. To explain the basic theories of electricity and magnetism, thermal physics, and mechanics.
3. To solve numerical problems regarding electricity and magnetism, thermal physics, and mechanics.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** different basic parameters in the field of electricity and magnetism, thermal physics and mechanics such as charge, Coulombs law, flux, thermometer, thermodynamics laws, entropy, momentum, wave function etc.	PO1	C1	-	-	K1	T, MT, F
CO2	**Explain** different basic theories in the field of electricity and magnetism, thermal physics and mechanics such as such as the electric field, dipole moment, Faraday's law, kinetic theory of gases, Carnot cycle, thermodynamic function, Maxwell-Boltzmann statistics, etc.	PO1	C2	-	-	K1	T, MT, F

CO3	**Solve** quantitative problems in the field of electricity and magnetism, thermal physics and mechanics such as such as electricity, magnetism, heat and thermodynamics, classical & quantum mechanics, etc.	PO1	C3	-	-	K2	T, ASG, MT, F

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- MID TERM Exam, F – Final Exam)

COURSE CONTENT

Electricity and Magnetism : Electric charges and Coulomb's law, quantization of charge, electric field, electric field due to : point charge, dipole, charged rod and charged ring, electric flux and calculation of flux, Gauss' law, application of Gauss' law, electric potential, calculation of electric potential, equipotential surfaces, energy and electric potential, Capacitors, capacitance for different capacitors, energy store in a capacitor, dielectrics and atomic view of dielectrics and Gauss' law with dielectrics, Current density, drift speed, resistances, ohm's law and resistivity-an atomic view, Ampere's law, solenoid, toroid, Faraday's law, self-inductance and mutual inductance, inductance of solenoid and toroid, magnetic field intensity, susceptibility, permeability, magnetization, Classification of magnetic materials, magnetization curves, M-H hysteresis loop, soft and hard magnetic materials, Maxwell equations.

Thermal Physics : Platinum resistance and thermo-electric thermometer, Calorimetry : Newton's law of cooling, specific heat, Cp, Cv, relation between Cp & Cv, different process, Kinetic theory of gases, pressure equation, RMS speed, Kinetic interpretation of temperature, degrees of freedom, equipartition of energy, mean free path, Laws of thermodynamics, zeroth law, first law of thermodynamics, thermodynamic equilibrium, PV diagram, Carnot Cycle, entropy, calculation of change in entropy, entropy and the second law of thermodynamics, reversible and irreversible process, temperature entropy diagram, Maxwell's thermodynamic relations, Clausius Clapeyron equation, thermodynamic function.

Mechanics : Linear momentum of a particle, linear momentum of system of particles, conservation law of linear momentum, some applications of the conservation law of linear momentum, angular momentum of system of particles, conservation law of angular momentum, some applications of the conservation law of angular momentum, Keplar's law of planetary motion, the laws of universal gravitation, the motion of planets and satellites, principle of statistical mechanics, probabilities, classical statistics, quantum statistics, Maxwell-Boltzmann statistics, Bose-Einstein statistics, Fermi-Dirac statistics, fundamental postulates of wave mechanics, wave function, uncertainty principle, Schrödinger's time dependent and time independent equation, eigen value, expectation value, probability, particle in a potential box.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 42 - - Total 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Class Test / Mid-Term Exam Final Examination	 3 3
Total	132

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course.	
Class-2	Electric charges and Coulomb's law, quantization of charge, electric field, electric field due to: point charge, uniformly charged wire, charged ring, charged disk.	
Class-3	Electric field due to dipole, dipole in an electric field, electric flux and calculation of flux, Gauss' law.	
Week 2		
Class-4	Gauss' law and Coulomb's law for a point charge, application of Gauss' law for: charged sphere, line of charge, sheet of charge, parallel charged plates.	
Class-5	Electric potential, potential and electric field strength, calculation of electric potential: due to a point charge, dipole.	
Class-6	Calculation of electric potential: charged ring, charged disk, electric potential energy, equipotential surfaces, calculation of electric field from the potential.	
Week 3		
Class-7	Capacitors, capacitance for different capacitors.	
Class-8	Energy store in a charged capacitor, energy density, dielectrics and atomic view of dielectrics and Gauss' law with dielectrics.	
Class-9	Concept of electric current, current density, drift velocity, resistances, ohm's law and resistivity-an atomic view.	
Week 4		
Class-10	Biot-Savart law and its applications, Ampere's law, solenoid, toroid.	
Class-11	Faraday's law, self-inductance and mutual inductance, inductance	

	of solenoid and toroid.	
Class-12	Magnetism: magnetic field intensity, susceptibility, permeability, magnetization.	CT2/MID TERM
Week 5		
Class-13	Classification of magnetic materials, magnetization curves, susceptibility curves.	
Class-14	M-H hysteresis loop, soft and hard magnetic materials, Maxwell equations.	
Class-15	Introduction of thermometry: Platinum resistance thermometer.	
Week 6		
Class-16	Thermocouple: See-beck effect, neutral temperature and temperature of inversion of a thermocouple, thermo-electric thermometer.	
Class-17	Calorimetry: Newton's law of cooling, specific heat of gases, isothermal change, adiabatic change; isochoric and isobaric processes.	
Class-18	Cp, Cv, relation between Cp and Cv, problems.	
Week 7		
Class-19	Adiabatic equation of a perfect gas, adiabatic and isothermal curves, work done during expansion or compression of a gas, problems.	
Class-20	Postulates of kinetic theory of gases, expression for pressure exerted by a gas, kinetic interpretation of temperature.	
Class-21	RMS speed, degrees of freedom of a gas, principle of equipartition of energy, ratio of specific heats of gases (γ).	
Week 8		
Class-22	Mean free path, problems.	
Class-23	Laws of thermodynamics, thermodynamic equilibrium, reversible and irreversible process, heat engine P-V diagram, efficiency of heat engines, Carnot's cycle.	
Class-24	Efficiency of Carnot engine, refrigerator, 2nd law of thermodynamics, Carnot's theorem, problems.	
Week 9		
Class-25	Entropy: properties of entropy, change in entropy for a reversible & irreversible process.	CT2/MID TERM
Class-26	Calculation of entropy change in reversible process: when heated at constant volume, constant pressure, isothermal expansion and general manner, Problems.	
Class-27	Thermodynamic relations: Maxwell's thermodynamic relations: one to sixth relation.	
Week 10		
Class-28	Thermodynamic function: Internal energy (U), Helmholtz free energy function (F) or free energy, Significance of free energy, Gibbs' free energy function (G), Enthalpy (H), Clausius and Clapeyron equation.	
Class-29	Mechanics: classical, quantum and statistical mechanics, centre of mass, centre of gravity, coincidence of centre of mass and centre of gravity, motion of the centre of mass, problems.	
Class-30	Linear momentum of a particle, linear momentum of a system of particles, conservation of linear momentum.	

Week 11		
Class-31	Some applications of the conservation law of linear momentum, angular momentum of a particle, angular momentum of a system of particles.	CT3
Class-32	Principle of conservation of angular momentum, some applications of the conservation law of angular momentum.	
Class-33	Kepler's law of planetary motion.	
Week 12		
Class-34	The law of universal gravitation, the motion of planets and satellites.	
Class-35	Principle of statistical mechanics, probabilities, classical statistics.	
Class-36	Maxwell-Boltzmann statistics, Fermi-Dirac statistics.	
Week 13		
Class-37	Quantum statistics, Bose-Einstein statistics.	
Class-38	Fundamental postulates of wave mechanics, wave function, uncertainty principle.	
Class-39	Time dependent Schrödinger's equation.	
Week 14		
Class-40	Time independent Schrödinger's equation.	
Class-41	Eigen value, expectation value, probability.	
Class-42	Particle in a potential box.	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C1
			CO 2	C2
			CO 3	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam)	10%	CO 1 CO 2 CO 3	C1, C2, C3
Final Examination (Section A & B)		60%	CO 1	C1
			CO 2	C2
			CO 3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Physics for Engineers: Part-I and Part-II: Dr Giasuddin Ahmad
2. Physics, Volume I & Volume II: Resnick and Halliday
3. Fundamentals of Physics: Halliday, Resnick and Walker
4. Physics for Scientists and Engineers: Serway and Jewett
5. B.Sc. Physics: C. L. Arora.
6. Concept of Electricity and Magnetism: Rafiqullah, Roy, Huq
7. Heat & Thermodynamics: Brijlal and N. Subrahmanyam
8. A Text Book of Heat: T. Hossain

9. Elements of Quantum Mechanics: Kamal Singh, S.P. Singh
10. Concepts of Modern Physics: Arthur Beiser
11. Quantum Mechanics: Gupta, Kumar & Sharma

COURSE INFORMATION			
Course Code	: PHY 120	Contact Hours	: 3.00
Course Title	: Physics Sessional	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a laboratory course in basic physics in the fields of waves and oscillations, optics, mechanics, electricity, modern physics, and thermal physics. The course will emphasize the fundamental experiments in different fields of physics that can be applicable to a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as work with a team or individual.

OBJECTIVE

1. To develop basic physics knowledge practically
2. To practice use of basic scientific instrument

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	PO1	C1			K1	R, Q, F
CO2	**Describe** the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	PO1	C1			K1	R, Q, T, F
CO3	**Skilled** to Construct Experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	PO2	P2			K2	R, Q, T, F

CO4	**Prepare** a report for an experimental work.	PO10	A2			K2	R

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- MID TERM Exam, F – Final Exam)

COURSE CONTENT

Quantitative measurement of different parameters in the field of waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics such as:

Specific resistance of materials, high resistance, resistance of a galvanometer, Electrochemical equivalent (ECE) of copper, comparison of the E.M.F's of two cells, radius of curvature, wavelength of light, focal length of lens, specific rotation of sugar, refractive index of a liquid, frequency of a tuning fork, acceleration due to gravity, spring constant, rigidity modulus, young's modulus, moment of inertia, conservation of linear momentum, thermal conductivity of a bad conductor, temperature co-efficient of resistance, pressure co-efficient of a gas, specific heat of a liquid, surface tension, Planck's constant.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Experiment	35
Self-Directed Learning	
Preparation of Lab Reports	21
Preparation for the Lab Test	13
Preparation of Quiz	9
Preparation of viva	9
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Final viva	1
Final lab exam	3
Total	**112**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Weeks	**Topics**
Week-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, evaluation system of the course, grouping, visit different section of the laboratory, introduction to different basic equipment
Week-2	Determination of the specific resistance of a wire using meter bridge or determination of ECE of copper by using copper voltameter
Week-3	Determination of high resistance by the method of deflection and determination of resistance of a galvanometer by half deflection method or comparison of the E.M. F's of two cells by a potentiometer
Week-4	Determination of the wavelength of sodium light by a spectrometer using a plane diffraction grating or determination of the specific rotation of sugar by polarimeter
Week-5	Determination of the radius of curvature of a plano-convex lens by Newton's ring method or determination of focal length of a concave lens by auxiliary lens method
Week-6	Determination of the frequency of a tuning fork by Melde's experiment or determination of the Planck's constant using photoelectric effect
Week-7	Determination of the value of g acceleration due to gravity by means of a compound pendulum
Week-8	Determination of the spring constant, effective mass and the rigidity modulus of the spring or determination of the Young's modulus of bar by bending method
Week-9	Determination of the moment of inertia of a Fly-wheel about its axis of rotation or verification of the law of conservation of linear momentum
Week-10	Determination of the thermal conductivity of a bad conductor by Lee's method or determination of specific heat of a liquid by the method of cooling
Week-11	Determination of the pressure co-efficient of a gas at constant volume by constant volume air thermometer or determination of the temperature co-efficient of resistance of the material of a wire using a meter-bridge
Week-12	Viva & lab final experimental exam
Week-13	Viva & lab final experimental exam
Week-14	Quiz exam

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><td colspan="3"></td><td rowspan="2">CO</td><td rowspan="2">Blooms Taxonomy</td></tr>
<tr><td colspan="2">Components</td><td>Grading</td></tr>
<tr><td rowspan="2">Continuous Assessment (40%)</td><td>Class performance/ Assignment</td><td>10%</td><td></td><td></td></tr>
<tr><td>Report Writing/ Assignment</td><td>30%</td><td>CO1, CO4</td><td>C1, A2</td></tr>
<tr><td rowspan="3">Final Exam (60%)</td><td>Lab test</td><td>30%</td><td rowspan="3">CO1, CO2, CO3</td><td rowspan="3">C1, P2</td></tr>
<tr><td>Viva</td><td>10%</td></tr>
<tr><td>Quiz</td><td>20%</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)</td></tr>
</table>

REFERENCE BOOKS
1. Practical physics for degree students : Dr Giasuddin Ahmad and Md. Sahabuddin 2. Practical Physics: G. L. Squires 3. B.Sc. Practical Physics: C. L Arora 4. Practical Physics: S.L. Gupta and V. Kumar

COURSE INFORMATION			
Course Code	: CHEM 101	Contact Hours	: 3.00
Course Title	: Fundamentals of Chemistry	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic concepts of inorganic, organic and physical chemistry.

OBJECTIVE

1. To define the different parameter and concepts of inorganic chemistry.
2. To apply different chemical theory to evaluate structure of molecules.
3. To explain the basic concepts of physical chemistry.
4. To describe basic reaction mechanism of selective organic reactions.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define/identify** the different parameters and fundamental concepts regarding Inorganic, Organic and Physical chemistry.	PO1	C1			K3	T, F, Mid Term ASG
CO2	Be able to **apply** different theory on chemical bonding and hybridization to determine structure of molecules.	PO1	C3			K3	T, Mid Term Exam, F.
CO3	Be able to **explain/illustrate /derive** different theories based on colligative properties, chemical equilibrium, chemical kinetics, thermochemistry, electrochemistry, and the mechanism of organic reactions.	PO1	C2			K3	MID TERM Exam, F, ASG.

CO4	**Solve/Analyze** different problems related to inorganic and physical chemistry	PO2	C4			K3	T, F, Mid Term ASG.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

a. Main Contents: Inorganic Chemistry, Organic Chemistry and Physical Chemistry

b. Detail Contents:

Atomic Structure: Atomic structure & quantum theory, Different atom models, Heisenberg's uncertainty principle

Periodic Table: Electronic configurations, Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases

Alkali metals: Chemical properties and uses

Chemical Bonding: Types and properties, Lewis theory, VBT, MOT, Hybridization and shapes of molecules

Basic concepts of organic chemistry: History, Physical and chemical properties, Classification

Selective topics on Organic chemistry: Different types of organic retractions (Addition, elimination,
substitution, polymerization), Introduction to organic polymer, basic concepts of dyes, color and constitution

Acids-Bases/Buffer Solution: Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water

Solutions: Solutions and their classification, Unit expressing concentration, Colloid and colloidal solution, Colligative properties and dilute solutions, Raoult's law, Van't Hoff equation

Thermochemistry: Laws of thermochemistry, Enthalpy, Hess's law, Heat off formation, Heat of neutralization, Heat of reaction,

Electrochemistry: Electrolytic conduction and its mechanism, Faraday's law, Kohlrausch Law, Debye-Huckel-Onsagar theory, Conductometric titrations, Different types of electrochemical cells and battery technology

Chemical Equilibria: Equilibrium law/constant, Kp and Kc, Homogeneous and heterogeneous equilibria, Le Chatelier's principle, Van't Hoff isotherm

Phase Rule: Basic terms and phase rule derivation, Phase Diagram of water

Chemical Kinetics: Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	**Simple Stresses in Machine Parts**	CT1
Class-1	Concepts of atomic structure, Different atom models	
Class-2	Concepts of atomic structure, Different atom models	
Class-3	Hydrogen spectral lines, Quantum numbers	
Week 2	**Atomic Structure/Periodic Table**	
Class-4	Heisenberg's uncertainty principle	
Class-5	Electronic configuration, Periodic classification of elements	
Class-6	Mathematical Problems.	
Week 3	**Periodic Table/Alkali Metals/Chemical Bonding**	
Class-7	Periodic properties of elements, Properties and uses of noble gases	CT2/ MID TERM
Class-8	Alkali metals: Chemical properties and uses	
Class-9	Chemical bonding (types, properties, Lewis theory, VBT)	

Week 4	**Chemical Bonding**	
Class-10	Molecular orbital theory (MOT)	
Class-11	Molecular orbital theory (MOT)	
Class-12	Hybridization and shapes of molecules	
Week 5	**Chemical Bonding/Organic Chemistry**	
Class-13	Hybridization and shapes of molecules	
Class-14	Hybridization and shapes of molecules	
Class-15	Basic concepts of organic chemistry: History, Physical & chemical properties, Classification	
Week 6	**Selected Topics on Organic Chemistry**	
Class-16	Different types of organic retractions (Addition, elimination, substitution,)	
Class-17	polymerization reaction, Introduction to organic polymer	
Class-18	basic concepts of dyes, color and constitution	
Week 7	**Acids-Bases**	
Class-19	Different concepts of acids-bases	
Class-20	Buffer solution, Mechanism of buffer solution	CT-2 / Mid Term
Class-21	Henderson-Hasselbalch equation	
Week 8	**Acids-Bases/Solutions**	
Class-22	Water chemistry and pH of water	
Class-23	Solutions and their classification, Unit expressing concentration	
Class-24	Colloid and colloidal solution	
Week 9	**Solutions/Thermochemistry**	
Class-25	Colligative properties and dilute solutions	
Class-26	Raoult’s law, Van’t Hoff isotherm	
Class-27	Thermochemistry: Laws of thermochemistry	
Week 10	**Thermochemistry/Electrochemistry**	
Class-28	Enthalpy, Hess's law	CT3
Class-29	Heat of formation, Heat of neutralization, Heat of reaction	
Class-30	Electrolytic conduction and its mechanism	
Week 11	**Electrochemistry**	
Class-31	Faraday's law, Kohlrausch Law, Debye-Huckel-Onsagar theory	
Class-32	Conductrometric titrations	
Class-33	Different types of cells	
Week 12	**Chemical Equilibrium**	
Class-34	Equilibrium law/constant, Kp and Kc,	
Class-35	Homogeneous and heterogeneous equilibria	
Class-36	Le Chatelier's principle	
Week 13	**Phase Rule/Chemical Kinetics**	
Class-37	Phase Rule: Basic terms and phase rule derivation, Phase Diagram of water	
Class-38	Order, molecularity and rate law of reaction, Pseudo and zero order reaction	
Class-39	First order reaction, Second order reaction, Half-life	
Week 14	**Chemical Kinetics**	
Class-40	Determination and factors affecting the rate of a reaction	
Class-41	Methods to determine the order of reaction	
Class-42	Collision theory, Transition state theory	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1
			CO2	C3
			CO3	C2
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam)	10%	CO2 CO3	C3, C2
Final Examination (Section A & B)		60%	CO1	C1
			CO2	C3
			CO3	C2
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Modern Inorganic Chemistry – S. Z. Haider
2. Concise Inorganic Chemistry – J. D. Lee
3. A Textbook of Organic Chemistry – ArunBahl And B. S. Bahl
4. Organic Chemistry – Morrison and Boyd
5. Principles of Physical Chemistry – Haque and Nawab
6. Essentials of Physical Chemistry – Bahl and Tuli
7. Physical Chemistry – Atkins

COURSE INFORMATION			
Course Code	: CHEM 102	Contact Hours	: 3.00
Course Title	: Chemistry Sessional	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic concepts of inorganic and physical chemistry.

OBJECTIVE

1. To familiarize the students with experimentation of acid and base neutralization, titration and quantitative analysis of metals etc.
2. To make students proficient in iodometric and iodimetric analysis and complexometric titration etc.
3. To develop students' ability in estimating zinc, ferrous content in water sample by using various titrimetric methods.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	PO1	C2			K2	R,Q,T
CO2	Be able to **explain** the different phenomena and **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.	PO5	C2, P2			K2	R,Q,T

CO3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.	PO5	P5			K2	R,Q,T, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Quantitative chemical analysis in the field of inorganic and physical chemistry such as: Acid-base titration, Redox titration, Iodometric and Iodimetric titration, Complexometric titration.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction
Week 2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate (C2H2O4.2H2O) Solution
Week 3	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.
Week 4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na2CO3) Solution.

Week 5	Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate ($CaCl_2.2H_2O$) Solution with Standard Di-Sodium Ethylene DiammineTetraAceticAcid (Na2-EDTA) Solution
Week 6	Standardization of Sodium ThiosulphatePentahydrate ($Na_2S_2O_3.5H_2O$) Solution with Standard Potassium Dichromate ($K_2Cr_2O_7$) Solution
Week 7	Estimation of Copper (Cu) Content in a Copper SulphatePentahydrate ($CuSO_4.5H_2O$) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium ThiosulphatePentahydrate ($Na_2S_2O_3.5H_2O$) Solution.
Week 8	Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution
Week 9	Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr`s Salt) [$FeSO_4.(NH_4)_2SO_4.6H_2O$] Solution with Standard Potassium Permanganate ($KMnO_4$) Solution
Week 10	Determination of Zinc (Zn) Content in a Zinc SulphateHeptahydrate ($ZnSO_4.7H_2O$) Solution with Standard Di-Sodium EthyleneDiamineTetraAcetic acid (Na2-EDTA) (Na2-EDTA) Solution by using Eriochrome black T indicator.
Week 11	Practice Lab
Week 12	Lab Test
Week 13	Quiz Test
Week 14	Viva

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment	Conduct Lab Test/ Class Performance	15%	CO 1	C2
			CO 2	C2, P2
	Report Writing/Programming	25%	CO 1	C2
			CO 2	C2, P2
Lab Quiz	MID TERM Evaluation (exam/project/assignment)	20%	CO3	P5
	Final Evaluation (Exam/project/assignment)	30%	CO1, CO2, C03	C2, P2, P5
Viva Voce/ Presentation		10%	CO1, CO2	C2, P2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Practical Chemistry - A Jabbar & M Haque
2. Quantitative Chemical Analysis - A I Vogel
3. Analytical chemistry - Gary D. Christian

COURSE INFORMATION			
Course Code	: MATH 101	Contact Hours	: 3.00
Course Title	: Differential and Integral Calculus	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Purpose of this course is to introduce basic knowledge of Differential and Integral Calculus and use it to engineering study.

OBJECTIVE

1. To impart basic knowledge on differential and integral Calculus to solve engineering problems and other applied problems.
2. Developing understanding some of the important aspects of rate of change, area, tangent, normal and volume.
3. To make proficient in imparting in depth knowledge of functional analysis such as increasing, decreasing, maximum and minimum values of a function.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** the limit, continuity and differentiability of functions, **identify** the rate of change of a function with respect to independent variables and **describe** the different techniques of evaluating indefinite and definite integrals.	PO1	C2			K3	CT, F, ASG.
CO2	**Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	PO2	C3			K3	CT, MT, F
CO3	**Calculate** the length, area, volume, center of gravity and average value	PO3	C3			K3	MT, F, ASG

	related to engineering study values of a function and concavity.						

CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT-MID TERM Exam)

COURSE CONTENT

1. **Differential Calculus:** Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability of function, Differentials. Cartesian differentiation Successive Differentiation, Leibnittz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions differentiation and integration, Indeterminate form, Cartesian differentiation, Partial differentiation, Euler’s theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, concavity, Curvature, Asymptotes.

2. **Integral Calculus:** Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its properties and its use, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, Beta and Gamma function, Multiple integral and its application, Arc lengths of curves, Area, Area under a plain curve, Area of the region enclosed by two curves, Volume of solid revolution

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
Week	**Contents**	**Assessment**
Week 1		CT1
Class 1	Introduction to Differential Calculus for Engineering study, Limit of a function and its properties.	
Class 2	Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems.	
Class 3	Concept of Differentiation, definition, classification of discontinuity and solving problems	
Week 2		
Class 4	Basic concept of Differentiability, definition, derivative of a function, differentiable function.	
Class 5	Differentiability – one sided derivatives (R.H.D and L.H.D), solving problems	
Class 6	Successive differentiation – Concept and problem solving	
Week 3		
Class 7	Leibnitz's theorem and its applications	
Class 8	Determination of $(y_n)_0$	
Class 9	Mean Value theorem, Taylor theorem	
Week 4		CT2/MID TERM
Class 10	Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder.	
Class 11	Indeterminate forms – concept and problem solving	
Class 12	L'Hospital's rules with application	
Week 5		
Class 13	Partial differentiation - partial derivatives of a function of two variables and problems	
Class 14	Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems	
Class 15	Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving	
Week 6		
Class 16	Tangents and Normals – Tangents and Normals in Cartesian, equation of tangent at the origin, equation of normal of functions of explicit and implicit forms, Angle between two intersection of two curves; problem solving	
Class 17	Tangents and Normals – Tangents and Normals in polar, Angle between two intersection of two curves; problem solving	
Class 18	Tangents and Normals – Subtangent and subnormals in Cartesian and polar coordinate; problem solving.	
Week 7		CT2/MID
Class 19	Maxima and minima of functions of single variables – concept, Increasing and decreasing function, Concave up and down with problems	

Class 20	Curvature	TERM
Class 21	Asymptotes	
Week 8		
Class 22	Introduction to integral calculus	
Class 23	Standard integrals – concept of definite and indefinite integrals, applications.	
Class 24	Indefinite integrals – Method of substitution, Techniques of integration	
Week 9		
Class 25	Indefinite integrals – Integration by parts, Special types of integration, integration by partial fraction	
Class 26	Integration by the method of successive reduction	
Class 27	Definite integrals – definite integrals with properties and problems	CT 3
Week 10		
Class 28	Definite integrals – Reduction formula, Walli's formula	
Class 29	Definite integrals – definite integral as the limit of the sum	
Class 30	Beta function – concept and problem solving	
Week 11		
Class 31	Gamma function - concept and problem solving	
Class 32	Relation between beta and gamma function, Legendre duplication formula, problems and applications	
Class 33	Multiple integrals – double integrals	
Week 12		
Class 34	Multiple integrals – triple integrals	
Class 35	Multiple integrals – successive integration for two and three variables	
Class 36	Area in Cartesian	
Week13		
Class 37	Area in polar	
Class 38	Volume of solid revolution	
Class 39	Area under a plain curve in Cartesian and polar coordinates	
Week 14		
Class 40	Area of a region enclosed by two curves in Cartesian and polar coordinates	
Class 41	Arc lengths of curves in Cartesian coordinates	
Class 42	Arc lengths of curves in polar coordinates	

ASSESSMENT STRATEGY

Components		**Grading**	**COs**	**Blooms Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C2, C3
			CO2	C3
	Class Participation	5%	CO3	C3
	MID TERM	15%	CO2, CO3	C3
Final Exam		60%	CO1	C2
			CO2	C3

		CO3	C3
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Calculus (9th Edition) by Howard Anton (Author), Irl C. Bivens (Author), Stephen Davis.
2. Calculus: An Intuitive and Physical Approach by Morris Kline.

COURSE INFORMATION			
Course Code	: MATH 103	Contact Hours	: 3.00
Course Title	: Differential Equations & Matrix	Credit Hours	: 3.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Purpose of this course is to introduce basic knowledge of ordinary and partial differential equations and use it to engineering study.

OBJECTIVE

1. To impart basic knowledge on ordinary and partial differential equations to solve engineering problems and other applied problems.
2. To develop understanding of some of the important aspects of ordinary and partial differential equations.
3. To provide knowledge on using concept of differential equations in engineering problems and solve other applied problems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Define** various types of differential equations, and **identify** the classifications of ordinary and partial differential equations, linear and non-linear differential equation.	PO1	C2			K2	T, F, ASG.
CO2	**Apply** the knowledge to identify and **solve** the various types of ordinary and partial differential equations.	PO2	C3			K2	T, MT, F
CO3	**Apply** the technique to obtain the inverse matrix that solve the system of linear equations	PO2	C3			K2	MT, F, ASG

CO4	**Apply** the technique to obtain the inverse matrix that solve the system of linear equations	PO2	C3			K2	T, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

1. **Differential Equations:** Introduction & Formulation of DE in Eng, Degree and order of ODE, Solution of first order differential equation by various methods. Solution of first order but higher degree DE by various methods, Solution of general linear DEs of second and higher order, Solution of Euler's homogeneous linear DEs, Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial, Formation PDE, Solution of linear first order PDE, Solution of Non-linear first order PDE, Standard form. Linear PDE with constant coefficients, PDEs of higher order and wave equation, particular solutions with boundary and initial condition, Applications of DE.

2. **Matrix:** Definition of matrix, different types of matrices, algebra of matrices, transpose and adjoint of a matrix and inverse matrix, rank and elementary transformation, solution of linear equation or system of linear equation, matrix polynomials determination characteristic roots and vectors, characteristic subspace of matrix and Eigen values and Eigen vectors, Cayley Hamilton theorem.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	120

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
Week 1		CT1
Class-1	Introduction & Formulation of DE in Eng, Degree and order of ODE	
Class-2	Introduction & Formulation of DE in Eng, Degree and order of ODE	
Class-3	Solution of first order first degree DE by various method	
Week 2		
Class-4	Solution of first order first degree DE by various method	
Class-5	Solution of first order first degree DE by various method	
Class-6	Solution of first order but higher degree DE by various methods	
Week 3		
Class-7	Solution of first order but higher degree DE by various methods	CT2/MID TERM
Class-8	Solution of first order but higher degree DE by various methods	
Class-9	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Week 4		
Class-10	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Class-11	Solution of general DEs of second and higher order, Solution of Euler's homogeneous linear DEs	
Class-12	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Week 5		
Class-13	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Class-14	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Class-15	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Week 6		
Class-16	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Class-17	Solution of DEs by methods based on factorization, Frobenious methods, Bessel's functions, Legendre's polynomial	
Class-18	Linear first order PDE of various type	
Week 7		
Class-19	Linear first order PDE of various type	
Class-20	Linear first order PDE of various type	CT2/MID TERM
Class-21	Non-linear PDE of order one: Charpit's method	
Week 8		
Class-22	Non-linear PDE of order one: Charpit's method	
Class-23	Particular solutions with boundary and initial conditions Standard form DEs of higher order	

Class-24	Linear PDE with constant coefficients	
Week 9		
Class-25	Linear PDE with constant coefficients	
Class-26	Linear PDE with constant coefficients	
Class-27	Particular solutions with boundary and initial condition	
Week 10		
Class-28	Application of OD and PDE in Eng study Particular solutions with boundary and initial condition	CT3
Class-29	Solving nonhomogeneous PDEs Particular solutions with boundary and initial condition	
Class-30	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables	
Week 11		
Class-31	Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables	
Class-32	Application of OD and PDE in Eng study	
Class-33	Boundary conditions associated with the wave equation	
Week 12		
Class-34	The vibrating string (standing waves)	
Class-35	Define various type of matrix and multiplication of matrixes.	
Class-36	Find the invers matrix by different method	
Week 13		
Class-37	Solve the system of linear equations by Gaussian elimination method	
Class-38	Solve the system of linear equations by invers matrix method	
Class-39	Find the rank of matrix any order	
Week 14		
Class-40	Calculus of variations (Euler-Lagrange equations) Eigenvalues and Eigenvectors	
Class-41	Cayley- Hamilton theorem	
Class-42	Revision	

ASSESSMENT STRATEGY

Components		**Grading**	**COs**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C2, C3
			CO2	C3
	Class Participation	5%	CO3	C3
	MID TERM	15%	CO2, CO3	C3
Final Exam		60%	CO1	C2
			CO2	C3
			CO3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS
1. An Introduction to Ordinary Differential Equations (Author: Earl A. Coddington) 2. A Textbook on Ordinary Differential Equations (Author: Antonio Ambrosetti, Shair Ahmad) 3. Partial Differential Equations for Scientists and Engineers (Author: Stanley J. Farlow) 4. Ordinary and Partial Differential Equations By Dr. M.D. Raisinghania , S. Chand Publishing

COURSE INFORMATION			
Course Code	: MATH 201	Contact Hours	: 3.00
Course Title	: Vector Analysis, Laplace Transform and Co-ordinate Geometry	Credit Hours	: 3.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Purpose of this course is to introduce basic knowledge to identify and solve vector mathematical problems, to demonstrate practical applications of Laplace Transform and analyze co-ordinate geometry.

OBJECTIVE

1. To impart basic knowledge on the vector analysis, Laplace transform and geometry.
2. To familiarize the students with straight lines, pair of straight lines, circles, conics in 2D and 3D co-ordinate systems.
3. To enable to find the length, volume and area of objects related to engineering study by using vector, application of Laplace transform to ordinary differential equations and also solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Know** the physical explanation of different vector notation and **Define** Laplace transform, inverse Laplace transform, different types of matrices, and their properties.	PO1	C1			K2	CT, F, ASG.
CO2	**Explain** the characteristics of conics and familiarize with straight lines, pair of straight lines, circles, radical axis and center in 2D and 3D co-ordinate systems.	PO1	C2			K2	CT, MID TERM Exam, F
CO3	**Calculate** length, volume and area of objects related to engineering study by using vector, **Apply**	PO2	C3			K2	MID TERM Exam, F, ASG

	Laplace transform to ODE and PDEs and the knowledge of geometry in engineering study. **Solve** the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

1. **Vector Analysis:** Definition of Vector and scalers, Scaler and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Differentiation of vectors, Gradient of scaler functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and its application, Stoke's theorem and its application, Gauss theorem and its application in Engineering.

2. **Laplace Transform (LT):** Definition of LT and Application of LT for Engineering , LT of some elementary functions and properties of LT, Sufficient condition for existence of LT, Inverse LT, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Partial fraction, Solution of DEs by LT, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Application of LT.

3. **Co-ordinate Geometry:** Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloidstraight lines, standard equation of coincides, sphere and ellipsoid.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	30
Revision of the previous lecture at home	21
Preparation for final examination	21

Formal Assessment Continuous Assessment Final Examination	 3 3
Total	**120**

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

Week	Contents	Assessment
Week 1		CT 1
Class 1	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Class 2	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Class 3	Definition of Vector and scalers & vector algebra, Scaler and vector products of two vectors and their geometrical interpretation	
Week 2		
Class 4	Triple products and multiple products, Linear dependence and independence of vectors, Differentiation of vectors	
Class 5	Gradient of scaler functions, Divergence and curl of point functions	
Class 6	Physical significance of gradient, divergence and curl	
Week 3		
Class 7	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
Class 8	Definition of line, surface and volume integral, Integration of Vectors, Green's theorem and application	
Class 9	Green’s theorem and it’s application	
Week 4		CT2/MID TERM
Class 10	Gauss theorem and application in Engineering	
Class 11	Stoke's theorem and it’s application.	
Class 12	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates	
Week 5		
Class 13	Introduction to geometry for Engineering and Rectangular co-ordinates, Transformation of co-ordinates, changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Class 14	Changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Class 15	Changes of axes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties	
Week 6		
Class 16	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	

Class 17	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Class 18	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Week 7		CT2/MID TERM
Class 19	Circles (tangents, normal, chord of contact, pole and polar), Equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves	
Class 20	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Class 21	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Week 8		
Class 22	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Class 23	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Class 24	Equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points	
Week 9		
Class 25	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
Class 26	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
Class 27	Three-dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	CT2/MID TERM
Week 10		
Class 28	Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid	
Class 29	Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT	

Class 30	Definition of LT and Application of LT for Engineering, LT of some elementary functions and properties of LT	
Week 11		
Class 31	Sufficient condition for existence of LT	
Class 32	LT of derivatives and it's application	
Class 33	LT of Integration with application, LT of sine and cosine integral	
Week 12		
Class 34	Unit step function and it's application	
Class 35	Periodic function with examples, LT of some special function.	
Class 36	Definition of inverse Laplace Transform and it's properties	
Week 13		CT 3
Class 37	Partial fraction and it's application in inverse Laplace Transform	
Class 38	Heaviside formula and it's application	
Class 39	Convolution theorem, Evaluation of improper integral, Application of LT	
Week 14		
Class 40	Solve ODE s by Laplace transform	
Class 41	Solve PDE s by Laplace transform	
Class 42	Application of LT in Eng study	

ASSESSMENT STRATEGY

Components		**Grading**	**COs**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
			CO2	C2
	Class Participation	5%	CO3	C3
	MID TERM	15%	CO2, CO3	C2, C3
Final Exam		60%	CO1	C1
			CO2	C2
			CO3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Vector Analysis, 2nd Edition 2nd Edition by Murray Spiegel, Seymour Lipschutz, Dennis Spellman
2. Schaum's Outline of Laplace Transforms by Murray R. Spiegel.
3. Engineering Mathematics, Volume Two 2 II: Containing Coordinate Geometry of Two Dimensions, Co-ordinate Geometry of Three Dimensions, Matrices.
4. Theory of Equations and Vector Calculus by K. Kandasamy, P.; Thilagavathy, K.; Gunavathy
5. A Text Book on Co-ordinate Geometry with Vector Analysis - Rahman & Bhattacharjee.

COURSE INFORMATION			
Course Code	MATH 221	Contact Hours	: 3.00
Course Title	Complex Variable and Fourier Analysis	Credit Hours	: 3.00

PRE-REQUISITE

Course Code & Title:

1. Math 101: Differential and Integral Calculus
2. Math 103: Differential Equations and Matrix

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to teach the students the concepts, principles and working field of Complex Variable, Harmonic property of a function which is a special property and Fourier Analysis of different types of function. It is targeted to provide a basic foundation and applications of Fourier Series, Fourier Integrals, complex variable and to develop the concept of harmonic functions. Finally, this course is designed to demonstrate practical applications of Complex Variable, Harmonic Function and Fourier Transform.

OBJECTIVE

1. Be able to impart basic knowledge about Complex Variable, Harmonic Function and Fourier Analysis for different types of function.
2. Be able to familiarize the students with the characteristics of Complex number, Complex Integrals and Harmonic Function.
3. Be proficient to familiarize the students with the characteristics of Fourier Series, Fourier Integrals.
4. Be able to impart knowledge on Fourier Analysis, Complex Variable, Harmonic Function and thereby students able to solve engineering problems to give physical interpretation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Recall** the basic idea about Complex Variable, Harmonic Function and Fourier Analysis.	PO1	C1			K1	Q, ASG, F
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	PO1	C2			K2	Q, ASG, F
CO3	**Apply** Fourier Transform to solve boundary value problems.	PO1	C3			K2	Q, ASG, F

CO4	**Solve** different coordinate system of engineering problems by Harmonic function.	PO1	C3			K5	Q, ASG, F

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, F – Final Exam)

COURSE CONTENT

Complex Variable: Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Differentiation and the Cauchy-Riemann equations, Mapping by elementary functions, Line integral of a complex function, Cauchy's Integral formula, Complex function, Convergence and Uniform convergence, Liouville's theorem, Taylor's and Laurent's theorem, Singular residues, Cauchy's residue theorem.

Harmonic Function: Definitions of Harmonics function, Laplace's equation in Cartesian, Polar, cylindrical and spherical co-ordinates, Solution of these equations with applications, Gravitational potential due to a ring, Steady state temperature, Properties of harmonic functions, Potential inside and outside of a sphere.

Fourier Analysis: Real and Complex form of Fourier Series, Definition and expansion of a function of x in a Fourier Series, Physical application of Fourier Series, Finite Fourier Transform, Fourier Integral Inverse Fourier transform, Fourier transform and their uses in solving boundary value problems, Diffusion, wave, Laplace Equation.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

	Topic	
Week 1	**COMPLEX VARIABLE**	CT1
Class-1	Complex number system	
Class-2	General functions of a complex variable	
Class-3	Graphical representation of complex number and complex variable	
Week 2	**COMPLEX VARIABLE**	
Class-4	Roots of Complex number	

Class-5	Limits of a function of complex variable.	
Class-6	Continuity of a function of complex variable and related theorems	
Week 3	**COMPLEX VARIABLE**	
Class-7	Differentiation and the cauchy Riemann equations	
Class-8	Mapping by elementary functions	
Class-9	Line integral of a complex function	
Week 4	**COMPLEX VARIABLE**	
Class-10	Green's theorem in complex form	
Class-11	Cauchy's Integral formula	
Class-12	Convergence and Uniform convergence	
Week 5	**COMPLEX VARIABLE**	CT2/MID TERM
Class-13	Liouville's theorem	
Class-14	Taylor's and Laurents theorem	
Class-15	Singular residues, Cauchy's residue theorem	
Week 6	**HARMONIC FUNCTION**	
Class-16	Definitions of Harmonics function	
Class-17	Properties of harmonic functions	
Class-18	Laplace's equation in cartesian co-ordinates	
Week 7	**HARMONIC FUNCTION**	
Class-19	Laplace's equation in polar co-ordinates	
Class-20	Laplace's equation in cylindrical co-ordinates	
Class-21	Laplace's equation in spherical co-ordinates	
Week 8	**HARMONIC FUNCTION**	
Class-22	Solution of these equations with applications	
Class-23	Gravitational potential due to a ring, Steady state temperature	CT2/MID TERM
Class-24	Potential inside and outside of a sphere	
Week 9	**FOURIER ANALYSIS**	
Class-25	Real and complex form of Fourier series	
Class-26	Definition and expansion of a function of x in a Fourier Series	
Class-27	Physical application of Fourier Seires	
Week 10	**FOURIER ANALYSIS**	
Class-28	Physical application of Fourier Seires	
Class-29	Finite Fourier sine Transform	
Class-30	Finite Fourier cosine Transform	
Week 11	**FOURIER ANALYSIS**	
Class-31	Infinite Fourier Transform	
Class-32	Inverse Fourier Transform	
Class-33	Inverse Fourier Transform	
Week 12	**FOURIER ANALYSIS**	
Class-34	Fourier Integral	CT3
Class-35	Fourier Integral	
Class-36	Convolution Theorem for Fourier Transform	
Week 13	**FOURIER ANALYSIS**	
Class-37	Parseval's identity for Fourier Transform	
Class-38	Fourier Transform and their uses in solving BVP	
Class-39	Fourier Transform and their uses in solving BVP (with physical interpretation)	

Week 14	**FOURIER ANALYSIS**	
Class-40	Solution of Diffusion Equation by using Fourier Transform	
Class-41	Solution of Wave Equation by using Fourier Transform	
Class-42	Solution of Laplace Equation by using Fourier Transform	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C1, C2, C3
			CO4	C3
	Class Performance	5%	CO4	C3
	Mid-Term Assessment (Exam)	15%	CO2, CO3	C2, C3
Final Examination		60%	CO 1, CO2	C1, C2
			CO 2, CO 3	C2,C3
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Complex Variables by - Murray R. Spiegel, Schaum's Outline Series.
2. Theory and functions of complex variables, Shanti Narayan.
3. Harmonic Function Theory by - Sheldon Axler.
4. Fourier series, Schaum's outlines series, Murray R. Spiegel.

COURSE INFORMATION			
Course Code	: LANG 102	Contact Hours	: 3.00
Course Title	: Communicative English-I	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course has mainly been designed to improve speaking and oral communication skills of the students. The course includes instructions and experience in speech preparation and speech delivery within various real-life situations, formal and informal. Emphasis will be given on various speeches, such as informative, persuasive and interactive. This course will help students progress in real life both personally and professionally. Students will be able to understand class lectures and can comfortably continue the Engineering course, and also to compete in the global job market and increase career skills.

OBJECTIVE

1. To develop the four basics skills of English language, i.e. listening, speaking, reading and writing.
2. To develop students' interpersonal skills engaging them in various group interactions and activities.
3. To improve students' pronunciation in order to improve their level of comprehensibility in both speaking and listening.
4. To give the students exposure to different types of texts in English in order to make them informed using different techniques of reading.
5. To gain an understanding of the underlying writing well-organized paragraphs and also to teach how to edit and revise their own as well as peer's writing.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Listen, **understand** and speak English quickly and smartly using the technics learnt in the class.	PO1	C2	-	-	K3	Listening
CO2	**Perform** the techniques of academic reading and academic writing	PO1	P2	-	-	K3	Reading

CO3	**Execute** the ability to Communicate effectively within the shortest possible time to present ideas and opinions.	PO10	P2	-	-	K3	Pr
CO4	**Develop** competency in oral, written communication	PO10	C6	-	-	K5	Pr

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- MID TERM Exam, F – Final Exam)

COURSE CONTENT

Main Contents	Detail Contents
Speaking	Introduction to Language: Introducing basic skills of language. English for Science and Technology
	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc.
	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
	Discussing everyday routines and habits, making requests /offers /invitations /excuses /apologies/complaints
	Describing personality, discussing and making plans (for a holiday or an outing to the cinema), Describing pictures / any incident / event
	Practicing storytelling, Narrating personal experiences/Anecdotes
	Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
Listening	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
	Listening to short conversations between two persons/more than two
Reading	Reading techniques: scanning, skimming, predicting, inference;
	Reading Techniques: analysis, summarizing and interpretation of texts;
Writing	Introductory discussion on writing, prewriting, drafting
	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
	Paragraph writing, Compare-contrast and cause- effect paragraph

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	

Lecture Practical / Tutorial / Studio	14 28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 05 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

	Topic	CT
Week 1		CT-1
Class-1	Introduction to Language: Introducing basic skills of language. English for Science and Technology	
Class-2	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc.	
Class-3	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc.	
Week 2		
Class-4	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
Class-5	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
Class-6	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
Week 3		
Class-7	Discussing everyday routines and habits, Making requests /offers /invitations /excuses /apologies/complaints	
Class-8	Discussing everyday routines and habits, Making requests /offers /invitations /excuses /apologies/complaints	
Class-9	Discussing everyday routines and habits, Making requests /offers /invitations /excuses /apologies/complaints	
Week 4		
Class-10	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event	CT-2 /MID TERM
Class-11	Describing personality, discussing and making plans(for a holiday or	

	an outing to the cinema), Describing pictures / any incident / event	
Class-12	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event	
Week 5		
Class-13	Practicing storytelling, Narrating personal experiences/Anecdotes	
Class-14	Practicing storytelling, Narrating personal experiences/Anecdotes	
Class-15	Practicing storytelling, Narrating personal experiences/Anecdotes	
Week 6		
Class-16	Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (roleplay of doctor-patient conversation, teacher –student conversation	
Class-17	Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (roleplay of doctor-patient conversation, teacher –student conversation	
Class-18	Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (roleplay of doctor-patient conversation, teacher –student conversation	
Week 7		
Class-19	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions	CT2/MID TERM
Class-20	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions	
Class-21	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions	
Week 8		
Class-22	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand	
Class-23	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand	
Class-24	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand	
Week 9		
Class-25	Listening to short conversations between two persons/more than two	
Class-26	Listening to short conversations between two persons/more than two	
Class-27	Listening to short conversations between two persons/more than two	
Week 10		
Class-28	Reading techniques: scanning, skimming, predicting, inference	
Class-29	Reading techniques: scanning, skimming, predicting, inference	
Class-30	Reading techniques: scanning, skimming, predicting, inference	
Week 11		
Class-31	Reading techniques: scanning, skimming, predicting, inference	CT3
Class-32	Reading techniques: scanning, skimming, predicting, inference	
Class-33	Reading techniques: scanning, skimming, predicting, inference	
Week 12		

Class-34	Introductory discussion on writing, prewriting, drafting
Class-35	Introductory discussion on writing, prewriting, drafting
Class-36	Introductory discussion on writing, prewriting, drafting
Week 13	
Class-37	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Class-38	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Class-39	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Week 14	
Class-40	Paragraph writing, Compare-contrast and cause- effect paragraph
Class-41	Paragraph writing, Compare-contrast and cause- effect paragraph
Class-42	Paragraph writing, Compare-contrast and cause- effect paragraph

ASSESSMENT STRATEGY

Components	**Grading**	CO	Bloom’s Taxonomy
Listening Test	15%	CO1	C1
Descriptive Writing	25%	CO2	P2
Public Speaking	30%	CO3	P2
Presentation	30%	CO4	C6
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)

REFERENCE BOOKS

1. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication
2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
3. Jones, L. (1981). Functions of English. (Student’s Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
4. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson
6. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
7. Speak like Churchill stand like Lincoln - James C. Humes
8. Cambridge IELTS Practice Book
9. Selected Sample Reports and Selected Research Articles

COURSE INFORMATION			
Course Code	: LANG 202	Contact Hours	: 3.00
Course Title	: Communicative English-II	Credit Hours	: 1.50

PRE-REQUISITE

Course Code & Title:

1. LANG 102: Communicative English-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The English language course is designed for the students to develop their competence in communication skills for academic purposes especially in reading and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to different types of texts to develop efficient reading skill. Reading will also involve activities and discussions leading to effective writing. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Emphasis is particularly put on the various forms of essay writing such as descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, students are expected to be able to communicate at various situations, participate in group activities and prepare formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills. In addition, the course emphasizes on providing constructive feedback on students' oral performances.

OBJECTIVE

1. To develop English language skills to communicate effectively and professionally.
2. To strengthen students' presentation skills.
3. To develop competency in academic reading and writing.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the techniques of academic reading and become acquainted with technical vocabularies	PO1	C2			K1	Reading
CO2	Be able to **understand** the techniques of effective academic writing such as research article/report writing	PO1	C2			K1	Writing

CO3	Be able to **communicate** effectively within the shortest possible time to present any report and research work	PO10	A3			K1	Pr
CO4	Be able to **analyze** any problem critically, analyze and interpret data and synthesize information to provide valid conclusions	PO10	C4			K2	Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, L – Listening test; R –Descriptive Writing; P – Public Speaking; Pr – Presentation)

COURSE CONTENT

Main Contents	Detail Contents
Reading	Reading Comprehension: Practice using different techniques
	Academic reading: comprehension from departmental or subject related passages
	Vocabulary for Engineers (some common Engineering terms for both general and dept specific)
	Reading subject specific text to develop vocabulary
Writing	Writing semi-formal, Formal/official letters, Official E-mail
	Applying for a job: Writing Cover Letter and Curriculum Vitae
	Statement of Purpose (SOP) writing, Proposal Writing: writing steps, principles and techniques, outlining, revising, editing, proofreading
	Report writing, article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing
	Analyzing and describing graphs or charts
	Practicing analytical and argumentative writing
Speaking	Public Speaking: Basic elements and qualities of a good public speaker
	Set Speech: How to get ready for any speech
	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation
Listening	Listening to long lecture on some topics
	Listening and understanding speeches/lectures of different accent

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical / Tutorial / Studio	28
Student-Centered Learning	-
	Total 42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	05

Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion,
Co-operative and Collaborative Method,
Project Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1	Reading Comprehension: Practice using different techniques	CT1
Week 2	Academic reading: comprehension from departmental or subject related passages	
Week 3	Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary	
Week 4	Writing semi-formal, Formal/official letters, Official E-mail	
Week 5	Applying for a job: Writing Cover Letter and Curriculum Vitae	CT2/MID TERM
Week 6	Statement of Purpose (SOP) writing: writing steps, principles and techniques, outlining, revising, editing, proofreading	
	Proposal writing: writing steps, principles and techniques, outlining, revising, editing, proofreading	
Week 7	Report writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing	
	Article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing	CT2/MID TERM
Week 8	Analyzing and describing graphs or charts	
Week 9	Practicing analytical and argumentative writing	
Week 10	Public Speaking: Basic elements and qualities of a good public speaker	
Week 11	Set Speech: How to get ready for any speech	
Week 12	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.	CT3
Week 13	Listening to long lecture on some topics	
Week 14	Listening and understanding speeches/lectures of different accents	

ASSESSMENT STRATEGY

Components	**Grading**	CO	Bloom's Taxonomy
Listening Test	15%	CO1	C2
Descriptive Writing	25%	CO2	C2
Public Speaking	30%	CO3	A3
Presentation	30%	CO4	C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)
3. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication
4. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
5. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes
7. Cambridge IELTS Practice Book
8. Selected Sample Reports and Selected Research Articles

6.2 General Education Courses:

COURSE INFORMATION			
Course Code	: GEBS 101	Contact Hours	: 2.00
Course Title	: Bangladesh Studies	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course has been designed for undergraduate engineering students to help them learn the rich history of Bangladesh, and to provide them with basic knowledge of historical events which eventually led to the formation of Bangladesh and constitution of Bangladesh, current trends in economic development, legislation, citizen charter, cultural aspects which will make them responsible citizen

OBJECTIVE

1. To equip students with factual knowledge that will enable them to learn the history of Bangladesh.
2. To trace the historical roots of Bangladesh as an independent state focusing on the social, cultural and economic developments that have taken place since its independence.
3. To promote an understanding of the development of Bangladesh and its culture.
4. To create an awareness among the students about the Geography, Economy, Politics and Culture of Bangladesh.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh.	PO6	C3			K7	T,Q,ASG, F
CO2	**Explain** the economy and patterns of economic changes through qualitative and Quantitative analysis.	PO6	C2			K7	T,Q,ASG,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

a. Main Contents: Impact of Geography, History, Environment, Economy, Constitution and Culture of Bangladesh in Engineering Application

b. Detail Contents:

Bangladesh Geography: Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones.

History: Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal; Bengal under the East India Company; religious and social reform movements; nationalist movements, division of the Indian sub-continent; language movement 1948-1952; education movement of 1962; six-point movement of 1966; mass uprising of 1969; war of independence and emergence of Bangladesh in 1971, Constitution of Bangladesh, Pre and post liberation development in the field of engineering and technology, Bangladesh's contribution to world peace and its security, engineering developments in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc) and its impact on socio-economic aspect .

Environment, Economy and Culture:

Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health, Education, Agriculture, Industries, NGOs, Population, Sociological and Cultural aspects of Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Art and Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

TEACHING LEARNING STRATEGY

COMPONENTS	**TEACHING AND LEARNING ACTIVITIES**	**STUDENT' LEARNING TIME (SLT)**
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL	80
	CREDIT = SLT/40	2

COURSE SCHEDULE		
WEEK-1	**TOPIC**	**CT/MID**
Class 1	Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course.	CT1
Class 2	Bangladesh Geography: Location, Area, Boundary, Physiography, River System, Forest and Climate, Demography of Bangladesh.	
WEEK-2		
Class 3	Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal	
Class 4	Bengal under the East India Company	
WEEK-3		
Class 5	Religious and Social reform movements	
Class 6	Nationalist movements, division of the Indian sub- continent	
WEEK-4		CT2/MID TERM
Class 7	Language movement 1948-1952, Education movement of 1962	
Class 8	Language movement 1948-1952, Education movement of 1962	
WEEK-5		
Class 9	Six-point movement of 1966; Mass uprising of 1969;	
Class 10	War of Independence and Emergence of Bangladesh in 1971	
WEEK-6		
Class 11	Constitution of Bangladesh	
Class 12	Constitution of Bangladesh	
WEEK-7		
Class 13	Bangladesh's contribution to world peace and security, Pre and post liberation development of engineering and technology	
Class 14	Bangladesh's contribution to world peace and security, Pre and post liberation development of engineering and technology	
WEEK-8		CT2/MID TERM
Class 15	Land, Characteristics of tropical Monsoon climate, Forests and biomass, Fish	
Class 16	Engineering development in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc) and its impact on socio-economic aspect	
WEEK-9		
Class 17	Minerals, Health and Education,	
Class 18	Agriculture, Industries	
WEEK-10		
Class 19	NGOs, Population, Sociological and Cultural aspects of Bangladesh	
Class 20	Economy and national development,	
WEEK-11		CT3
Class 21	Development and Progress of the Millennium Development Goals (MDGs),	
Class 22	Public Administration in Bangladesh, State of Good	
WEEK-12	Governance in Bangladesh	
Class 23	Art and Literature	
Class 24	Traditional cultural events	
WEEK-13		
Class 25	Vision-2021, Digitalization	
Class 26	Tourism and Natural Resources	
WEEK-14		
Class 27	Bangladesh and International Relations	

Class 28	Revision of the course	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO1 CO2	C2, C3
Final Examination (Section A & B)		60%	CO1 CO2	C2, C3
Total Marks		100%		

REFERENCE BOOKS

1. **Bangladesh Studies**: Md. Shamsul Kabir Khan and Daulatunnahar Khanam
2. **The Constitution of the People's Republic of Bangladesh**
3. **Discovery of Bangladesh**: Akbar Ali Khan
4. **History of Bangladesh, Vols, 1-3**: Sirajul Islam
5. **History of Modern Bengal, Vol, 1**: R C Majumdar
6. **Dynastic History of Bengal**: Dr. Abdul Mumin Chowdhury
7. **A History of Bangladesh**: William Van Schendel
8. **Geography of Bangladesh**: Harun Er Rashid
9. **Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10**: Sirajul Islam
10. **History of Bengal: (Mughal Period 1526-1765)**: R. A. Chandra
11. **Land of Two Rivers:** Nitesh Sengupta
12. **A History of Bangladesh**: Cambridge University Press
13. Bengali Nationalism and the Emergence of Bangladesh: A.F Salahuddin Ahmed
14. Language Movement and The Making of Bangladesh: Safar Ali Akanda

COURSE INFORMATION			
Course Code	: GEA 101	Contact Hours	: 2.00
Course Title	: Principles of Accounting	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Accounting is often referred to as the "language of business" because it provides a systematic way to record, analyze, and communicate financial information about an organization's activities. By learning the Principles of accounting, students gain the ability to interpret financial statements and reports, which are crucial for decision-making by investors, creditors, managers, and other stakeholders.

OBJECTIVE

1. Understand the meaning, history and definition of accounting, the users and uses of accounting, importance of ethics in financial reporting.

2. Understand the International Financial Reporting (IFRS), Generally Accepted Accounting Principles (GAAP), cost principle, monetary unit assumption and the economic entity assumption.

3. Understand the worksheet, preparation of financial statements, cost benefit analysis of different projects with honesty and integrity.

4. To provide the students with an in-depth knowledge of Management Accounting to enable them to apply its methods and techniques for preparing and presenting information for management decision-making and control purposes.

5. Applying selected management accounting techniques and analyze the implications of the techniques with regards to cost-volume profit analysis, budgeting, standard costing and variance analysis

COURSE OUTCOMES & GENERIC SKILLS

NO.	Course Outcome	Bloom's Taxonomy	PO	CP	CA	KP	Assessment Methods
CO1	**Understand** the cost principle, monetary unit assumption and the economic entity assumption and ethics in financial reporting for each and every project. .	C2	PO1			K3	T, Q, ASG, F

CO2	**Understand** worksheet, preparation of financial statements, cost benefit analysis of different projects.	C2	PO1			K3	T, Q, ASG, F.
CO3	**Acquire** knowledge of Management Accounting and apply it for preparing and presenting information for management decision-making and control purposes.	C3	PO2			K3	T, Q, ASG, F
CO4	**Apply and Analyze** the cost-volume profit, budgeting, standard costing and variance analysis for any project.	C4	PO2			K3	T, Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project
Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

(1) Accounting in Action
(2) Recording Process
(3) Adjusting the Accounts and prepare financial statement
(4) Financial Statement Analysis
(5) Computerized Accounting System and
(6) Cost Concepts
(7) Absorption costing and Variable costing
(8) Job Order Costing and Process Costing
(9) Short & Long-Term Decision-Making in Accounting

b. Detail Contents:

(1) Accounting in Action
(a) History & Definition of Accounting,
(b) Objectives and Importance of Accounting
(c) Accounting & Engineering
(d) International Financial Reporting Standard (IFRS), Generally Accepted Accounting Principles (GAAP), Ethics in Accounting
(e) Accounting Equation (Math)

(2) Recording Process: Journal, Ledger, T-account and Trial balance

(3) Adjusting the Accounts: Adjusting Entries, Adjusted Trial Balance, Income Statement, Retained Earnings Statement and Statement of Financial Position (Balance Sheet), Worksheet

(4) Financial Statement Analysis: Horizontal Analysis, Vertical Analysis and Ratio Analysis

(5) Computerized Accounting System: Manual vs. Computerized Accounting system, Some Accounting Software: NetSuite ERP. Tipalti. Sage Business Cloud Accounting. Sage 50cloud. Plooto. Tradogram. Tally accounting software.

TEACHING LEARNING STRATEGY		
COMPONENTS	**TEACHING AND LEARNING ACTIVITIES**	**STUDENT' LEARNING TIME (SLT)**
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL	80
	CREDIT = SLT/40	2

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

WEEK-1	**TOPIC**	**CT/MID**
Class 1	Meaning, history and definition of accounting	CT1
Class 2	The users and uses of accounting.	
WEEK-2		
Class 3	Ethics in financial reporting	
Class 4	The cost principle, monetary unit assumption and the economic entity assumption	
WEEK-3		
Class 5	Accounting equation and its components	
Class 6	The effects of business transactions on the	
WEEK-4		CT2/MID TERM
Class 7	Four financial statements and how they are prepared	
Class 8	Journal	
WEEK-5		
Class 9	Journal	
Class 10	T-account, Ledger, Trial balance	
WEEK-6		
Class 11	Adjusting Accounts	
Class 12	Worksheet.	
WEEK-7		
Class 13	Completion of the Accounting cycle.	
Class 14	Managerial Accounting Basics	
WEEK-8		CT2/MID TERM
Class 15	Managerial Accounting Basics	
Class 16	Cost Concepts	
WEEK-9		
Class 17	Job Order Cost Accounting	
Class 18	Job Order Cost Accounting	
WEEK-10		

Class 19	Process Cost Accounting	
Class 20	Process Cost Accounting	
WEEK-11		CT3
Class 21	Cost-Volume-Profit Relationships	
Class 22	Cost-Volume-Profit Relationships	
WEEK-12		
Class 23	Performance Evaluation through Standard Costs	
Class 24	Performance Evaluation through Standard Costs	
WEEK-13		
Class 25	Incremental Analysis	
Class 26	Incremental Analysis	
WEEK-14		
Class 27	Capital Budgeting	
Class 28	Capital Budgeting	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO3	C2, C3
			CO4	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2	C2
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C2
			CO3	C3
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Financial Accounting IFRS edition by Weygand, Kimmel & Kieso (3th)
2. Accounting Principles by Weygandt, Kieso& Kimmel (IFRS Latest edition)

COURSE INFORMATION			
Course Code	: GES 101	Contact Hours	: 2.00
Course Title	: Fundamentals of Sociology	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The fundamentals of sociology course provide a foundational understanding of societal structures, cultural dynamics, and social interactions, fostering critical thinking and cultural awareness essential for navigating diverse social landscapes and advocating for social justice in a globalized world.

OBJECTIVE

1. **Understand** the basic nature, scope and perspective of sociology
2. **Understand** the stages of social research process and methodologies
3. **Analyze** different culture and civilization
4. **Apply** contextual knowledge to assess societal and cultural issues in national and global context
5. **Analyze** different social problems and stratifications and design solutions for those
6. **Analyze** socialism, capitalism and economic life and manage projects
7. **Apply** the knowledge of sociology in environmental context for sustainable development

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the basic nature scope and perspectives of sociology and **Apply** sociological imagination to the context of social problems of BD society	PO6	C3			K7	T, Q, ASG, F
CO2	**Understand** the stages of social research processes and methodologies and **Analyze** different cultures, civilizations and different social problems and design solutions for those	PO6	C4			K7	T, Q, ASG, F.

CO3	**Understand** and **analyze** social stratification, different social systems, socialism, capitalism and relate them to BD society	PO6	C4			K7	T, Q, ASG, F
CO4	**Apply** contextual knowledge to assess societal and cultural issues in environmental context for sustainable development	PO7	C3			K7	T, Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Main Contents: Understanding society, social phenomena and social change

Detail Contents: Nature and scope Sociological imagination, Perspectives of sociology, Stages of social research and research method, Culture and civilization, Socialization and self - development, Globalization and social changes, Media and individual, Social organizations and social problems, social stratification; industrial revolution, Capitalism and socialism, Work and economic life, Environment and human activities, Climate change and global risk, Population and human society, Urbanization and city development, Social changes and technology

TEACHING LEARNING STRATEGY

COMPONENTS	TEACHING AND LEARNING ACTIVITIES	STUDENT' LEARNING TIME (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL	80
	CREDIT = SLT/40	2

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE		
	Topic	**CT**
WEEK-1		CT1
Class 1	Definition, nature and scope of sociology	
Class 2	Sociological imagination	
WEEK-2		
Class 3	Perspectives of sociology	
Class 4	Orientation of sociological theories	
WEEK-3		
Class 5	Social research and its process	
Class 6	Research designs and techniques.	
WEEK-4		CT2/ MID TERM
Class 7	Introducing culture and its variations	
Class 8	civilization	
WEEK-5		
Class 9	Defining family and its changes	
Class 10	Socialization process and development of self	
WEEK-6		
Class 11	Introducing globalization and its impact on human	
Class 12	l Factors responsible to globalization	
WEEK-7		
Class 13	Media and its impact in modern society	
Class 14	Addressing social problems of Bangladesh	
WEEK-8		
Class 15	Introducing social groups and Organizations.	
Class 16	Introducing bureaucracy and good governance Continue	
WEEK-9		
Class 17	Introducing social stratifications and social inequality	
Class 18	Poverty and its types and dimensions	CT2/ MID TERM
WEEK-10		
Class 19	Industrial revolution and aftermath	
Class 20	Urbanization and city development	
WEEK-11		
Class 21	Capitalism: features and influence	
Class 22	Socialism: features and influence	
WEEK-12		
Class 23	Unemployment problem and its impact on society	
Class 24	Climate change and global risk	
WEEK-13		
Class 25	Population of Bangladesh: problem or prospect	CT3
Class 26	Crime and deviance: a brief analysis	
WEEK-14		
Class 27	Review Class	
Class 28	Review Class	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Blooms Taxonomy</th></tr>
<tr><td rowspan="6">Continuous Assessment (40%)</td><td rowspan="3">Class Test/ Assignment 1-3</td><td rowspan="3">20%</td><td>CO1</td><td>C3</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO2, CO3</td><td>C4</td></tr>
<tr><td colspan="2" rowspan="4">Final Examination (Section A & B)</td><td rowspan="4">60%</td><td>CO1</td><td>C3</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td>CO4</td><td>C3</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
2. Sociology - Primary Principles: by CN Shankar Rao
3. Anthony Giddens- 5th edition
4. Relevant journal

COURSE INFORMATION			
Course Code	: GEE 201	Contact Hours	: 2.00
Course Title	: Fundamentals of Economics	Credit Hours	: 2.00

PRE-REQUISITE
None

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To design, analysis and selection of commonly used mechanical components subject to static and dynamic loads.

OBJECTIVE

1. Students will demonstrate their knowledge of the fundamental and technical concepts of economics.
2. To work effectively in the organizations with honesty and integrity.
3. Students will be able to understand consumer behavior, elasticity and different market structure.
4. Students will be able to identify the determinants of various macroeconomic aggregates such as national income, full employment, unemployment, consumption and savings function, inflation, productivity and the major challenges associated with the measurement of these aggregates.
5. Students will apply the basic theories of economics in critical thinking and problem solving.
6. Students will be able to identify the basic features of economic development and regarding planning for the economy of the country.

COURSE OUTCOMES & GENERIC SKILLS

NO.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the basic concepts and principles of Micro and Macro Economics.	PO1	C2			K1	T,ASG,Q,F
CO2	**Identify and apply** the indifference curve theory and market equilibrium in real life situation	PO1	C3			K2	T,ASG,Q,F
CO3	**Explain** time-value of money concept and **apply** the knowledge of	PO2	C3			K2	T,ASG,Q,F

	inflation, investment and cost benefit analysis.						
CO4	**Understand** the Economic Development and Planning for the country and get idea of the international economy.	PO1	C2			K2	T,ASG,Q,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Broad Topic	Details Topic
Fundamental of Economics	Definition
Production Possibility	1. PPF Curve.
Frontier and Engineering	2. Applying the PPF to Society's Choices by the
Decision	Engineers.
Utility Theory	Law of diminishing marginal utility.
Demand	1. Definition. 2. Law of Demand. 3. Market Demand. 4. Reason for demand curve downward slopping. Mathematical Analysis
Supply	1. Definition. 2. Supply curve. 3. Market Equilibrium.
Elasticity of Demand	1. Different types of elasticity. 2. Different types of price elasticity. 3. Relation between AR, MR and elasticity 4. Mathematical Analysis
Indifference Curve Analysis and Consumers Equilibrium	Budget Line, MRS, Consumer Choice
Production Function from Engineering point of view	1. TP, AP, MP. 2. Law of Variable proportion. 3. Law of returns
Cost Analysis and Engineering Economics	1. TC, AC, MC. 2. Short run cost analysis
Analysis of Market Structure and Engineering Decision	1. Perfectly Competitive Market 2. Monopoly and Monopolistic Market
Key concept of Macroeconomics	Definition
National Income	GDP, GNP, NNP, NI
Circular Flow of National Income and Engineering Resources	Two, Three and Four sector Economy
Savings	Consumption functions, APC, MPC
Engineering Plan considering the Inflation Rate of the Country	Demand-Pull and Cost-Push Inflation
The Effect of Monetary policy on Engineering Plan	Impact and Use

The Effect of Fiscal Policy on Engineering Plan	Impact and Use
Theories of Developments	1 or 2 Theories of Economic Development
Economic Problems in Developing Countries especially in Bangladesh.	

TEACHING LEARNING STRATEGY

COMPONENTS	TEACHING AND LEARNING ACTIVITIES	STUDENT' LEARNING TIME (SLT)
Face to Face	Lecture (2 hours/week x 14 weeks)	28
Guided Learning	Tutorial/ Assignments (2 hours/week x 5 weeks)	10
Independent Learning	Individual learning (1-hour lecture ≈ 1hour learning) Preparation for tests and examination	24 13
Assessment	Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
	TOTAL	80
	CREDIT = SLT/40	2

TEACHING METHODOLOGY

Lecture and Discussion,
Co-operative and Collaborative Method,
Problem Based Method.

COURSE SCHEDULE

WEEK-1	TOPIC	CT/MID
Class 1	Introduction to Engineering Economics Importance of Economics in Engineering.	CT1
Class 2	Definition of economics, Difference between micro and macroeconomics. Production possibility frontier (PPF) and Engineering choice.	
WEEK-2		
Class 3	Demand and determinants of Demand	
Class 4	Demand curve related basic idea and Mathematical Application	
WEEK-3		
Class 5	Demand curve related basic idea and Mathematical Application	
Class 6	Consumer Choice (Indifference Curve and Budget Line)	
WEEK-4		CT2/MID TERM
Class 7	Indifference Curve, Properties of IC, MRS	
Class 8	Theory of production in the point of view of Engineers	
WEEK-5		
Class 9	Theory of cost, Short run and long run cost curve	
Class 10	Firms Equilibrium (Concepts)	
WEEK-6		
Class 11	Different types of Market.	
Class 12	How the Engineers will act in perfectly Competitive market.	
WEEK-7		
Class 13	How the Engineers will act in Monopoly Market	
Class 14	National Income analysis	
WEEK-8		
Class 15	Aggregate Demand and Aggregate Supply	

Class 16	Determination of Level of Income and Employment	CT2/MID TERM
WEEK-9		
Class 17	Keynes Full Employment. Theory	
Class 18	Circular flow of Income and Expenditure (How engineers will utilize the resources and decision-making process of project plan)	
WEEK-10		
Class 19	Consumption Function	
Class 20	Saving Function	
WEEK-11		CT3
Class 21	Inflation, Type of Inflation	
Class 22	Impact of Inflation	
WEEK-12		
Class 23	Unemployment problem and its impact on society	
Class 24	Cost benefit analysis	
WEEK-13		
Class 25	Theories of Economic Development	
Class 26	Economic Problems in Developing Countries	
WEEK-14		
Class 27	Contribution of the Engineers in the Economic Development of Bangladesh.	
Class 28	How the Engineers compare their development projects in the context of World Economy.	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C2, C3
			CO3	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 2 CO3	C3
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO3	C3
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Economics by P. A. Samuelson and W. D. Nordhaus (7th Edition)
2. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Edition)
3. Macroeconomics by N. Gregory Mankiw (8th Edition)
4. Principle of Economics by N. Gregory Mankiw (8th Edition)
5. Engineering Economics by Niall M. Fraser and Elizabeth M. Jewkes. (5th Edition)

COURSE INFORMATION			
Course Code Course Title	: GELM 275 : Leadership and Management	Contact Hours Credit hours	2.00 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education			
SYNOPSIS/RATIONALE			
The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer			

OBJECTIVES

1. To introduce different management functions and approaches.
2. To expose students to different views and styles of leadership.
3. To understand how an organization functions collaboratively with managers and engineers.
4. To understand various personality traits and its impact on leadership and management.
5. To solve real-world management problems as an engineer.

COURSE OUTCOMES & GENERIC SKILLS

NO.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Discuss** the fundamental concepts of leadership and management skills	PO9	C2, A2				T, R, F, Pr
CO2	**Adapt** to the role and contribution of a leader in achieving organizational goals	PO9	C2, P5				T, ASG, R, F
CO3	**Incorporate** the contribution of leadership traits and management skills in decision making and solving real life problems	PO12	C2, A5				T, ASG, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENTS
a. Main Contents: Introduction to Leadership and Management; Management Fundamentals; Leadership Motivation; Organizational Management; Planning and goal setting; Control; Change and Innovation; Attitude; Personality; Perception and Individual Decision Making; Understanding Work Team; HR Management; Operations Management; Information Technology and Management; Case studies. **b. Detailed Contents:** **Introduction to Leadership and Management:** Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history. **Management Fundamentals:** Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management. **Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory; Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning). **Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration. **Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal. **Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence. **Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity vs innovation. **Attitude:** Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction. **Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality). **Perception and Individual Decision Making**: Factors influencing perception; attribution theory; errors/biases in attribution; Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.

Understanding Work Team: Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.

HR Management: Process of Human Resource Planning; forecasting demand for labor; staffing; internal supply of labor; performance appraisal.

Operations Management: Project managing basics; goals and boundary of project; WBS; scheduling a project; Demand and supply forecasting; inventory control.

Information Technology and Management: Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	28 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home **Preparation for final examination**	 10 14 14
Formal Assessment Continuous Assessment Final Examination	2 3
Total	71

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

WEEK-1	TOPIC	CT/MID
Class 1	**Introduction to Leadership and Management:** Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.	CT1
Class 2	**Management Fundamentals:** Definition of management &manager; levels of management; management functions and kills; Mintzberg's managerial roles; Henri Fayol'smanagement principles; strategic management.	
WEEK-2		
Class 3	**Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory	
Class 4		

WEEK-3		
Class 5 Class 6	**Leadership:** Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).	
WEEK-4		CT2/MID TERM
Class 7 Class 8	**Case Study – I: Engineer as Great Leaders**	
WEEK-5		
Class 9	**Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.	
Class 10	**Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.	
WEEK-6		
Class 11	**Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback &concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.	
Class 12	**Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity innovation.	
WEEK-7		
Class 13	**Case Study – II: Planning and Goal Setting; A Managerial Approach: Engineer as Great Managers (Interactive Discussions in the Class)**	
Class 14	**Attitude:** Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.	
WEEK-8		CT2/MID TERM
Class 15	**Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).	
Class 16	**Perception and Individual Decision Making**: Factors influencing perception; attribution theory; errors/biases in attribution	
WEEK-9		
Class 17	**Perception and Individual Decision Making**: Factors of individual decision making; rational decision making; bounded	

	rationality; satisfice; common errors in decision making; creativity in decision making.	
Class 18	**Case Study – III: A Case on Decision Making – Involves both leadership and managerial skills (Interactive Discussion in the Class)**	
WEEK-10		
Class 19	**Understanding Work Team:** Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.	
Class 20	**HR Management:** Process of Human Resource Planning; forecasting demand for labor; staffing.	
WEEK-11		CT3
Class 21	**HR Management:** Internal supply of labor; performance appraisal.	
Class 22	**Operations Management:** Project managing basics; goals and boundary of project; WBS; scheduling a project.	
WEEK-12		
Class 23	**Operations Management:** Demand and supply forecasting; inventory control.	
Class 24	**Exercise – Use of Microsoft Project (MSP) for scheduling a project at student level**	
WEEK-13		
Class 25 Class 26	**Case Study – IV:** A case that covers all relevant theories taught throughout the course and involves both leadership and management issues, e.g., Columbia's Final Mission. (This may be given as group assignment followed by in class short presentations/discussions)	
WEEK-14		
Class 27	**Information Technology and Management:** Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.	
Class 28	REVISION	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class test 1-2	20%	CO 1	C2, A2
			CO 2	C2, P5
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO 1	C2, A2
			CO 2	C2, P5
			CO 3	C2, A5
		60%	CO 1	C2, A2
Final Examination (Section A & B)			CO 2	C2, P5
			CO 3	C2, A5
Total Marks		100%		

REFERENCE BOOKS
1. Students must be provided with SOLID reading material instead of referring text books. However, course teacher may select any text book as per his choice. 2. Engineering Management (Revised Edition) – A.K. Gupta 3. Industrial Engineering and Production Management - Martand T. Telsang 4. Leadership in Organizations – Gary Yukl 5. Developing Management Skills – David A. Whetten and Kim S. Cameron

COURSE INFORMATION			
Course Code	: GEEM 339	Contact Hours	: 2.00
Course Title	: Engineering Ethics and Moral Philosophy	Credit Hours	: 2.00

PRE-REQUISITE

None.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to formulate philosophical thoughts about engineering with an emphasis on moral philosophy and ethical decision-making.

OBJECTIVE

1. To learn to identify ethical aspects of engineering problems.
2. To acquire skills for preventing or dealing with ethical problems.
3. To develop moral imagination to enter into the outlooks of engineers.
4. To think systematically and analytically about particular ethical dilemmas.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** theories and tools about ethical issues in the engineering profession.	PO1	C2	-	-	K3	T, Q, ASG, F
CO2	Be able to **identify** ethical problems, dilemmas, and areas of responsibility in engineering practice.	PO8	C3, A4	-	-	K7	T, Q, ASG, F
CO3	Be able to **analyze** the moral philosophy and professional responsibilities of engineers.	P08	C4	-	-	K1	T, Q, ASG, F

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- MID TERM Exam, F – Final Exam)

COURSE CONTENT

Basic ethical theories such as consequentialism, deontology, and virtue ethics, but also more modern theories such as discourse ethics, feminist ethics as well as theories about justice and equal opportunities. Decision-making models and frameworks within engineering ethics

Case Study: Analysis of examples of situations which engineers may encounter in their professional life with the help of the studied ethical theory. Interview with professionally active engineers on ethical issues they have encountered during their career. The social and value dimensions of technology, trust and reliability, risk and liability in engineering, engineers in organizations, theories of whistle blowing, Individual, professional, and institutional values and competency with good character.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	28
Guided Learning Tutorial/ Assignments Independent Learning Individual learning Preparation for tests and examination	10 24 13
Formal Assessment Pop Quiz/Class Test/Mid-Term Exam Final examination	2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion
Co-operative and Collaborative Method

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1	Consequentialism, deontology, and virtue ethics	
Class-2	Continue	
Week 2		
Class-4	Discourse ethics, feminist ethics, theories about justice and equal opportunities	
Class-5	Continue	
Week 3		
Class-7	Decision-making models and frameworks within engineering ethics	
Class-8	Continue	
Week 4		
Class-10	Case Studies	CT2/ MID
Class-11	Continue	

Week 5		TERM
Class-13	Continue	
Class-14	Continue	
Week 6		
Class-16	The social and value dimensions of technology	
Class-17	Continue	
Week 7		
Class-19	Trust and reliability	CT2/ MID TERM
Class-20	Continue	
Week 8		
Class-22	Risk and liability in engineering	
Class-23	Continue	
Week 9		
Class-25	Engineers in organizations,	
Class-26	Continue	
Week 10		
Class-28	Theories of whistle blowing	
Class-29	Continue	
Week 11		
Class-31	Interview with professionally active engineers on ethical issues they have encountered during their career	CT3
Class-32	Continue	
Week 12		
Class-34	Unemployment problem and its impact on society	
Class-35	Continue	
Week 13		
Class-37	Competency with Good Character	
Class-38	Continue	
Week 14		
Class-40	Review Class	
Class-41	Continue	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-2	20%	CO1, CO2	C2, C3, A4
			CO3	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2 CO3	C3, A4, C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C3, A4
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)

REFERENCE BOOKS

1. Vincenti, W. G. What Engineers Know and How They Know It: Analytical Studies from Aeronautical History. Reprint ed. Baltimore, MD: The Johns Hopkins University Press, 1993.
2. Davis, M., ed. Engineering Ethics. Burlington, VT: Ashgate Publishing Co., 2005.
3. Koen, B. V. Discussion of the Method: Conducting the Engineer's Approach to Problem Solving. New York, NY: Oxford University Press, 2003.
4. Pinkus, R. L. B., et al. Engineering Ethics: Balancing Cost, Schedule, and Risk - Lessons Learned from the Space Shuttle. New York, NY: Cambridge University Press, 1997.

COURSE INFORMATION			
Course Code	: GERM 350	Contact Hours	: 2.00
Course Title	: Fundamentals of Research Methodology	Credit Hours	: 1.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This is a hands-on course designed to impart education in the foundational methods and techniques of academic research in the Science and Engineering context. UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing.

In addition to their application in an academic setting, many of the methodologies discussed in this course would be like those deployed in professional research environments.

OBJECTIVE

The primary objective of this course is to develop research orientation among the UG students and to acquaint them with the fundamentals of research methods. Some other objectives of the course are:

1. To evaluate/review related extant literature, form a variety of sources, pertinent to the research objectives/questions.
2. To expose students to various research methodologies (design), relevant to the research problem needing to be addressed.
3. To explain and justify how researchers will collect and analyze research data.
4. To educate students in the common mistakes, research misconduct, and ethical considerations in the field of research methodology.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain t**he foundations of research, including the meaning, objectives, types, and scientific methods involved, to establish a solid base for conducting academic and applied research in engineering.	PO1	C2			K3	R, Q, T

CO2	Be able to **develop** skills in problem identification and formulation, including conducting a thorough literature review, formulating research questions, developing hypotheses, and understanding the significance of hypothesis testing in addressing engineering questions.	PO3	C3			K4	R, Q, T
CO3	Be able to **execute** a complex engineering research project, incorporating research design, ethical considerations, and comprehensive data analysis, culminating in the production of a well-structured research paper and presentation, while effectively managing project timelines.	PO4	P4	CP1, CP2, CP3		K4	Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; Genera l Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive Theory; Characteristics of scientific method.
2.	Practice session on Foundations of Research
3.	Problem identification & formulation: meaning & need of review of literature; how conduct the review of literature; research question investigation question measurement issues – hypothesis – qualities of a good hypothesis –null hypothesis & alternative hypothesis. Hypothesis testing logic & importance.
4.	Practice session on Problem Identification & Formulation
5.	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
6.	Practice session on Research Design
7.	Data Analysis: Data Preparation – Univar ate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing Hypothesis of association.
8.	Practice session on Data Analysis
9.	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
10.	Practice session on Research misconduct and Ethics

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	14
	Total 28
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Total	98

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; Genera l Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive Theory; Characteristics of scientific method.
Week 2	Practice session on Foundations of Research
Week 3	Problem identification & formulation: meaning & need of review of literature; how conduct the review of literature; research question investigation question measurement issues – hypothesis – qualities of a good hypothesis –null hypothesis & alternative hypothesis. Hypothesis testing logic & importance.
Week 4	Practice session on Problem Identification & Formulation
Week 5	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
Week 6	Practice session on Research Design
Week 7	Data Analysis: Data Preparation – Univar ate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing Hypothesis of association.
Week 8	Practice session on Data Analysis
Week 9	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
Week 10	Practice session on Research misconduct and Ethics
Week 11	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office;

	Software for detection of Plagiarism. Time Management and developing Gantt. Charts.
Week 12	Practice session on Use of tools / techniques for Research
Week 13	Project Work
Week 14	Project Demonstration

ASSESSMENT STRATEGY

Components		**Grading**	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Participation and Report	10%	CO 1	C2
			CO 2	C3
	Lab test	30%	CO 1	C2
			CO 2	C3
	Project and Presentation	20%	CO3	P4
Lab Quiz		15%	CO 1	C2
			CO 2	C3
Project		50%	CO2, C03	C3, P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Engineering Research Methodology: A Practical Insight for Researchers. Springer, by Deb, Dipankar, Dey, Rajeeb, Balas, Valentina E.
2. Research Methods for Engineers, 1st Edition, by David V. Thiel.
3. Handbook of Research Methodology by Talati, J.K.
4. Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project by Uwe Flick
5. DRM, a Design Research Methodology by Lucienne T.M. Blessing and Amaresh Chakrabarti
6. Research Methods: Information, Systems, and Contexts by Kirsty Williamson, Graeme Johanson
7. Zelkowitz, M. V. and Wallace, D. R. (1998), Experimental models for validating technology, Computer, vol. 31, no. 5, pp. 23-31.
8. Internet, mail, and mixed-mode surveys: the tailored design method (3rd ed.) by Dillman, D. A., Smyth, J. D., & Christian, L. M.
9. Improving survey questions: design and evaluation. Sage Publications, by Fowler, F. J.
10. Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, by Cohen, J., Cohen, P., West, S., & Aiken, L.
11. Experimental and Quasi-Experimental Design for Generalized Causal Inference. Boston, Mass: Houghton Mifflin, by Shadish W.R., Cook T.D. & Campbell P.T.
12. Computational handbook of statistics (4th ed.). New York: Longman, by Bruning, J. L. & Kintz, B. L.

COURSE INFORMATION			
Course Code	: GESL 409	Contact Hours	: 2.00
Course Title	: Environment Sustainability and Law	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to introduce students to environmental law. In doing so, the course not only provides students with an understanding of general legal principles, methods and institutions but also provides them with a framework for understanding and analyzing environmental law.

OBJECTIVE

1. To examine a wide range of legislative measures at different levels of government that are intended to contribute to the goal of environmental sustainability;
2. To understand the impact of environmental laws on corporations;
3. To understand the role of courts and tribunals in relation to the effective implementation of these legislative measures.
4. To explore the legal aspects of several critical sustainability issues (for example, climate change, water scarcity, genetically modified organisms)

COURSE OUTCOMES & GENERIC SKILLS

NO.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO 1	Be able to i**dentify** the key principles of, and institutions within, environmental law	PO1	C2			K1	T, F
CO 2	Be able to **analyze** and **reflec**t on the interplay between politics, policy, science and values in environmental law	PO2	C4			K2	T, ASG, F
CO 3	Be able to **explain** and **analyze** the impact of environmental laws on ecology and the methods for enhancing sustainability	PO7	C4			K7	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

The concept of environmental sustainability and its reflection in specific legal principles (precaution, inter and intra-generational equity, the polluter pays); the key components of environmental sustainability law; responsibility for the development and implementation of environmental sustainability law under the Constitution; introduction to tools and mechanisms for the achievement of environmental sustainability (regulatory mechanisms; economic instruments; and voluntary measures); examination of key legislation relevant to the delivery of environmental sustainability (pollution controls and waste management; land-use controls and environmental impact assessment; natural resource management; and biodiversity protection); the role of courts and tribunals in relation to the implementation of environmental sustainability legislation; case-studies of legal aspects of emerging environmental sustainability issues – for example, climate change, water scarcity, genetically modified organisms.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	28
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	28
Revision of the previous lecture at home	14
Preparation for final examination	14
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	89

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week-1	**Topic**	**CT**
Class-1	The concept of environmental sustainability.	CT1
Class-2	Reflection of environmental sustainability in specific legal principles (precaution)	
Week-2		
Class-3	Reflection of environmental sustainability in specific legal principles (inter-generational equity)	
Class-4	Reflection of environmental sustainability in specific legal principles (intra-generational equity)	

Week-3		
Class-5	Reflection of environmental sustainability in specific legal principles (the polluter pays)	
Class-6	Review of the reflection of environmental sustainability in specific legal principles.	
Week-4		
Class-7	The key components of environmental sustainability law.	CT2/MID TERM
Class-8	Review	
Week-5		
Class-9	Responsibility for the development and implementation of environmental sustainability law under the Constitution.	
Class-10	Review	
Week-6		
Class-11	Introduction to tools and mechanisms for the achievement of environmental sustainability (regulatory mechanisms)	
Class-12	Introduction to tools and mechanisms for the achievement of environmental sustainability (economic instruments)	
Week-7		
Class-13	Introduction to tools and mechanisms for the achievement of environmental sustainability (voluntary measures)	
Class-14	Review	
Week-8		
Class-15	Examination of key legislation relevant to the delivery of environmental sustainability (pollution controls and waste management; land-use controls and environmental impact assessment; natural resource management; and biodiversity protection)	
Class-16	Examination of key legislation relevant to the delivery of environmental sustainability (land-use controls and environmental impact assessment)	
Week-9		CT2/MID TERM
Class-17	Review	
Class-18	Examination of key legislation relevant to the delivery of environmental sustainability (natural resource management)	
Week-10		
Class-19	Examination of key legislation relevant to the delivery of environmental sustainability (biodiversity protection)	
Class-20	Review	
Week 11		
Class-21	The role of courts and tribunals in relation to the implementation of environmental sustainability legislation.	
Class-22	Review	
Week 12		
Class-23	Case-studies of legal aspects of emerging environmental sustainability	

	issues (i.e. climate change)
Class-24	Review
Week 13	
Class-25	Case-studies of legal aspects of emerging environmental sustainability issues (i.e. water scarcity)
Class-26	Review
Week 14	
Class-27	Case-studies of legal aspects of emerging environmental sustainability issues (i.e. genetically modified organisms)
Class-28	Review

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-2	20%	CO1, CO2	C2, C4
			CO3	C4
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C4
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C4
			CO3	C4
Total Marks		100%		

REFERENCE BOOKS

1. The Global Environment: Institutions, Law, and Policy by Regina S. Axelrod and Stacy D. Van Deveer;
2. Resolving Environmental Conflicts (Social Environmental Sustainability) by Chris Maser;
3. Environmental Ethics and Sustainability: A Casebook for Environmental Professionals by Hal Taback and Ram Ramanan;
4. International Environmental Law and Policy by David Hunter and James Salzman.

COURSE INFORMATION			
Course Code Course Title	GEPM 469 Project Management and Finance	Contact Hours Credit hours	2.00 2.00

PRE-REQUISITE

Principles of Accounting

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will provide a general introduction to project management. This course will equip the students to various feasibility analyses – Market, Technical, Financial and Economic. To equip them with the knowledge and skills required to be successful in applying Project Management. To make them understand techniques for Project planning, scheduling and Execution Control. Lectures the focus will be on quizzes, group projects and case studies.

OBJECTIVES

1. To make them understand the concepts of Project Management and Finance for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing, Finance and Budgeting.
4. To analyze, apply and appreciate contemporary project management tools and methodologies in Bangladeshi context.

COURSE OUTCOMES & GENERIC SKILLS

NO.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** project characteristics and various stages of a project finance and have the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic	PO1	C2			K3	T, ASG, F
CO2	Be able **Prepare** a project plan and explain various stages of project management process	PO11	C2			K3	T, F

CO3	Be able to **apply** economic and financial principles to economic decision-making and **seek** cost estimation in a project	PO11	C4			K4	T, ASG, F,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENTS

Introduction to Applied Project Management, Project Definition: Project Feasibility Analysis, developing a Project Execution Plan, Setting up a Project Organization, Resource Scheduling, Cost Estimating, Controlling Project Execution, Project Control, Planning and Scheduling, Cost Engineering and Detailed Engineering, Project Procurement, Construction Management, Construction Progress, Productivity and Supervision, Subcontract Administration and Control.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	28
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	28
Revision of the previous lecture at home	14
Preparation for final examination	14
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	89

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week-1	**Topic**	**CT**
Class-1	Introduction to Applied Project Management	CT1
Class-2	Introduction to Applied Project Management	
Class-3	Project Feasibility Analysis	
Class-4	Developing a Project Execution Plan	
Week-3		
Class-5	Developing a Project Execution Plan	
Class-6	Setting up a Project Organization	

Week-4		
Class-7	Setting up a Project Organization	CT2/MID TERM
Class-8	Resource Scheduling, Cost Estimating	
Week-5		
Class-9	Resource Scheduling, Cost Estimating	
Class-10	Controlling Project Execution	
Week-6		
Class-11	Controlling Project Execution	
Class-12	Project Control, Planning and Scheduling	
Week-7		
Class-13	Cost Engineering and Detailed Engineering	
Class-14	Cost Engineering and Detailed Engineering	
Week-8		
Class-15	Project Procurement	
Class-16	Project Procurement	
Week-9		CT2/MID TERM
Class-17	Construction Management	
Class-18	Construction Progress	
Week-10		
Class-19	Productivity and Supervision	
Class-20	Productivity and Supervision	
Week 11		
Class-21	Productivity and Supervision	
Class-22	Productivity and Supervision	
Week 12		
Class-23	Subcontract Administration and Control	
Class-24	Subcontract Administration and Control	
Week 13		
Class-25	Subcontract Administration and Control	
Class-26	Subcontract Administration and Control	
Week 14		
Class-27	Review classes	
Class-28	Review classes	

ASSESSMENT STRATEGY

Components		Grading	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-2	20%	CO1	C2, C4
			CO3	
			CO2	C2
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C2
Final Examination (Section A & B)		60%	CO1	C2
			CO2	C2
			CO3	C4
Total Marks		100%		

REFERENCE BOOKS
1. Prasanna Chandra; Projects- Planning, Analysis, Selection, Financing Implementation and Review',VI Edition, Tata Mc Graw Hill, 8th Edition 2015. 2. Project Finance in Theory and Practice: Designing, Structuring, and Financing Private and Public Projects 3rd Edition by Stefano Gatti

6.3 Interdisciplinary Courses:

COURSE INFORMATION			
Course Code	: CSE 173	Contact Hours	: 3.00
Course Title	: Computer Programming and Application	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to design and develop computer programs.

OBJECTIVE

1. To understand the basic idea of computer programming in C/C++.
2. Learn how to solve problems with Structured Programming using C/C++.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the fundamental concepts and purpose of computer programming and implementing programming skills	PO1	C2			K3	T, F, ASG.
CO2	**Organizing** the sequence of the program using basic control structures of programming.	PO2	C3			K3	T, F, MID TERM ASG.
CO3	Identify structure, classes, objects and **understanding** and interpreting them needed for a specific problem.	PO2	C2			K3	T, F, ASG
CO4	**Using** the knowledge of function, pointer, string to give logical outputs based on the requirement.	PO2	C3			K4	T, F, MID TERM Exam.

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Programming concepts; Program development stages; Flow charts; Structured programming language: data types, operators, bitwise operations, expressions, control structures: if-else, switch-case, loop (for loop, while loop, do-while loop).Input and Output: standard input and output, formatted input and output. Functions and program structure: function basics, parameter passing conventions, scope rules, storage classes, recursion, header files, the pre-processor, Pointer, and its uses, Arrays, Strings, Multidimensional array; User-defined data types: structures, unions, and enumerations. File, Variable length argument list, Command line parameters, Error Handling, Linking, Library Functions.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Cantered Learning	-
	Total 42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Quiz	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem-Based Method.

COURSE SCHEDULE

	Topic	CT
Week 1		CT1
Class-1 Class-2 Class-3	1. Introduction to Computer Programming. 2. Environment Setup and introduction with the IDE. 3. Standard input and output. 4. Formatted input and output.	
Week 2		
Class-4 Class-5 Class-6	1. Introduction to data types, mathematical problems using data types, data type conversion, operators, bitwise operation, and expressions. 2. Program development stages-flow chart.	
Week 3		
Class-7 Class-8 Class-9	1. Introduction to the conditional statement (if-else, nested if-else, switch case). 2. Problem-solving with conditional statements.	CT2/ MID TERM
Week 4		
Class-10 Class-11	1. Introduction to the loop statement (for loop, while loop, do-while loop). 2. Problem-solving with loop statements.	

Class-12		
Week 5		
Class-13 Class-14 Class-15	1. Functions and program structure: Function Basics, Parameter passing conventions, Scope Rules, Storage classes, Recursion. 2. Problem-solving with implementing Function.	
Week 6		
Class-16 Class-17 Class-18	1. Recursion 2. Problem-solving with recursions.	
Week 7		
Class-19 Class-20 Class-21	1. String 2. Problem solving with string.	CT2/ MID TERM
Week 8		
Class-22 Class-23 Class-24	1. Header files 2. Preprocessor 3. Pointer and its uses. 4. Problem-solving with pointers.	
Week 9		
Class-25 Class-26 Class-27	1. Arrays 2. Multidimensional array 3. Problem-solving with arrays.	
Week 10		
Class-28 Class-29 Class-30	1. Structures 2. Problem-Solving with structures.	CT3
Week 11		
Class-31 Class-32 Class-33	1. Unions 2. Enumerations	
Week 12		
Class-34 Class-35 Class-36	1. Opening, reading, writing, and closing a file. 2. Problem-solving with implementing files.	
Week 13		
Class-37 Class-38 Class-39	1. Variable length argument list 2. Command Line parameters 3. Linking 4. Library Functions	
Week 14		
Class-40 Class-41 Class-42	1. Error handling 2. Problem-solving with error handling	

ASSESSMENT STRATEGY

Components		**Grading**	CO	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C3
			CO3	C2

			CO4	C3
	Class Performance	5%		
	Class Attendance	5%		
	Mid-Term Assessment (Exam/Project)	10%	CO2	C3
			CO4	
Final Examination (Section A & B)		60%	CO 1	C2
			CO 2	C3
			CO 3	C2
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Teach Yourself C (3rd Edition) by Herbert Schidlt
2. Programming in Ansi C (6th Edition) by E Balagurusamy
3. C: The Complete Reference (4th Edition) by Herbert Schildt
4. C++: The Complete Reference (4th Edition) by Herbert Schildt
5. C Programming Language (2nd Edition) by Dennis M. Ritche

COURSE INFORMATION			
Course Code	: CSE 174	Contact Hours	: 3.00
Course Title	: Computer programming and Application Sessional	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed to practically introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to design and develop computer programs.

OBJECTIVE

1. The course is designed to provide practical knowledge of C language.
2. Students will be able to develop logics which will help them to create programs, applications in C.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **arrange** programs systematically using a structured logic approach, proper syntax and algorithms.	PO1	C1-C3			K1, K3	F, T, ASG
CO2	Be able to **identify** and analyze problems to develop complete programs	PO2	C3, C6			K3, K4	T, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

a. **Main Contents:** Introduction to computer programming; Number System; Basic programming Structures; Control Structure; Array; User defined data types; Bitwise Operations; File I/O

b. **Detailed Contents:**

Introduction to computer programming: Programming Concepts, Mathematical problems using printf, scanf**,** Basic programming Structures: Data types and their memory allocation, operators, expressions, basic input/ output**,** Control Structure: if-else, switch case, nested if-else, loop, nested loop **,** Array: one-dimensional array, multi-dimensional array, character array/ string**,** User defined data types: Structure, union, enumeration, File I/O

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	-
Practical	42

Self-Directed Learning Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 15 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	Lab	Topics	Remarks
1	Lab 1	1. Introduction to Computer Programming. 2. Environment Setup and introduction with the IDE. 3. Standard input and output. 4. Formatted input and output.	
2	Lab 2	1. Introduction to data types, mathematical problems using data types, data type conversion, operators, bitwise operation, and expressions. 2. Program development stages-flow chart.	
3	Lab 3	1. Introduction to the conditional statement (if-else, nested if-else, switch case). 2. Problem-solving with conditional statements.	
4	Lab 4	Introduction to the loop statement (for loop, while loop, do-while loop).	Evaluation
5	Lab 5	Problem-solving with loop statements.	Evaluation
6	Lab 6	One-dimensional Arrays & String	Evaluation
7	Lab 7	Lab Test – 1	
8	Lab 8	1. Multidimensional array	
9	Lab 9	1. Functions and program structure: Function Basics, Parameter passing conventions. 2. Problem-solving with implementing Function.	Evaluation
10	Lab 10	1. Structures 2. Unions 3. Enumerations 4. Problem-Solving with structures.	Evaluation
11	Lab 11	1. Opening, reading, writing, and closing a file. 2. Problem-solving with implementing files.	Evaluation

12	Lab 12	Solving real life problems using C	Evaluation
13	Lab 13	Lab Test – 2	
14	Lab 14	Presentation / quiz/ viva	

<table>
<tr><th colspan="5">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="5">Continuous Assessment (40%)</td><td rowspan="2">Lab Test</td><td rowspan="2">20%</td><td>CO1</td><td>C1-C3</td></tr>
<tr><td>CO2</td><td>C3,C6</td></tr>
<tr><td rowspan="2">Class Participation</td><td rowspan="2">5%</td><td>CO 1</td><td>C1-C3</td></tr>
<tr><td>CO2</td><td>C3,C6</td></tr>
<tr><td>Assignment</td><td>15%</td><td>CO2</td><td>C3, C6</td></tr>
<tr><td colspan="2" rowspan="2">Lab Test-1</td><td rowspan="2">20%</td><td>CO 1</td><td>C1-C3</td></tr>
<tr><td>CO 2</td><td>C3, C6</td></tr>
<tr><td colspan="2" rowspan="2">Lab Test-2</td><td rowspan="2">20%</td><td>CO 1</td><td>C1-C3</td></tr>
<tr><td>CO 2</td><td>C3, C6</td></tr>
<tr><td colspan="2">Quiz / Presentation/viva</td><td>20%</td><td>CO 2</td><td>C3, C6</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

REFERENCE BOOKS

1. Teach Yourself C (3rd Edition) by Herbert Schidlt
2. Programming in Ansi C (6th Edition) by E Balagurusamy
3. C: The Complete Reference (4th Edition) by Herbert Schildt
4. C Programming Language (2nd Edition) by Dennis M. Ritche

COURSE INFORMATION			
Course Code	: EECE 161	Lecture Contact Hours	: 3.00
Course Title	: Electrical Circuit Analysis-I	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuit.

OBJECTIVE

1. To learn the basic electrical quantities, their applications and unit.
2. To study the different electrical network theorems and apply those theorems in solving complex circuit networks.
3. To use the principles of DC circuit in various practical fields.
4. To understand the basic working principle of various energy storage devices like capacitors, inductors and resistors.
5. To be able to apply the basics of transient circuit in alternating current analysis.
6. To understand the ac circuit and their practical applications in day to day life uses.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Analysis** of Resistive Circuits and Solution of resistive circuits with independent sources Understand the most important concepts like mesh and nodal analysis	PO 2	C4			K1	T, F
CO2	Two Terminal Element Relationships for inductors and capacitors and **analysis** of magnetic circuit.	PO 3	C4			K3	T, F
CO3	**Analysis** of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits	PO 2	C4			K3	MID TERM

CO4	Will be able to **explain** the concept of capacitance and inductance and the concept of two terminal linear devices.	PO 1	C1			K3, K4	MID TERM

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Circuit variables and elements: Voltage, current, power, energy, independent and dependent sources, resistance. Basic laws: Ohm's law, Kirchoff's current and voltage laws.
Simple resistive circuits: Series and parallel circuits, voltage and current division, wye-delta transformation.
Techniques of circuit analysis: Nodal and mesh analysis including supernode and supermesh. Network theorems: Source transformation, Thevenin's, Norton's and superposition theorems with applications in circuits having independent and dependent sources, maximum power transfer condition and reciprocity theorem.
Energy storage elements: Inductors and capacitors, series parallel combination of inductors and capacitors. Responses of RL and RC circuits: Natural and step responses.
Introduction to Alternating current: Instantaneous current, voltage, power, Effective current and voltage, average power, Phasors and complex quantities, impedance, real and reactive power, Series RL, RC and RLC circuits, analysis of three phase supply.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of previous and (or) subsequent lecture at home Preparation for final Exam	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Circuit Variables and Elements**	
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	CT 1
Class 2	Power and energy, Active elements, Passive elements, Independent and Dependent source	

	Class 3	Ohm's law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh		
	Week 2	**Series and Parallel DC Circuits**		
	Class 4	Series-parallel connection		
	Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit		
	Class 6	Analysis of voltage, current and power		
	Week 3	**Current Divider Rule and Voltage Divider Rule**		
	Class 7	Analysis of current in different branches		
	Class 8	Analysis of voltage in different parts of circuit		
	Class 9	Practice mathematical problems related to current divider and voltage divider rule.		
	Week 4	**Y-Δ and Δ-Y conversion**	CT2/ MID TERM	
	Class 10	Y to Δ conversion derivation		
	Class 11	Analysis of electrical circuits with Y-Δ connection		
	Class 12	Practice problems related to Y-Δ connection		
	Week 5	**Source Calculation Nodal Analysis**		
	Class 13	Multiple numbers of current and voltage source calculation		
	Class 14	Method of Obtaining Node voltages		
	Class 15	Various mathematical problems solving nodal analysis		
	Week 6	**Nodal and Mesh Analysis**		
	Class 16	Method of obtaining mesh currents using mesh analysis		
	Class 17	Method of obtaining mesh currents using mesh analysis		
	Class 18	Method of obtaining mesh currents using mesh analysis		
	Week 7	**Network Theorem**	CT2/ MID TERM	
	Class 19	Superposition Theorem and Application of Superposition Theorem		
	Class 20	Thevenin's Theorem Procedure		
	Class 21	Application of Thevenin Theorem and Norton's Theorem		
	Week 8	**Energy Storage Element- Capacitor & Inductor**		
	Class 22	Electric field and capacitance of capacitor and construction and types of capacitor		
	Class 23	Inductance, Inductance voltage		
	Class 24	Transient response of capacitive networks		
	Week 9	**Energy Storage Element-Capacitor**		
	Class 25	Transient response of capacitive networks- Charging phase		
	Class 26	Transient response of capacitive networks- Discharging phase		
	Class 27	Transient response of capacitive networks- initial condition and instantaneous value		
	Week 10	**Energy Storage Element-Inductor**	CT 3	
	Class 28	Transient response of capacitive networks- Charging phase		
	Class 29	Transient response of capacitive networks- Discharging phase		
	Class 30	Transient response of capacitive networks- initial condition and instantaneous value		
	Week 11	**Magnetic Circuits**		
	Class 31	Ohm‘s law and Ampere‘s circuital law		
	Class 32	Instantaneous current, voltage, power, Effective current and voltage, average power, Phasors.		
	Class 33	complex quantities, impedance, real and reactive power, Series RL, RC and RLC circuits, analysis of three phase supply.		
	Week 12	**AC Circuits**		
	Class 34	Instantaneous power		
	Class 35	Effective current and voltage, average power		
	Class 36	Phasors		
	Week 13	**AC Circuits**		
	Class 37	Complex quantities		
	Class 38	Impedance, real and reactive power		

Class 39	Series RL< RC and RLC circuits	
Week 14	**AC Circuits**	
Class 40	Analysis of three phase supply	
Class 41	Analysis of three phase supply	
Class 42	Analysis of three phase supply	

ASSESSMENT STRATEGY

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td>Class Test/ Assignment 1-3</td><td>20%</td><td>CO1, CO2</td><td>C4</td></tr>
<tr><td>Class Performance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Attendance</td><td>5%</td><td></td><td></td></tr>
<tr><td>Mid-Term Assessment (Exam/Project)</td><td>10%</td><td>CO3, CO4</td><td>C1, C4</td></tr>
<tr><td colspan="2" rowspan="2">Final Examination (Section A & B)</td><td rowspan="2">60%</td><td>CO 1</td><td>C4</td></tr>
<tr><td>CO 2</td><td>C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Fundamentals of Electric Circuit- Alexander & Sadiku.
2. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
3. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd.
4. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons

COURSE INFORMATION			
Course Code	: EECE 162	Contact Hours	: 3.00
Course Title	: Electrical Circuit Analysis-I Sessional	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuit practically.

OBJECTIVE

1. To learn about IC used in building up and development of any required circuit.
2. To know about design and implementation of any desire circuit.
3. To learn to generate desired output of any circuit
4. To compare the theoretical and practical values of circuit.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** an electronic device for application in real life adapting the desired requirements.	PO 5	P1			K6	R,Q,T
CO2	Be able to **construct** electrical circuits practically applying the knowledge of basic electrical components and networks.	PO 5	P4			K6	R,Q,T
CO3	Be able to **construct** an electrical device for application in real life adapting the desired requirements.	PO 9	P5			K6	Pr,PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 161 using different hardware equipment and simulation software.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Experiment	28
Self-Directed Learning	
Preparation of Lab Reports	30
Preparation of Lab-test	4
Preparation of Quiz	5
Preparation of Presentation	5
Engagement in Group Projects	24
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction of DC electrical circuits and various switches implemented for 220 Volts AC systems
Week 2	Implantation of Mesh analysis and verification of Kirchhoff's Voltage Law in a DC network.
Week 3	Implantation of Nodal analysis and verification of Kirchhoff's Current Law in a DC network.
Week 4	Verification of Superposition theorem in DC linear networks and its realization in practical field.
Week 5	Verification of Thevenin's theorem in DC networks and its realization in practical field.
Week 6	Lab Test-1
Week 7	Study of Wheatstone bridge and wye- delta circuit.
Week 8	Study of the various types of Alternating Current waveforms and their properties
Week 9	Experimental analysis of Non-linear circuit elements (R-L-C) and their effects on current and voltage
Week 10	Construction of Tuning Circuit using the concepts of series resonant R-L-C network.
Week 11	Construction of Wave Traps using the concepts parallel resonant R-L-C network.
Week 12	Lab Test-2
Week 13	Quiz and Viva
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	10%	CO 1	P1
			CO 2	P4
	Labtest-1, Labtest-2	30%	CO 1	P1
			CO 2	P4
	Project and Presentation	30%	CO 3	P5
Lab Quiz		30%	CO 1	P1

		CO 2	P4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd

COURSE INFORMATION

Course Code	: SHOP 108	Contact Hours	: 1.50
Course Title	: Workshop Technology Sessional – I	Credit Hours	: 0.75

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing and production. The workshop practical courses make students competent in handling practical work in engineering environment.

OBJECTIVE

1. To know about Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores, create molding by using molding sand and analyze metal melting and Casting inspection of casting and casting defects.
2. To know about Electric arc welding, Gas welding, Metal Inert Gas (MIG) welding, Tungsten Inert Gas (TIG) welding and analyze the procedure of different welding.
3. To create a congenial environment that promotes learning, growth and imparts ability to work with multi-disciplinary groups in professional, industry and research organizations.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** the basics concepts of Safety and precaution systems, tool handing and different types of manufacturing processes using modern tools.	PO3	P4			K5	R, Q, T , ASG, F

CO2	**Develop** practical skills by performing different manufacturing processes individually and/or in a team.	PO9	C4			K3	R, Q,T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Familiarization of Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores. Create molding by using molding sand.
2.	Analyze metal melting and Casting, inspection of casting and casting defects.
3.	Electric arc welding and analyze the procedure of arc welding. Resistance Welding and Spot Welding.
4.	Gas welding and analyze the procedure of Gas welding.
5.	Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and analyze the procedure of these both

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
Total	21
Self-Directed Learning	
Preparation of Lab Reports	05
Preparation of Lab Test	05
Preparation of presentation	03
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	07
Final Quiz	01
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
	Topic
Week 1	Familiarization of Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores. Create molding by using molding sand.
Week 2	Analyze metal melting and Casting, inspection of casting and casting defects.
Week 3	Electric arc welding and analyze the procedure of arc welding. Resistance Welding and Spot Welding.
Week 4	Lab Test-1
Week 5	Gas welding and analyze the procedure of Gas welding.
Week 6	Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and analyze the procedure of these both
Week 7	Lab Quiz

ASSESSMENT STRATEGY

Components	**Grading**	CO	Bloom's Taxonomy
Conduct Lab Test/ Class Performance	25%	CO 1	P4
		CO 2	C4
Report Writing/Programming	15%	CO 1	P4
		CO 2	C4
MID TERM Evaluation (exam/project/assignment)	20%	CO1	P4
Final Evaluation (Exam/project/assignment)	30%	CO1, CO2	C4, P4
Viva Voce/ Presentation	10%	CO1, CO2	C4, P4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Machine Shop Practice – James Anderson; W. A. Chapman.
2. Shop Theory –Anderson & Tatro.

COURSE INFORMATION			
Course Code	: SHOP 112	Contact Hours	: 1.50
Course Title	: Workshop Technology Sessional – II	Credit Hours	: 0.75

PRE-REQUISITE
Course Code: SHOP 108 Course Title: Workshop Technology Sessional –I

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing parts and production of samples. The workshop practical courses make students competent in handling practical work in engineering environment. This course gives undergraduates the opportunity to engage in machine shop operation under the supervision of qualified machine shop personnel. Students learn to operate the lathe, milling and drilling machines. The course may be repeated for credit multiple times, either on different topics (e.g., CNC coding).

OBJECTIVE
1. To Know about Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine and create part by doing different operations. 2. To learn to use CNC Milling machine to manufacture a part automatically by using a CAD drawing.

COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Demonstrate** the use of Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine.	PO5	P3			K6	R, Q, T, ASG, F
CO2	**Analyze** a job for CNC Milling machine to manufacture a part automatically by using a CAD	PO2	C4			K3	R, Q, T, F

	drawing.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; F – Final Exam)

COURSE CONTENT

Exp No	Exp Name
1.	Study of Lathe Machine and Its Various Operations in Manufacturing parts.
2.	Study of Milling Machine and Its Various Operations in Manufacturing gears.
3.	Study of Shaping Machine and Its Various Operations in Manufacturing grooves.
4.	Study of Drilling Machine and Its Various Operations.
5.	Study of CNC Machine and Its Various Operations in Manufacturing parts.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	07
Practical	14
Total	21
Self-Directed Learning	
Preparation of Lab Reports	05
Preparation of Lab Test	05
Preparation of presentation	03
Preparation of Quiz	05
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	07
Final Quiz	01
Total	57

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Study of Lathe Machine and Its Various Operations in Manufacturing parts.
Week 2	Study of Milling Machine and Its Various Operations in Manufacturing gears.
Week 3	Study of Shaping Machine and Its Various Operations in Manufacturing grooves.
Week 4	Lab Test-1
Week 5	Study of Drilling Machine and Its Various Operations.
Week 6	Study of CNC Machine and Its Various Operations in Manufacturing parts.
Week 7	Lab Quiz

ASSESSMENT STRATEGY

Components	**Grading**	**CO**	**Bloom's Taxonomy**
Conduct Lab Test/ Class Performance	25%	CO 1	P3
Report Writing/Programming	15%	CO 1	P3
MID TERM Evaluation (exam/project/assignment)	20%	CO1	P3
Final Evaluation (Exam/project/assignment)	30%	CO1, CO2	P3, C4
Viva Voce/ Presentation	10%	CO1, CO2	P3, C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Machine Shop Practice – James Anderson; W. A. Chapman.
2. Shop Theory –Anderson & Tatro.

COURSE INFORMATION			
Course Code Course Title	: ME 249 : Engineering Mechanics (Statics and Dynamics)	Contact Hours Credit Hours	: 4.00 : 4.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To provide the students with the basic knowledge in the mechanics of rigid body which will be helpful while studying strength of materials, aircraft structures etc.

OBJECTIVE

1. To be able to express and resolve the position and force into vector unit components.
2. To determine the forces in the members of trusses and frames using the method of joints and sections.
3. To draw and describe the free-body diagram and to solve the problems using the equations of equilibrium.
4. To determine to the location of centre of gravity and centric for a system and to determine the moment of inertia for an area.
5. To apply Newton's laws of motion and conservation principles to solve real life
6. To understand the principles and methods used in analyzing motion of a particle.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	**Explain** basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).	PO1	C2	K1			Q, ASG, F
CO2	**Demonstrate** use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems	PO2	C4	K2			Q, ASG, F
CO3	**Apply** scalar and vector analytical techniques for analyzing forces in statically determinate structures	PO5	C3	K6			Q, F, CS
CO4	**Evaluate** equilibrium of particles and bodies in real world problems.	PO2	C5	K2			Q, F, CS, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; CS – Case study, F – Final Exam)

COURSE CONTENT

a. Main Contents:

i. Properties of forces, moments, couples and resultants;
ii.Moment of inertia of areas and masses;
iii. Principle of work, energy, impulse and momentum
iv. System of particles;
v. Kinematics of rigid bodies

b. Detail Contents:

Statics of particles and rigid bodies; Properties of forces, moments, couples and resultants; Analysis of two- and three-dimensional problems; Centroids of lines, areas and volumes; Forces in truss, frames, and cables; Friction; Moments of inertia of areas and masses; Relative motion.

Planar mechanisms, linkages, mobility; instant centers of rotation, Kennedy's theorem; Velocity and acceleration polygons; Euler's first law; angular momentum and Euler's second law.

Kinetics of particles: Newton ‘s second law of motion; Principles of work, energy, impulse and momentum; System of particles; Kinematics of rigid bodies;

Kinetics of plane motion of rigid bodies: forces and acceleration; Principles of work and energy.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	70
Self-Directed Learning	84
Formal Assessment	6
Total	**160**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

	Topic	**CT**
Week-1	**Topic**	CT1
Class-1	Fundamental concepts and principles	
Class-2	Systems of units and conversion from one system of units to another	
Class-3	Forces in a plane	
Class-4	Forces on a particle: resultant of two forces	
Week-2	**Statics of Particles**	
Class-5	Addition of vectors	
Class-6	Resultant of several concurrent forces	
Class-7	Resolution of a force into components and rectangular components of a force: unit vectors	
Class-8	Equilibrium of a particle	CT2/ MID TERM
Week-3	**Rigid Bodies: Equivalent Systems of Forces**	
Class-9	Moment of a force about a point, given axis	
Class-10	Varignon’s theorem	
Class-11	Moment of a couple	
Class-12	Reduction of a system of forces to one force and one couple	
Week-4	**Equilibrium of Rigid Bodies**	

Class-13	Equilibrium in two dimensions	
Class-14	Equilibrium of a two force body	
Class-15	Equilibrium of a three force body	
Class-16	Equilibrium in three dimensions	
Week-5	**Distributed Forces: Centroids and Centres of Gravity**	
Class-17	Centre of Gravity of a two dimensional body	
Class-18	Determination of centroids by integration	
Class-19	Centre of Gravity of a three dimensional body	
Class-20	Determination of centroids of volumes by integration	
Week-6	**Analysis of structures**	
Class-21	Analysis of trusses by method of joints	
Class-22	Analysis of trusses by method of sections	
Class-23	Analysis of frames	
Class-24	Analysis of cables	
Week-7	**Friction**	
Class-25	Introduction	
Class-26	The Laws of Dry Friction, Coefficients of Friction	
Class-27	Angles of Friction	
Class-28	Problems involving Dry Friction	
Week-8	**Distributed Forces: Moments of inertia**	
Class-29	Moments of inertia of areas	
Class-30	Polar moment of inertia and radius of gyration of an area	
Class-31	Moments of inertia of a mass	
Class-32	Moments of inertia of composite bodies	
Week-9	**Instant centres of rotation, Kennedy's theorem, Velocity and acceleration polygons**	CT2/ MID TERM
Class-33	Instant centres of rotation	
Class-34	Kennedy's theorem	
Class-35	Velocity and acceleration polygons	
Class-36	Velocity and acceleration polygons	
Week-10	**Euler's First Law, Angular Momentum and Euler's Second law**	
Class-37	Euler's first law	
Class-38	Angular momentum	
Class-39	Angular momentum	
Class-40	Euler's second law	
Week 11	**Kinetics of Particles: Newton’s Second Law**	
Class-41	Newton’s second law of motion	
Class-42	Linear momentum of a particle : rate of change of linear momentum	
Class-43	Equations of motion	
Class-44	Annear momentum of a particle : rate of change of angular momentum	
Week 12	**Kinetics of Particles: Energy and Momentum Methods**	
Class45	Kinetic energy of a particle: principles of work and energy	CT3
Class-46	Applications of principles of work and energy	
Class-47	Principle of impulse and momentum	
Class-48	Problems involving energy and momentum	
Week 13	**System of Particles**	
Class-49	Linear and angular momentum of system of particles	
Class-50	Conservation of momentum of a system of particles	

Class-51	Kinetic energy of a system of particles	
Class-52	Principle of impulse and momentum of a system of particles	
Week 14	**Kinematics of rigid bodies**	
Class-53	Rotation about a fixed axis	
Class-54	General plane motion	
Class-55	Instantaneous centre of rotation in plane motion	
Class-56	Absolute and relative acceleration in plane motion	

ASSESSMENT STRATEGY

COs	**Assessment Method**	**(100%)**	**Remarks**
	Class Assessment		
CO1	Assignment	**20**	
CO2	Assignment	**20**	
	Exam		
CO1	Final Exam, CT	**80**	
CO2	Final Exam, CT, MID	**80**	
CO3	Final Exam, CT	**80**	
CO4	Final Exam, CT, Mid	**80**	

REFERENCE BOOKS

1. Vector Mechanics for Engineers: Statics and Dynamics – Ferdinand P. Beer, E Russell Jr. Johnstone; McGraw-Hill Companies, 5th edition 1988.
2. Engineering Mechanics - Timoshenko, D H Young, J V Rao
3. Engineering Mechanics – Andrew Pytel, JaonKiusaloas
4. Engineering Mechanics, Statics and Dynamics – Joseph F Shelley; McGraw-Hill, 1980.
5. Engineering Mechanics - J.L. Merian& LG Kraige