MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

SYLLABUS

BACHELOR OF SCIENCE
IN
AERONAUTICAL ENGINEERING

SYLLABUS 2018
RE-REVISED ON SEPTEMBER 2021

DEPARTMENT OF AERONAUTICAL ENGINEERING (AE)
MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)
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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).

1.2 Vision and Mission of MIST.

Vision:

To be a centre of excellence for providing advanced quality education in the field of scientific, engineering and technology advanced to create diverse quality leaders and professionals and conduct innovative research to meet the national and global needs and challenges.

Mission

MIST is working on following missions:

a. To develop as a Centre of Excellence for providing comprehensive education and conducting creative and innovative research in diverse disciplines of engineering, technology, science, management and related fields.

b. To produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the national and global needs for sustainable socio- economic development.

c. To provide consultancy, advisory and testing services to government, industrial, educational and other organizations to render technical support for widening practical knowledge and to contribute in sustainable socio-economic advancement.

d. To extend collaborative and research activities with national and international communities for life-long learning and long term interaction with the academician and industry.

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. **Integrity and Respect-** We embrace honesty, inclusivity, and equity in all that we do.
b. **Honesty and Accountability-** Our actions reflect our values, and we are accountable for both.
c. **Dedication to Quality and Intellectual Rigour-** We strive for excellence with energy, commitment and passion.
d. **Pursuit of Innovation-** We cultivate creativity, adaptability and flexibility in our students, faculty and staff.

1.4 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 minimum 'A+' (Plus) in any TWO(2) subjects out of FIVE (5) subjects including Mathematics, Physics, Chemistry, English, and Bengali and 'A' in rest THREE (3) subjects.

(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 'A' in ONE subject out of three subjects including Mathematics, Physics, and Chemistry with and minimum 'B' in rest TWO subjects.

(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.

1.5 Number of Seats.

The highest number of seats 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**	**Seats**
1	**A**	Civil Engineering (CE)	60
2		Computer Science and Engineering (CSE)	60
3		Electrical, Electronic and Communication Engineering (EECE)	60
4		Mechanical Engineering (ME)	60
5		Aeronautical Engineering (AE)	50
6		Naval Architecture and Marine Engineering (NAME)	40
7		Biomedical Engineering (BME)	40
8		Nuclear Science and Engineering (NSE)	40
9		Environmental, Water Resources & Coastal Engineering (EWCE)	60
10		Industrial and Production Engineering (IPE)	50
11		Petroleum and Mining Engineering (PME)	25
12	**B**	Architecture (Arch)	25
	Total		570

The total number is 570. In general, about 50% seats will be allocated to military officers. However, in case of the requirement of military students vacancy is less in any particular year, the deficient vacancy will be filled up by civil students. MIST also maintains quota as mentioned below:

Ser	Quota Allocation	Seats
1	General Candidates	54%
2	Children of Military Personnel	40%
3	Children of Freedom Fighters	2%
4	Tribal Citizen	1%
5	International Students	3%
	Total	100%

1.6 Admission Procedure

1.6.1 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.	Subjects	Marks
a.	Mathematics	60
b.	Physics	60
c.	Chemistry	60
d.	English	20
		Total = 200

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

1.6.3 Medical Check Up: Civil candidates selected through 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.

1.7 Students Withdrawal Policy

1.7.1 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.

1.7.2 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 Behaviours:** 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.

1.7.3 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 introduced course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This will be introduced with an aim of creating 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 5 in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow relaxation in this regard. This relaxation is to be reported to Academic Council of MIST.

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 Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on 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

2.3.1 There will be two terms (Spring and Fall) in an academic year. In addition to these two regular terms there will be a short term after the Fall Term of each academic session. During the short term, students can take only failed courses to cover up the credit deficiencies.

2.3.2 Respective departments will take the decisions about courses to be offered during each short term depending upon the availability of course teachers and number of students willing to take a particular course.

2.4 Duration of Terms

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

Ser	Events	Durations
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

2.4.2 The duration of a Short Term will be around 7 weeks of which about 6 weeks will be spent for class lectures and one week for Term Final Examination. The duration for Short Term and Examination will be as under:

Ser	Events	Durations
1.	Classes	6 weeks
2.	Final Examination	1 week
Total		**7 Weeks**

2.5 Course Pattern and Credit Structure

The undergraduate program is covered by a set of theoretical courses along with a set of laboratory (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 left most digit corresponds to the year in which the course is normally taken by the students. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

b. 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:

<u>AEAS</u> 101 **<u>Introduction to Aeronautical Engineering</u>**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1^{st} Year/ 1^{st} Level course
Department Identification(Aerospace Discipline)

<u>AEAS</u> 206 **<u>Mechanics of Solids Sessional</u>**

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

<u>AEAV</u> 101 **<u>Electrical Circuit Analysis – I</u>**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1^{st} Year/ 1^{st} Level course
Department Identification(Avionics Discipline)

<u>AEAV</u> 202 **<u>Electrical Circuit Analysis – II Sessional</u>**

Course Title
Even digit designates a sessional course
Reserved for departmental use Signifies 2^{nd} Year/ 2^{nd} Level course Department Identification(Avionics Discipline)

2.7 <u>Assignment of Credits</u>

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 the entire 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 <u>Course Registration</u>

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 **<u>Registration Procedure</u>.** 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 Limits on the Credit Hours to be taken

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 Commandant, a lesser number of credit hours to suit individual requirements. Such cases are also applicable to students of Level 4 requiring less than 15 credit hours for graduation.

2.12.7 Course Add/Drop

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 and only during the first week of a short term. Dropping a course is permitted within the first four weeks of a regular term and two weeks of a short term.

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:

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
Incomplete	I	-
Withdrawal	W	-
Project/ Thesis continuation	X	-

* 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. Thirty percent (30%) of marks of a theoretical course shall be allotted for continuous assessment, i.e. quizzes, home assignments, class tests, observations/ class participation and class attendance. 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 Participation/Observation	5%
Class Attendance	5%
Homework assignment/Quizzes/CTs	20%
Final Examination (Section A & B)	70%
Total	**100%**

2.14.2 <u>Sessional/Practical Examinations</u>. Sessional courses are designed and conducted by the concerned departments. Examination on 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 sessional courses on the basis of the followings (all or as decided by the Examination Sub-Committee):

a. Class Attendance
b. Class performance/observation
c. Lab Test/Report Writing/project work/Assignment
d. Quiz Test
e. Viva Voce

Total **100%**

2.14.3 <u>Sessional Course in English</u>. The distribution will be as under:

a. Class Attendance
b. Class performance/observation
c. Written Assignment
d. Oral Performance
e. Listening Skill
f. Group Presentation
g. Viva Voce

Total **100%**

2.15 <u>Basis for awarding marks for class attendance</u>.
This will be as follows:

	Marks
90% and above	100%
85% to less than 90%	80%
80% to less than 85%	60%
75% to less than 80%	40%
Below 75%	0%

2.16 Collegiate and Non-collegiate

Students having class attendance of 90% or above in individual subject will be treated as collegiate and less than 90% and up to 75% 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 75% 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 Calculation of GPA

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

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

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

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

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
AEAS 110	1.50	A-	3.50	5.250
AEAS 101	3.00	A+	4.00	12.000
CHEM 105	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
CSE112	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 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

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 GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20.

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 hour 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 the 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 their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and backlog courses, 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 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.

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. The university 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. **Short Term Examination:** Short Term may be conducted after one week completion of Term 2 final examination. Students will be allowed to take maximum three theoretical courses in the Short Term. Examination will be conducted at the end of Short Term (6^{th} week class). However, Head of concerned department with the approval of Commandant may decide to take Supplementary examination instead of Short Term. No Laboratory/Sessional Courses can be taken in short term.

c. **Supplementary Examination:** It will take place once in a year, after each term-I final break. It should be completed within first 3 weeks of a new term. Students will be allowed to appear this examination for one subject at a time. Graduating students will be allowed to appear maximum two subjects during supplementary examination in their last Term. However, Head of the concerned department with the approval of Commandant may decide to take another Supplementary Examination instead of Short Term. In that case, a student will be allowed to take only one failed course in the particular Supplementary Examination. This examination will be conducted in the previous week of the beginning of Term I. Highest achieved grade for all courses of Supplementary Examination will be B+.

d. **Improvement Examination:** It will be taken during supplementary and short term examination. Questions will be same as the question of the regular examination of that Short Term Final Examination (if any). Student can take two subject at a time 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.

e. **Self-Study Course Examination:** Only graduating students (level-4) will be allowed to appear at Self Study course examination. It will be taken with Term Final Examination. No regular class will be arranged for this, but teachers will be assigned for supervising and guiding the students for study, conducting class test/quiz and regular assessment for 30% marks. Maximum two theory courses may be taken as self-study course by a student. Highest achieved grade for these courses will be B+. In that case a student will be allowed to take maximum 24 credit instead of 15 in the last Term of his/her graduation.

f. **Special Referred Examination:** Since course system will start from 1st Term of 2018, for all casualty cases like referred, backlog, failed courses, level repeat students will be given chance to clear their respective all failed courses by appearing in this examination. It will be held after the confirmation of the result of Term-II Final Examination of 2017 and before starting of the class of the Term-I of 2018. Students of all levels, failed in any courses even after appearing in Special Referred Examination-1, will be allowed to re-appear again in the failed courses during Special Referred Examination-2 to be held during Mid Term break of Term-1 of 2018. Student of Level-4 of 2017, failed in any courses even after appearing in these two referred examinations, will be allowed to clear failed courses as a last chance, during Term-1 final examination of 2018 (as a Special Referred Examination-3). Students of other levels, failed in any courses even after appearing in two Special Referred Examinations, will be allowed to clear these failed courses as per normal rules of course system (either by retaking these courses or appearing at the supplementary Examination). Highest grade for courses in all these examinations will be 'B+'.

2.30 Rules of Different Examinations

2.30.1 Term Final Examination:

Following rules to be followed:

a. Registration to be completed before commencement of the class. 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 first one week 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 Short Term Examination:

Following rules to be followed:

a. Short Term for period of 6 weeks may be offered by a department after one week of completion of Term II Final Examination.

b. Short Term Final Examination is to be conducted on 7th week of Short Term.

c. Only repeat course can be offered, not any fresh course.

d. Classes will be arranged for the students who register a failed course in the Short Term.

e. After 6 (six) weeks of class, in the 7th week short Term Examination will be held. Academic calendar for this Short Term will be declared by the Department during the Mid-Term break of Term-II.

f. One student can take only three (failed/improvement) courses at a time in the Short Term.

g. Students will have to complete registration of course for Short Term by paying all the fees, before starting of the Term-II final Exam.

h. Graduating students may register for Short Term examinations after finalization of result of T 2 final examination.

j. Maximum grading will be ‘B+’.

k. Question Setting, Moderation, Result Publication will be done following the same rules of Term Final Exam as per Exam Policy. Separate Tabulation sheet will be made for this examination.

l. However, Head of concerned department with the approval of Commandant may decide to take Supplementary Examination instead of Short Term.

2.30.3 <u>Supplementary Examination</u>:

Following rules to be followed:

a. After the final break of every Term-I, Supplementary Examination will be held (once in a year).

b. Examination will be taken on 70% marks like Term Final examination. Remaining 30% marks on continuous assessment earned previously in that particular course will be counted. If a student fails in a course more than once in regular terms, then best one of all continuous assessment marks will be counted.

c. A student will be allowed to take one course at a time for each supplementary examination, but in the graduating Term one student can take two courses if required.

d. Highest grade of supplementary examination will be 'B+'.

e. Registration for supplementary courses to be done during the mid-term break of Term 1, paying the required fees.

f. Examination will be completed after Term I End break within three weeks of Term II.

g. If any student fails in a course, he can clear the course retaking it 2^{nd} time or, he can clear the examination appearing at the supplementary examination as well. But anyone fails twice in a course consecutively, he has to take approval of Academic Council of MIST for appearing third/last time in a course and need to pay extra financial penalty.

h. If anyone fails in the sessional course, that course cannot be cleared in the supplementary examination.

j. Question setting, Moderation, Result Publication will be done following the same rules of Term Final Examination as per Examination Policy.

k. However, Head of the concerned department with the approval of Commandant may decide to take another Supplementary Examination instead of Short Term. In that case, a student will be allowed to take only one failed course in that particular Supplementary Examination. This examination will be conducted in the previous week of the beginning of Term 1. Registration of that Supplementary Examination should be completed during registration of Short Term course.

2.30.4 <u>Improvement Examination</u>:

Following rules to be followed:

a. 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.

b. Highest grade of Improvement examination will be 'B+'.

c. 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.

d. For Improvement examination, registration is to be done before Term 2 Final Examination with the Short Term Courses or, during the registration of Supplementary Courses by paying all the fees.

e. Improvement examination to be taken during the supplementary and short term examinations.

f. Choice of Improvement course is restricted within the offered courses of that Short Term by the Departments and in two courses at a time.
g. Question Setting, Moderation and Result Publication to be done with courses of regular Term Final Examination.

2.30.5 <u>Self-Study Course and Examination</u>:

Following Rules to be followed:
a. An irregular student for completion of his graduation can take maximum two repeat courses as self-study course in the graduating Term if he desires and is accepted by department.
b. One student can take maximum 24 credit hours course in the graduating Term to complete his graduation.
c. Registration for self-study course by paying all fees, must be completed with other course of regular Term.
d. To run the self-study course, concerned Department will assign one teacher each for every self-study course offered. No regular theory class will be held, but that assigned teacher will take necessary class Tests, Quiz Test and give attendance and observation marks to give 30% marks at the end of the Term. For remaining 70% marks written examination will be taken with the Term Final Examination.
e. Assigned teacher for self-study examination will be responsible for setting questions of 70% marks and other examination formalities.
f. Question Setting, Moderation, and Result Publication to be done with courses of Term Final Examination.
g. Grading of Self Study course and examination will be maximum 'B+'.

2.30.6 <u>Special Referred Examination</u>:

Following rules will be followed:
a. Immediately after the finalization of result of Term-2 final exam of 2017, for all failed/leftover courses, special referred examination will be arranged and students will have to register the courses for the examination by paying required fees and charges. Following the registration, Admit Card will be issued.
b. Examination will be held before commencement of Term-1 of 2018.
c. One student can appear at all of his failed courses (Referred/Backlog) in the Referred Examination including present level-repeat students.
d. Highest grade for all courses in this Examination will be 'B+'.
e. Question Setting, Moderation and Result Publication will be done following the same rules of Term Final Examination as per Examination Policy.
f. Separate Tabulation Sheet will be made for this special referred examination.

2.31 <u>Irregular Graduation</u>

If any graduating student clears his/her failed course in Term-1 and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Term-1 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 **160.5 credits & 191 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 Aeronautical Engineering undergraduate program provides an excellent technical background for persons who want to work in the field of Aerodynamics, Jet Propulsion, Structural Analysis, 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.

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 <u>Vision and Mission of the Program</u>

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 be able to solve critical technical problems related to Aeronautical Engineering.

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

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 post graduate and doctorate and excel in academic and research careers.

5. Our graduates will be able to positively contribute in national and global socio economic development.

3.4 Learning Outcomes/Program Outcomes (PO)

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

a) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
b) **Problem analysis:** 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/development of solutions**: 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) **Investigation:** Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
e) **Modern tool usage:** 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) **The engineer and society:** 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) **Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
h) **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.

i) Individual work and teamwork: Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.
j) Communication: 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) Project management and finance: 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) Life-long learning: 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

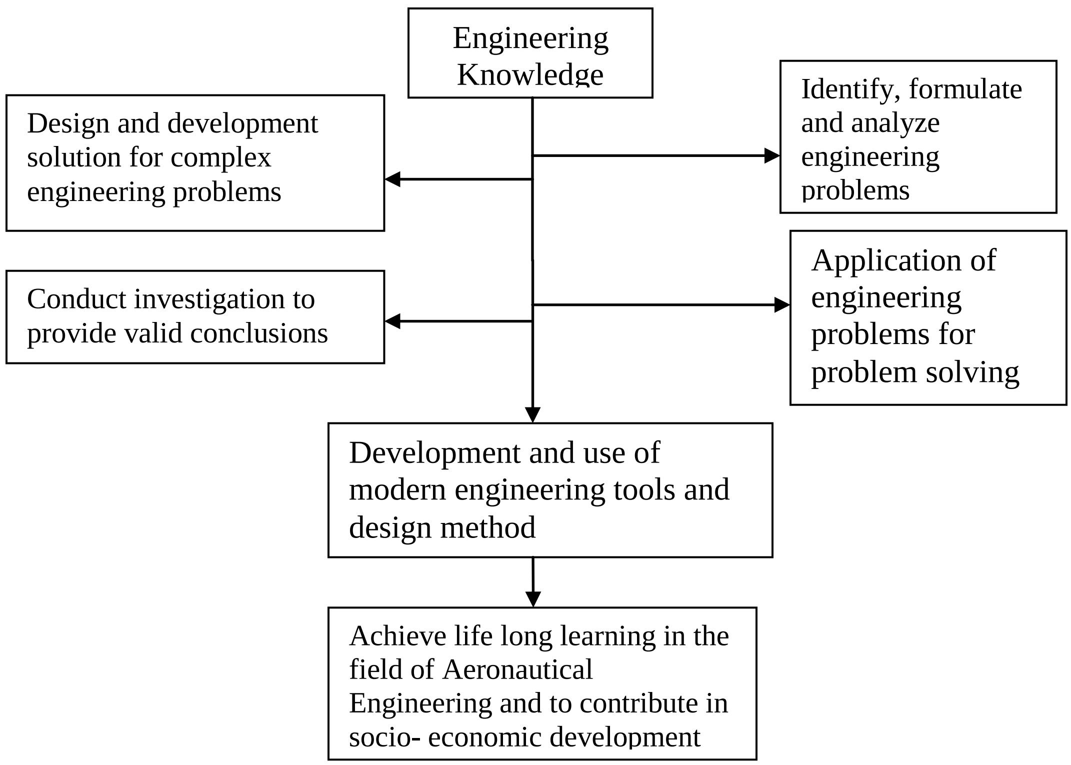
No	POs Statement	PEO-I	PEO-2	PEO-3	PEO-4	PEO-5
I.	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**Yes**	No	No	No	No
2.	**Problem analysis:** Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.	**Yes**	**Yes**	No	No	No
3.	**Design/development of solutions**: 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.	**Investigation:** Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	No	No	No	**Yes**	No
5.	**Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an	No	**Yes**	**Yes**	**Yes**	No

	understanding of the limitations.					
6.	**The engineer and society:** 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.	**Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.	**Yes**	No	No	No	**Yes**
8.	**Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.	No	**Yes**	No	No	No
9.	**Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.	No	**Yes**	No	No	**Yes**
10.	**Communication:** 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.	**Project management and finance:** 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.	**Life-long learning:** 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	No

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

Keeping the above mentioned program outcome, the course schedule for the undergraduate students of the Department of Aeronautical Engineering (AE) is given below:

Summary of Course Curriculum for Aerospace Discipline

Level/ Term	Humanities	Math	Basic Science	Dept Engg courses	Optional courses	Total
1-I	-	6.00	3.00+1.50	6.00+3.75	-	20.25
1-II	3+1.50	3.00	6.00+1.50	3.00+2.25	-	20.25
2-I	3.00	3.00	-	10.00+2.25	-	18.25
2-II	-	3.00	-	12.00+4.50	-	19.50
3-I	3.00	-	-	15.00+3.75	-	21.75
3-II	-	-	-	19.00+2.50	-	21.50
4-1	-	-	-	**12.00+5.25**	3.00	**20.25**
4-II	3.00	-	-	**6.00+3.75**	**6.00**	18.75
% Of Total Course	**8.41%**	**9.35%**	**7.47%**	**69.15%**	**5.60%**	-
Total Credit Hr	13.50	15.00	12.00	**111.00**	**9.00**	**160.5**

Summary of Course Curriculum for Avionics Discipline

Level/ Term	Humanities	Math	Basic Science	Dept Engg courses	Optional courses	Total
1-I	-	6.00	3.00+1.5	6.00+3.75	-	20.25
1-II	3+1.50	3.00	6.00+1.50	3.00+2.25	-	20.25
2-I	3.00	3.00	-	13.00+2.25	-	21.25
2-II	-	3.00	-	12.00+4.50	-	19.50
3-I	3.00	-	-	15.00+3.00	-	21.00
3-II	-	-	-	15.00+3.25	-	18.25
4-1	-	-	-	**12.00+5.25**	3.00	**20.25**
4-II	3.00	-	-	**7.00+3.75**	**6.00**	19.75
% Of Total Course	**8.41%**	**9.35%**	**7.47%**	**69.15%**	**5.60%**	-
Total Credit Hr	13.50	15.00	12.00	**111.00**	**9.00**	**160.5**

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	15.00	10.50	15.00	5.25	25.50	20.25
1/II	15.00	10.50	15.00	5.25	25.50	20.25
2/I	16.00	4.50	16.00	2.25	20.50	18.25
2/II	15.00	9.00	15.00	4.50	24.00	19.50
3/I	18.00	7.50	18.00	3.75	25.50	21.75
3/II	19.00	3.00+8 weeks	19.00	2.50	22.00+ 8 weeks	21.50
4/I	15.00	**10.50**	15.00	**5.25**	**25.50**	**20.25**
4/II	**15.00**	**7.50**	**15.00**	**3.75**	**22.50**	18.75
For (Aerospace)	**128.00**	**63.00**+8 weeks	**128.00**	**32.50**	**191.00+8weeks**	**160.5**

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	15.00	10.50	15.00	5.25	25.50	20.25
1/II	15.00	10.50	15.00	5.25	25.50	20.25
2/I	19.00	4.50	19.00	2.25	23.50	21.25
2/II	15.00	9.00	15.00	4.50	24.00	19.50
3/I	18.00	6.00	18.00	3.00	24.00	21.00
3/II	15.00	4.50+8 weeks	15.00	3.25	19.5+8weeks	18.25
4/I	15.00	**10.50**	15.00	**5.25**	**25.50**	**20.25**
4/II	**16.00**	**7.50**	**16.00**	**3.75**	**23.50**	19.75
For (Avionics)	**128.00**	**63.00+ 8 Weeks**	**128.00**	**32.50**	**191.00 + 8 weeks**	**160.5**

4.3 Final Year Project/Thesis

Project/thesis will have to be undertaken by students under a supervisor in partial fulfillment of the requirement of his/her degree. Credits allotted to the project/thesis 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	Pg. No
PHY 115	Physics I (Waves and Oscillation, Optics and Thermal Physics)	Theory	3.00	3.00	362
AEAV 101	Electrical Circuit Analysis-I	Theory	3.00	3.00	210
MATH 121	Math I (Differential and Integral Calculus)	Theory	3.00	3.00	377
MATH 127	Math II (Vector Analysis, Matrix and Coordinate Geometry)	Theory	3.00	3.00	381
AEAS 103	Fundamentals of Aeronautical Engineering	Theory	3.00	3.00	42
Subtotal (Theory)			**15**	**15.00**	
PHY 116	Physics Sessional	Sessional	3.00	1.50	366
AEAV 102	Electrical Circuit Analysis-I Sessional	Sessional	3.00	1.50	214
SHOP 108	Workshop Technology Sessional –I	Sessional	1.50	0.75	417
AEAS 110	Aeronautical Engineering Drawing-1	Sessional	3.00	1.50	46
Subtotal (Sessional)			**10.50**	**5.25**	
Total = Contact hours: 25.50; Credits: 20.25					

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

Course No	Course Name	Type of Course	Contact hours	Credits	Pg. No
PHY 117	Phy II (Electricity and Magnetism, Modern Physics and Mechanics)	Theory	3.00	3.00	368
CHEM 107	Chemistry (Atomic Structure, Thermo-chemistry and Chemistry of Engineering Materials)	Theory	3.00	3.00	372
MATH 129	Math III (Ordinary and Partial Differential Equations)	Theory	3.00	3.00	386
AEAV 103	Computer Programming and Applications	Theory	3.00	3.00	216
HUM 111	English	Theory	3.00	3.00	398
Subtotal (Theory)			**15.00**	**15.00**	
HUM 112	Technical Report Writing and Presentation	Sessional	3.00	1.50	403
CHEM 108	Chemistry Sessional	Sessional	3.00	1.50	375
AEAV 104	Computer Programming and Applications Sessional	Sessional	3.00	1.50	221
SHOP 112	Workshop Technology Sessional –II	Sessional	1.50	0.75	420
Subtotal (Sessional)			**10.50**	**5.25**	
Total = Contact hours: 25.50; Credits: 20.25					

LEVEL 2, TERM-I (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAS 201	Engineering Mechanics (Statics and Dynamics)	Theory	4.00	4.00	48
AEAV 205	Numerical Analysis and Application	Theory	3.00	3.00	235
AEAV 203	Electronics-I	Theory	3.00	3.00	229
MATH 223	Math IV (Complex Variable and Laplace Transform)	Theory	3.00	3.00	390
HUM 211	Principles of Accounting	Theory	3.00	3.00	406
		Subtotal (Theory)	**16.00**	**16.00**	
AEAV 206	Numerical Analysis and Application Sessional	Sessional	3.00	1.50	236
AEAV 204	Electronics-I Sessional	Sessional	1.50	0.75	233
		Subtotal (Sessional)	**4.50**	**2.25**	
Total = Contact hours: 20.50; Credits: 18.25					

LEVEL 2, TERM-I (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAV 203	Electronics-I	Theory	3.00	3.00	229
AEAV 201	Electrical Circuit Analysis- II	Theory	3.00	3.00	223
AEAV 205	Numerical Analysis and Applications	Theory	3.00	3.00	235
AEAS 201	Engineering Mechanics (Statics and Dynamics)	Theory	4.00	4.00	48
MATH 223	Math IV (Complex Variable and Laplace Transform)	Theory	3.00	3.00	390
HUM 211	Principles of Accounting	Theory	3.00	3.00	406
		Subtotal (Theory)	**19.00**	**19.00**	
AEAV 202	Electrical Circuit Analysis- II Sessional	Sessional	3.00	1.50	227
AEAV 226	Numerical Analysis and Applications Sessional	Sessional	1.50	0.75	236
		Subtotal (Sessional)	**4.50**	**2.25**	
Total = Contact hours: 23.50; Credits: 21.25					

LEVEL 2, TERM-II (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAS 203	Fundamentals of Fluid Mechanics	Theory	3.00	3.00	52
AEAS 205	Mechanics of Solids	Theory	3.00	3.00	58
AEAS 207	Thermodynamics	Theory	3.00	3.00	64
AEAS 215	Aircraft Aerospace Systems	Theory	3.00	3.00	72
MATH 225	Math V (Fourier Analysis and Statistics)	Theory	3.00	3.00	394
		Subtotal (Theory)	**15.00**	**15.00**	
AEAS 206	Mechanics of Solids Sessional	Sessional	3.00	1.50	62
AEAS 204	Fundamentals of Fluid Mechanics Sessional	Sessional	1.50	0.75	56
AEAS 208	Thermodynamics Sessional	Sessional	1.50	0.75	68
AEAS 210	Aeronautical Engineering Drawing-II	Sessional	3.00	1.50	70
		Subtotal (Sessional)	**9.00**	**4.50**	
Total = Contact hours: 24.00; Credits: 19.50					

LEVEL 2, TERM-II (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAV 215	Electronics-II	Theory	3.00	3.00	241
AEAV 209	Electro-Mechanical System	Theory	3.00	3.00	247
AEAS 203	Fundamentals of Fluid Mechanics	Theory	3.00	3.00	52
AEAS 207	Thermodynamics	Theory	3.00	3.00	64
MATH 225	Math V (Fourier Analysis and Statistics)	Theory	3.00	3.00	394
		Subtotal (Theory)	**15.00**	**15.00**	
AEAV 216	Electronics-II Sessional	Sessional	3.00	1.50	245
AEAV 210	Electro-Mechanical System Sessional	Sessional	1.50	0.75	251
AEAS 208	Thermodynamics Sessional	Sessional	1.50	0.75	68
AEAS 210	Aeronautical Engineering Drawing-II	Sessional	3.00	1.50	70
		Subtotal (Sessional)	**9.00**	**4.50**	
Total = Contact hours : 24.00 ; Credits hours : 19.50					

LEVEL 3, TERM-I (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAS-301	Heat Transfer	Theory	3.00	3.00	78
AEAS-335	Applied Aerodynamics	Theory	3.00	3.00	84
AEAS-337	Aerospace Propulsion	Theory	3.00	3.00	90
AEAS-307	Aircraft Loading & Structure Analysis	Theory	3.00	3.00	97
AEAS-331	Material Science & Aerospace Materials	Theory	3.00	3.00	101
HUM 305	Economics	Theory	3.00	3.00	410
	Subtotal (Theory)		**18.00**	**18.00**	
AEAS-336	Applied Aerodynamics Sessional	Sessional	1.50	0.75	88
AEAS-338	Aerospace Propulsion Sessional	Sessional	1.50	0.75	95
AEAS-322	Heat Transfer Sessional	Sessional	3.00	1.50	82
AEAS-332	Material Science & Aerospace Materials Sessional	Sessional	1.50	0.75	105
	Subtotal (Sessional)		**7.5**	**3.75**	
	Total = Contact hours : 25.50 ; Credits : 21.75				

LEVEL – 3, TERM – I (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAV 301	Digital Systems	Theory	3.00	3.00	253
AEAV 303	Signals and Systems	Theory	3.00	3.00	260
AEAS 337	Aerospace Propulsion	Theory	3.00	3.00	90
AEAV 309	Aircraft Avionics Systems	Theory	3.00	3.00	276
AEAS 335	Applied Aerodynamics	Theory	3.00	3.00	84
HUM 305	Economics	Theory	3.00	3.00	410
Subtotal (Theory)			**18.00**	**18.00**	
AEAV 302	Digital Systems Sessional	Sessional	3.00	1.50	257
AEAS-338	Aerospace Propulsion Sessional	Sessional	1.50	0.75	95
AEAS 336	Applied Aerodynamics Sessional	Sessional	1.50	0.75	88
Subtotal (Sessional)			**6.00**	**3.00**	
Total = Contact hours: 24.00; Credits hours: 21.00					

LEVEL 3, TERM-II (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAS 313	High Speed Aerodynamics	Theory	3.00	3.00	107
AEAS 315	Aerospace Vehicle Stability and Control	Theory	3.00	3.00	111
AEAS 317	Mechanics of Structures, Structural Vibration and Aero Elasticity	Theory	4.00	4.00	115
AEAS 319	Machine Design	Theory	3.00	3.00	125
AEAV 329	Measurement and Aircraft Instruments	Theory	3.00	3.00	
AEAS 325	Computational Fluid Dynamics	Theory	3.00	3.00	119
		Subtotal (Theory)	**19.00**	**19.00**	
AE 300	Industrial Training	Sessional	8 Weeks	1.00	76
AEAV 330	Measurement and Aircraft Instruments Sessional	Sessional	1.50	0.75	287
AEAS 326	Computational Fluid Dynamics Sessional	Sessional	1.50	0.75	123
		Subtotal (Sessional)	**3.00+8 weeks**	**2.50**	
				Total = Contact hours : 22.00+8weeks; Credits : 21.50	

LEVEL –3, TERM – II (Avionics)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAV 305	Communication Engineering	Theory	3.00	3.00	264
AEAV 307	Electro-Magnetic Field Theory	Theory	3.00	3.00	271
AEAV 313	Digital Signal Processing	Theory	3.00	3.00	281
AEAV 329	Measurement and Aircraft Instruments	Theory	3.00	3.00	287
AEAS 315	Aerospace Vehicle Stability and Control	Theory	3.00	3.00	111
		Subtotal (Theory)	**15.00**	**15.00**	
AE 300	Industrial Training	Sessional	8 weeks	1.00	76
AEAV 306	Communication Engineering Sessional	Sessional	1.50	0.75	269
AEAV 324	Digital Signal Processing Sessional	Sessional	1.50	0.75	285
AEAV 330	Measurement and Aircraft Instruments Sessional	Sessional	1.50	0.75	292
		Subtotal (Sessional)	**4.50+8 weeks**	**3.25**	
				Total = Contact hours : 19.50 +8 weeks; Credit hours : 18.25	

LEVEL 4, TERM-I (Aerospace)

Course No	Course Name	Type of Course	Contact hours	Credits	Pg. No
AEAS 437	Aerospace Vehicle Design	Theory	3.00	3.00	132
AEAS 439	Rotor-dynamics and Aircraft Performance	Theory	3.00	3.00	138
AEAS 447	Space Engineering	Theory	3.00	3.00	142
AEAV 411	Control System Engineering	Theory	3.00	3.00	303
AEAS XXX	Selected from prescribed optional Courses	Theory	3.00	3.00	
		Subtotal (Theory)	**15.00**	**15.00**	
AEAS 480	**Final Year Design and Research Project**	Sessional	6.00	3.00	315
AEAV 412	Control Systems Engineering Sessional	Sessional	1.50	0.75	307
AEAS 438	Aerospace Vehicle Design Sessional	Sessional	3.00	1.50	136
		Subtotal (Sessional)	**10.50**	**5.25**	
				Total = Contact hours : 25.50; Credit hours : 20.25	

LEVEL 4, TERM-I (Avionics)

Course No	Course Name	Type of Course	Contact hours	Credits	Pg. No
AEAV 401	Microwave Engineering	Theory	3.00	3.00	297
AEAV 411	Control Systems Engineering	Theory	3.00	3.00	303
AEAV 407	Radar Engineering	Theory	3.00	3.00	309
AEAS 447	Space Engineering	Theory	3.00	3.00	142
AEAV XXX	Selected from prescribed optional Courses	Theory	3.00	3.00	
		Subtotal (Theory)	**15.00**	**15.00**	
AEAV 480	**Final Year Design and Research Project**	Sessional	6.00	3.00	315
AEAV 408	Radar Engineering Sessional	Sessional	1.5	0.75	312
AEAV 412	Control Systems Engineering Sessional	Sessional	1.50	0.75	307
AEAV 442	Microwave Engineering Sessional	Sessional	1.50	0.75	301
		Subtotal (Sessional)	**10.50**	**5.25**	
				Total = Contact hours : 25.50; Credit hours : 20.25	

Note: List of AEAS/AEAV XXX and AEAS/AEAV YYY is given in para 4.5 & 4.6

LEVEL 4, TERM-II (Aerospace)

Course No	Course Name	Type of course	Contact hours	Credits	Pg. No
AEAS 407	Turbo Machinery	Theory	3.00	3.00	150
AEAS 445	Industrial and Business Management	Theory	3.00	3.00	146
HUM 421	Engineering Ethics and Society	Theory	3.00	3.00	414
AEAS-YYY	Select from prescribed optional courses	Theory	3.00	3.00	
AEAS/ AEAV-ZZZ	**Select from prescribed optional courses**	**Theory**	**3.00**	**3.00**	
		Subtotal (Theory)	**15.00**	**15.00**	
AEAS 480	**Final Year Design and Research Project**	Sessional	6.00	3.00	315
AEAS 408	Turbo Machinery Sessional	Sessional	1.50	0.75	154
		Subtotal (Sessional)	**7.50**	**3.75**	
				Total = Contact hours : 22.50 ; Credits : 18.75	

LEVEL – 4, TERM – II (Avionics)

Course No	Course Name	Type of Course	Contact hours	Credits	Pg. No
AEAV 443	Aircraft Communication and Navigation	Theory	4.00	4.00	317
AEAS 445	Industrial and Business Management	Theory	3.00	3.00	146
AEAV YYY	Select from prescribed optional courses	Theory	3.00	3.00	
AEAS/ AEAV-ZZZ	**Select from prescribed optional courses**	**Theory**	**3.00**	**3.00**	
HUM 421	Engineering Ethics and Society	Theory	3.00	3.00	414
		Subtotal (Theory)	**16.00**	**16.00**	
AEAS 480	**Final Year Design and Research Project**	Sessional	6.00	3.00	315
AEAV 444	Aircraft Communication and Navigation Sessional	Sessional	1.50	0.75	322
		Subtotal (Sessional)	**7.50**	**3.75**	
				Total = Contact hours : 23.50 Credit: 19.75	

Note: List of AEAS/AEAV XXX and AEAS/AEAV YYY is given in para 4.5 & 4.6

4.5 List of Elective Courses for Aerospace Discipline

Sr. No.	Course Code	Course Name	Level/ Term	Contact hours	Credits
1.	AEAS 419	Maintenance Management and Repair of Aircraft	4-I/ 4-II	3.00	3.00
2.	AEAS 421	Aviation Safety	4-I/ 4-II	3.00	3.00
3.	AEAS 423	Aerospace Management	4-I/ 4-II	3.00	3.00
4.	AEAS 425	Pressurization and Air Conditioning systems	4-I/ 4-II	3.00	3.00
5.	AEAS 427	Noise, Control and Vibration	4-I/ 4-II	3.00	3.00
6.	AEAS 429	Rotorcrafts Performance	4-I/ 4-II	3.00	3.00
7.	AEAS 431	Weapons Engineering	4-I/ 4-II	3.00	3.00
8.	AEAS 435	Aircrafts Structural Design	4-I/ 4-II	3.00	3.00
9.	AEAS 455	Human Performance and Limitations	4-I/ 4-II	3.00	3.00
10.	AEAS 457	Airworthiness Legislations	4-I/ 4-II	3.00	3.00
11.	AEAS 459	Entrepreneurship Development	4-I/ 4-II	3.00	3.00
12.	AEAS 461	Advanced Materials Processing Technologies	4-I/ 4-II	3.00	3.00
13.	AEAS 463	Fluid Power and Control	4-I/ 4-II	3.00	3.00
14.	AEAS 449	Space Engineering- II	4-I/ 4-II	3.00	3.00
15.	AEAV451	Avionics Technology	4-I/4-II	3.00	3.00

4.6 List of Elective Courses for Avionics Discipline

Sr. No.	Course Code	Course Name	Level/ Term	Contact hours	Credits
1.	AEAV 413	Mobile Cellular Communication	4-I/ 4-II	3.00	3.00
2.	AEAV 415	Satellite Communication	4-I/ 4-II	3.00	3.00
3.	AEAV 417	Optoelectronics	4-I/ 4-II	3.00	3.00
4.	AEAV 419	Electronics Warfare	4-I/ 4-II	3.00	3.00
5.	AEAV 421	Optical Fiber Communication	4-I/ 4-II	3.00	3.00
6.	AEAV 435	Computer Networks	4-I/ 4-II	3.00	3.00
7.	AEAS 419	Maintenance Management and Repair of Aircraft	4-I/ 4-II	3.00	3.00
8.	AEAS 421	Aviation Safety	4-I/ 4-II	3.00	3.00
9.	AEAS 423	Aerospace Management	4-I/ 4-II	3.00	3.00
10.	AEAS 431	Weapons Engineering	4-I/ 4-II	3.00	3.00
11.	AEAS 455	Human Performance and Limitations	4-I/ 4-II	3.00	3.00
12.	AEAS 457	Airworthiness Legislations	4-I/ 4-II	3.00	3.00
13.	AEAS 459	Entrepreneurship Development	4-I/ 4-II	3.00	3.00
14.	AEAV 409	Microprocessors and Interfacing	4-I/ 4-II	3.00	3.00
14.	AEAS 449	Space Engineering- II	4-I/ 4-II	3.00	3.00
15.	AEAV 403	Electric and Magnetic Properties of Materials	4-I/ 4-II	3.00	3.00

4.7 Equivalence of Courses

Syllabus September 2014		Syllabus September 2018	
Course Code	**Course Name**	**Course Code**	**Course Name**
AEAS 101	Introduction to Aeronautical Engineering	AEAS 103	Fundamentals of Aeronautical Engineering
MATH 123	Math II (Complex Variables and Vector Analysis)	MATH 127	Math II (Vector Analysis, matrix and coordinate geometry
CHEM 105	Chemistry (Atomic Structure, Thermochemistry and Chemistry of Engineering Materials	CHEM 107	Chemistry (Atomic Structure, Thermochemistry and Chemistry of Engineering Materials
MATH 125	Math III (Ordinary and Partial Differential Equations and Laplace Transform)	MATH 129	Math III (Ordinary and Partial Differential Equations)
CHEM 106	Chemistry Sessional	CHEM 108	Chemistry Sessional
MATH 221	Math IV (Matrices, Coordinate Geometry and Harmonic Analysis	MATH 223	Math IV (complex variables and Laplace transform
HUM 209	Sociology	HUM 421	Society, Culture and Engineering Ethics
AEAV 217	Aircraft Electrical System	AEAV 209	Electro-Mechanical System
AEAV 218	Aircraft Electrical System Sessional	AEAV 210	Electro-Mechanical System Sessional
AEAS 303	Applied Aerodynamics and Computational Fluid Dynamics (CFD	AEAS-335	Applied Aerodynamics
		AEAS 325	Computational Fluid Dynamics

Syllabus September 2014		Syllabus September 2018	
Course Code	**Course Name**	**Course Code**	**Course Name**
AEAS 324	Applied Aerodynamics and CFD Sessional	AEAS 336	Applied Aerodynamics Sessional
		AEAS 326	Computational Fluid Dynamics Sessional
AEAS 305	Aerospace Propulsion	AEAS-337	Aerospace Propulsion
AEAS 306	Aerospace Propulsion Sessional	AEAS-338	Aerospace Propulsion Sessional
AEAV 327	Aircraft Navigation System-I	AEAV 443	Aircraft Communication and Navigation
AEAV 447	Aircraft Navigation System– II		
AEAV 448	Aircraft Navigation System– II Sessional	AEAV 444	Aircraft Communication and Navigation Sessional
AEAS 400	Capstone Project and Thesis	**AEAS 480**	**Final Year Design and Research Project**
AEAV 400	Capstone Project and Thesis	**AEAV 480**	**Final Year Design and Research Project**
AEAS 215	Aircraft Systems	**AEAS 215**	**Aircraft Aerospace Systems**

CHAPTER 5

COURSE CONTENTS

5.1 Detailed Curriculum and Outcome Based Mapping of Undergraduate Courses

Core and specialized courses offered by Aerospace Discipline is given below:

AEAS 103: Fundamentals of Aeronautical Engineering

3.00 Contact Hour ; 3.00 Credit Hour;

Pre-requisite: None.

Rationale:
The purpose of this course is to serve as an introduction into the basics of aircraft aerodynamic-characteristics, components, structures and avionics systems.

Objective:

1. To provide the knowledge about basic Aeronautical Engineering and the aerodynamic characteristics of aircraft.
2. To identify the forces acting on aircraft and learn how to analyze them.
3. To interpret the aircraft basic Structure, different aircraft component configurations.
4. To explain about the Mechanics of flight and fight performance.
5. To analyze aircraft avionics systems regarding Instrumentation, Communication and Navigation System.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Explain basics of Aeronautical Engineering.
2. Identify the forces acting on aircraft.
3. Interpret the aircraft Structure and basic configurations.
4. Explain about Mechanics of flight.
5. Analyze aircraft Instrumentation, Communication and Navigation System.

Course Contents:
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. Centre of pressure and its movement, Forces and moments acting on airfoil, centre of gravity, centre of pressure and aerodynamic centre concepts. Characteristics of Lift, drag and pitching moment curves. Stall and its effects.

Flight Mechanics: 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.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain basics of Aeronautical Engineering.	√											
2. Identify the forces acting on aircraft.		√										
3. Interpret the aircraft Structure and aircraft basic configurations.						√						
4. Explain about Mechanics of flight.	√											
5. Analyze aircraft Instrumentation, Communication and Navigation System.	√											

Lecture Schedule:

Week 1	Introduction to Aeronautical Engineering	
Class 1	Introduction to Aerospace Engineering.	
Class 2	Aerodynamics, Astronautics.	

Class 3	Types of aircraft.	CT 1
Week 2	**Aerodynamics**	
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	**High lift devices**	
Class 7	Familiarization to high lifting devices.	
Class 8	Distinguish between different types of flaps.	
Class 9	Analyze the lift generation of different types of flaps.	
Week 4	**Aircraft performance parameters and maneuvers**	CT 2
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	**Aircraft structure**	
Class 13	Aircraft basic configurations.	
Class 14	Aerospace structures – familiarization to construction of wing, fuselage, horizontal stabilizer, vertical stabilizer.	
Class 15	Mechanics of different control system, Structures of wing.	
Week 6	**Aircraft structure and Primary and secondary control surfaces**	
Class 16	Structures of fuselage and empennage.	
Class 17	Basic control surfaces.	
Class 18	Analyze the movement of aircraft.	
Week 7	**Airfoil and Review**	CT 3
Class 19	Airfoil Nomenclature.	
Class 20	Types of airfoil.	
Class 21	Review on Aerospace engineering.	
Week 8	**Introduction to Avionics Engineering**	
Class 22	Introduction to Avionics Engineering.	
Class 23	Instrumentation, Introduction to the cockpit and its instruments.	
Class 24	Introduction to Basic 6 instruments and their functions.	
Week 9	**Basic 6 cockpit instrument**	
Class 25	ASI, VSI, ALT, Directional Gyro.	
Class 26	Glass cockpit, HUD.	
Class 27	Types of HUD, Functions of cockpit display and types.	
Week 10	**Aircraft communication**	CT 4
Class 28	Fundamentals of aircraft communication system.	
Class 29	ATC, Functions of communication system.	
Class 30	Communication block diagram, TCAS.	

Week 11	**Continue…**
Class 31	Difference between Ground and air communication, ADC.
Class 32	Black box and its functions.
Class 33	Review on aircraft communication system.
Week 12	**Navigation systems**
Class 34	Fundamentals of aircraft navigation system
Class 35	Continue
Class 36	Stages of flight, Heading, drift angle, Math.
Week 13	**Navigation equipment**
Class 37	VOR, Radio RADAR, Doppler RADAR.
Class 38	ILS, DME, GPS.
Class 39	ADF, Functions of Navigation systems, Math.
Week 14	**Standard atmosphere and Aero-engine**
Class 40	Local & free stream characteristics, Calculate Temperature of different altitude, Math relating aircraft speed.
Class 41	Aero-engine, Principles of Jet reaction, types of aero-engine.
Class 42	Review of whole Syllabus.

Text and Ref Books:

1. Airframe and Power Plant – C A Zweng; Galotia Publications.
2. Spacecraft Systems Engineering –Peter Fortescue and John Stark; John Wiley and Sons.
3. Introduction to Flight -John D Anderson Jr; Tata McGraw-Hill.
4. Introduction to Aerospace structural Analysis –David H Allen, Publisher ;Weley and Sons.
5. Avionics Navigation Systems, 2nd Ed – Myron Kayton
6. Aerodynamics – Clancy
7. Flight without Formulae – Kermode
8. Fundamentals of Aerodynamics- John D. Anderson; McGraw-Hill
9. Principles of Avionics – 6th Ed.– Albert Helfrick.

AEAS 110: Aeronautical Engineering Drawing-I

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: None

Rationale:
It will be useful for designing and drawing accurate schematics for simple blocks, orthographic and isometric representations, dimensioning, etc., which will be helpful during project, work in later semesters, as well as professionally.

Objective:
1. To introduce the principles and perspectives of geometric drawing that includes the standardization, drafting, dimensions and etc.
2. To introduce the technique of engineering graphics as a basis of engineering communication and expression of idea and thought
3. To use proper and standard technique in lettering, basic geometric constructions, sketching, dimensioning methods to describe size, shape and position accurately on an engineering drawing.
4. To create orthographic projection auxiliary, sectional views, and apply 3Dpictorials to choose the best view to present the drawings.
5. To produce final drawings during the design process including assembly, machine and working drawings.

Course Outcomes (CO):

Upon completion of all sessional, the students will be able to:
1. Demonstrate use of appropriate standards and conventions in drawing sheet preparation and layout
2. Apply the correct methods of referencing relevant specifications in the interpretation of aeronautical engineering drawings.
3. Apply the correct conventions and techniques in drawing sectional, auxiliary views.
4. Develop isometric and oblique pictorial form from third angle orthogonal drawings

Course Contents:
Class 1: Introduction, Familiarization with drawing tools and types of projections.
Class 2: Drawing orthographic views of simple blocks
Class 3: Drawing orthographic views of objects with round features.
Class 4: Drawing orthographic views of objects with fillets, rounds.
Class 5: Class test on orthographic views.
Class 6: Drawing sectional views.
Class 7: Class test on sectional views.
Class 8: Drawing auxiliary views.
Class 9: Drawing oblique views.
Class 10: Class test on auxiliary and oblique views.
Class 11: Drawing isometric views of simple blocks

Class 12: Drawing orthographic views of objects with round features, fillets and rounds.
Class 13: Class test on isometric views
Class 14: Final Quiz.

Teaching-learning and Assessment Strategy: Class Assessment, Class Participation/ Observation, Class Attendance, Lab Exam, Quiz, Viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation/ Observation	5%
Class Attendance	5%
Lab Exam	40%
Quiz	40%
Viva	10%

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1 Demonstrate use of appropriate standards and conventions in drawing sheet preparation and layout.					√							
2 Apply the correct methods of referencing relevant specifications in the interpretation of aeronautical engineering drawings.				√						√		
3 Apply the correct conventions and techniques in drawing sectional, auxiliary views.					√							
4 Develop isometric and oblique pictorial form from Third angle orthogonal drawings.			√									

Text and Ref Books:

1.Mechanical Engineering Drawing- Dr. Amalesh Chandra Mandal
Dr. Md. Quamrul Islam.

AEAS 201: Engineering Mechanics (Statics and Dynamics)

4.00 Contact Hour; 4.00Credit Hour;

Pre-requisite: None.

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.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Explain basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).
2. Demonstrate use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems
3. Apply scalar and vector analytical techniques for analyzing forces in statically determinate structures.
4. Calculate the location of "centre of gravity" and "centroids" for bodies of arbitrary shape.
5. Evaluate equilibrium of particles and bodies in real world problems.

Course Contents:

Basic concepts of mechanics; 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 centres 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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Method

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcome (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).	√											
2. Demonstrate use of basic dynamics concepts- Work-Energy principle, Impulse-Momentum principle to solve dynamics problems		√										
3. Apply scalar and vector analytical techniques for analyzing forces in statically determinate structures					√							
4. Calculate the location of “centre of gravity” and “centroids” for bodies of arbitrary shape.		√										
5. Evaluate equilibrium of particles and bodies in real world problems.		√										

Lecture Schedule:

Week 1	Introduction and Statics of Particles	
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	CT 1
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	
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**	CT 2
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	CT 3
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**	
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**	CT 4
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**	CT 5
Class 45	Kinetic energy of a particle: principles of work and energy	
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	

Text and Ref 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's Mechanics - J.L. Merian& LG Kraige

AEAS 203: Fundamentals of Fluid Mechanics

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None.

Rationale:
By completing this course, the students will learn the concept of a fluid and hence to provide knowledge on the fundamentals of static and dynamic flows.

Objective:

1. To introduce the properties of fluid mechanics, hydrostatic pressure, fluid static forces.
2. Able to determine hydrostatic pressure, centre of pressure, forces,stability of immersed or floating bodies.
3. Able to calculate the flow field for in viscid fluid flow.
4. To apply the Bernoulli equation and continuity equation for flow measurements.
5. Able to calculate the losses in piping system and use the dimensional analysis.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe the basic laws of (i) Hydrostatic forces, (ii) Buoyancy forces, (iii) Stability of floating body, (iv) Losses in pipes and Fittings etc.
2. Analyze fluid in motion using continuity, momentum and energy equation.
3. Explain the design of different types of pipe flow measuring devices and their measurement system.
4. Apply basic similitude analysis in fluid flow.

Course Contents:

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 homogeneit, 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.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Know the basic laws of (i) Hydrostatic forces, (ii) Buoyancy forces, (iii) Stability of floating body, (iv) Losses in pipes and Fittings etc.	√											
2.Analyze fluid in motion using continuity, momentum and energy equation.		√										
3. Explain the design of different types of pipe flow measuring devices and their measurement system.	√											
4.Apply basic similitude analysis in fluid flow.		√										

Lecture Schedules

Week 1	**Fundamental concept of fluid**	
Class 1	Concept of fluid,	CT 1
Class 2	Properties of fluid,	
Class 3	Fluid statics.	
Week 2	**Hydrostatic forces on submerged surfaces**	
Class 4	Manometers,	
Class 5	Mathematical problems of manometer,	
Class 6	Buoyancy and stability.	
Week 3	**Fluid kinematics**	
Class 7	Fluids in rigid body motion,	
Class 8	Lagrangian descriptions of fluid flow,	
Class 9	Eulerian descriptions of fluid flow.	
Week 4	**Continuity and Momentum equations**	
Class 10	Reynolds transport theorem,	
Class 11	Continuity equation and its applications,	
Class 12	Momentum equation and its applications.	

Week 5	Energy and Bernoulli‘s equations	
Class 13	Energy equation and its applications,	CT 2
Class 14	Bernoulli‘s equations and its applications,	
Class 15	Mathematical problems.	
Week 6	**Dimensional analysis**	
Class 16	Dimensional analysis and similitude,	
Class 17	Dimensional homogeneity,	
Class 18	Mathematical problems.	
Week 7	**Experimental testing and modeling**	CT 3
Class 19	Experimental testing	
Class 20	Experimental modeling	
Class 21	Mathematical problems.	
Week 8	**Introduction to two dimensional incompressible flows**	
Class 22	Incompressible flow.	
Class 23	Boundary layer,	
Class 24	Different boundary layer formation on flat plate.	
Week 9	**Laminar and turbulent flows**	
Class 25	Laminar boundary layer and its characteristics.	
Class 26	Turbulent boundary layer and its characteristics.	
Class 27	Losses relating floe types.	
Week 10	**Losses in pipes**	
Class 28	Different losses in pipes,	
Class 29	Flow of fluid in pipes,	
Class 30	Minor losses in pipe fittings.	
Week 11	**Measurements of fluid flow**	
Class 31	Fundamentals measuring instruments,	
Class 32	Density and different types of pressures,	
Class 33	Mathematical problem.	
Week 12	**Miscellaneous Mathematical Problems**	
Class 34	Mathematical problem solving of dimensional analysis.	
Class 35	Mathematical problem solving of losses in pipes.	
Class 36	Mathematical problem solving of Flow velocity calculation.	

Week 13	Miscellaneous Mathematical Problems	
Class 37	Mathematical problem solving of Continuity equation.	CT 4
Class 38	Mathematical problem solving of Energy equation,	
Class 39	Mathematical problem solving of Momentum equation.	
Week 14	**Miscellaneous Mathematical Problems**	
Class 40	Mathematical problem solving of Bernoulli's Equation,	
Class 41	Review,	
Class 42	Review.	

Text and Ref 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

AEAS 204: Fundamentals of Fluid Mechanics Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Fundamentals of Fluid Mechanics

Rationale:
To enhance student knowledge on the basic principles of fluid mechanics and design problem solution.

Objective:

1. To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4. To imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. To inculcate the importance of fluid flow measurement and its applications in Industries.
6. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Apply some concept of fluid mechanics.
2. Analyze how to measure flow nature precisely through venture meter and orifice.
3. Analyze coefficient of velocity by coordinate method.
4. Explain about flow through mouthpiece, flow over V –notch, flow over sharp crested weir.
5. Analyze performances of different fluids subject to friction in pipe.

Course Contents:

Centre of pressure; proof of Bernoulli's theorem; flow through venturimeter; flow through orifice; coefficient of velocity by coordinate method; flow through mouthpiece; flow over V – notch; flow over sharp crested weir; fluid friction in pipe.

Teaching-learning and Assessment Strategy: Class Assessment, Class Participation/ Observation, Class Attendance, Lab Exam, Quiz, Viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation/ Observation	5%
Class Attendance	5%
Lab Exam	40%
Quiz	40%
Viva	10%

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply some concept of fluid mechanics.	√											
2. Analyze how to measure flow nature precisely through venturimeter and orifice.		√										
3. Analyze coefficient of velocity by coordinate method.				√								
4. Explain about flow through mouthpiece, flow over V –notch, flow over sharp crested weir.	√											
5. Analyze performances of different fluids subject to friction in pipe.					√							

Text and Ref 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

AEAS 205: Mechanics of Solids

3.00 Contact Hour; 3.00Credit Hour;

Pre-requisite: None

Rationale:
To enhance student knowledge on the basic principles of solid mechanics and design problem solution.

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 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.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the concepts and principles, and perform calculations, relative to the strength and stability of structures and mechanical components.
2. Evaluate the characteristics and calculate the magnitude of combined stresses in individual members and complete structures.
3. Analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.
4. Evaluate stresses & strains for structural elements.
5. Evaluate the deflection at any point on a beam subjected to a combination of loads.

Course Contents:

Stress analysis: Stress-strain concept and their inter-relationship, axially loaded member, thermal and centrifugal stresses; Stresses in thin and thick walled cylinders a nd spheres.
Beams: 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 bea ms: integration and area moment methods; Introduction to reinforced concrete beams and slabs.
Torsion formula; Angle of twist; Modulus of rupture; Helical springs; Combined stresses: principal stress, Mohr‘s Circle.
Columns: Euler‘s formula, intermediate column formulas, the Secant formula; Flexure formula of curved beams; Problem-based applications in aerospace, mechanical and biomedical engineering.
Introduction to experimental stress analysis techniques : Strain energy; Failure theories.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the concepts and principles, and perform calculations, relative to the strength and stability of structures and mechanical components.	√											
2. Evaluate the characteristics and calculate the magnitude of combined stresses in individual members and complete structures.		√										
3. Analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress.		√										
4. Evaluate stresses & strains for structural elements.		√										
5. Evaluate the deflection at any point on a beam subjected to a combination of loads.		√										

Lecture Schedule:

Week 1	**Stress analysis**	
Class 1	Stress-strain concept and their inter-relationship	
Class 2	Axially loaded member	
Class 3	Continue	
Week 2	**Stress Analysis**	

Class 4	Thermal and centrifugal stresses	CT 1
Class 5	Stresses in thin and thick walled cylinders and spheres	
Class 6	Numerical	
Week 3	**Beams**	
Class 7	Forces under different loading conditions	
Class 8	Numerical	
Class 9	Continue	
Week 4	**Beams**	CT 2
Class 10	Force effect on the resisting member	
Class 11	Numerical	
Class 12	Numerical	
Week 5	**Diagram**	
Class 13	Shear force diagram	
Class 14	Bending moment diagram	
Class 15	Examples	
Week 6	**Various types of stresses**	
Class 16	Bending, torsion, shear etc. in beams	
Class 17	Flexure formula and numerical	
Class 18	Continue	
Week 7	**Deflection analysis of beams**	CT-3
Class 19	Integration and area moment methods	
Class 20	Continue	
Class 21	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	Torsion formula	
Class 26	Terminologies (angle of rupture, modulus of rupture)	
Class 27	Helical spring	

Week 10	**Combined stress**	
Class 28	Principle stress	
Class 29	Continue	
Class 30	Numerical	
Week 11	**Mohr's circle**	
Class 31	Introduction	
Class 32	Application	
Class 33	Numerical	CT 4
Week 12	**Columns**	
Class 34	Euler‘s formula	
Class 35	Intermediate column formulas	
Class 36	The Secant formula	
Week 13	**Beams**	
Class 37	Numerical	
Class 38	Numerical	
Class 39	Flexure formula of curved beams;	
Week 14	**Problem-based Applications in Aerospace, Mechanical and Biomedical Engineering.**	
Class 40	Introduction to experimental stress analysis techniques	
Class 41	Strain energy and Failure theory	
Class 42	Review Class	

Text and Ref Books:

1. Strength of Materials – James M. Gere & Barry Goodno.
2. Strength of Materials (4^{th} edition) – Andrew Pytel, Ferdinand L. Singer.
3. Strength of materials (4^{th} edition) -William Nash; Mcgraw-hill International Editions, Schaum‘s Outline Series.
4. Strength of Materials – Beer and John Stone.

AEAS 206: Mechanics of Solids Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: Mechanics of Solids

Rationale:
Apply the concept of Mechanics of Solids to 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 performances of different materials under different loading.
4. To learn the strength, stiffness and stability design and construction requirements.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Apply some concept of solid mechanics.
2. Analyze how to measure objects precisely and develop skill.
3. Analyze the failure patterns and failure surfaces of testing materials.
4. Explain about different testing methods and machines.
5. Analyze performances of different materials under different loading.

Course Contents:

Experiments cover basic concepts of mechanics, structures and materials science; Selected experiments on Kater's Pendulum, equilibrium of forces and moments, tension and torsional test of different materials and deflection of thin- walled members, bending of beams under flexural loads.

Teaching-learning and Assessment Strategy: Class Assessment, Class Participation/ Observation, Class Attendance, Lab Exam, Quiz, Viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation/ Observation	5%
Class Attendance	5%
Lab Exam	40%
Quiz	40%
Viva	10%

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply some concept of solid mechanics.	√											
2. Analyze how to measure objects precisely and develop skill.		√										
3. Analyze the failure patterns and failure surfaces of testing materials.				√								
4. Explain about different testing methods and machines.	√											
5. Analyze performances of different materials under different loading.					√							

Text and Ref Books:

1. Strength of Materials – James M. Gere & Barry Goodno.
2. Strength of Materials (4th edition) – Andrew Pytel, Ferdinand L. Singer.
3. Strength of materials (4th edition) -William Nash; Mcgraw-hill International Editions, Schaum's Outline Series.
4. Strength of Materials – Beer and John Stone.

AEAS 207: Thermodynamics

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Physics I(Waves and Oscillation, Optics and Thermal Physics)

Rationale:
To introduce the fundamental concepts of energy, work and heat, as well as to provide understanding on the thermodynamic concepts, first and second thermodynamic laws.

Objective:

1. To define and explain the basic concepts including the First Law of Thermodynamic and to derive the corollaries of the First Law.
2. To solve problems for each thermodynamic process using steam or air.
3. To explain the Second Law of Thermodynamics and its corollaries, entropy and explain thermodynamic processes based on T-s diagram.
4. To determine the performance of various steam and air thermodynamics cycle.
5. Equations of state for ideal gases, Properties of gases and vapors; Properties of atmospheric air; Non- flow and flow processes.

Course Outcomes (CO):
Upon completion of the course, the students will be able to

1. Develop the basic concepts of Thermodynamics.
2. Describe Thermodynamics Laws.
3. Apply basic of thermodynamics to thermal equipment.

Course Contents:
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.

Air standard and Refrigeration cycles: Equations of state for ideal gases, Properties of gases and vapours; Properties of atmospheric air; Non-flow and flow processes; air standard cycles; Brayton, Otto and Diesel cycles. Refrigeration cycles; phase change of working substance. Thermodynamic

relations and equations of state; Mass and energy balance for a combustion reaction; Mixtures of gases and vapours; Fuels and combustion.

Teaching-learning and Assessment Strategy: Lectures, class performances, class tests, assignments, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program outcomes:

Course Outcomes(CO) of the Course	**Program outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Develop the basic concepts of Thermodynamics.	√											
2. Describe Thermodynamics Laws.	√											
3. Apply basic of thermodynamics to thermal equipment.					√							

Lectures Schedule:

Week 1	**Fundamental concepts**	
Class 1	Concept of continuum & macroscopic approach.	
Class 2	Closed, open and isolated system.	
Class 3	Property, state, path and process.	
Week 2	**Fundamental concepts**	
Class 4	Work, modes of work.	CT 1

Class 5	Zeroth law of thermodynamics.	
Class 6	Concept of temperature and heat.	
Week 3	**Fundamental concepts**	
Class 7	Internal energy and specific heat capacities.	
Class 8	Enthalpy.	
Class 9	Concept of ideal and real gases.	CT 2
Week 4	**First law**	
Class 10	First law of thermodynamics.	
Class 11	Applications to closed and open systems.	
Class 12	Steady flow processes.	
Week 5	**Second law**	
Class 13	Second law of thermodynamics.	
Class 14	Kelvin Planck and Clausius statements of second law.	
Class 15	Reversibility and irreversibility.	
Week 6	**Carnot Cycle**	
Class 16	Carnot theorem.	
Class 17	Carnot cycle using steam.	
Class 18	Reversed Carnot cycle	
Week 7	**Carnot Cycle**	CT 3
Class 19	Efficiency	
Class 20	COP	
Class 21	Thermodynamic temperature scale - clausius inequality.	
Week 8	**Entropy**	
Class 22	Concept of entropy.	
Class 23	Entropy of ideal gas.	
Class 24	Principle of increase of entropy.	
Week 9	**Thermodynamic availability**	
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	**Thermodynamic availability**	
Class 28	Consumption and entropy generation.	
Class 29	Expressions for exergy in steady flow processes.	
Class 30	Exergy dissipation and entropy generation.	
Week 11	**Properties of pure substance**	
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	**Properties of pure substance**	CT 4
Class 34	Use of property tables.	
Class 35	Phase rule & PVT surfaces.	
Class 36	Standard Rankine cycle.	
Week 13	**Air standard and Refrigeration cycles**	
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	**Air standard and Refrigeration cycles**	
Class 40	Refrigeration cycles.	
Class 41	Thermodynamic relations and equations of state.	
Class 42	Mixtures of gases and vapours; Fuels and combustion.	

Text Book:

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.

AEAS 208: Thermodynamics Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Thermodynamics

Rationale
To describe the concepts of heat, work, and energy and correctly use thermodynamic terminology.

Objective:

1. To determine the identity of an unknown metal.
2. To prove the whether the laws of thermodynamics hold when determining this identity.
3. To calculate the approximate specific heat of unknown metal.
4. To evaluate the relationship between the heat that is transferred and change in temperature.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe and correctly use thermodynamic terminology.
2. Define the concepts of heat, work, and energy.
3. Explain fundamental thermodynamic properties.
4. Analyze basic thermodynamic cycles.

Course Contents:

These are the experiments name:

1. Determination of Flash Point of Liquid Fluid
2. Study of Sling Psychrometer
3. Viscosity Test of Liquid Substance.
4. Determination of Carbon Residue of a given fuel.
5. (a) Proximate Analysis of Coal
   (b) Study of Different Speed Measuring Devices
6. Study of a Refrigeration and Air Conditioning Unit.
7. Study and Calibration of pressure gauge by Dead Weight Tester.
8. Determination of the Calorific value of Fuel.
9. Determination of Calorific value of Gaseous by Gas Calorimeter.
10. Concept of pressure and pressure sensor behavior.

Teaching-learning and

Assessment Strategy: Class Assessment, Class Participation/ Observation, Class Attendance, Lab Exam, Quiz, Viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation/ Observation	5%
Class Attendance	5%
Lab Exam	40%
Quiz	40%
Viva	10%

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Describe and correctly use thermodynamic terminology**.**	√											
2. Define the concepts of heat, work, and energy.							√					
3. Explain fundamental thermodynamic properties.		√										
4. Analyze basic thermodynamic cycles.					√							

Text and Ref 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.

AEAS 210: Aeronautical Engineering Drawing-II

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: Aeronautical Engineering Drawing I Sessional

Rationale:
To introduce 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 3Dpictorials to choose the best view to present the drawings.
2. To able to use 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 outcome:

1. Gain necessary knowledge to make part, assembly and drawing using Solid Works.
2. Understand various features, sketch tools and sketch relations used in Solid Works.
3. Create drawing of complex mechanical objects.
4. Apply the knowledge (point 1) to draw various components of an RC aircraft and assemble them.
5. Evaluate the performance of an airfoil using Solid Works Simulation.

Course Contents:

Lesson 1: Using the Interface
Lesson 2: Design Intent, 2D Sketching and Sketch entities
Lesson 3: Creating airfoil from co-ordinates.
Lesson 4: Drawing different shapes of 3D wings
Lesson 5: 3D Sketching and Reference Planes
Lesson 6: Assembly Basics
Lesson 7: Drawings Basics

Teaching-learning and

Assessment Strategy: Class Assessment, Class Participation/ Observation, Class Attendance, Lab Exam, Quiz, Viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	30%
Lab quiz	25%
Lab viva	10%

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain necessary knowledge to make part, assembly and drawing using Solid Works.					√							
2. Understand various features, sketch tools and sketch relations used in Solid Works.			√									
3. Create drawing of complex mechanical objects.		√										
4. Apply the knowledge (point 1) to draw various components of an RC aircraft and assemble them.			√									
5. Evaluate the performance of an airfoil using Solid Works Simulation.				√								

Text and Ref Books:

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.

AEAS 215: Aircraft Aerospace Systems

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Fundamental of Aeronautical Engineering.

Rationale:
To introduce the students with various systems associated with aircraft operations and safety issues.

Objective:

1. To create an idea about the operation of different systems of aircraft.
2. To be able to visualize the importance of different systems for aircraft safe operations.
3. To understand various features of the systems and subsystems for further courses like aerospace vehicle design.
4. To describe avionics systems associated with aircraft control and navigation.
5. To apply the knowledge of aircraft systems in aircraft design and assemble them.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand the principles and mechanisms of mechanical and electrical flight control systems of aircraft.
2. Understand the principles of safe operation to aircraft cabin atmospheric control systems, ice protection systems, position and warning systems, fire protection and warning systems and their components when operating and maintaining aircraft.
3. Explain the major electrical loads, power generation & distribution principles and the characteristics of modern aircraft electrical system.
4. Knowledge about basic aircraft instrumentation, Flight Data recorders, Cockpit voice recorders.
5. Understand about different engines applicable for various types of aircrafts.

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand the principles and mechanisms of mechanical and electrical flight control systems of aircraft.	√											
2.Understand the principles of safe operation to aircraft cabin atmospheric control systems, ice protection systems, position and warning systems, fire protection and warning systems and their components when operating and maintaining aircraft.	√											
3. Explain the major electrical loads, power generation & distribution principles and the characteristics of modern aircraft electrical system	√											
4. Knowledge about basic aircraft instrumentation , Flight Data recorders, Cockpit voice recorders	√											
5.Understand about different engines applicable for					√							

Various types of aircrafts.													

Lecture Schedule:

Week 1	Aircraft systems	
Class 1	Types of Systems	
Class 2	Aviation authorities	
Class 3	Importance of systems	
Week 2	**Control systems**	CT 1
Class 4	Basic control systems	
Class 5	Open and close loop control systems	
Class 6	Elements of basic control system	
Week 3	**Airplane Control Systems**	
Class 7	Various control surfaces	
Class 8	Conventional control systems	
Class 9	Different control systems	
Week 4	**Power Assisted Control Systems**	CT 2
Class 10	Pascals law and applications	
Class 11	Power assisted and fully powered control systems	
Class 12	push pull rod system	
Week 5	**Modern control systems**	
lass 13	Basic fly by wire systems	
Class 14	Operating principle and factors	
Class 15	Types of fly by wire	
Week 6	**Auto pilot system**	
Class 16	Importance , Basic operation	
Class 17	Different functions of auto pilot	
Class 18	Modes of operation, basic gyroscope	
Week 7	**Air conditioning and pressurizing system**	CT 3
Class 19	Basic air cycle systems	
Class 20	Basic Oxygen systems	
Class 21	Principle of operation and safety precautions	
Week 8	**Fire protection systems**	
Class 22	Causes of fire in aircraft	
Class 23	Types of fire protection systems	
Class 24	Basic deicing and anti- icing system.	
Week 9	**deicing and anti-icing system**	

Class 25	Types of ice & Principle of ice detection	
Class 26	Anti- icing systems	
Class 27	Deicing systems	
Week 10	**Electrical Systems**	
Class 28	Aircraft electrical systems	
Class 29	Power generation, Primary power distribution	
Class 30	Power conversion and energy storage	
Week 11	**Hydraulic systems & Pneumatic systems**	
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	**Engine systems**	CT 4
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	**Avionics systems**	
Class 37	aircraft instrumentation	
Class 38	Basic six instruments	
Class 39	Principle of ASI, VSI, altimeter	
Week 14	**Avionics systems**	
Class 40	Flight data recording system, operation and survival test	
Class 41	cockpit voice recording system, operation, data	
Class 42	Review of whole Syllabus	

Text and Ref 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.
4. Gas Turbine Technology- Treager, S.; McGraw Hill.
5. Aircraft Maintenance & Repair- Mckinley, J.L. and Bent R.D; McGraw Hill.
6. Handbooks of Airframe and Power plant Mechanics; US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995
7. Aircraft Instruments & Principles- Pallet, E.H.J; Pitman & Co 1993.

AE 300: Industrial Training

4 weeks Contact Hour; 1.0 Credit Hour;

Pre-requisite: Student should complete all courses up to 3rd Year, 2nd Semester

Rationale:
To provide the experience for the students of the industrial environment and organization as well as the functionality of the engineers in industries.

Objective:
1. To be able to practice the responsibility of becoming an engineer in the profession of engineering.
2. To be able to Able to instill communication skill in engineering which include daily interaction with working environment and technical writing.
3. To be able to involve and experience the true working environment of the engineer.
4. To be able to work in a team.
5. To be able to manage a project within a given time frame.
6. To be able to effectively communicate solution to problems (oral, visual, written).

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain about the structure and management of an industry/organization to apply this knowledge in the individual's professional life.
2. Devise the industrial works like maintenance, planning, engineering service and aircraft inspection with practical experience.
3. Apply the industrial training knowledge further in project or research work.
4. Describe various engineering aspects of different industries/organizations through group presentation.
5. Develop the responsibility of safety, legal and cultural issues in engineering practices**.**

Teaching-learning and Assessment Strategy: Internship for 4 weeks, assessment and presentation, observation and evaluation by Officers of that industry.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Assessment	
Class Attendance	10
Observation and Presentation	90

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain about the structure and management of an industry/organization to apply this knowledge in the individual's professional life.						√						
2. Devise the industrial works like maintenance, planning, engineering service and aircraft inspection with practical experience.							√					
3. Apply the industrial training knowledge further in project or research work.												√
4. Describe various engineering aspects of different industries/organizations through group presentation.										√		
5. Develop the responsibility of safety, legal and cultural issues in engineering practices.								√				

AEAS 301: Heat Transfer

3.00 Contact Hour; 3.00 Credit Hour;
Pre-requisite: Thermodynamics

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

Objective:

1. Apply principles of heat and mass transfer to basic engineering systems
2. Explain heat transfer by conduction, convection
3. Analyze and design heat exchangers
4. Analyze diffusion processes and calculate the flux in a diffusion process
5. Describe the fundamental principles of radiactive emission and absorption

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Explain heat and different heat transfer mechanisms.
2. Evaluate basic heat transfer problems occur in engineering field involving Conduction, Convection and Radiation.
3. Know different types of boiling.
4. Analyze heat exchanger capacity using LMTD and effective NTU relations

Course Contents:

Basic modes of heat transfer; General conduction equations; Steady state conduction in different geometrics 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; Radiactive 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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes(CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain heat and different heat transfer mechanisms.		√										
2. Evaluate basic heat transfer problems occur in engineering field involving Conduction, Convection and Radiation.	√											
3. Know different types of boiling.	√											
4. Analyze heat exchanger capacity using LMTD and effective NTU relations.					√							

Lecture Schedule:

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

Class 7	Mechanism of convective heat transfer	
Class 8	General methods for estimation of convective heat transfer coefficient	
Class 9	Related mathematical problems.	
Week 4	**Forced convection**	
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	CT 2
Week 5	**Free convection**	
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	**Radiation**	
Class 16	Mechanism and laws of radiation heat transfer	
Class 17	Blackbody emission	
Class 18	Gray body emission	
Week 7	**Radiative properties**	CT 3
Class 19	Radiative properties of surfaces.	
Class 20	Radiation equation,	
Class 21	Spectrum analysis.	
Week 8	**Boiling**	
Class 22	Pool boiling,	
Class 23	Forced convection boiling,	
Class 24	Mathematical Problems.	
Week 9	**Condensation**	
Class 25	Film condensation	
Class 26	Dropwise condensation	
Class 27	Condensation number	
Week 10	**Heat exchanger**	CT 4
Class 28	Types of Heat exchanger,	
Class 29	Fundamentals of Heat exchanger,	
Class 30	Principles of Heat exchanger.	
Week 11	**LMTD**	
Class 31	LMTD relation analysis.	
Class 32	Heat exchanger performance,	
Class 33	Mathematical Problems.	
Week 12	**Exchanger effectiveness**	
Class 34	NTU relations,	
Class 35	Techniques of heat transfer augmentation	

Class 36	Mathematical problems.	
Week 13	**Heat exchanger devices**	
Class 37	Different heat exchanger devices,	
Class 38	Working principle of heat exchanger devices,	
Class 39	Mathematics relating heat exchanger devices.	
Week 14	**Refrigeration**	
Class 40	Fundamentals of refrigeration,	
Class 41	Refrigeration cycle,	
Class 42	Review.	

Text and Ref 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. NecatiOzisik

AEAS 322: Heat Transfer Sessional

3.00 Contact Hour ; 1.50 Credit Hour

Pre-requisite: Heat Transfer

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

Objective:
1. Apply principles of heat and mass transfer to basic engineering systems
2. Analyze heat transfer by conduction, convection
3. Analyze and design heat exchangers
4. Analyze diffusional processes and calculate the flux in a diffusion process
5. Understand the fundamental principles of radiative emission and absorption

Course Outcomes (CO):
Upon completion of all sessional, the students will be able to:

1. Describe basic calculations involving heat and mass transfer as is typical for an aeronautical engineer.
2. Explain the basic heat transfer phenomena regarding convection, conduction and radiation.
3. Apply empirical correlations to analyze external and internal, forced and free convection problems.
4. Analyze heat transfer through convection and radiation by plotting graph from obtained data.
5. Evaluate the performance characteristics of different types of heat exchangers through practical observation.

Course Contents:

Experiment no. 1: Determination of Thermal Conductivity of A Metal By Stead y State Method.
Experiment no. 2: Determination of Thermal Contact Conductance.
Experiment no. 3: (A) Inverse Square Law for Light Radiation. (B) Lamberts Cosine Law for Light.
Experiment no. 4: Study of a Free Convection of Fin/ Flat Plate/ Pipe Bundle.

Experiment no. 5: Force Convection Heat Transfer in a Flat Plate.
Experiment no. 6: Study of Heat Exchanger.
Experiment no. 7: Study of Thermal Radiation Unit.
Experiment no. 8: Study of Heat Transfer by Radiation.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	**30**
Class Participation	5
Class Attendance	5
Quiz	50
Daily Evaluation	**10**
Total	100

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe basic calculations involving heat and mass transfer as is typical for an aeronautical engineer.		√										
2. Explain: Explain the basic heat transfer phenomena regarding convection, conduction and radiation.	√											
3. Apply: Apply empirical correlations to analyze external and internal, forced and free convection problems.		√										
4. Analyze: Analyze heat transfer through convection and radiation by plotting graph from obtained data.				√								
5. Evaluate: Evaluate the performance characteristics of different types of heat exchangers through practical observation.				√								

Text and Ref Books:

1. Principles of Heat Transfer - F. Kreith, Mark S. Bohn
2. Heat Transfer - Binay K. Dutta

AEAS 335: Applied Aerodynamics

3.00 Contact Hour; 3.00 Credit Hour

Pre-requisite: Fundamentals of Aeronautical Engineering,
Fundamentals of Fluid Mechanics,
Mechanics of Solid

Rationale:
This course introduces the students with the fundamental principles of aerodynamics for understanding stability and control, aircraft performance etc.

Objective:
1. To understand the fundamental principles of incompressible and compressible fluid mechanics and aerodynamics.
2. To apply these principles to real systems such as pipe flows, automobiles and aircraft.
3. To explain the sources of friction, induced, wave, and pressure drag.
4. To understand aspects of flight characteristics that relates to lift, drag, thrust and power.
5. To be able to perform calculations involving lift, drag in relation to various aspects of flight and aircraft performance.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the methods of fluid flow analysis i.e. theoretical, experimental and computational.
2. Analyze the concept potential theory and its application to incompressible and inviscid flows.
3. Apply of theoretical techniques to analyze the simple viscous flows.
4. Apply the numerical methods for solution of complex flow situations.
5. Describe implications errors and stability analysis of numerical methods.

Course Contents:

Inviscid flows
Models of fluid flow, continuity and momentum equations applied to inviscid flows, drag momentum theory, concept of stream lines, stream tubes, streak line, pathlines. 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 chracateristics 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, concept of turbulence modeling, Prandtl mixing length theory.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the methods of fluid flow analysis i.e. theoretical, experimental and computational.		√										
2. Analyze the concept potential theory and its application to incompressible and inviscid flows.												
3. Apply of theoretical techniques to analyze the simple viscous flows.					√							
4. Apply the numerical methods for solution of complex flow situations.					√							
5. Describe implications errors and stability analysis of numerical methods.		√										

Lectures Schedule:

Week 1	Introduction to Applied Aerodynamics	
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	**Discussion on basic topics of theoretical Aerodynamics**	CT 1
Class 4	Angular velocity, strain rate and vorticity of fluid flows	
Class 5	Classification of rotational and irrotational flows, Fluid Stressed and strain	

	rates	
Class 6	Circulation, stream function and velocity potential	
Week 3	**Development of Potential theory**	CT 2
Class 7	Flow analysis of Invisicid and incompressible flows, review of Bernoulli's equation and its applications	
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	**Application of potential theory for flow analysis**	
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	**Classical thin airfoil theory**	CT-3
Class 13	Discussion on airfoil nomenclature and their characteristics.	
Class 14	Kutta condition and Kelvin's circulation theorem and starting vortex.	
Class 15	Introduction to Classical thin airfoil theory .	
Week 6	**Flow separation**	
Class 16	Types of flow separation.	
Class 17	Inviscid flow characteristics over a 2D airfoil.	
Class 18	Inviscid & incompressible flow over finite wings.	
Week 7	**Lift distribution**	
Class 19	Lift distribution over finite wings.	
Class 20	Effect of aspect ratio.	
Class 21	Different types of drags.	
Week 8	**Finite wing and its Lift**	CT-4
Class 22	Finite wing theory or Prandtl classical lifting line theory.	
Class 23	Elliptical lift distribution.	
Class 24	Effect of aspect ratio and physical significance.	
Week 9	**Derivation of N-S equation and its application to simple flows**	
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	**Boundary layer theory**	
Class 28	Introduction to Boundary layers. Properties of B-L properties.	
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	**Boundary layer theory**	CT 5
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	**Laminar flow**	
Class 34	Skin friction and skin friction drag.	
Class 35	Laminar flow past flat plate	
Class 36	Concept free shear flows viz. jet	
Week 13	**Flow past cylinder and spheres**	
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	**Introduction to turbulence**	
Class 40	Introduction to turbulence	
Class 41	Concept of turbulence modeling	
Class 42	Prandtl mixing length theory	

Text and Ref Books:

1. Mechanics of Fluids - Irving H. Shames
2. Mechanics of Fluids - B. S. Messy
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 – Anderson

AEAS 336: Applied Aerodynamics Sessional

1.50 Contact Hour ; 0.75 Credit Hour

Pre-requisite: Applied Aerodynamics

Rationale:
This course introduces the students with the fundamental principles of aerodynamics for understanding stability and control, aircraft performance etc.
Objective:

1. To understand the fundamental principles of incompressible and compressible fluid mechanics and aerodynamics.
2. To apply these principles to real systems such as pipe flows, automobiles and aircraft.
3. To explain the sources of friction, induced, wave, and pressure drag.
4. To understand aspects of flight characteristics that relate to lift, drag, thrust and power.
5. To be able to perform calculations involving lift, drag in relation to various aspects of flight and aircraft performance..

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Conduct experiments, and then analyze and interpret results successfully.
2. Demonstrate that theoretical characteristics of low speed aerodynamics can be implemented through the wind tunnel operations and flow visualization techniques.
3. Analyze the Pressure and velocity distribution along the radius of a forced vortex and interpret the results
4. .Demonstrate coefficient of drag for a right circular cylinder
5. Evaluate the performance of lift and drag characteristics of NACA-0012 airfoil.

Course Contents:
Experiments include topics of theory of flight, low speed aerodynamics, wind tunnel operations and flow visualization techniques; Pressure and velocity distrib ution along the radius of a forced vortex, coefficient of drag for a right circular cylinder, and lift and drag characteristics of NACA-0012 airfoil; Experiments in the open circuit subsonic wind tunnel, wind tunnel calibration, model testing and data reduction for obtaining important aerodynamic and stability parameters of an aircraft; Familiarization with the use of supersonic wind tunnel and its flow visualization system.

Teaching-learning and Assessment Strategy:	Class Assessment, Class Participation, Class Attendance, Lab Report, Lab Test

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	10
Class Attendance	10
Lab Report	40
Lab Test	40

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
Conduct experiments, and then analyze and interpret results successfully.										√		
Demonstrate that theoretical characteristics of low speed aerodynamics can be implemented through the wind tunnel operations and flow visualization techniques.					√							
Analyze the computational approach by using CFD and interpret the results.	√											
Demonstrate that the CFD simulation can also implement theoretical characteristics of low speed aerodynamics.				√								
Evaluate the performance of both the experimental and computational approach of low speed aerodynamics and bring out a comparative assessment.		√										√

Text and Ref Books:

1. Mechanics of Fluids - Irving H. Shames
2. Mechanics of Fluids - B. S. Messy
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 – Anderson

AEAS 337: Aerospace Propulsion

3.00 Contact Hour; 3.00 Credit Hour

Pre-requisite: Fundamentals of thermodynamics.

Rationale:
To learn about the fundamentals of air breathing and non-air breathing engines and their different components.

Objective:
1. To learn about the contemporary propulsion systems used in both air breathing and non-air breathing aircrafts.
2. To use the knowledge of thermodynamics to 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 be able to evaluate the thermodynamic properties involved in each components associated with the Gas Turbine cycle.
4. To understand the how the design variables affect the performance of each component of a turbine engine.
5. To be able to explain the basic aspects of rocket propulsion, propellants, rocket staging and dynamics.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about various types of aircraft &spacecraft propulsion systems.
2. Explain the thermodynamics of each component of a turbine engine which include inlets, fans, compressors, combustion chambers, turbines, afterburners and nozzles and how they interact with each other.
3. Evaluate various thermodynamic properties associated with the Gas Turbine cycle;
4. Gain knowledge about the performance &design variables for each component of a turbine engine.
5. Understand the basic aspects of rocket propulsion, propellants, rocket staging and dynamics.

Course Contents:

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.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about various types of aircraft & spacecraft propulsion systems.							✓					
2.Explain the thermodynamics of each component of a turbine engine which include inlets, fans, compressors, combustion chambers, turbines, afterburners and nozzles and how they interact with each other.					✓							
3.Evaluate various thermodynamic properties associated with the Gas Turbine cycle.		✓										
4.Gain knowledge about the performance &			✓									

design variables for each component of a turbine engine.												
5.Understand the basic aspects of rocket propulsion, propellants, rocket staging and dynamics.			✓									

Lecture Schedule:

Week 1	**Introduction and Intake System**	
Class 1	Gas turbine engine types, thrust, propulsive efficiency	
Class 2	Function of intake	
Class 3	Intake thermodynamic process, types of intake	
Class 4	Subsonic intake	
Week 2	**Intake System and Combustion Chamber**	
Class 5	Drag and flow separation in intake	
Class 6	Major design variables of intake	CT-1
Class 7	Supersonic intake and its types	
Class 8	Introduction to combustion chamber	
Week 3	**Combustion Chamber**	
Class 9	Classification of combustion chambers	
Class 10	Combustion chamber performance	
Class 11	Continue	
Class 12	flame stabilization	
Week 4	**Propelling Nozzle**	
Class 13	Real flow in nozzles and nozzle efficiency, losses in nozzles.	
Class 14	Equilibrium flow and frozen flow in nozzles, two phase flow in nozzles	
Class 15	Ejector and variable area nozzles.	
Class 16	Interaction of nozzle flow with adjacent surfaces, thrust reversal	
Week 5	**Ram jet, Scram-jets, Pulse jet and Rocket**	
Class 17	Ram jet engine	
Class 18	Scram-jet engine	
Class 19	Pulsejet engine	
Class 20	Introduction to Rocket	
Week 6	**Rocket**	CT-2
Class 21	Rocket propulsion and rocket propellants	
Class 22	liquid and solid rocket propulsion systems	
Class 23	nozzle design	
Class 24	rocket performance	
Week 7	**Rocket**	

Class 25	Dynamics of rocket flight, orbital velocity	
Class 26	Sub-orbital propulsion systems	CT-3
Class 27	Staging	
Class 28	Minimization of noise and pollution	
Week 8	**Piston Engine**	
Class 29	Operating principles of piston engines	
Class 30	classification of piston engines	
Class 31	thermal efficiency calculations	
Class 32	continue	
Week 9 Class 33	**Compressor** Introduction	
Class 34	Compressor operation, performance & construction	
Class 35	continue	CT-4
Class 36	Compressor flow instabilities	
Week 10	**Turbine &Gas turbine Engine (Thrust)**	
Class 37	Turbine operation,	
Class 38	Turbine performance	
Class 39	thrust equation	
Class 40	factors affecting thrust	
Week 11	**Gas turbine Engine (Cycle performance)**	
Class 41	Shaft power cycle, cycle efficiency	
Class 42	Gas turbine cycles for aircraft propulsion: turbojet, turbo shaft engines.	
Class 43	Gas turbine cycles for aircraft propulsion: turbofan engine	
Class 44	Reheat cycle	CT-5
Week 12	**Component design, Materials & Fuel**	
Class 45	Efficiency of components	
Class 46	Off-design considerations	
Class 47	Selection of materials for aero-engine	
Class 48	Aero-thermochemistry of Fuels and Propellants	
Week 13	**Thrust Control Method**	
Class 49	Methods of thrust augmentation	
Class 50	Thrust Reverser	
Class 51	Aero engine control	
Class 52	continue	
Week 14	**Propeller**	
Class 53	Propeller theory, construction	
Class 54	Variable pitch and constant RPM propellers	
Class 55	Flight characteristics with propellers	
Class 56	Review of whole Syllabus	

Text and Ref 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.

AEAS 338: Aerospace Propulsion Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Fundamentals of Thermodynamics, Aero-space Propulsion.

Rationale:
To get a hands-on experience on the various aspects of reciprocating and gas turbine engine as taught in the Aerospace Propulsion theory course.

Objective:

1. To compare the structural layout of the Piston & Jet engines.
2. To observe practically the actual operation of a jet engine and match this with the theoretical knowledge.
3. To be able to apply the theoretical knowledge basic formulas in relation to the diesel & 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 practical operation.

Course Outcomes (CO):

Upon completion of all sessional, the students will be able to:

1. Know about of major structural and working components & their relative layout of Piston & Jet engines.
2. Apply basic formulas and equations regarding diesel & jet engine learned in the theory course.
3. Analyze the dimensional effects of compressor & turbine section (of a jet engine) on flow properties by plotting graphs from obtained data.
4. Evaluate the thrust and cycle efficiency of a small scale jet engine with the parameters obtained from practical operation.

Course Contents:
Experiment no. 1: Construction of a Typical Jet Engine (WP7C Jet Engine) of a Fighter Aircraft.
Experiment no. 2: Dimensional Change of Compression Sections and Effects.
Experiment no. 3: Dimensional Change of Turbine Sections and Effects.
Experiment no. 4: Ground Operation of a CM-14 Jet Engine.
Experiment no. 5: Construction of a Typical Radial Piston Engine (HUO SAI-7A Engine) of a Trainer Aircraft.
Experiment no. 6: Performance Test of a High Speed Diesel Engine.

Teaching-learning and Assessment Strategy: Class Assessment, Class Participation, Class Attendance, Lab Test, Lab Report

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	10
Class Attendance	10
Lab Report	40
Lab Test	40

Mapping of Course Outcome and Program Outcomes:

Course Outcome (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Know about of major structural and working components & their relative layout of Piston & Jet engines.												
2. Apply basic formulas and equations regarding diesel &jet engine learned in the theory course.		✓										
3. Analyze the dimensional effects of compressor & turbine section (of a jet engine) on flow properties by plotting graphs from obtained data.				✓								
4. Evaluate the thrust and cycle efficiency of a small scale jet engine with the parameters obtained from practical operation.		✓										

Text and Ref Books:

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

AEAS 307: Aircraft Loading and Structural Analysis

3.00 Contact Hour ; 3.00 Credit Hour;

Pre-requisite: Mechanics of Solids

Rationale:
To learn and familiarize the basics of Aircrafts Structure and its components.

Objective:

1. Introduction of design philosophies like damage tolerance, safe- life, fail-safe
2. Introduction of the aircraft data requirements and description of the critical airloads used in the design and analysis of aircraft structures
3. Introduction of the aero-elastic stability design constraint
4. Overview of the role and lay-out of main structural members used in aircraft structures
5. Fatigue failure consideration and its relation with design philosophies, fatigue loads in aircraft operations and fatigue life analysis methods.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain fundamental concepts in the analysis of flight structures.
2. Apply theory of elasticity in solution of engineering problems.
3. Apply energy methods in the analysis of statically indeterminate structures.
4. Evaluate stress distribution in aircraft components.
5. Create an appreciation for the design and sizing of aircraft structural configurations subjected to various load combinations.

Course Contents:

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 complimentary 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.
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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes(CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain fundamental concepts in the analysis of flight structures.	√											
2. Apply theory of elasticity in solution of engineering problems.	√											
3. Apply energy methods in the analysis of Statically indeterminate structures.	√											
4. Evaluate stress distribution in aircraft components.		√										
5.Create an appreciation for the design and sizing of aircraft structural configurations subjected to various load combinations.				√								

Lecture Schedule:

Week 1	**Theory of Elasticity**	
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 (cont'd)**	
Class 4	Strain-displacement relations	
Class 5	Volumetric strain and determination of limiting value of Poisson's ratio.	CT 1
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	CT 2
Week 4	**Two Dimensional Elasticity (cont'd)**	
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**	
Class 13	Airy's stress function	
Class 14	Related Numerical	
Class 15	Strain energy and complementary energy.	
Week 6	**Energy Methods in Structural Analysis (cont'd)**	
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**	CT 3
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	
Class 24	Shear centre 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	CT 4
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	
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	Energy methods for plate buckling.	
Class 36	Related 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	Related numerical.	

Text and Ref 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.

AEAS 331: Materials Science and Aerospace Materials

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

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 learn the basic scientific facts of Physics/ Chemistry disciplines about different materials and their properties.
2. To use the knowledge of material science to provide solution to related engineering, commercial problems.
3. To be able to evaluate the different materials and their properties and to select them rightly for design and construction.
4. To understand the basic working principle of various methods involving the inspection of materials.
5. To be able to ensure the safety of components with different materials from unwanted decay/corrosion.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe modern materials chemistry, materials physics and energy physics.
2. Apply core concepts in Materials Science to solve engineering problems.
3. Explain how to select materials for design and construction.
4. Analyze the methods required to inspect material components using different approaches.
5. Explain how to protect materials from unwanted/untimely decay.

Course Contents:
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-FeC3 equilibrium diagram, general requirements of materials 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 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 powder metallurgy, modern ceramic materials, cermet, glass ceramic, plastics and rubber, carbon/carbon composites, fabrication processes involved in metal matrix composites, shape memory alloys, applications in aerospace vehicle design, Basic concepts of Nano-science and Nanotechnology.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100 %)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes(CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Explain modern materials chemistry, materials physics and energy physics.	√											
2. Apply core concepts in Materials Science to solve engineering problems.		√										
3.Explain how to select materials for design and construction.			√									
4. Analyze the methods required to inspect material components using different approaches.					√							
5.Explain how to protect materials from unwanted/untimely decay.					√							

Lecture Schedule:

Week 1	**Elements Of Aerospace Materials**	CT 1
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 Imperfections in Solids	
Class 5	Hexagonal Close-Packed (HCP) Crystal Structure	
Class 6	Crystallographic Points, Directions, and Planes	
Week 3	**Elements Of Aerospace Materials**	
Class 7	Equilibrium Diagram	
Class 8	Iron-Carbon Diagram, Lead–Tin Phase Diagram, Copper–Silver Phase Diagram	
Class 9	Iron-Carbon Diagram, Lead–Tin Phase Diagram, Copper–Silver Phase Diagram	
Week 4	**Material Selection For Aerospace Applications**	CT 2
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**	CT 3
Class 19	Classification of Ceramics	
Class 20	General Properties of Ceramics	
Class 21	Common Ceramics	
Week 8	**Ceramics And Glass**	
Class 22	Shaping Methods for Glass	
Class 23	Glassworking Processes	
Class 24	Continue	
Week 9	**Processing Of Plastics**	
Class 25	Types of Processing of Plastics	

Class 26	Extrusion, Lamination (Calendaring)	
Class 27	Thermoforming, Casting	
Week 10	**Processing Of Plastics**	CT 4
Class 28	Molding	
Class 29	Expansion, Foaming	
Class 30	Spinning, Solid-Phase Forming	
Week 11	**Composite Materials**	
Class 31	Introduction	
Class 32	Components of Composite Materials	
Class 33	Types and General Characteristics of Composite Materials	
Week 12	**Composite Materials**	
Class 34	Polymer Matrix Composites (PMC)	
Class 35	Metal Matrix Composites (MMC) , Ceramic Matrix Composites (CMC)	
Class 36	Advantages & Disadvantages of Composites	
Week 13	**Non-Destructive Testing (Ndt)**	
Class 37	Introduction	
Class 38	Uses of NDT Methods	
Class 39	NDT methods using time	
Week 14	**Non-Destructive Testing (Ndt)**	
Class 40	Methods of NDT	
Class 41	Continue	
Class 42	Common Application of NDT	

Text and Ref 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.

AEAS 332: Materials Science and Aerospace Materials Sessional

1.50 Contact Hour ; 0.75 Credit Hour;

Pre-requisite: Materials Science and Aerospace Materials

Rationale:
To learn the necessary knowledge about metallurgy and phase diagram.

Objectives:

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 (CO):
Upon completion of the course, the students will be able to:

1. Understanding different types of carbon steel.
2. Know about phase diagram of different steel.
3. Apply the knowledge about different types of material in making of alloys.
4. Evaluate different heat treatment methods.

Course Contents:

Elements of Aerospace materials; crystal structure, imperfection in crystals, physical metallurgy, Phase diagram including the Fe-FeC3 equilibrium diagram, general requirements of materials for aerospace applications. Mechanical behavior of materials; Linear and nonlinear elastic properties, Yielding, strain hardening, fracture, creep and fatigue -Comparative study of metals.
Introduction to destructive and non-destructive tests. Corrosion & heat treatment of metals and alloys; Types of corrosion, effect of corrosion on mechanical properties.
Heat treatment of carbon steels, aluminum alloys, magnesium alloys and titanium alloys.
High temperature materials: Characterization; classification, production and characteristics, methods and testing.

The Experiments are:

1. Study of Crystal structure of different types of iron.
2. Study of Phase diagram including the Fe-FeC3 equilibrium diagram.
3. Study of Mechanical behavior of materials.
4. Study of destructive and non-destructive tests.

5. Heat treatment of carbon steels, aluminum alloys, magnesium alloys and titanium alloys.

Teaching-learning and Assessment Strategy: Daily Evaluation, Class Participation, Class Attendance, Lab report, Final quiz

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Daily Evaluation	**40**
Class Participation	05
Class Attendance	05
Lab report	20
Final quiz	30

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understanding different types of carbon steel.					√							
2. Know about phase diagram of different steel.	√											
3. Apply the knowledge about different types of materials in making of alloys.												√
4. Evaluate different heat treatment methods.										√		

Text and Ref 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.

AEAS 313: High Speed Aerodynamics

3.0 Contact Hour; 3.0 Credit Hour;

Pre-requisite: Fundamentals of Aeronautical Engineering
Engineering Mechanics (Statics and Dynamics)

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 simple problems related to adiabatic flow
4. To design and perform the experimental work related to water table experiments.
5. To evaluate and perform the CFD simulations works related to compressible

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Explain the concept of compressible flow involving subsonic and supersonic cases.
2. Explain the mechanism of formation of sound wave and shock wave and their effect on the compressible flow involving change of pressure, temperature, velocity, entropy etc.
3. Analyze the influence of normal shock, oblique shock and expansion wave on compressible flow.
4. Evaluate the change of properties of compressible flow due to stationary and moving shock waves.

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	100%
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the concept of compressible flow involving subsonic and supersonic cases.		√										
2. Explain the mechanism of formation of sound wave and shock wave and their effect on the compressible flow involving change of pressure, temperature, velocity, entropy etc.	√											
3. Analyze the influence of normal shock, oblique shock and expansion wave on compressible flow.		√										
4. Evaluate the change of properties of compressible flow due to stationary and moving shock waves.				√								

Lecture Schedule:

Week 1	**Basic equations of compressible flow**	
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	**Subsonic and supersonic flows**	
Class 4	Aspects of subsonic flow,	CT 1
Class 5	Aspects of supersonic flow: shock wave.	
Class 6	Types of flow: subsonic, supersonic and hypersonic.	
Week 3	**Compressibility**	
Class 7	Definition of total (stagnation) condition.	
Class 8	Speed of sound	
Class 9	Sound formation and propagation in air.	

Week 4	**Stagnation properties**	
Class 10	Special forms of Energy equation.	
Class 11	Prandlt-Glauert compressibility correction.	CT 2
Class 12	Drag divergence mach number, critical mach number.	
Week 5	**Flow through convergent-divergent nozzle**	
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	**Normal shock waves**	
Class 16	The basic normal shock equations.	
Class 17	Calculation of normal shock waves.	
Class 18	Related mathematics.	
Week 7	**Oblique shock and expansion waves**	
Class 19	Oblique shock relations	
Class 20	Supersonic flow over wedges and cones.	
Class 21	Detached shock wave in front of a blunt body.	CT 3
Week 8	**Prandatl-Mayer expansion waves**	
Class 22	Prandatl-Mayer expansion waves	
Class 23	Continue	
Class 24	Mathematical problem.	
Week 9	**Shock expansion theory**	
Class 25	Shock expansion theory: application to supersonic airfoils.	
Class 26	Continue	
Class 27	Mathematical problem.	
Week 10	**Linearized flow theory**	CT 4
Class 28	Derivation of the Linearized Supersonic pressure coefficient formula.	
Class 29	Application to supersonic airfoils.	
Class 30	Super critical airfoils and related problems.	
Week 11	**Flow with friction and heat transfer**	
Class 31	Explain basic equations and formulae	
Class 32	Mathematical problem solve	
Class 33	Mathematical problem solve	
Week 12	**Moving shock wave**	
Class 34	Introduction to moving shock wave	
Class 35	Equations of moving shock wave	
Class 36	Shock tube flow	
Week 13	**Types of flow**	
Class 37	Transonic flow	
Class 38	Subsonic flow	
Class 39	Supersonic flow	

Week 14	Measurements in compressible flow	
Class 40	Equations of motion for compressible flow	
Class 41	Energy equation for compressible flow	
Class 42	Problem solving and review	

Text and Ref 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

AEAS 315: Aerospace Vehicle Stability and Control

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
The main course's objective is to teach students about the stability, the trim and the control characteristics of the aircraft.

Objective:
1. To define the longitudinal static stability of the aircraft.
2. To determine the longitudinal control of the aircraft.
3. To derive the equation of motion of the aircraft.
4. To solve the longitudinal equations of motion which result in an exact description of the stability and response characteristics of the aircraft.
5. Explain the difference between, and factors affecting, static and dynamic stability

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Describe aircraft dynamic modes.
2. Analyze contribution of various aircraft components to longitudinal, directional and lateral stability.
3. Evaluate aircraft stability and appreciate relevant flight and handling qualities
4. Develop the equations of motion of an aircraft.

Course Contents:

Importance and significance of flight stability and control: Static Longitudinal, Directional and Lateral stability with respect to 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, stabilizers, fuselages and power plants; Trailing edge aerodynamic controls; Trimmed equilibrium condition; Static margin; Effect on static stability of free and reversible controls.
Introduction to automatic flight control: Setup of the flight control system, System performance specification: - Requirements on flying and handling qualities and Parameters.
Stability augmentation systems: - Dampers-Acquiring static stability, Feedback-Acquiring static stability. Basic autopilot systems- Basic Longitudinal and Lateral autopilot systems; Navigational autopilot systems- Longitudinal and Lateral autopilot systems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100 %)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes(CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the difference between, and factors affecting, static and dynamic stability	√											
2. Describe aircraft dynamic modes.	√											
3. Analyze contribution of various aircraft components to longitudinal, directional and lateral stability.		√										
4. Evaluate aircraft stability and appreciate relevant flight and handling qualities				√								
5. Develop the equations of motion of an aircraft.			√									

Lecture Schedule :

Week 1	**Introduction to Stability**	
Class 1	Introduction to stability, controllability & maneuverability	CT 1
Class 2	States of equilibrium	
Class 3	Possible type of motion after disturbance	
Week 2	**Static Stability Prerequisite Terminologies**	
Class 4	Longitudinal, lateral & directional stability regarding static stability	
Class 5	Adverse yaw & ways of countering it	
Class 6	Angle of bank & Mean Aerodynamic Chord (MAC)	
Week 3	**Longitudinal Static Stability Analysis**	
Class 7	Related problems about Mean Aerodynamic Chord (MAC)	
Class 8	Longitudinal stability analysis of wing	

Class 9	Contribution of wing to Cm_{cg} and Cm_{α}	
Week 4	**Longitudinal Static Stability Analysis of Wing**	CT 2
Class 10	Primary & Secondary condition for Longitudinal stability	
Class 11	Secondary effect of $Cm_{\alpha w}$ on the wing location	
Class 12	Related math on Longitudinal Stability Analysis of Wing	
Week 5	**Longitudinal Static Stability analysis of Tail Plane, Fuselage & Powerplant**	
Class 13	Contribution of horizontal tail to Cm_{cg} and Cm_{α}	
Class 14	Contribution of fuselage to Cm_{cg} and Cm_{α}	
Class 15	Contribution of powerplant to Cm_{cg} and Cm_{α}	
Week 6	**Directional Static Stability**	
Class 16	Neutral point, elevator control power, elevator angle to trim	
Class 17	Flight path, Side-slip angle, Angle of yaw	
Class 18	Criteria for Directional Static Stability	
Week 7	**Contribution of Various components on Directional Static Stability**	CT 3
Class 19	Contribution of power plant on Directional Static Stability	
Class 20	Contribution of fuselage on Directional Static Stability	
Class 21	Contribution of wing & vertical tail on Directional Static Stability	
Week 8	**Contribution of Various components on Lateral Static Stability**	
Class 22	Contribution of wing on Directional Static Stability	
Class 23	Contribution of power plant and vertical tail on Directional Static Stability	
Class 24	Contribution of fuselage on Directional Static Stability	
Week 9	**Aircraft Equations of Motion**	
Class 25 Class 26	Development of equations for linear motion Development of equations for linear motion (cont'd)	
Class 27	Development of equations for angular motion	
Week 10	**Aircraft Equations of Motion (cont'd)**	
Class 28	Development of equations for angular motion (cont'd)	
Class 29	Linearization of aircraft equations of motion	
Class 30	Linearization of aircraft equations of motion (cont'd)	
Week 11	**Stability Derivatives**	

Class 31	u derivatives	
Class 32	q derivatives	
Class 33	p derivatives	
Week 12	**Aircraft Longitudinal Modes**	
Class 34	Short period mode	
Class 35	Long period mode	
Class 36	Long period mode (cont'd)	
Week 13	**Aircraft Longitudinal and Lateral-directional Modes**	
Class 37	Porpoise landing	
Class 38	Roll subsidience and spiral divergence	CT 4
Class 39	Dutch roll	
Week 14	**Aircraft Control**	
Class 40	Critical flight conditions and controls requirement	
Class 41	Trailing edge aerodynamic controls	
Class 42	Effect on static stability of free and reversible controls.	

Text and Ref Books:

1. Aircraft Performance Stability and Control, Vol-I, - James D; Lang United States Air force Academy.
2. Automatic Control of Aircraft and Missiles - Col. John H, Blakelock
3. Airplane Performance, Stability and Control - Perkins and Hage
4. Dynamics of Flight – Bernard Etkin

AEAS 317: Mechanics of Structure, Structural Vibration and Aero Elasticity

4.00 Contact Hour; 4.00 Credit Hour**;**

Pre-requisite: Engineering Mechanics (Statics and Dynamics)

Rationale:
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 (CO):
Upon completion of the course, the students will be able to:

1. Apply graphical and analytical methods to study the motion of a planar mechanism.
2. Analyze simple mechanisms and gear trains.
3. Evaluate natural frequency and period of simple vibrating mechanical systems and obtain the analytical solution for system's time response.
4. Develop mathematical model of dynamic systems with single and multi-degrees of freedom.
5. Explain the concepts of vibration isolation and rotating imbalance.

Course Contents:

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, multi-cylinder in- line and radial engines, Vengines and opposed-piston engines; Balancing machines; Principles and applications to orbital and gyroscopic motion.
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.
Introduction to aero elasticity, load distribution, concepts of divergence, control effectiveness and reversal.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Apply graphical and analytical methods to study the motion of a planar mechanism	√											
2.Analyze simple mechanisms and gear trains		√										
3.Evaluate natural frequency and period of simple vibrating mechanical systems and obtain the analytical solution for system's time response				√								
4.Develop mathematical model of dynamic systems with single and multi-degrees of freedom			√									
5. Explain the concepts of vibration isolation and rotating imbalance.	√											

Lecture Schedule:

Week 1	**Kinematics of motion**	
Class 1	Linear displacement, velocity and acceleration	CT 1
Class 2	Angular displacement, velocity and acceleration	
Class 3	Relation between linear motion and angular motion	
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	
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)**	CT 2
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	CT 3
Class 24	Energy stored in a flywheel	
Week 7	**Balancing of rotating and reciprocating masses**	
Class 25	Balancing of rotating masses	
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	

Class 35	Equations of motion of single degree of freedom systems	
Class 36	Equations of motion of multi degrees of freedom systems	
Week 10	**Damped Free Vibration and Forced Underdamped Vibration**	CT 4
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 Instrume nts**	
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**	CT 5
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	
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	

Text and Ref Books:

1. Theory of Machines (S. I. Units) – R. S. Khurmi, J. K. Gupta; Eurasia Publishing House (Pvt.) Ltd.
2. Mechanical Vibration-Theory and Applications (2nd Edition) - Frances S Tse, Ivan E Morse and R T Hinkle
3. Theory of Vibration with Application - William T Thomson

AEAS 325: Computational Fluid Dynamics

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Fundamentals of Aeronautical Engineering,
Engineering Mechanics (Statics and Dynamics),
Mechanics of Solids

Rationale:
This course introduces the students with the fundamental principles of **Computational** Fluid Dynamics (CFD) for understanding fluid flow and fluid properties based on computational method.

Objective:

1. To understand the fundamental principles of computational fluid dynamics and its application.
2. To apply these principles to real systems such as pipe flows, automobiles and aircraft.
3. To Explain the governing equations, their forms (conservative and non-conservative formulations) and variants
4. To understand aspects of CFD techniques for Finite Difference.
5. To be able to apply Finite volume techniques for diffusion problems, convection-diffusion problems
6. To provide students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the methods of fluid flow analysis i.e. theoretical, experimental and computational.
2. Describe the concept potential theory and its application to incompressible and inviscid flows.
3. Apply of theoretical techniques to analyze the simple viscous flows.
4. Apply the numerical methods for solution of complex flow situations.
5. Describe implications errors and stability analysis of numerical methods.

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the methods of fluid flow analysis i.e. theoretical, experimental and computational.		√										
2. Describe the concept potential theory and its application to incompressible and	√											
3. Apply of theoretical techniques to analyze the simple viscous flows.					√							
4. Apply the numerical methods for solution of complex flow situations.					√							
5. Describe implications errors and stability analysis of numerical methods.		√										

Lectures Schedule

Week 1	**Introduction to computational fluid dynamics**	
Class 1	Introduction to computational fluid dynamics	
Class 2	Review of governing equations, their forms (conservative and non-conservative formulations) and variants.	
Class 3	Boundary conditions	
Week 2	**Classification of Partial Differential Equations**	CT 1
Class 4	Classification of Partial Differential Equations and	
Class 5	Effects of Partial Differential Equations on CFD problem setup and solutions.	

Class 6	Concept of equation discretization using finite difference methods	
Week 3	**Explicit**	
Class 7	Explicit methods of formulations and solutions	
Class 8	Domain discretization	
Class 9	Algebraic grid generations	
Week 4	**implicit methods**	CT 02
Class 10	implicit methods of formulations and solutions	
Class 11	Domain discretization	
Class 12	Algebraic grid generations	
Week 5	**Grid generation techniques**	
Class 13	stretched grids	
Class 14	staggered grids	
Class 15	elliptic grid	
Week 6	**CFD techniques for Finite Difference Methods**	
Class 16	CFD techniques for Finite Difference Methods	
Class 17	Lax-Wendroff technique	
Class 18	MacCormack's Technique,	
Week 7	**Consistency and stability analysis**	
Class 19	Consistency and stability analysis	
Class 20	Numerical dispersion and artificial viscosity.	
Class 21	Errors	CT-3
Week 8	**Finite volume techniques for diffusion problems**	
Class 22	Finite volume techniques	
Class 23	under relaxation techniques	
Class 24	over relaxation techniques	
Week 9	**Convection-diffusion problems**	
Class 25	Convection-diffusion problems	
Class 26	Solved out examples	
Class 27	Solved out examples	
Week 10	**Algorithms for pressure-velocity coupling in steady flows**	
Class 28	SIMPLE	
Class 29	SIMPLER	
Class 30	SIMPLEC, PISO	
Week 11	**Solution of discretized equations**	CT-4
Class 31	Discritization equations	
Class 32	point iterative	
Class 33	line iterative	
Week 12	**Solution of discretized equations**	
Class 34	Discritization techniques	
Class 35	TDMA	

Class 36	ADI techniques
Week 13	**Concept of turbulence models.**
Class 37	Turbulence flow
Class 38	Turbulence flow modeling
Class 39	Turbulence flow modeling using CFD techniques
Week 14	**Post processing techniques in CFD.**
Class 40	Post processing techniques in CFD.
Class 41	Post processing techniques in CFD.
Class 42	Revision class

Text and Ref Books:

1. Mechanics of Fluids - Irving H. Shames
2. Mechanics of Fluids - B. S. Messy
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 - Anderson.

AEAS 326: Computational Fluid Dynamics Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Computational Fluid Dynamics

Rationale:
This course introduces the students with the fundamental principles of **Computational** Fluid Dynamics (CFD) for understanding fluid flow and fluid properties based on computational method.

Objective:

1. To understand the fundamental principles of computational fluid dynamics and its application.
2. To apply these principles to real systems such as pipe flows, automobiles and aircraft.
3. To Explain the governing equations, their forms (conservative and non-conservative formulations) and variants
4. To understand aspects of CFD techniques for Finite Difference.
5. To be able to apply Finite volume techniques for diffusion problems, convection-diffusion problems
6. To provide students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Conduct experiments, and then analyze and interpret results successfully.
2. Demonstrate that theoretical characteristics of low speed aerodynamics can be implemented through the wind tunnel operations and flow visualization techniques.
3. Analyze the computational approach by using CFD and interpret the results.
4. Demonstrate that the CFD simulation can also implement theoretical characteristics of low speed aerodynamics.
5. Evaluate the performance of both the experimental and computational approach of low speed aerodynamics and bring out a comparative assessment.

Course Contents:

Exp1: Numerical solution of parabolic equation using FDM
Exp2: Circular grid generation
Exp3: Supersonic flow over an aerofoil using ANSYS- FLUENT
Exp4: Subsonic flow over an aerofoil using ANSYS -FLUENT

Teaching-learning and Assessment Strategy: Class Assessment, Class Participation, Class Attendance, Lab Report, Lab Test

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	10
Class Attendance	10
Lab Report	40
Lab Test	40

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Conduct experiments, and then analyze and interpret results successfully.										√		
2. Demonstrate that theoretical characteristics of low speed aerodynamics can be implemented through the wind tunnel operations and flow visualization techniques.					√							
3. Analyze the computational approach by using CFD and interpret the results.	√											
4. Demonstrate that the CFD simulation can also implement theoretical characteristics of low speed aerodynamics.				√								
5. Evaluate the performance of both the experimental and computational approach of low speed aerodynamics and bring out a comparative assessment.		√										√

Text and Ref Books:

1. Mechanics of Fluids - Irving H. Shames
2. Mechanics of Fluids - B. S. Messy
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 – Anderson.

AEAS 319: Machine Design

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To design, analysis 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 rolling element bearings
5. To analyze and design of lubrication and sliding bearings
6.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand the theories relating to power screws, shaft, keys, springs, bearings, gears, brakes and clutches.
2. Apply the knowledge to design such machines like power screws, shaft, keys, springs, bearings, gears, brakes and clutches.
3. Evaluate the design requirement of various engineering machines.
4. Analyze of design parameters of various engineering machines.

Course Content :

Introduction to machine design. Design of basic machine elements like power screws, shaft and hole systems, keys and couplings, rivets, springs, bearings, gears, brakes and clutches. Design with composite materials.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1 Understand the theories relating to power screws, shaft, keys, springs, bearings, gears, brakes and clutches	√											
2 Apply the knowledge to design such machines like power screws, shaft, keys, springs, bearings, gears, brakes and clutches			√									
3 Evaluate the design requirement of various engineering machines.		√										
4 Analyze of design parameters of various engineering machines.				√								

Lecture schedule:

Week 1	**Simple Stresses in Machine Parts**	
Class 1	Load, Stress, Strain, Tensile Stress and Strain, Compressive Stress and Strain, Young's Modulus or Modulus of Elasticity, Shear Stress and Strain.	CT 1
Class 2	Stress-strain Diagram, Working Stress, Factor of Safety, Selection of Factor of Safety, Stresses in Composite Bars.	
Class 3	Stresses Due to Change in Temperature—Thermal Stresses, Linear and Lateral Strain, Poisson's Ratio, Volumetric Strain, Bulk Modulus.	
Week 2	**Keys**	
Class 4	Types of Keys, Sunk Keys, Saddle Keys, Tangent Keys, Round Keys, Splines, Forces acting on a Sunk Key.	
Class 5	Strength of a Sunk Key, Effect of Keyways.	
Class 6	Mathematical Problems.	
Week 3	**Shafts**	
Class 7	Material Used for Shafts, Manufacturing of Shafts, Types of Shafts, Standard Sizes of Transmission Shafts.	
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 Twisting Moment and Bending Moment.	
Week 4	**Shafts**	CT 2
Class 10	Shafts Subjected to Fluctuating Loads, Shafts Subjected to Axial Load in addition to Combined Torsion and Bending Loads.	

Class 11	Design of Shafts on the Basis of Rigidity.	
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**	CT 3
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.	
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	**Clutchces**	
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**	CT 4
Class 28	Energy Absorbed by a Brake, Heat to be Dissipated during Braking.	
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.	

Text and Ref 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 (7th Edition) - Joseph E Shigley, Charles R Mischke& Richard G Budynas.

AEAS 400: Capstone Project and Thesis

12.00 Contact Hour; 6.00 Credit Hour;

Pre-requisite: Student should complete all courses up to 4th Year

Rationale:
The main course is to expose and teach students the aspects and techniques related to performing a research project in the aerospace engineering fields.

Objectives:
1. Able to compile the necessary and related info via literature review process (appreciate previous researcher works) and show justification of the FYP topic.
2. Able to make a proper planning strategy before starting the project and manage the project.
3. Able to apply engineering principles to the design and development of the project via engineering design, experimental works, simulation works, theoretical and conceptual approach.
4. Able to communicate, present, and report.

Course Outcomes (CO):
Upon completion of the course, the students will be able:

1. To develop the ability to undertake complex problem identification, formulation and solution utilizing a system approach.
2. To design and conduct experiments of complex engineering problems with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.
3. To conduct investigations, devise appropriate measurement, analyze and interpret data and form reliable conclusions.
4. To apply modern engineering and IT tools to find the solution of well-defined Aeronautical engineering problems.
5. To develop the effective all round communication skills.
6. To solve the problems effectively in multi-disciplinary and multi-cultural environment both as a team member and a leader with effective managerial skills.
7. To be able to apply ethical principles in all professional and research work.
8. To develop engineers with universal socio cultural adaptability who can undertake responsibilities in the global arena without compromising on environmental safety.

9. To develop the capacity to undertake life-long learning.

Teaching-learning and Assessment Strategy: Students are observed and evaluated by their innovative knowledge about engineering solutions.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Attendance	10
Observation and Presentation	90

Mapping of Course Outcomes (CO)and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. To develop the ability to undertake complex problem identification, formulation and solution utilizing a system approach.		√										
2. To design and conduct experiments of complex engineering problems with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.			√									
3. To conduct investigations, devise appropriate measurement, analyze and interpret data and form reliable conclusions.				√								
4. To apply modern engineering and IT tools to find the solution of well-defined Aeronautical engineering problems.					√							
5. To develop the effective all round communication skills.										√		
6. To solve the problems effectively in multi-disciplinary and multi-cultural environment both as a team member and a leader with effective managerial skills.									√			
7. To be able to apply ethical principles in all professional and research work.								√				

8. To develop engineers with universal socio cultural adaptability who can undertake responsibilities in the global arena without compromising on environmental safety.						√						
9. To develop the capacity to undertake life-long learning.												√

AEAS 437: Aerospace Vehicle Design

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Aeronautical Engineering Drawing-I, Aeronautical Engineering Drawing II, Applied Aerodynamics, Aerospace Propulsion, Aircraft Loading and Structure Analysis, Aerospace Vehicle Stability and Control.

Rationale:
The main course's objective is to teach students the methodology and decision makinginvolved 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, propulsion system design.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand and experience of design of an aerospace system, mission, or vehicle.
2. Apply the knowledge of fundamentals of aeronautics with different disciplines.
3. Understand the conceptual design phase, design layout and design analysis - various types and categories of aircraft, requirement of teamwork for complex engineering projects.
4. Understand the preliminary design phase and evaluating Max take-of weight (MTOW), wing area& engine sizing.
5. Understand the detail design phase and analyzing the wing design, tail design, fuselage design, propulsion system design.

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, centre 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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Understanding and experience of design of an aerospace system, mission, or vehicle.						√						
2.Applying the knowledge of fundamentals of aeronautics with different disciplines.	√											
3.Understanding the conceptual design phase, design layout and design analysis - various types and categories of aircraft, requirement of teamwork for complex engineering projects.		√										
4.Understanding the preliminary design phase and evaluating Max take-of weight (MTOW), wing area & engine sizing.		√										
5.Understanding the detail design phase and analyzing the wing design, tail design, fuselage design, and propulsion system design.			√									

Lecture Schedule:

Week 1	**Aircraft Design Fundamentals**	CT 1
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	
Class 8	Aircraft Configuration Alternatives	
Class 9	Aircraft Classification and Design Constraints	
Week 4	**Preliminary Design**	CT 2
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	Continue	
Class 15	High-Lift Device	
Week 6		
Class 16	Continue	
Class 17	Wing Design Steps	
Class 18	Continue	
Week 7	**Tail Design**	CT 3
Class 19	Tail Configuration	
Class 20	Continue	
Class 21	Horizontal Tail Parameters	
Week 8		
Class 22	Continue	
Class 23	Vertical Tail Design	
Class 24	Continue	
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**	CT 4
Class 28	Engine Type Selection	
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	

Text and Ref Books:

1. Aircraft Design: A systems of Engineering Approach- Mohammad H. Saddaey
2. Aircraft Design: A Conceptual Approach - Raymer, 3rd Ed; AIAA Virginia, 1999.
3. Airplane Design: John Roskam, Parts

AEAS 438: Aerospace Vehicle Design Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite : Aerospace Vehicle Design

Rationale:
To apply all the design phases & structural layout for aircraft design.

Objective:

1. To learn the system engineering approach.
To solve Numerical problems on maximum take-off weight estimation, wing area &engine sizing.
2. To Analyze the influence of design for manufacture and maintainability.
3. To analyze the fuselage structure.
4. To evaluate requirements, selection & sizing method for the design of an aerospace vehicle

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain design of an aerospace system, mission, or vehicle.
2. Apply all design phases & structural layout through participation on design project.
3. Analyze the requirements, selection & sizing method for the design of an aerospace vehicle.
4. Evaluate of different structural parameters.
5. Analyze the influence of design for manufacture and maintainability.

Course Content :

1. Aircraft Conceptual Design:
Development of system operational requirement,
Selection of configuration from different alternative using Figure of Merit.

2. Preliminary Design:
Numerical problems on maximum take-off weight estimation, wing area &engine sizing.

3. Detail design:
    - Wing design: Selection of aero foil, Numerical on determination of wing parameters using Geometric and Trigonometric method.
    - Tail design: Numerical on determination of tail parameters.
    - Fuselage Design: Numerical on determination of fuselage parameters

- Propulsion System Design: Numerical on determination of propulsion system parameters
- Landing Gear Design: Numerical on determination of landing gear parameters
- Weight of Components & Weight Distribution: Estimation of component's weight and distribution.

4. Individual project on specified Aircraft Design.

Teaching-learning and Assessment Strategy: Lab performances, Lab Report/Assignment/Presentation, Lab Test/ Quiz

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100 %)
Class Assessment	
Class Participation	05
Class Attendance	05
Lab Report/Assignment/Presentation	20
Exam	
Lab Test/Quiz	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Explain the design of an aerospace system, mission, or vehicle.	√											
2.Apply all design phases & structural layout through participation on design project.											√	
3.Analyze the requirements, selection & sizing method for the design of an aerospace vehicle.					√							
4. Evaluation of different structural parameters		√										
5. Analyze the influence of design for manufacture and maintainability.					√							

Text and Ref Books:

1. Aircraft Design: A systems of Engineering Approach- Mohammad H. Saddaey
2. Aircraft Design: A Conceptual Approach - Raymer, 3rd Ed; AIAA Virginia, 1999.
3. Airplane Design: John Roskam, Parts 1-8

AEAS 439: Rotordynamics and Aircraft Performance

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: High Speed Aerodynamics, Aerospace Vehicle Stability and Control, Applied Aerodynamics

Rationale:
To learn the details of Performance of Fixed-Wing and rotary Aircraft:

Objective:
1. To understand flight mechanisms of Rotary Wing Aircraft.
2. To develop the basic concepts momentum theory and blade elementary theory as applied to Rotor Dynamics.
3. To understand different performance parameters and factors influencing these performance parameters a helicopter.
4. To analyze performance of a fixed wing aircraft.

Course Outcomes (CO):
Upon completion of the course, the students will be able to
1. To understand flight mechanisms of Rotary Wing Aircraft.
2. To develop the basic concepts momentum theory and blade elementary theory as applied to Rotor Dynamics.
3. To understand different performance parameters and factors influencing these performance parameters a helicopter.
4. To analyze performance of a fixed wing aircraft.

Course Content :

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.

Rotary-Wing Aircraft Performance: 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.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program outcomes:

Course Outcomes(CO)of the Course	Program outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.To understand flight mechanisms of Rotary Wing Aircraft	√											
2. To develop the basic concepts momentum theory and blade elementary theory as applied to Rotor Dynamics.	√											
3. To understand different performance parameters and factors influencing these performance parameters a helicopter.		√										
4. To analyze performance of an fixed wing aircraft		√										

Lectures Schedule:

Week 1	**Introduction to Helicopter dynamics**	
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	CT 1
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	
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**	CT 2
Class 10	Applicability of momentum theory and discussion 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. Practical exposure to	
Class 17	Analysis of forward flight using momentum theory blade elementary theory, induced power in forward flight	
Class 18	Performance of Helicoptor 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**	CT-3
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)	
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**	CT 4
Class 31	Equations of motion for steady and level flight.	
Class 32	Thrust required	
Class 33	Aerodynamic relations associated with Maximum $\frac{C_L}{C_D}, \frac{C_L^{3/2}}{C_D}$ *and* $\frac{C_L^{1/2}}{C_D}$	
Week 12	**Airplane Performance: Steady Flight**	
Class 34	Thrust available and the maximum velocity of **propeller driven** aircraft.	
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 cocept.	
Class 42	Takeoff and landing performance.	

Text 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.

AEAS 447: Space Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To prepare students with a better understanding concerning the motion of spacecraft.

Objective:
1. To be able to determine the motion of two bodies and develop several fundamental
1. properties of the different types of orbit
2. To be able to define position as a function of time for all types of orbit
3. To be able to define the fundamental of spacecraft system
4. To be able to determine the elements for each subsystem in spacecraft.
5. To be able to Able to define the trajectory properties for orbit manoeuvres
6. To understand basics of satellite systems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to

1. Develop the basic concepts of Orbital Mechanics.
2. Investigate Space Environment.
3. Explain Space Laws and Legislative Issues.
4. Apply basic of Orbital Mechanics to Satellite Operations & Rocket Launching.
5. Apply system engineering approach in space vehicles designing.

Course Content :

Introduction: Space environment, types of spacecraft, 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.

Basic properties of the electro-magnetic environment in space; Basic Space Law and legislative issues; The Outer Space Treaty; The Space Activities Act Standards.

Introduction to rocket launching: Rocket equation, multi-staging, parallel staging, optimal staging, sensitivity ratios, vertical ascent trajectories, gravity turn trajectories.

Introduction to satellite system: Types of satellite, Satellite components. Satellite link design; uplink & downlink. Satellite constellation. Dilution of precision, Satellite Receivers: characteristics, error. Receiver Autonomous Integrity Monitoring. Introduction to systems engineering approach.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program outcomes:

Course Outcomes(CO)of the Course	Program outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Develop the basic concepts of Orbital Mechanics.	√											
2. Investigate Space Environment.				√								
3. Explain space Laws and Legislative Issues.								√				
4. Apply basic of Orbital Mechanics to Satellite Operations & Rocket Launching.						√						
5. Apply system engineering approach in space vehicles designing.			√									

<u>Lectures Schedule</u>

Week 1	**Orbital mechanics**	
Class 1	Two-body Problem, Kepler's laws.	CT 1
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	**Space Law**	

Class 4	The Outer Space Treaty.	
Class 5	The Outer Space Treaty.	
Class 6	The Space Activities Act Standards.	
Week 3	**Satellite operations**	
Class 7	Different types of orbits.	
Class 8	International Space Station.	
Class 9	Hohmann transfer.	
Week 4	**Satellite operations**	CT 2
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	**Attitude dynamics and control**	
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	**Attitude dynamics and control**	
Class 16	Torque free motion of axisymmetric rigid bodies.	
Class 17	Attitude control of spinning and non-spinning satellites.	
Class 18	Attitude control of non-spinning satellites.	
Week 7	**Space Environment**	CT 3
Class 19	Radiation Environment & Plasma Environment.	
Class 20	Neutral Environment & Particulate Environment.	
Class 21	Sunspot, solar wind, corona, Solar Prominences, Solar Flares.	
Week 8	**SUN & EARTH**	
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	**Satellite Subsystems**	
Class 25	Mechanical structure.	
Class 26	Propulsion subsystem	
Class 27	Propulsion subsystem	
Week 10	**Satellite Subsystems**	
Class 28	Thermal control subsystem.	
Class 29	Power supply subsystem.	
Class 30	Telemetry, tracking and command (TT&C) subsystem.	
Week 11	**Satellite Subsystems**	

Class 31	Attitude and orbit control subsystem.	CT 4
Class 32	Payload subsystem.	
Class 33	Antenna subsystem.	
Week 12	**Rocket launching**	
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	**Systems engineering approach**	
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	**Systems engineering approach**	
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.	

Text Book:

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
5. Digital Satellite Communications - Tri T. Ha; McGraw-Hill International.
6. Satellite Communications- Dennis Roddy; McGraw-Hill TELECOM.
7. Satellite Communications - T. Pratt, C. Bostian, J. Allnut; John Wiley & Sons Inc.

AEAS 445: Industrial and Business Management

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn the principles and techniques of industrial management which is essential for doing job in industry

Objective:

1. To Be able to describe central theories within the field of industrial management, such as costing
2. To Be able to describe the transactions of a company.
3. To Be able to analyze the cash flow and the financial tools for a company.
4. To be able to describe how the accounting system of a company is constructed..
5. To be able to describe the most well-known theories and perspectives on management
6. To have a basic understanding of contemporary organizational forms

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about financial concepts used in making business decisions.
2. Apply quantitative measurements to solve business problems related to depreciation, percentages, future value of money and to be able to make better business decisions.
3. Understand the roles of Manager and how to use motivation in workplace.
4. Gain knowledge about the methods and processes of plant layout & production planning and control.
5. Understand project scheduling selection and operations management.

Course Content :

Organization and management: system approach to organization, organization theory and organizing practices, basics of organizing.
Personnel and human resource management in business human factors and motivation, leadership, group decision making and communication, Job gradation, process of performance appraisal and reward systems
Emergence of management thought and the patterns of management analysis scientific management and Taylorism, Modern operational-management theory, emergence of the behavioural sciences, recent contributors to management thought.
Cost management elements of cost of products, cost centres and allocation of overhead costs; Management accounting: marginal costing, standard costing, cost planning and control, budget

and budgetary control; Development and planning process; Annual development plan; National budget.
Financial management: objectives, strategy, financing, performance analysis of enterprises, investment appraisal, criteria of investment.
Marketing management: marketing concept, marketing organization; Industrial and consumer selling; Channel decisions; Advertising decisions; new product strategy.
Elements of production planning and control; plat location and layout; Types of production system; Functions of production, planning and control with an overview of different types of manufacturing systems; Factors affiliated with different fields of production including product characteristics and economic analysis.
Forecasting methods and their application; Aggregate planning; Master production scheduling; MRP; Coding and standardization; Capacity planning; Inventory management - ABC analysis; Production scheduling techniques - CPM and PERT; Line balancing; Capacity planning.
Types of information systems and it‘s benefits at different management levels; Computers in production planning and control; MRPII and JIT.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about financial concepts used in making business decisions.												√
2. Apply quantitative measurements to solve business problems related to depreciation, percentages, future value of money and to be able to make better business decisions.		√										
3. Explain the roles of manager and how to use motivation in workplace.										√		
4. Gain knowledge about the methods and processes of plant layout & production			√									

planning and control.												
5. Explain project scheduling selection and operations management.											✓	

Lecture Schedule:

Week 1	**Principles Of Management**	CT 1
Class 1	Types of Managers	
Class 2	Roles and Functions of Management	
Class 3	Taylor’s Scientific Management	
Week 2	**Principles Of Management**	
Class 4	Administrative Management and Human Resource Management	
Class 5	Motivation and Needs Theories of Motivation	
Class 6	Atkinson and McClellan’s Need Theory	
Week 3	**Engineering Economy**	
Class 7	Cash Flow and Cash Flow Diagram	
Class 8	Time Value of Money	
Class 9	Converting Effective Interest Rates	
Week 4	**Engineering Economy**	CT 2
Class 10	Payback Period (PBP)	
Class 11	Net Present Value (NPV)	
Class 12	Internal Rate of return (IRR)	
Week 5	**Plant Location And Plant Layout**	
Class 13	Steps in Choosing Location	
Class 14	Plant Location Problems	
Class 15	Factors Affecting Plant Location	
Week 6	**Plant Location And Plant Layout**	
Class 16	Objectives of Plant Layout	
Class 17	Types of plant layout	
Class 18	Material Flow Pattern	
Week 7	**Project Scheduling And Control Techniques**	CT 3
Class 19	Characteristic of a project	
Class 20	Scheduling the Project	
Class 21	Situations in Network Diagram	
Week 8	**Project Scheduling And Control Techniques**	
Class 22	Building the Network: AON and AOA	
Class 23	Critical Path Method (CPM)	
Class 24	Gantt Chart	

Week 9	**Production Planning And Control**	
Class 25	Objectives of Production Management	
Class 26	Objectives, Functions, Elements of Production Planning and Control (PPC)	
Class 27	Limitations &Benefits of Production Planning and Control	
Week 10	**Cost Management**	
Class 28	Basic Accounting Principles	
Class 29	Types of Businesses	
Class 30	Classification of Costs	
Week 11	**Cost Management**	
Class 31	Break-Even Analysis	
Class 32	Methods of Lowering BEP	
Class 33	Application of BEP	
Week 12	**Depreciation Methods**	
Class 34	Factors in the Depreciation Process	
Class 35	Methods of Depreciation	CT 4
Class 36	Related math on Methods of Depreciation	
Week 13	**Operations Management In Supply Chain**	
Class 37	Basic Principles of Manufacturing Management	
Class 38	Mass Production System	
Class 39	Lean Manufacturing	
Week 14	**Operations Management In Supply Chain**	
Class 40	Agile Manufacturing	
Class 41	Quick Response Manufacturing (QRM)	
Class 42	Just-In-Time (JIT)	

Text and Ref Books:

1. Management - Jams A. F. Stoner, R. Edward Freeman, Daniel R. Gilbert,
2. Management - Stephen P. Rubbins, Mar Conlter, Robin Stuart kotze.
3. Operation Management - Chase & Jacob.
4. Managerial Accounting - Garrison, Noreen.
5. Product Design & Development - Ulrich &Eppinger
6. Product Design Methods & Practices - Henry W Stoll
7. Developing New Products with TQM - Charles Gevirtz

AEAS 407: Turbomachinery

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Thermodynamics, Heat Transfer, Aerospace Propulsion

Rationale:
To learn about the details of turbo machines and working principles.

Objectives:

1. To Classification and applications of different turbo machines.
2. To develop the basic concepts of thermodynamic analysis of diffusers, nozzles.
3. To undertake thermodynamic and aerodynamic analysis of axial and radial flow compressors and turbines.
4. To understand instabilities of compressor operations and methods to arrest instabilities.
5. To identify performance parameters influencing the operation of turbo machines

Course Outcomes (CO):
Upon completion of the course, the students will be able to

1. To Classification and applications of different turbo machines.
2. To develop the basic concepts of thermodynamic analysis of diffusers, nozzles.
3. To undertake thermodynamic and aerodynamic analysis of axial and radial flow compressors and turbines.
4. To understand instabilities of compressor operations and methods to arrest instabilities.
5. To identify performance parameters influencing the operation of turbo machines

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	

Final exam	70

Mapping of Course Outcomes (CO) and Program outcomes:

Course Outcomes(CO) of the Course	Program outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.To Classification and applications of different turbo machines		√										
2. To develop the basic concepts of thermodynamic analysis of diffusers, nozzles	√											
3. To undertake thermodynamic and aerodynamic analysis of axial and radial flow compressors and turbines.							√					
4. To understand instabilities of compressor operations and methods to arrest instabilities.		√										
5. To identify performance parameters influencing the operation of turbo machines				√								

Lectures Schedule

Week 1	**Introduction to Turbo-machines**	
Class 1	Historical review of evolution of turbo-machines	CT 1
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.	
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**	CT 2
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	Aerodynamic analysis of axial flow compressors	
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.	
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**	CT-3
Class 25	Thermodynamic analysis of axial flow turbines	
Class 26	Aerodynamic analysis of axial flow turbines.	
Class 27	Multistaging and multi pooling requirements of turbines	
Week 10	**Stage velocity triangles**	
Class 28	Stage velocity triangles.	
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	Rothalpy and conservation of rothalpy across rotors	
Week 12	**Centrifugal compressors**	

Class 34	Comparison of centrifugal compressors with axial flow compressors, advantages and applications.	CT 4
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	

Text Book:

1. Mechanics and Thermodynamics of Propulsion - Hill & Peterson.
2. Fluid Mechanics, Thermodynamics of Turbo-machinery - S L Dixon; Pergamon Press, 1966.
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.

5.1.2 Elective Courses (Aerospace Discipline)

AEAS 419: Maintenance Management and Repair of Aircraft

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn the vocabulary, practice and technologies of aircraft maintenance management, the areas of concern for maintenance professionals.

Objective:
1. To be familiarized with aviation regulatory framework in which continuing airworthiness and aircraft maintenance is managed
2. To learn about tools used in the planning and control of maintenance.
3. To understand aircraft maintenance principles and procedures.
4. To have knowledge about the personnel issues of training and safety.
5. To understand the processes of maintenance program development.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand the basic function of an organization/industry and associated role of an aircraft maintenance engineer to ensure compliance to industry standards to accomplish its objective.
2. Study the concept, benefits, policies, performance indicators, methods and techniques of different maintenance programs for proactive and cost-effective approaches of aircraft maintenance.
3. Apply systematic approaches in a variety of different ways to describe, investigate and analyze complex engineering systems and associated issues as well as conduct any type of management in engineering projects.
4. Develop decision-making methodologies for components, systems and/ or processes to meet specified requirements, including innovative approaches to synthesis alternative solutions, concepts and procedures.
5. Apply aircraft maintenance principles, procedures and airworthiness regulations to aircraft maintenance management.

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.

Practical issues in maintenance and repair of structures and systems and details of maintenance scheduling activities; Advanced methods of maintenance and repair; Application of NDI for manufacture and maintenance of structural components in aircraft industry.

Different structural failure modes and analysis the causes of failure; Aircraft accident investigation and prevention.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic function of an organization/industry and associated role of an aircraft maintenance engineer to ensure compliance to industry standards to accomplish its objective.	√											
2. Apply aircraft maintenance principles, procedures and airworthiness regulations to meet the requirement of safety, legal and cultural issues of the society.						√						
3. Apply systematic approaches in a variety of different ways to describe, investigate and analyze complex engineering systems and associated issues as well as conduct any type of management in engineering projects.				√								
4. Develop decision-making methodologies for components, systems and/ or processes to meet specified requirements working as a member or a leader by following engineering and management principles.											√	

Lecture Schedule:

Week 1	**Introduction of an organization**	CT 1
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	Aircraft maintenance history and objective	
Week 3	**Aircraft Maintenance Strategies**	
Class 7	Maintenance Strategies, working assumption and mathematical model	
Class 8	Conditional Maintenance Models	
Class 9	Conditional Maintenance Models	
Week 4	**Maintenance Management Information Systems**	CT 2
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)**	CT 3
Class 19	Definition of FADEC, Digital electronic control, design requirement of modern engine control.	
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**	CT 4
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	

Text and Ref 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.

AEAS 431: Weapons Engineering

3.0 **Contact Hour** 3.0 **Credit Hour**

Pre-requisite: High Speed Aerodynamics, Aerospace Vehicle Stability and Control, Applied Aerodynamics

Rationale:
To provide theoretical background for research, development weapons and other artillery associated with it.

Objective:
1. To be familiarized with different aspects of explosives.
2. To understand fundamental concepts of missiles.
3. To learn missile aerodynamics, missile guidance.
4. To have a proper understanding of phenomena related to blast.
5. To understand basics of designing explosives, missile

Course Outcomes (CO):
Upon completion of the course, the students will be able to

1. To differentiate between energetic materials and non-energetic materials.
2. To explain the explosion process and its effects
3. To explain working principle of warheads, propulsion systems.
4. To apply the theoretical knowledge for designing of explosive storage areas.

Course Content :

History of explosives; Types and properties of explosives; Initiation systems, quantity distance procedures; Effect of blast, fragmentation and shaped charge warheads; Quarry blasting and explosive demolition; Blast waves and interactions, blast loads on structures, blast analysis and structural design; Survivability of structures.
Kinetic energy of penetrations; Propellant charges; Fuses, initiators, detonators and safe / arm devices; Dynamics of unguided weapons: fin and spin stabilization.
Principles of missile flight and propulsion; Aerodynamics and dynamics of slender bodies and wings; Spin and fin stabilization of projectiles, trajectories and maneuver capabilities; Layout, control, propulsion and their integration with other systems; Storage, maintenance, transport and launch considerations. Missile guidance techniques; Physics and accuracy of missile sensors and effect on guidance; Advanced guidance and sensor systems; Prediction techniques for missile aerodynamics; Introduction to Electronic warfare.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program outcomes:

Course Outcomes(CO)of the Course	Program outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. To differentiate between energetic materials and non-energetic materials.		√										
2. To explain the explosion process and its effects	√											
3. To explain working principle of warheads, propulsion systems, missile guidance.	√											
4. To apply the theoretical knowledge for designing of explosive storage areas.			√									

Lectures Schedule

Week 1		CT 1
Class 1	History of explosives, Classification of explosives	
Class 2	Performance properties of explosives – Heat of Explosion, Temperature of Explosion, Volume of gas,	
Class 3	Formation of gases of explosion. Evaluation of oxygen balance and achieving desired temperature of explosion	
Week 2		
Class 4	Burning, deflagration and Detonation differences and similarities. Mechanism of detonation and deflagration,	
Class 5	Pressure and velocity of detonation, rate of burning, Brisance, power index of explosives	
Class 6	Explosive train, initiating systems	
Week 3		
Class 7	Features of explosives – compatibility, stability, sensitivity and sensitiveness	
Class 8	Method of ascertaining stability, sensitivity rate of burning etc	

Class 9	Discussion on energy partitioning in explosive devices for different applications	
Week 4		CT 2
Class 10	Explosive regulation, UN classification of dangerous goods	
Class 11	UN classification of Hazard division and hazard classification.	
Class 12	Explosive Store Compatibility groups and compatibility of explosives	
Week 5		
Class 13	Concept of Quantity distance for safe storage and operation	
Class 14	Traverses in explosive storage area	
Class 15	Introduction to Quarry blasting and explosive demolition	
Week 6		
Class 16	Anatomy of High explosive Blast	
Class 17	Blast waves and interactions, blast loads on structures,	
Class 18	blast analysis and structural design; Survivability of structures	
Week 7		
Class 19	Military and Civil application of explosive technology	
Class 20	Classification of warheads, Blast warhead	
Class 21	Fragmentation process and fragmentation warheads	
Week 8		CT-3
Class 22	Shaped charge warheads	
Class 23	Kinetic energy penetration and kinetic energy warheads	
Class 24	Fuses, initiators, detonators and safe / arm devices	
Week 9		
Class 25	Theory on Rocket propulsion systems	
Class 26	Classification and working of propulsion systems.	
Class 27	Propellants; gun propellants and their design and composition.	
Week 10		
Class 28	Rocket propellants, their characteristics	
Class 29	Solid, liquid and hybrid propulsion systems and propellants	
Class 30	Design of propellants and compositions	
Week 11		
Class 31	Principles of missile flight and propulsion	
Class 32	Aerodynamics and dynamics of slender bodies and wings	
Class 33	Spin and fin stabilization of projectiles, trajectories and maneuver capabilities	
Week 12		
Class 34	Layout, control, propulsion and their integration with other systems	

Class 35	Storage, maintenance, transport of missiles.	CT 4
Class 36	Missile launch considerations	
Week 13		
Class 37	Missile guidance phases and requirements, their phases	
Class 38	Missile guidance techniques	
Class 39	Physics and accuracy of missile sensors and effect on guidance	
Week 14		
Class 40	Advanced guidance and sensor systems;	
Class 41	Prediction techniques for missile aerodynamics	
Class 42	Introduction to Electronic warfare	

Text Book:

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

AEAS 455: Human Performance and Limitations

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn the details of human performance and human errors.

Objectives

1. To Know about various incidence and accidence happened previously for human performance and limitations.
2. To Explain the causes that may lead to hazard.
3. To Evaluate this knowledge of human performance and its limitations in their real life work field to avoid any kind of undesirable incident.
4. To Know about recognizing and avoiding hazards, dealing with emergencies.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Know about various incidence and accidence happened previously for human performance and limitations.

2. Explain the causes that may lead to hazard.

1. 3.Evaluate this knowledge of human performance and its limitations in their real life work field to avoid any kind of undesirable incident.

3. Know about recognizing and avoiding hazards, dealing with emergencies.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Know about various incidence and accidence happened previously for human performance and limitations.	√											
2. Understand the causes that may lead to hazard.							√					
3. Evaluate this knowledge of human performance and its limitations in their real life work field to avoid any kind of undesirable incident.						√						
4. Know about recognizing and avoiding hazards, dealing with emergencies.												√

Lecture Schedule:

Week 1	**Chapter 01-FUNDAMENTALS OF HUMAN FACTORS**	CT 1
Class 1	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	**Chapter 1 And Chapter 2** **Incidents Attributable To Human Factors/ Errors**	
Class 4	1.10 The Cost Effectiveness Of Implementing Hf Rograms 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	**Chapter-3** **Human Performance & Limitations**	
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	**Chapter 4** **Social Psychology**	CT 2
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	**Chapter 4 And Chapter 5** **Factors Affecting Performance**	
Class 13	4.8 Management, Supervision And Leadership 4.9 Maintenance Resource Management (Mrm)	
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	**Chapter 5 And Chapter 6** **Physical Environment**	
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 Illuminasion	
Week 7	**Chapter 6** **Physical Environment**	
Class 19	6.4 Climates And Temperature	

Class 20	6.5 Motion And Vibration	
Class 21	6.6 Working Environment	
Week 8	**Chapter 7** **Tasks**	CT 3
Class 22	7.0 Introduction 7.1 Physical Work	
Class 23	7.2 Repetitive Tasks 7.3 Visual Inspection	
Class 24	7.4 Complex Systems	
Week 9	**Chapter 8** **Communication**	
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	**Chapter 8** **Communication**	
Class 28	8.4 Communication Problems	
Class 29	8.5 Work Logging And Recording	
Class 30	8.6 Keeping Up-To-Date	
Week 11	**Chapter 8 And Chapter 9** **Human Error**	CT 4
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 9.4 Avoiding And Managing Errors	
Week 12	**Chapter 9** **Human Error**	
Class 34	9.3 Implications Of Errors (I. E. Accidents)	
Class 35	9.4 Avoiding And Managing Errors	
Class 36	Continue.	

Week 13	**Chapter 10** **Hazards In Workplace**	
Class 37	10.0 Introductions 10.1 Potential Hazards In Aircraft Maintenance Engineering	
Class 38	10.2 Relevant Legislation And The Maintenance Organisation's Responsibilities	
Class 39	10.3 Engineer's Individual Responsibilities 10.4 Dealing With Emergencies	
Week 14	**Chapter 11** **Situation Awareness**	
Class 40	11.0 Introduction	
Class 41	11.1 Situation Awareness In Workplace	
Class 42	Review Of Whole Syllabus	

Text and Ref 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

AEAS 457: Airworthiness Legislation

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None.

Rationale:
To learn about whole aircraft licensing and certifications.

Objectives:

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 (CO):
Upon completion of the course, the students will be able to:

1. Know about the legislative and regulatory framework of national and international aviation authorities and the relationship between them.

2. 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. Understand aircraft operation and certification requirements and the associated documentation.

4. Analyze the applicable National and International requirements and the EASA Part-M regulation for the continued airworthiness and maintenance of aircraft.

Course Content :

Aircraft Maintenance Engineers License: Civil Aviation Rules 1984 PART I, Air Navigation Orders & Sections, Responsibilities: by the need to fly aircraft in a satisfactory condition i. e. Common, civil, constitutional law, Penalties under statutory law and resulting from civil law suits, Categories - which parts of the aircraft, Area and extent of limitations and privileges within Categories, Overlap of Category applicability, Relevant Airworthiness Notices (e.g.5,11and 36) .

Certifications: Civil Aviation Rules 1984 PART VIM, Certificate of Compliance: Maintenance Release; Fitness for Fight; Duplicate inspections, Contributory certifications and reliance on.

Aircraft Log Books: Civil Aviation Rules 1984 PART Vlll, CAAB Approval: Light Aircraft, large aircraft,

Worksheets: Aircraft Maintenance Log, Data to be entered in log books, Condition reports; e.g., investigations, NDT and other inspections, Maintenance checks and inspections, Cross-reference to other files, records of other documentation and persons.

Aircraft Maintenance Log: Aircraft Maintenance Log - Air Operator's Certificate requirements.

Aircraft Maintenance: Type Certification, Weight Schedule, External and Internal Markings and Signs, National and Registration, Cabin Warning Placards, Doors and Exits. Certificate of Airworthiness Categories, Purposes of Flight, Flight Manual, Certificate of Registration, Air Operators Certificates, Radio Station License and Approval, Change of ownership, Maintenance Organization, Maintenance Schedule, General Engineering Manual, Stores Systems, Release of Parts.

Civil Aviation Rules: 1984 part VIII, Reportable Defects, Reportable Accidents,

Air Navigation Orders: Maintenance Requirements, Airworthiness Notice,

Airworthiness Directives: Bangladesh and Foreign.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**										
	1		3	4	5	6	7	8	9	10	11	12
1. Know about the legislative and regulatory framework of national and international aviation authorities and the relationship between them.	√											

2. 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. Understand aircraft operation and certification requirements and the associated documentation.							√					
4. Analyze the applicable National and International requirements and the EASA Part-M regulation for the continued airworthiness and maintenance of aircraft.		√										

Lecture Schedule:

Week 1	**PART A – Airworthiness Certification**	
Class 1	Chapter-A.1, A.2, A.3, A.4	
Class 2	Chapter-A.5, A.6, A.7, A.8	
Class 3	Chapter-A.9, A.10, A.11	
Week 2	**PART B - Maintenance Directions**	
Class 4	Chapter- B.1 To B.8	CT 1
Class 5	Chapter- B.9 To B.16	
Class 6	Chapter- B.17 To B.22	
Week 3	**PART C - Certificate Of Approval- Organisations And Individuals**	
Class 7	Chapter- C.1, C.2, C.3	
Class 8	Chapter- C.4, C.5	
Class 9	Chapter- C.6, C.7, C.8	
Week 4	**PART D - Licensing Aircraft Maintenance Engineers Chapter**	
Class 10	Chapter- D.1, D.2	
Class 11	Chapter- D.3, D.4	
Class 12	Chapter- D.5, D.6, D.7	
Week 5	**PART E - Aircraft Equipment**	CT 2
Class 13	Chapter- E.1, E.2, E.3	
Class 14	Chapter- E.4, E.5	
Class 15	Chapter- E.6, E.7	
Week 6	**PART F- Airworthiness And Operations Directions**	
Class 16	Chapter- E.8, E.9	

Class 17	Chapter- E.10, E.11, E.12	
Class 18	Chapter- F.1	
Week 7	**PART M- Continuing Airworthiness Requirements**	CT 3
Class 19	Chapter 1: Regulations & Acceptable Means Of Compliance (Section A)	
Class 20	Chapter 2: Procedures For Competent Authority & Acceptable Means Of Compliance (Section B)	
Class 21	Chapter 3: Appendices To The Regulation	
Week 8	**PART M- Continuing Airworthiness Requirements**	
Class 22	Chapter 4: Appendices To Amcs	
Class 23	Chapter 5: Opt-Outs	
Class 24	Part 66- Chapter 1: Regulations& Acceptable Means Of Compliance (Section A)	
Week 9	**PART 66- Aircraft Maintenance Licence** **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 Organisations**	CT 4
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	**CAR 84**	
Class 31	PART I- Personnel Licensing.	
Class 32	PART I- Personnel Licensing.	
Class 33	PART I- Personnel Licensing.	
Week 12	**CAR 84**	
Class 34	PART II- Rules Of The Air	
Class 35	PART III- Aviation Meteorlogy PART IV- Aeronautical Charts PART V- Units Of Measurement PART VI- Operation Of Aircraft	
Class 36	PART VII- Registration And Marking Of Aircraft PART VIII- Airworthiness Requirements	
Week 13	**CAR 84**	

Class 37	PART IX- Facilitation PART X- Aeronautical Telecommunications PART XI- Air Traffic Services	
Class 38	PART XII- Search And Rescue PART XIV- Aerodromes And Airports	
Class 39	PART XV- Aeronautical Information Services PART XVI- Aircraft Noise PART XVII- Safeguard Against Acts Of Unlawful Interference	
Week 14	**CAR 84**	
Class 40	Part XVIIIA- Safe Transportation Of Dangerous Goods By Air PART XVIII- Air Transport Services	
Class 41	Preliminary	
Class 42	Review Of Whole Syllabus	

Text and Ref Books:

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

AEAS 421 Aviation Safety

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn about aviation safety procedures and necessary arrangements.

Objectives:
1. To familiarize with the aviation safety systems
2. To Explain necessary precautions to be taken

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about various types of safety management programs;
2. Understand the human factors in aviation;
3. Evaluate various human error and risk management planning;
4. Gain knowledge about accident prevention strategies;
5. Analysis of aircraft incidents and accidents in flight for human error.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about various types of safety management programs;						√						
2. Understand the human factors in aviation.								√				
3. Evaluate various human error and risk management planning.						√						
4. Gain knowledge about accident prevention strategies.			√									
5. Analysis of aircraft incidents and accidents in flight for human error						√						

Lecture Schedule:

Week 1	**Safety in aviation**	
Class 1	Safety in aviation including aircrew, aircraft	
Class 2	Safety in aviation includingmaintenance	
Class 3	Safety in aviation including management operations and airspace	
Week 2	**Human performance**	
Class 4	emphasis on human performance	
Class 5	Safety issues	CT-1
Class 6	Safety management programs	
Week 3	**Human factors in aviation**	
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 ofthe people	
Week 4	**Human behavior**	
Class 10	environment and technology - human behavior	

Class 11	Continue	CT-2
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	**Human error**	CT-3
Class 19	Human error	
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**	CT-4
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	

Text and Ref Books:

1. Hand notes provided - the teacher / instructor.
2. Flight safety Journal/ manuals from BAF.

AEAS 423 Aerospace Management

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn about how the aviation sector and related areas are coordinated and organized.

Objectives:
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 be able 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 be able to incorporateemergency procedure management and risk management, accident investigation and dispatch reliability management.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about flight mechanics;
2. Analysis of airline operations;
3. Evaluate various aviation regulations and safety;
4. Gain knowledge about flight safety and airworthiness standards;
5. Analysis of emergency procedure management and risk management, accident investigation and dispatch reliability management.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about flight mechanics;	✓											
2. Analysis of airline operations.						✓						
3. Evaluate various aviation regulations and safety.							✓					
4. Gain knowledge about flight safety and airworthiness standards.	✓											
5. Analysis of emergency procedure management and risk management, accident investigation and dispatch reliability management											✓	

Lecture Schedule:

Week 1	**Introduction to aerospace management**	
Class 1	Aerospace management	
Class 2	Principles and practice of aviation	
Class 3	Air traffic services	
Week 2	**Airline management**	
Class 4	Airline management incorporating flight mechanics	
Class 5	Continue	CT-1
Class 6	Airline management incorporating aircraft handling	
Week 3	**Human factors in aviation**	

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 ofthe people	
Week 4	**Airline operations**	
Class 10	Airline operations	
Class 11	Continue	
Class 12	Basic human factors and systematic safety issues involving aircraft accident case	
Week 5	**Flight separation**	
Class 13	Classification and use of civil and military airspace	
Class 14	Aspects of flight separation	CT-2
Class 15	Continue	
Week 6	**Aircraft performance**	
Class 16	Aircraft performance regarding flight mechanics	
Class 17	Continue	
Class 18	Continue	
Week 7	**Basic meteorology**	
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	CT-3
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	
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	CT-4
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	

Text and Ref Books:

1. Hand notes provided - the teacher / instructor.

AEAS 425 Pressurization and Air Conditioning systems

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn about the pressurization and air conditioning system in an aircraft.

Objectives:
1. To learn the basic knowledge about the Concept of pressurization and its applications in the cockpit
2. To analyze the various components related to cockpit pressurization
3. To be able to ensure the flight safety by actively considering the effect of Air conditioning equipment.
4. To analyze the associated risk and reliability in relation to Pressurization and Air Conditioning Systems
5. To be able to incorporate emergency procedure in handling Fire hazard and firefighting equipment.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about pressurization system and different components related to cockpit pressurization;
2. Analysis of vapor compression refrigeration, absorption refrigeration and air-cycle refrigeration systems;
3. Evaluate various Air conditioning systems;
4. Gain knowledge about Refrigeration equipment: compressors, condensers, evaporators, expansion devices, other control and safety devices;
5. Analysis of Fire hazard and firefighting equipment

Course Content :

Concept of pressurization and its applications in the cockpit; Study of pressurization system and different components related to cockpit pressurization.
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.

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 and firefighting equipment.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Gain knowledge about pressurization system and different components related to cockpit pressurization;	✓											
2. Analysis of vapor compression refrigeration, absorption refrigeration and air-cycle refrigeration systems.		✓										
3. Evaluate various Air conditioning systems.				✓								
4. Gain knowledge about Refrigeration equipment: compressors, condensers, evaporators, expansion devicesand other control and safety devices.		✓										
5.Analysis of Fire hazard and firefighting equipment						✓						

Lecture Schedule:

Week 1	**Introduction topressurization**	
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**	CT-1
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	
Class 8	Different refrigeration methods	
Class 9	Continue	
Week 4	**Vapor compression refrigeration**	CT-2
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**	CT-3
Class 19	Expansion devices	
Class 20	Other control and safety devices	
Class 21	Continue	
Week 8	**Refrigeration equipment**	
Class 22	Multi-evaporator	
Class 23	Multi-compressor systems	
Class 24	Low temperature refrigeration	
Week 9	**Air conditioning**	
Class 25	Introduction	
Class 26	Concept of air conditioning and its uses	
Class 27	Cooling load calculation	
Week 10	**Cooling load calculation**	
Class 28	Mathematical problem	
Class 29	Cooling load calculation of different air conditioning cycle	
Class 30	Continue	
Week 11	**Psychometric analysis**	

Class 31	Psychometric analysis	CT-4
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	

Text and Ref Books:

1. 1.Modern Refrigeration and Air-conditioning – A D. Althause, C. H. Turnquist, A.F. Bracciano; The Goodheant Wilcox Company, Inc. 1982.
2. Heating cooling of Building, Design for Efficiency – J. F. Kreidev, A. Raldl; McGraw-Hill International Edition, 1994.

AEAS 427 Noise Control and Vibration

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn about the details of noise control and vibration in aircrafts.

Objectives:
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 (CO):

Upon completion of the course, the students will be able to:

1. Gain knowledge about sound transmission, its level and effect on human health.
2. Understand the mathematical perspective of sound/vibration propagation.
3. Evaluate various properties in relation to controlling noise.
4. Understand about how vibration from vibrating machinery affects the surrounding environment.
5. Design different preventive measures to cancel out harmful vibrations in aircraft and helicopters.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about sound transmission, its level and effect on human health.			✓									
2. Understand the mathematical perspective of sound/vibration propagation.	✓											
3. Evaluate various properties in relation to controlling noise.		✓										
4. Understand about how vibration from vibrating machinery affects the surrounding environment.			✓									
5. Design different preventive measures to cancel out harmful vibrations in aircraft and helicopters.			✓									

Lecture Schedule:

Week 1	**Sound waves**	
Class 1	Sound sources	CT 1
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	
Class 8	Sound control inside the aircraft	
Class 9	Continue	
Week 4	**Physical acoustics**	CT 2
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**	CT 3
Class 19	Noise attenuation and control	
Class 20	Statistical properties of noise	
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**	CT 4
Class 28	Introduction to vibration isolation	
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	

Text and Ref 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

AEAS 429 Rotorcraft Performance

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn about the performance of rotorcraft.

Objectives:

1. To Gain knowledge about various types 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 (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about various types rotorcraft flight conditions.
2. Understand the performance of rotors and engines in the presence of a helicopter fuselage and other rotors.
3. Evaluate various control settings and actuator forces for trim in hover, forward and climbing flight.
4. Gain knowledge about various types of flight tests in relation to rotorcrafts.
5. Gain knowledge about and design components of rotorcrafts considering fail safe and safe life concepts.

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 centre 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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about various types rotorcraft flight conditions.							√					
2. Understand the performance of rotors and engines in the presence of a helicopter fuselage and other rotors.	√											
3. Evaluate various control settings and actuator forces for trim in hover, forward and climbing flight.		√										
4. Gain knowledge about various types of flight tests in relation to rotorcrafts.					√							
5. Gain knowledge about and design components of rotorcrafts considering fail safe and safe life concepts.			√									

<u>Lecture Schedule:</u>

Week 1	**Performance of rotorcraft in hover**	
Class 1	Examine the performance of rotorcraft in hover	CT 1
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	
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**	CT 2
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 inforward flight**	
Class 16	Calculate thecontrol 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**	CT 3
Class 19	Calculate the Control settings and actuator forces for trim in climbing flight	
Class 20	Continue	
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**	CT 4
Class 28	Rotorcraft flight test engineering	

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	

Text and Ref Books:

1. Rotary Wing aerodynamics - W.Z. Stepniewski and C.N. Keys; Dover Publications.
2. Theory of Flight (AP 3456A) - Royal Air Force Manual.
3. Helicopter Flight Dynamics - Gareth D. Padfield.

AEAS 435 Aircraft Structural Design

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

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 (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about an engineer's responsibility in relation to designing various components of an aircraft.

2. Understand the basic contemporary factors for designing various components of an aircraft.

3. Evaluate various types of loads acting on the aircraft.

4. Gain knowledge about various contemporary configurations of different aircraft components.

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about an engineer's responsibility in relation to designing various components of an aircraft.								√				
2. Understand the basic contemporary factors for designing various components of an aircraft.							√					
3. Evaluate various types of loads acting on the aircraft.		√										
4. Gain knowledge about various contemporary configurations of different aircraft components.							√					
5. Design various components of aircraft based on safety and stability.				√								

Lecture Schedule:

Week 1	**Introduction to Aircraft Structural Design**	CT 1
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	
Class 8	Continue	
Class 9	Fuselage Loads, Propulsion Loads	
Week 4	**Aircraft Loads (Continued)**	CT 2
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)**	CT 3
Class 19	Skin-Stringer Panel – General	
Class 20	Integrally Stiffened Panel	
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)**	CT 4
Class 28	Wing Control Surfaces	
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)	

Text and Ref Books:

1. Design of Aircraft by Thomas C. Corke; Pearson Education.
2. Synthesis of Subsonic Airplane Design (Delft UP) – Torenbeek.
3. Airframe Structural Design: Practical Design Information and Data on Aircraft Structures-Michael Chun-Yung Niu

AEAS 459 Entrepreneurship Development

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn how to start, organize and 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.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Apply the ability to discern distinct entrepreneurial traits
2. Explain the parameters to assess opportunities and constraints for new business ideas
3. Identify the systematic process to select and screen a business idea

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests and Assignment	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO)of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the ability to discern distinct entrepreneurial traits			√									
2. Explain the parameters to assess opportunities and constraints for new business ideas	√											
3. Identify the systematic process to select and screen a business idea		√										

<u>Lecture Schedule:</u>

Week 1	**Entrepreneurship**	CT 1
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	
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**	CT 2
Class 10	Skills	
Class 11	Skills	
Class 12	Entrepreneurial process	
Week 5	**Entrepreneurship**	
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**	CT 3
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	
Class 24	Merger	
Week 9	**Small Business**	
Class 25	acquisition & joint venture	
Class 26	Business plan	
Class 27	Business plan	
Week 10	**Market research**	CT 4
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**	
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.	

AEAS 461 Advanced Materials Processing Technologies

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn about Advanced Materials Processing Technologies.

Objectives:
1. To Explain the common mechanisms by which engineering materials fail
1. 2.To Explain the general internal structure of each major class of engineering material
2. To Identify the principal concerns of common materials processing techniques;

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the common mechanisms by which engineering materials fail
2. Explain the general internal structure of each major class of engineering material
3. Identify the principal concerns of common materials processing techniques;

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 and
Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests and Assignment	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the common mechanism by which engineering materials fail	√											
2. Explain the general internal structure of each major class of engineering material		√										
3. Identify the principal concerns of concerns of common materials processing techniques		√										

Lecture Schedule:

Week 1	**Overview of Advanced Materials Processing Technologies**	CT 1
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	
Class 8	Precision Forming	
Class 9	Precision Forming	
Week 4	**Microwave Technology**	CT 2
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**	CT 3
Class 19	Fundamentals of industrial lasers.	
Class 20	Fundamentals of industrial lasers	
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**	CT 4
Class 28	Laser processing for various industries	
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.	

Text and Ref books:

1. Aerospace Materials Handbook- Editors: Sam Zhang, Dongliang Zhao
2. Manufacturing Technology for Aerospace Structural Materials- F.C. Campbell; Elsevier

AEAS 463 Fluid Power and Control

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn and familiarize the details of fluid power and control.

Objective:
1. To Explain hazards of hydraulic and pneumatic circuits and be able to work safely.
2. To Explain the concepts of fluid statics and dynamics as applied to commercial and industrial control.
3. To Recognize standard schematic symbols for common fluid power components.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain hazards of hydraulic and pneumatic circuits and be able to work safely.
2. Explain the concepts of fluid statics and dynamics as applied to commercial and industrial control.
3. Recognize standard schematic symbols for common fluid power components.

Course Content :
Introduction to Fluid Power, properties of Hydraulic Fluids, Energy, Power and Frictional losses in Hydraulic Systems, Pumps, Valves, Hydraulic Conductors and Fittings,

Auxillary Hydraulic Devices, Hydraulic Circuit Design and Analysis.

Introduction to pneumatics, Pneumatic logic control, Pneumatic Circuits and Applications, Basic Electrical Controls for Fluid Power Circuits. Compressors, Air preparation, Valves and actuators.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes (CO)and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain hazards of hydraulic and pneumatic circuits and be able to work safely.	✓											
2. Explain the concepts of fluid statics and dynamics as applied to commercial and industrial.	✓											
3. Recognize standard schematic symbols for common fluid power components.		✓										

Lecture Schedule:

Week 1	**Introduction to Fluid Power**	
Class 1	Fluid Power	CT-1
Class 2	Types of fluid	
Class 3	Application	
Week 2	**Hydraulic Fluid**	
Class 4	Introduction	
Class 5	Application	
Class 6	Properties	
Week 3	**Hydraulic Fluid**	
Class 7	losses in Hydraulic Systems	
Class 8	Energy loss	
Class 9	Continue	
Week 4	**Hydraulic Fluid**	
Class 10	Power loss	
Class 11	Continue	
Class 12	Continue	
Week 5	**Hydraulic system**	
Class 13	Introduction	
Class 14	Working Principles	
Class 15	Applications	
Week 6	**Hydraulic Components**	
Class 16	Hydraulic Pump	
Class 17	Continue	
Class 18	Hydraulic valves	

Week 7	**Hydraulic Components**	CT-2
Class 19	Hydraulic Conductors and fittings	
Class 20	Continue	
Class 21	Numerical	
Week 8	**Hydraulic Devices**	
Class 22	Auxiliary Hydraulic Devices	
Class 23	Continue	
Class 24	Continue	
Week 9	**Hydraulic Circuit**	CT-3
Class 25	Design	
Class 26	Continue	
Class 27	Analysis	
Week 10	**Hydraulic Circuit**	
Class 28	Numerical problems	
Class 29	Continue	
Class 30	Continue	
Week 11	**Introduction to pneumatics**	
Class	Pneumatic logic control	
Class	Pneumatic logic control	
Class	Numerical	
Week 12	**Pneumatic Circuits**	CT-4
Class	Introduction	
Class	Applications	
Class	Continue	
Week 13	**Basic Electrical Controls for Fluid Power Circuit**	
Class	Description	
Class	Analysis	
Class	Continue	
Week 14	**Applications**	
Class	Compressors	
Class	Air preparation	
Class	Valves and actuators	

Text and Ref 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.

Core and Specialized Courses Offered by Avionics Discipline

AEAV 101: Electrical Circuit I

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None.

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 (CO):
Upon completion of the course, the students will be able to:

1. Analysis of Resistive Circuits and Solution of resistive circuits with independent sources Understand the most important concepts like mesh and nodal analysis
2. Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuit.
3. Analysis of Single Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits
4. Will be able to explain the concept of capacitance and inductance and the concept of two terminal linear devices.
5. Be able to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and three-phase circuits in sinusoidal steady state.

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignments	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analysis of Resistive Circuits and Solution of resistive circuits with dependent and independent sources and Understand the most important concepts like mesh and nodal analysis.		√										
2. Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuit.			√									
3. Analysis of Single Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.		√										
4. Will be able to explain the concept of capacitance and inductance and the concept of two terminal linear devices.	√											
5. Be able to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and three-phase circuits in sinusoidal steady state.			√									

Lecture Schedule:

Week 1	**Circuit Variables And Elements**	CT 1
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	
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**	CT 2
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	Super node analysis	
Class 17	Super node analysis continued	
Class 18	Method of obtaining mesh currents using mesh analysis	
Week 7	**Mesh Analysis**	CT 3
Class 19	Mesh analysis with current source	
Class 20	Mathematical problems related to Mesh analysis	
Class 21	Mathematical problems related to Mesh Analysis (Continued)	
Week 8	**Network Theorem**	
Class 22	Superposition Theorem	
Class 23	Application of Superposition Theorem	
Class 24	Continue	

Week 9	Network Theorem	
Class 25	Thevenin's Theorem Procedure	
Class 26	Application of Thevenin Theorem	
Class 27	Norton's Theorem	
Week 10		CT 4
Class 28	Application of Norton's Theorem	
Class 29	Maximum Power Transfer Theorem	
Class 30	Reciprocity Theorem	
Week 11	**Energy Storage Element- Capacitor& Inductor**	
Class 31	Electric field and capacitance of capacitor and construction and types of capacitor	
Class 32	Inductance, Inductance voltage	
Class 33	Transient response of capacitive networks	
Week 12	**Energy Storage Element-Capacitor**	
Class 34	Transient response of capacitive networks- Charging phase	
Class 35	Transient response of capacitive networks- Discharging phase	
Class 36	Transient response of capacitive networks- initial condition and instantaneous value	
Week 13	**Energy Storage Element-Inductor**	
Class 37	Transient response of capacitive networks- Charging phase	
Class 38	Transient response of capacitive networks- Discharging phase	
Class 39	Transient response of capacitive networks- initial condition and instantaneous value	
Week 14	**Magnetic Circuits**	
Class 40	Ohm‘s law and Ampere‘s circuital law	
Class 41	Instantaneous current, voltage, power, Effective current and voltage, average power, Phasors.	
Class 42	complex quantities, impedance, real and reactive power, Series RL, RC and RLC circuits, analysis of three phase supply.	

Text and Ref 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

AEAV 102: Electrical Circuit I Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: Electrical Circuit Analysis I (Theory)

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 use 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.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Explain basic electrical components like resistors, capacitors, digital and analog measuring equipment etc.

2. Describe the properties of basic electrical networks.

3. Apply the knowledge of basic electrical components and networks practically.

4. Analyze the differences between theoretical knowledge with the practical observations.

5. Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations in social work.

Course Contents:

Experiment no. 01: Familiarization with resistor color codes and analogue & digital measuring instruments.
Experiment no. 02: Validation of ohm's law.
Experiment no. 03: Familiarization with series resistors DC circuit.
Experiment no. 04: Familiarization with parallel DC circuits and Kirchhoff's current law.
Experiment no.05: Verification of series-parallel dc circuits and Kirchhoff's voltage law & Kirchhoff's current law.
Experiment no. 06: Verification of superposition theorem.
Experiment no. 07: Thevenin's theorem & maximum power transfer.
Experiment no.08: Study of Wheatstone bridge and wye- delta circuit.
Experiment no. 09: Study of the capacitors properties.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	30%
Lab quiz	25%
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain basic electrical components like resistors, capacitors, digital and analog measuring equipment etc.	√											
2. Describe the properties of basic electrical networks.					√							
3. Apply the knowledge of basic electrical components and networks practically.						√						
4. Analyze the differences between theoretical knowledge with the practical observations.										√		
5. Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations in social work.						√						

Text and Ref 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

AEAV 103: Computer Programming and Applications

3.0 Contact Hour; 3.0 Credit Hour;

Pre-requisite: None.

Rationale:
To deliver the basic knowledge of C++ programming language as a preparation for students in using programming tools to solve engineering related problems.

Objective:

1. Develop a greater understanding of the issues involved in programming language design and implementation
2. Develop an in-depth understanding of functional, logic, and object-oriented programming paradigms
3. Implement several programs in languages other than the one emphasized in the core curriculum
4. Understand design/implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing
5. Develop an understanding of the compilation process.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Know the use and workings of programming tools (such as compilers, linkers and debuggers), standard libraries and operating system functions to support program execution.
2. Explain fundamental syntax rules for identifiers, declarations, expressions, statements, and functions.
3. Analyze code, document, test, and implement a well-structured, robust computer program using the C programming language.
4. Evaluate the condition of the problem and find out the procedure to solve it using programming language.
5. Apply the knowledge of programming to solve different complex problems.

Course Contents:
Fundamentals of Computer: Basic concepts of computer organizations, CPU, Memory, I/O units such as hard disk, pen drives, CDROM/Writer, scanner, printers, keyboards etc. Number System Representation.

Introduction to programming languages: Evolution of programming languages, structured programming, the compilation process, object code, source code, executable code, operating systems, interpreters, linkers, loaders, fundamentals of algorithms, flow charts.

C Language Fundamentals: Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-output Assignments, Control structures, Decision making and Branching, Decision making & looping.

C Functions: User defined and standard functions, Formal and Actual arguments, Functions category, function prototypes, parameter passing, Call-by-value, Call-by-reference.

Arrays and Strings: One dimensional Array, Multidimensional Array declaration and their applications, String Manipulation.

Pointers: Pointer variable and its importance, Pointer Arithmetic, passing parameters by reference, pointer to pointer, linked list, pointers to functions.
Structures, Declaration of structures, declaration of unions, pointer to structure & unions.

File Handling: Console input output functions, Disk input output functions, Data files.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Know the use and workings of programming tools (such as compilers, linkers and debuggers), standard libraries and operating system functions to support program execution.					√							
2. Explain fundamental syntax rules for identifiers, declarations, expressions, statements, and functions.	√											
3. Analyze code, document, test, and implement a well-structured, robust computer program using the C programming language.		√										
4. Evaluate the condition of the problem and find			√									

out the procedure to solve it using programming language.												
5. Apply the knowledge of programming to solve different complex problems		√										

Lecture schedule:

Week 1	**Fundamentals of Computer**	
Class 1	CPU, Memory, I/O units such as hard disk, pen drives, CDROM/Writer	
Class 2	Interpreter, compiler	
Class 3	Number System Representation.	
Week 2	**Programming languages**	
Class 4	Evolution of programming languages, structured programming, the compilation process	
Class 5	Object code, source code, executable code, operating systems, interpreters, linkers, loaders, fundamentals of algorithms, flow charts.	CT 1
Class 6	continue	
Week 3	**C Language Fundamentals**	
Class 7	Character set, Identifiers, Keywords, Data Types	
Class 8	Continue	
Class 9	Constant and Variables, Statements, Expressions, C Functions (User defined and standard functions of operators	
Week 4	**C Language Fundamentals**	
Class 10	Input-output Assignments, Control structures	
Class 11	Continue	
Class 12	Continue	
Week 5	**C Language Fundamentals**	
Class 13	Decision making and Branching, Decision making & looping	CT 2
Class 14	Continue	
Class 15	Applications of loops	
Week 6	**Arrays (one dimensional)**	
Class 16	One dimensional Array	
Class 17	Continue	
Class 18	Continue	

Week 7	**Arrays (two and three dimensional)**	CT 3
Class 19	Multidimensional Array declaration and their applications	
Class 20	Continue	
Class 21	Continue	
Week 8	**C Functions**	
Class 22	User defined and standard functions	
Class 23	Formal and Actual arguments	
Class 24	Continue	
Week 9	**C Functions**	
Class 25	Parameter passing, Call-by-value	
Class 26	Call-by-reference	
Class 27	Continue	
Week 10	**Strings**	CT 4
Class 28	Introduction to String	
Class 29	String Manipulation	
Class 30	Runge-Kutta Method	
Week 11	**Pointers**	
Class 31	Pointer variable and its importance	
Class 32	Pointer Arithmetic, passing parameters by reference	
Class 33	Continue	
Week 12	**Combined use of function, array and pointer**	
Class 34	Use of function, array and pointer	
Class 35	Continue	
Class 36	Continue	
Week 13	**Structure**	
Class 37	Declaration of structures	
Class 38	Solving program using structures	
Class 39	Continue	
Week 14	**Review and problem solving**	

Class 40	Discussion on previous topics	
Class 41	Solving various complex program	
Class 42	Review of whole Syllabus	

Text and Ref Books:

1. C, The Complete Reference – Schildt, H; McGraw-Hill.
2. Turbo C/C++: The complete reference – HerberSchildt; Osborne McGraw-Hill.
3. The Waite Group‘s C Programming using Turbo C++ – Robert Lafore; Sams Publishing.

AEAV 104: Computer Programming and Applications Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: Electrical Circuit Analysis I (Theory)

Rationale:
To deliver the basic knowledge of C++ programming language as a preparation for students in using programming tools to solve engineering related mathematical problems.

Objective:

1. To know about compiler to solve any mathematical problem.
2. To know about code and logics to develop code for solving those problems.
3. To be able to understand a problem and identify related inputs and outputs.
4. To be able to formulate step-by-step procedures in solving problem.
5. To be able to write a complete C++ program to solve engineering problems.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Describe basic Structure of the C programming, declaration and usage of variables.
2. Demonstrate use of conditional and iterative statements, loops, array, string.
3. Apply user defined functions to solve real time problems.
4. Analyze problems and develop logics which will help them to create programs.
5. Create C programs for simple applications of real life.

Course Contents:

LESSON 01: Understanding the basic steps of a C program.
LESSON 02: Application of printf() and scanf() functions in C programming.
LESSON 03: Application of arithmetic operators in C programming.
LESSON 04: Application of conditional, relational, and logical operators C programming.
LESSON 05: Application of switch...case statement in C programming.
LESSON 06: Application of Loops in C programming.
LESSON 07: Application of Array in C programming
LESSON 08: Application of String in C programming.
LESSON 09: Application of two dimensional arrays in C programming

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe basic Structure of the C programming, declaration and usage of variables.	√											
2. Demonstrate use of conditional and iterative statements, loops, array, string.					√							
3. Apply user defined functions to solve real time problems.			√									
4. Analyze problems and develop logics which will help them to create programs.				√								
5. Create C programs for simple applications of real life.			√									

Text and Ref Books:

1. Programming In ANSI C -by E. Balagurusamy

AEAV 201: Electrical Circuits Analysis – II

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Electrical Circuits Analysis – I

Rationale:
This subject comes under the Basic Technology group and intended to teach students the concepts and methods of analysis of different types of Electronic Circuits and Networks, network theorems and their applications in electrical and electronic circuits. The prerequisite for this subject is knowledge of basic electronics which is taught in the preceding semesters. It is important to note that a good knowledge of mathematics is necessary for a better understanding of this subject due to the depth of coverage, and hence the practice of the contents covered in the mathematics subjects of the first three semesters is also essential.

Objective:

1. Be able to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and three-phase circuits in sinusoidal steady state.
2. Acknowledge the principles of operation and the main features of electric machines and their applications.
3. Acquire skills in using electrical measuring devices.
4. Be aware of electrical hazards and able to implement basic actions to avoid unsafe work conditions

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Understand about measurement of voltage, current, power and phase shift in AC power circuits
2. Analyze single phase RLC circuits for impedances, voltages, currents, powers and phase shift
3. Formulate 3-phase RLC circuits (balanced and unbalanced) for impedance, voltage, current, power (P, Q and S), phase shift and power factor
4. Analyze different types of passive filters using RLC circuits in terms of their design and application.

Course Contents:

Sinusoidal functions: Instantaneous current, voltage, power, Effective current and voltage, average power, Phases and complex quantities, impedance, real and reactive power, power factor.

Analysis of 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, passive filters.

Resonance in AC circuits: Series and parallel resonance, magnetically coupled circuits.

Analysis of three phase circuits: Three phase supply, balanced and unbalanced circuits, power calculation.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand the measurement of voltage, current, power and phase shift in AC power circuits	√											
2. Analyze single phase RLC circuits for impedances, voltages, currents, powers and phase shift		√										
3. Formulate 3-phase RLC circuits (balanced and unbalanced) for impedance, voltage, current, power (P, Q and S), phase shift and power factor		√										
4. Analyze different types of passive filters using RLC circuits in terms of their design and application.				√								

Lecture schedule:

Week 1	**Introduction to Alternating Current**	
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	**Sinusoidal functions**	
Class 4	Details of Sinusoidal functions & its different terminology	
Class 5	Effective voltage & current	CT-1
Class 6	Average value	
Week 3	**Sinusoidal functions**	
Class 7	Phase relation and complex quantities	
Class 8	Continue	
Class 9	Impedance function	
Week 4	**R-branch, L-branch, C-branch**	
Class 10	Impedance & phase calculation	
Class 11	Continue	
Class 12	Continue	CT-2
Week 5	**Series RL, RC and RC circuits**	
Class 13	Impedance, phase, power, average power & energy calculation	
Class 14	Continue	
Class 15	Continue	
Week 6	**Single phase AC circuits**	
Class 16	Analysis of single phase AC circuits	
Class 17	Superposition theorem, Nodal and mesh analysis,	
Class 18	Application of network theorems in AC circuits	
Week 7	**Resonance**	
Class 19	Introduction to Resonant circuits	
Class 20	Series Resonance in AC circuits	
Class 21	Application of resonance	
Week 8		
Class 22	Impedance, voltage, current of three phase circuit	
Class 23	Continue	
Class 24	Continue	
Week 9		
Class 25	Power Calculation	
Class 26	Continue	

Class 27	Balanced and unbalanced circuit	CT-3
Week 10		
Class 28	Continue	
Class 29	Continue	
Class 30	Numerical Analysis	
Week 11		
Class 31	Continue	
Class 32	Low pass filter	
Class 33	Continue	
Week 12		CT-4
Class 34	High pass filter	
Class 35	Continue	
Class 36	Band pass filter	
Week 13		
Class 37	Continue	
Class 38	Band stop filter	
Class 39	Continue	
Week 14		
Class 40	Numerical analysis	
Class 41	Continue	
Class 42	Syllabus Review	

Text and Ref 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.

AEAV 202: Electrical Circuits Analysis – II Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Electrical Circuit Analysis II (Theory)

Rationale:
Students will be able to compare the performance of ac circuits and knowledge will help to build a strong foundation for further development of their project work in the final year.
Objective:

1. To prepare the students to have a basic knowledge in the analysis of Electric Networks.
2. To solve the given circuit with various theorems and methods.
3. To analyses the various three phase circuits star and delta connections.
4. To distinguish between tie set and cut set methods for solving various circuits.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Understand about measurement of voltage, current, power and phase shift in AC power circuits
2. Analyze single phase RLC circuits for impedances, voltages, currents, powers and phase shift
3. Design different types of passive filters and analyze their response.
4. Evaluate the performance of a resonant circuit with the variation in frequency.

Course Contents:

Experiment No: 01
Name of the Experiment: Familiarization with alternating current (ac) waves.
Experiment No: 02
Experiment name: Study of R-L-C series circuit.
Experiment No. 03
Experiment Name: Different types of filters and its characteristics with different input frequency.
Experiment No 04
Experiment Name: Series Resonance and Parallel Resonance.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand about measurement of voltage, current, power and phase shift in AC power circuits	√											
2. Analyze single phase RLC circuits for impedances, voltages, currents, powers and phase shift		√										
3. Design different types of passive filters and analyze their response.			√						√			
4. Evaluate the performance of a resonant circuit with the variation in frequency.				√								

Text and Ref 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.

AEAV 203: Electronics-I

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Electrical Circuit Analysis

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. It is targeted to provide a basic foundation for technology areas like communication systems, 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 (CO)

Upon completion of the course, the students will be able to:

1. Explain the operation of semiconductor diodes, transistors and operational amplifiers in order to design basic circuits.
2. Compare and analyze the characteristics of different types of diodes, transistors and operational amplifiers.
3. Application of semicoductor diodes, BJT, JFET, MOSFET and operational amplifiers to solve real world problems.
4. Identify, analyze and solve mathematical and practical problems of electronic circuits.
5. Design, Develop and test small electronic circuits using solid state devices.

Course Contents:

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) 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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain the operation of semiconductor diodes, transistors and operational amplifiers in order to design basic circuits.**	√											
2. Compare and analyze the characteristics of different types of diodes, transistors and operational amplifiers.	√											
3. Application of semicoductor diodes, BJT, JFET, MOSFET and operational amplifiers to solve real world problems.	√											
4. Identify, analyze and solve mathematical and practical problems of electronic circuits		√										
5. **Design, Develop and test small electronic circuits using solid state devices.**			√									

Lecture Schedule:

Week 1	Intoduction to Electronics	CT-1
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		
Week 2	Semiconductor Diode	
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	Semiconductor Diode	
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	Diode Applications	CT-2
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, Clipper and Clapper Circuit	
Week 5	Special Purpose Diode	
Class 13	Gauss Central Difference Formula	
Class 14	Continue	
Class 15	Sterling’s Formula and Bessel’s Formula	
Week 6	Bipolar Junction Transistors	
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	Bipolar Junction Transistor	CT-3
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	**Field effect transistor(FETs)**	CT-4
Class 22	Field effect transistor(FETs), Classification	
Class 23	Construction and operating principle ofd MOSFETs	
Class 24	Current-Voltage Characteristics of MOSFETs	
Week 9	**MOS Field-Effect Transistor (MOSFETs)**	
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	**MOS Field-Effect Transistor (MOSFETs)**	
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	**CMOS Field-Effect Transistor (CMOS)**	
Class 31	Maths to determine RD, Current mirror	
Class 32	CMOS construction, operation	
Class 33	Maths related to CMOS	
Week 12	**Small signal Analysis of MOS**	
Class 34	Small signal operation and Models (hybrid-π, hybrid-T)	
Class 35	Common-source(CS) amplifier (Circuit, Small signal equivalent Circuit, advantage, disadvantage, Comparison)	
Class 36	Common drain(CD) amplifier (Circuit, Small signal equivalent Circuit, advantage, disadvantage, Comparison), Source follower/Buffer	
Week 13	**Small signal Analysis of MOS**	
Class 37	Small signal equivalent circuit of MOSFETs	
Class 38	Derivation of gain, Impedance	
Class 39	Math related to gain, Impedance	
Week 14	**MOSFETs and Junction Field Effect Transistor (JFET)**	
Class 40	MOS biasing	
Class 41	Construction and Operation of JFET	
Class 42	Construction and Operation of JFET (Continuation)	

Text and Ref 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.
3. Semi Conductor Circuit Approximation - Albert P Malvino; Tata McGraw- Hill.
4. Electronic Devices and Circuits – Jacob Millman& Christos C. Halkias; Tata McGraw-Hill.
5. Micro-Electronic Circuit Analysis and Design- Donald A. Neamen; McGraw-Hill

AEAV 204: Electronics-I Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Electronics I (Theory)

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 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 (CO)

Upon completion of all sessional, the students will be able to:

1. Explain the basic electronic components like diode, Bipolar Junction Transistor(BJT), Op-Amp, digital and analog measuring equipment etc.
2. Describe the properties of basic electronic networks and generate sine, square and triangular waveforms with required frequency and amplitude using function generator.
3. Apply the knowledge of basic electronic components and networks practically.
4. Analyze the characteristics of different electronic devices such as diodes, Transistors etc., and simple circuits like rectifiers, amplifier set.
5. Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations.

Course Contents:

Experiment no. 01: Study of diode i-v characteristics.
Experiment no. 02: Study of diode rectifier circuits.
Experiment no. 03: Study of n-p- n cb (common base) transistor characteristics.
Experiment no. 04: Study of n-p-n ce (common emitter) transistor characteristics.
Experiment no.05: Mathematical operations using op-amp adder and differentiator.
Experiment no. 06: Mathematical operations using op-amp integrator circuit.

Teaching-learning and

Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain basic electronic components like diode, Bipolar Junction Transistor(BJT), Op-Amp, digital and analog measuring equipment etc.	√											
2.Describe the properties of basic electronic networks and generate sine, square and triangular waveforms with required frequency and amplitude using function generator.					√							
3.Apply the knowledge of basic electronic components and networks practically.					√							
4.Analyzethe characteristics of different electronic devices such as diodes, transistors etc., and simple circuits like rectifiers, amplifiers etc.				√								
5.Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations.		√										

Text and Ref 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.

AEAV 205: Numerical Analysis and Applications

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Math-1(Differential and Integral Calculus)

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

Objective:

1. Analyzing appropriate numerical methods to solve algebraic and transcendental equations as well as generating approximate function
2. 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 stedents able to perform an error analysis for various numerical methods
4. Prepare for various numerical root finding methods and to derive appropriate numerical methods to calculate a definite integral
5. Compose various numerical methods in a modern computer language

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Demonstrate understanding of common numerical methods, number representation and errors and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

2. Apply numerical methods to obtain approximate solutions to mathematical problems.

3. Understanding numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

4. Performing an error analysis for various numerical methods and prove results for various numerical root finding methods

Course Contents:

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; Applications in structural mechanics.
Iterative solutions for non-linear problems; Use fundamental programming concepts to solve mathematical problems; Develop computer programs to solve simple engineering and mathematical problems.
Engineering analysis by using graphical tools in MATLAB and MS Excel; Use of spreadsheet; Data structures; Graphing; Recursion; Packages for data manipulation.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests and Assignment	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Demonstrate understanding of common numerical methods, number representation and errors and how they are used to obtain approximate solutions to otherwise intractable mathematical problems		√										
2. Apply numerical methods to obtain approximate solutions to mathematical problems.				√								
3. Understanding numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.			√									
4**.** Performing an error analysis for various numerical methods and prove results for various numerical root finding methods						√						

Lecture Schedule:

Week 1	**Errors in numerical calculation**	CT 1
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**	
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)**	CT 2
Class 10	Central difference	
Class 11	Continue	
Class 12	Symbolic relations and Separation of symbols	
Week 5	**Interpolation methods (Central & Divided difference interpolation method)**	
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**	CT 3
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	
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	
Week 10	**Numerical solution of ordinary differential equations**	CT 4
Class 28	Solution by Tylor series	
Class 29	Pieard's Method and Euler's Method	
Class 30	RungeKutta Method	
Week 11	**Numerical solution of partial differential equation**	
Class 31	Jacobi;s Method	
Class 32	Gauss-Seidal Method	
Class 33	Continue	
Week 12	**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	Eigenvalues of a Symmetric Tridiagonal Matrix	
Class 41	Continue	
Class 42	Review of whole Syllabus	

Text and Ref 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 User's Guide for Student Edition of MATLAB – Duane Hanselman& Bruce Littlefield, Prentice Hall, NJ, 1997.
4. Introductory methods of Numerical Analysis--- S.S. Sastry

AEAV 206: Numerical Analysis Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: C programming

Rationale:
To learn and familiarize the basics of common numerical methods as well as the analysis and implementation and application of numerical methods.

Objective:
1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Analyze and evaluate the accuracy of common numerical methods.
4. Implement numerical methods in MATLAB.
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 (CO)
1. Understanding and to familiarize the student with software MATLAB for numerical computations and in particular familiarizing yourself with the MATLAB Desktop, basic commands through the Command window and output through the Graph window
2. Analyzing practical Numerical problems and approaching to solve accordingly applying MATLAB
3. To provide a foundation in use of this software for real time applications
4. To prepare the students to use MATLAB/LABVIEW in their project works.

Course Contents:

Experiment No	**Experiment Name**
Experiment 01	Introduction to MATLAB
Experiment 02	Creating Matrix
Experiment 03	Matrix operations and Matrix Applications
Experiment 04	Plotting and Graphing
Experiment 05	Using Statements
Experiment 06	Loops
Experiment 07	Bracketing Methods of Numerical Analysis
Experiment 08	Open Methods of Numerical Analysis
Experiment 09	Basic Simulink
Experiment 10	Solving Engineering Problems Using MATLAB and Simulink

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva

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Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understanding and to familiarize the student with software MATLAB for numerical computations and in particular familiarizing yourself with the MATLAB Desktop, basic commands through the Command window and output through the Graph window	√											
2.Analyzing practical Numerical problems and approaching to solve accordingly applying MATLAB		√										
3.To provide a foundation in use of this software for real time applications			√									
4. To prepare the students to use MATLAB/LABVIEW in their project works.			√									

AEAV 215: Electronics-II

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: 1) Electronics-I 2) Electrical Circuit Analysis

Rationale:
This subject focuses on how to create electronic systems with 'building block' circuits using biplolar 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. Understand the basic electrical engineering principles and abstractions on which the design of electronic systems is based. These include lumped circuit models, digital circuits, and operational amplifiers.
2. Use these engineering abstractions to analyze and design simple FET circuits.
3. Formulate and solve differential equations describing the time behavior of circuits containing energy storage elements.
4. To understand the concepts of filter design, and be able to demonstrate knowledge and understanding of how to design a simple filter using operational amplifiers.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Analyze analog and digital electronic circuits from a circuit and monolithic (integrated circuit) implementation point of view.

2. 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.

3. Apply the concepts of basic electronic devices to design, fabricate and test small electronic circuit.

4. Analysis the design, operation, and troubleshooting of electronic systems.
5. Explain fundamental theoretical and practical knowledge to pursue advanced topics in analog and digital integrated circuits

Course Contents:

Frequency response of amplifiers: Poles, zeros and 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 and physical operation of JFET, transistor characteristics, and pinch-off voltage.
Differential and multistage amplifiers: Description of differential amplifiers, smallsignal 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, 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 bandpass filters using Op-Amps. **Signal generators**: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, and LC and crystal oscillators. Power Amplifiers: Classification of output stages, class A, B and AB output stages.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify and analyze analog and digital electronic circuits from a circuit and monolithic (integrated circuit) implementation point of view.		√										
2. 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.	√											
3. Apply the concepts of basic electronic devices to design, fabricate and test small electronic circuit.			√									
4. Analysis the design, operation, and troubleshooting of electronic systems.		√										

5. Explain about fundamental theoretical and practical knowledge to pursue advanced topics in analog and digital integrated circuits.	√											

Lecture Schedule:

Week 1	**Operational Amplifier(Op-Amp)**	
Class 1	Basic of Op-Amp and Circuit Symbol, Classification, Ideal Op-Amp Characteristics	CT 1
Class 2	Buffer/ Source Follower, Non Ideal Effects	
Class 3	Integrator(Non-inverting), Differentiator	
Week 2	**Operational Amplifier(Op-Amp)**	
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	**Operational Amplifier(Op-Amp)**	
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	**Bode Plotting**	CT 2
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	**Stability**	
Class 13	Stability	
Class 14	Pole-Zero Plot	
Class 15	Stability from Pole-Zero Plot	
Week 6	**Filter**	
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	**Filter**	CT 3
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	**Filter, Oscillator**	
Class 22	Filter Design	

Class 23	Filter Design -Continued	
Class 24	Oscillator	
Week 9	**Oscillator/Feedback Amplifier**	
Class 25	Phase-Shift Oscillator, Oscillator Design	
Class 26	The Colpitts Oscillator, Wein bridge Oscillator	
Class 27	Feedback Amplifier, Classification of Amplifier	
Week 10	**Feedback Amplifier**	CT 4
Class 28	Gain with feedback	
Class 29	Advantages of feedback	
Class 30	Advantages of feedback -Continued	
Week 11	**Feedback Amplifier**	
Class 31	Voltage series feedback	
Class 32	Current series feedback	
Class 33	Voltage shunt feedback	
Week 12	**Feedback Amplifier**	
Class 34	Related Math problems of feedback	
Class 35	Current-Shunt feedback	
Class 36	Method of Analysis of Current-shunt Amplifier	
Week 13	**Power Amplifier**	
Class 37	Power Amplifier	
Class 38	Classification of Power Amplifier	
Class 39	Advantages of Power Amplifier	
Week 14	**Power Amplifier**	
Class 40	Crossover distortion of Power Amplifier	
Class 41	Efficiency of Power Amplifiers	
Class 42	Efficiency of Power Amplifiers -Continued	

Text and Ref Books:

1. Semi-Conductor Circuit Approximation - Albert P Malvino; Tata McGraw- Hill.
2. Electronic Devices and circuit – Jacob Millman& Christos C. Halkias; Tata McGrawHill.
3. Micro-Electronic Circuit Analysis and Design- Donald A. Neamen; McGraw-Hill.
1. 4. Operational Amplifier and Linear Integrated Circuit - RamakantGayakwad; Prentice Hall College Div.
4. Microelectronic Circuits – Adel S. Sedra&Keneth C. Smith; Oxford University Press.
5. Electronic Devices and Circuit Theory - R.L Boylestad; Prentice Hall of India Private Limited.

AEAV 216: Electronics-II Sessional

3.00 Contact Hour; 1.50 Credit Hour

Pre-requisite: Electronics II (Theory)

Rationale:
To learn the basics and application of operational amplifiers in different circuit as well as analyzing the behavior of the circuit.

Objective:
1. To learn the effects of ideal feedback network on gain sensitivity, noise, distortion, bandwidth and impedance.
2. To study differential amplifiers, active loads, level shifters, output stage in BJT & CMOS. Appreciate frequency response compensations & stability of operational amplifier
3. To analyze operational transconductance amplifier (OTA), current- differencing (Norton) amplifier. Understand application of Op Amp as precision rectifiers, sample-and-hold circuits, curve shapers and clippers, comparators and Schmitt trigger and peak detector circuit.
4. To calculate the power supply specifications. Design rectifier circuits and integrated circuit voltage regulators.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Explain the basic electronic components like diode, Bipolar Junction Transistor(BJT), Op-Amp, digital and analog measuring equipment etc.
2. Describe the properties of basic electronic networks and generate sine, square and triangular waveforms with required frequency and amplitude using function generator.
3. Apply the knowledge of basic electronic components and networks practically.
4. Analyze the characteristics of different electronic devices such as diodes,
1. transistors etc., and simple circuits like rectifiers, amplifiers etc.
5. Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations.

Course Contents:

Experiment no. 01: Study of diode i-v characteristics.
Experiment no. 02: Study of diode rectifier circuits.
Experiment no. 03: Study of n-p- n cb (common base) transistor characteristics.
Experiment no. 04: Study of n-p-n ce (common emitter) transistor characteristics.
Experiment no.05: Mathematical operations using op-amp adder and differentiator.
Experiment no. 06: Mathematical operations using op-amp integrator circuit.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

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Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
Explain the basic electronic components like diode, Bipolar Junction Transistor(BJT), Op-Amp, digital and analog measuring equipment etc.	√											
Describe the properties of basic electronic networks and generate sine, square and triangular waveforms with required frequency and amplitude using function generator.					√							
Apply the knowledge of basic electronic components and networks practically.					√							
Analyze the characteristics of different electronic devices such as diodes, transistors etc., and simple circuits like rectifiers, amplifiers etc.				√								
Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations.		√										

Text and Ref 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.

AEAV 209: Electro-mechanical System

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Introductory circuit analysis

Rationale:
To learn the basics and application of different electro- mechanical systems including DC motor, AC motor, Generator etc.

Objective:
1. To learn the effects of Magnetic quantities and variables
2. To study Laws in magnetic circuits
3. To analyze Ideal transformer, transformation ratio, no-load and load vector diagrams, transformer test, tosses of transformer, eddy current loss, hysteresis loss.
4. To understand the performance and operation of DC motor and AC motor.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Explain the basic ideal of electromagnetic machines such as transformers, motors and generators.

2. Ability to formulate and then analyze the working of any electrical machine under loaded and unloaded conditions

3. Enable students to identify and solve AC, DC machine and Transformer related problems.

4. Ability to recognize suitable electrical and non-electrical instruments for a given application of an aircraft

Course Contents:

Magnetic quantities and variables: Flux, permeability and reluctance, magnetic field strength, magnetic potential, flux density, magnetization curve. Laws in magnetic circuits: Ohm‘s lawand Ampere‘s circuital law. Magnetic circuits: Series, parallel and series-parallel circuits.
Transformer: Ideal transformer, transformation ratio, no-load and load vector diagrams, transformer test, tosses of transformer, eddy current loss, hysteresis loss.
DC generator: Types, no load voltage characteristic, effect of speed on no-load and load characteristics and voltage regulation.
DC motor: Torque, counter emf, speed, torque-speed characteristics, starting and speed regulation.
Three phase induction motor: Rotating magnetic field, equivalent circuit, vector diagram, torque-speed characteristics, effect of changing rotor resistance and reactance on torque-speed curves, motor torque and developed rotor power, starting and speed control.

Three Phase Alternator: Overview, Principle of operation.
Synchronous motor: Operation, effect of loading, under different excitation condition, effect of changing excitation, V-curves and starting.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic ideal of electromagnetic machines such as transformers, motors and generators.	√											
2. Ability to formulate and then analyze the working of any electrical machine under loaded and unloaded conditions		√										
3. Enable students to identify and solve AC, DC machine and Transformer related problems.			√									
4.Ability to recognize suitable electrical & non-electrical instruments for a given application of an aircraft				√								

Lecture Schedule:

Week 1	**Magnetic quantities and variables**	
Class 1	Flux, permeability and reluctance	CT 1
Class 2	Magnetic field strength, magnetic potential	
Class 3	Flux density, magnetization curve.	
Week 2	**Laws in magnetic circuits**	
Class 4	Laws in magnetic circuits: Ohm‘s law and Ampere‘s circuital law	
Class 5	Magnetic circuits: Series, parallel	
Class 6	Series-parallel circuits.	
Week 3	**Electro-Mechanical System**	
Class 7	What is Transformer, construction, application	

Class 8	Idea transformer & working principle	
Class 9	Transformation ratio, no-load and load vector diagrams	
Week 4	**Electro-Mechanical System**	CT 2
Class 10	Transformer test and tosses of transformer	
Class 11	Eddy current loss, hysteresis loss	
Class 12	Continue	
Week 5	**Generator**	
Class 13	Excitation systems	
Class 14	Equivalent circuit	
Class 15	Continue	
Week 6	**Generator**	
Class 16	Vector diagrams at different loads	
Class 17	Continue	
Class 18	Generator Factors	
Week 7	**Three Phase Alternator and DC motor**	CT 3
Class 19	Introduction to Three phase alternator &construction	
Class 20	Working Principle of Three Phase alternator	
Class 21	Introduction to DC motor	
Week 8	**DC Motor**	
Class 22	Torque	
Class 23	Counter EMF	
Class 24	Speed	
Week 9	**DC Motor**	
Class 25	Torque-speed characteristics	
Class 26	Starting and speed regulation.	
Class 27	Mathematical problems	
Week 10	**Three phase induction motor**	CT 4
Class 28	Rotating magnetic field,	
Class 29	Equivalent circuit, vector diagram	
Class 30	Starting and speed control.	
Week 11	**Three phase induction motor**	
Class 31	Torque-speed characteristics	
Class 32	Effect of changing rotor resistance and reactance on torque-speed curves	
Class 33	Motor torque and developed rotor power	
Week 12	**Three Phase Alternator**	
Class 34	Overview	
Class 35	Principle of operation	

Class 36	Mathematical problems	
Week 13	**Synchronous motor**	
Class 37	Operation	
Class 38	Effect of loading	
Class 39	Under different excitation condition	
Week 14	**Synchronous motor**	
Class 40	Effect of changing excitation	
Class 41	V-curves and starting	
Class 42	Mathematical problems	

Text and Ref 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; S.Chand& Company Ltd.
3. Electric Machinery Fundamental - Stephan J. Chapman; McGraw-Hill.
4. Alternating Current Machines - A.F. Puchntein& T.C Lioyd; John Wiley & Sons, Inc New York.

AEAV 210: Electro- Mechanical System Sessional

1.50 Contact Hour; .75 Credit Hour

Pre-requisite (if any)**: Electro- Mechanical System**

Rationale:
To familiarize the basics of electro-mechanical components and their operations.

Objective:

1. To to have a basic knowledge of transformers.
2. To study basic knowledge of induction motor.
3. To use the principles of DC motors in various practical fields.
4. To understand the basic working principle of various generators and motors.
5. To be able to understand the basics of DC Self-Excited Shunt Generator.
6. To understand the ac circuit and their practical applications in day to day life uses.

Course Outcomes (CO):

1. Understanding the knowledge about fundamental laws governing working of electromagnetic circuits
2. Analyzing the working of linear machine as generator, motor and transformer by applying basic electromagnetic laws on them
3. Evaluating the properties of three phase alternators.
4. Apply acquired knowledge to develop modern day applications out of these practical electrical machines exploiting their unique characteristics

Course Synopsis:

Experiment No	**Experiment Name**
Experiment 01	Regulation of the Transformer in Various Loads
Experiment 02	Study the properties of DC Separately Excited Shunt Generator
Experiment 03	Study the properties of DC Self-Excited Shunt Generator
Experiment 04	Study the properties of DC Shunt Motor
Experiment 05	Study the properties of Three-Phase Alternator in various loads

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcome (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understanding the knowledge about fundamental laws governing working of electromagnetic circuits.	√											
2. Analyzing the working of linear machine as generator, motor and transformer by applying basic electromagnetic laws on them					√							
3. Evaluating the properties of three phase alternators.	√											
4. Apply acquired knowledge to develop modern day applications out of these practical electrical machines exploiting their unique characteristics					√							

Text and Ref 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; S.Chand& Company Ltd.
3. Electric Machinery Fundamental - Stephan J. Chapman; McGraw-Hill.

AEAV 301: Digital Systems

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn and familiarize the basics of digital systems as well as the analysis and design of different circuit.

Objective:
1. To learn the knowledge of mathematics, science, and engineering
2. To study the design and conduct experiments, as well as to analyze and interpret data.
3. To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. To identify, formulate, and solve engineering problems.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Explain and examine the structure of various number systems,combinational and sequential circuits and its applications in digital circuit design.

2. Explain the architecture of 8086 microprocessor, addressing modes, instruction set, assembly language programming of microprocessors and its application.

3. Design complete logic circuits that can contribute positively in real life conditions.

4. Analyze and synthesize logic networks using modern engineering techniques and tools (such as K-maps, mat labs and state tables).

5. Analysis, execute and report on a project working in a group both as a member and as a leader.

Course Contents:

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.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain and examine the structure of various number systems,combinational and sequential circuits and its applications in digital circuit design.	√											
2. Explain the architecture of 8086 microprocessor, addressing modes, instruction set, assembly language programming of microprocessors and its application.	√											
3. Design complete logic circuits that can contribute positively in real life conditions.			√									
4. Analyze and synthesize logic networks using modern engineering techniques and tools (such as K-maps, mat labs and state tables).					√							
5. Analysis, execute and report on a project working in a group both as a member and as a leader.											√	

Lecture Schedule:

Week 1	Intoductory Digital Concepts, Number Systems, Operations and Codes	CT-1
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	**Logic Gates**	
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	**Boolean Algebra and Logic Simplification**	
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	**Boolean Algebra and Logic Simplification**	CT-2
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	**Combinational Logic Circuits**	
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	**Functions of Combinational Logic Circuits**	
Class 16	The half adder, the full adder, parallel binary adders	
Class 17	Continue	
Class 18	Comparators (magnitude and cascaded comparators)	
Week 7	**Functions of Combinational Logic Circuits**	CT-3
Class 19	Operation, truth table and logic symbol of basic decoders	
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	**Functions of Combinational Logic Circuits**	
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	**Flip Flops**	
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 fip-flops.	

Week 10	**Counters**	
Class 28	Asynchronous Counter operation	
Class 29	Application of Asynchronous Counter	
Class 30	Synchronous Counter operation	
Week 11	**Counters**	
Class 31	Application of Synchronous Counter	
Class 32	Up/ down Synchronous Counter	
Class 33	Design of a Synchronous Counter	
Week 12	**Shift Registers**	
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	**Shift Registers**	CT-4
Class 37	Mathematical problems	
Class 38	Bidirectional shift registers, shift register counters	
Class 39	Continue	
Week 14	**Memory devices and their structure.**	
Class 40	Introduction to memory devices	
Class 41	Memory devices’ structure	
Class 42	Review of whole syllabus	

Text and Ref Books:

1. Digital Logic and Computer Design- M Morris Mano; Prentice Hall of India Private Ltd.
2. Digital Fundamentals - Floyd; Prentice Hall International, Inc.
3. Pulse, Digital and Switching waveforms - Jacob Millman& Herbert Taub; Tata McGraw-Hill.
4. Microprocessor and Interfacing - Douglas V. Hall; Tata McGraw-Hill.
5. Microprocessor and Microprocessor Based System Design - Dr M. Rafiquzzaman; Universal Book Stall New Delhi.

AEAV 302: Digital Systems Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite: None.

Rationale:
This subject is classified and 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.

Objectives:

1. Be able to demonstrate knowledge and understanding of:
2. Describe sequential digital systems in a hardware description language.
3. How to include design for test structures in a sequential digital system.
4. Generate tests for a combinational digital circuit.
5. Validate a digital system using a simulator.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Conduct experiments, and then analyze and interpret results successfully.

2. Demonstrate that theoretical device/circuit operation can be implemented in properly constructed digital circuits

3. Analyze and correlate standard electronic test equipment such as logic gates, digital multi-meters, and power supplies and other digital equipment to test, and implement digital circuits.

4. Analyze a circuit correctly and compare its theoretical performance to actual performance.

5. Demonstrate proficiency in digital circuit analysis and design methods by designing, implementing, and testing project-based digital circuits.

6. Design a digital system to interpret the theoretical knowledge effectively.

Course Contents:

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 and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

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Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Lab Report	20
Project	30
Lab Test	20
Lab Quiz	20

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
Conduct experiments, and then analyze and interpret results successfully.				√								
Demonstrate that theoretical device/circuit operation can be implemented in properly constructed digital circuits		√										
Analyze and correlate standard electronic test equipment such as logic gates, digital multi-meters, and power supplies and other digital equipment to test, and implement digital circuits.					√							
Analyze a digital circuit correctly and compare its theoretical performance to actual performance.										√		

Demonstrate proficiency in digital circuit analysis and design methods by designing, implementing, and testing project-based digital circuits.												√
Design a digital system to interpret the theoretical knowledge effectively.			√									

AEAV 303: Signals and Systems

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To understand the basics of electrical signals as well as the analysis and design of systems.

Objective:

1. Be able to describe signals mathematically and understand how to perform mathematical operations on signals. The operations should include operations on the dependent as well as independent variables.
2. Be familiar with commonly used signals such as the unit step, ramp, impulse function, sinusoidal signals and complex exponentials.
3. Be able to classify signals as continuous-time vs. discrete-time, periodic vs. non-periodic, energy signal vs. power signal, odd vs. even, conjugate symmetric vs. anti-symmetric
4. Be able to describe systems using linear constant coefficient differential equations and using their impulse response.
5. Understand system properties - linearity, time invariance, presence or absence of memory, causality, bounded-input bounded-output stability and inevitability. Be able to identify whether a given system exhibits these properties and its implication for practical systems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Understand continuous-time signals and discrete-time signals.

2. Understand about the application and use of mathematical transforms and state-variables in order to solve electrical engineering problems.

3. Analyze electrical engineering signals and circuit problems.

4. Design various electrical systems using different transforms and also monitor the performance.

5. Analyze systems for a discrete-time (DT) processing of continuous-time (CT) signals using software

Course Contents:

Classification of signals and systems: 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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Understand continuous-time signals and discrete-time signals	√											
2.Understand about the application and use of mathematical transforms and state-variables in order to solve electrical engineering problems		√										
3.Analyze electrical engineering signals and circuit problems		√										

4.Design various electrical systems using different transforms and also monitor the performance			√									
5.Analyze systems for a discrete-time (DT) processing of continuous-time (CT) signals using software					√							

Lecture Schedule:

Week 1	**Introduction to signal and system**	CT 1
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**	CT 2
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.**	CT 3
Class 19	Introduction to Fourier series	
Class 20	Dirichlet Condition and orthogonality	
Class 21	Properties of Fourier series	
Week 8	**Types of Fourier Series**	

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**	
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	CT 4
Class 36	time-division and frequency-division multiplexing	
Week 13	**Laplace transformation**	
Class 37	Properties	
Class 38	Inverse transform	
Class 39	Problem solving	
Week 14	**system equations**	
Class 40	System stability	
Class 41	System transfer function	
Class 42	Frequency response and application.	

Text and Ref Books:

1. Continuous and Discrete Signals & Systems - S.S. Soliman & M. D. Srinath; Prentice Hall of India Private Ltd.
2. Signal and System (Continuous & Discrete) - R.E. Ziemer; Pearson Education Asia.
3. Feedback Control System - Phillips & Horbour; Prentice Hall.
4. Signals and Systems- Alan V. Oppenheim and Alan S. Willsky; Prentice Hall.

AEAV 305: Communication Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
The course objective is to cover the principles of analog and digital communication systems involving different modulation and coding schemes in the background of noise and interference

Objective:

1. Understanding the communication channel and apply both deterministic and statistical Fourier concepts to transmission propagation, power spectral density and modulation/coding characteristics.

2. Develop and compare the functional blocks of coding/modulation and demodulation/decoding for analog and digital communication systems.

3. Analyze the analog-to-digital conversion process with emphasis on Nyquist Sampling Criteria, line coding, pulse shaping and optimum detection functions.

4. Develop and compare the performance of binary, M-ary and spread spectrum digital communications in the presence of noise and interference. Design of linear systematic block coding and its error detection/correction capability is also discussed.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Explain different modulation and demodulation techniques used in analog communication systems

2. Evaluate and solve basic communication problems

3. Analyze transmitter and receiver circuits

4. Compare, create and contrast design issues, advantages, disadvantages and limitations of analog communication systems

Course Contents:

Overview of communication systems: Basic principles & fundamental elements; Noise: Sources & characteristics.
Information theory: Measure of information, channel capacity of a continuous system and channel capacity;
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: Amplitude-shift keying - Phase-shift keying (PSK): Frequency-shift Keying (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, Emergency Locator Transmitter.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain different modulation and demodulation techniques used in analog communication system.	√											
2. Evaluate and solve basic communication problems.		√										
3. Analyze transmitter and receiver circuits.			√									
4. Compare, create and contrast design issues, advantages, disadvantages and limitations of analog communication systems					√							

Lecture Schedule:

Week 1	**Communication Basics**	CT 1
Class 1	Information Theory	
Class 2	Shanon's information capacity theorem	
Class 3	Basic communication block diagram	
Week 2	**Amplitude modulation**	
Class 4	SSB-SC modulation	
Class 5	DSB-SC modulation	
Class 6	Mathematical problems	
Week 3		
Class 7	Modulaion index	
Class 8	Side band power and carrier power	
Class 9	Tone modulation	
Week 4	**Generation of AM signal**	CT 2
Class 10	Switching modulation	
Class 11	Demodultaion (rectifier detection)	
Class 12	Envelope detection, quadrature amplitude modulator	
Week 5	**Angle modulation**	

Class 13	Pulse modulation: Sampling theorem	
Class 14	Nyquist criterion Aliasing	
Class 15	Instantaneous and natural sampling & related maths	
Week 6	**Pulse Amplitude Modulation**	
Class 16	Definition, Principle	
Class 17	Bandwidth requirements and application	
Class 18		
Week 7	**Pulse code modulation (PCM)**	CT 3
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	**Time Division Multiplexing (TDM)**	
Class 22	Time Division Multiplexing	
Class 23	TDM: Receiver synchronization, frame synchronization	
Class 24	Continue	
Week 9	**Delta Modulation (DM) and Derivative Pulse code Modulation (DPCM)**	
Class 25		
Class 26	DPCM (transmitter, receiver)	
Class 27	Continue	
Week 10	**ADPCM and Demodulation of PCM**	CT 4
Class 28	ADPCM &Demodulation of PCM	
Class 29	Continue	
Class 30	TDM of multiple bit rate systems	
Week 11		
Class 31	Delta modulation (DM):Principle, transmitter & receiver	
Class 32	Continue	
Class 33	Adaptive DM: (transmitter and receiver)	
Week 12	**Adaptive Delta Modulation & Digital Modulation**	
Class 34	ADM continue	

Class 35	DM: Threshold of coding and overloading	
Class 36	Digital modulation: Amplitude-shift keying	
Week 13	**Digital Modulation**	
Class 37	Phase-shift keying (PSK):	
Class 38	BPSK & QPSK	
Class 39	Frequency-shift Keying (FSK)	
Week 14	**Principle of Digital Transmission**	
Class 40	Line coding and its properties	
Class 41	PSD of various line coding	
Class 42	Continue	

Text and Ref 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 – Thiagarajan Viswanathan; Prentice Hall of India Private Ltd.
5. Electronic Communication Systems-Kennedy & Davis; Tata McGraw Hill.

AEAV 306: Communication Engineering Sessional

1.50 Contact Hour; .75 Credit Hour;

Pre-requisite: Communication Engineering

Rationale:
To learn and familiarize the basics of communication as well as the analysis and implementation of various communication methods.

Objective:

1. To learn the basic of AM Modulation and demodulation by Transistor
2. To study the different electrical network theorems and apply FM Modulation & FM Demodulation
3. To use the principles of communication in various practical fields.
4. To understand the basic of DSBSC and SSB modulation and demodulation

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Explain the basic theory of different types modulation techniques of communication

2. Apply the basic theory of modulation using different engineering equipment

3. Compare the numerical results with software results to design a communication system as per requirement

4. Analyze the effect of noise by analyzing different communication techniques

Course Contents:

Experiment No: 1- AM Modulation by Transistor
Experiment No: 2- AM Demodulation by Diode detector
Experiment No: 3- FM Modulation
Experiment No: 4- FM Demodulation
Experiment No: 5- DSB-SC and SSB Modulator
Experiment No: 6- DSB-SC and SSB Demodulators
Experiment No. 7- Delta Modulation and Demodulation

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	30%
Lab quiz	25%
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic theory of different types modulation techniques of communication	√											
2. Apply the basic theory of modulation using different engineering equipment		√										
3. Compare the numerical results with software results to design a communication system as per requirement			√									
4. Analyze the effect of noise by analyzing different communication techniques										√		

Text and Ref 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 – Thiagarajan Viswanathan; Prentice Hall of India Private Ltd.
5. Electronic Communication Systems-Kennedy & Davis; Tata McGraw Hill

AEAV 307: Electromagnetic Field Theory

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
To learn and familiarize with the basics of electro- magnetic field theories and implement that knowledge in the field of communication.

Objective:

1. To learn the basic of Static electric field
2. To study the different boundary conditions
3. To use the principles Poisson‘s and Laplace‘s equations in different co-ordinate systems.
4. To understand the basic of Maxwell‘s equations: Faraday‘s law of electromagnetic induction,

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Apply vector calculus to static electric-magnetic fields in different engineering situations.
2. Analyze Maxwell’s equation in different forms (differential and integral) and apply them to diverse engineering problems.
3. Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
4. Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
5. Calculate electric and magnetic fields from stationary and dynamic charge and current distributions and solve simple electrostatics boundary problems.

Course Contents:

Static electric field: Postulates of electrostatics, Coulomb‘s law for discrete and continuously distributed charges, Gauss‘s law and its application, electric potential due to charge distribution, conductors and dielectrics in static electric field, flux density - boundary conditions, capacitance - electrostatic energy and forces, energy in terms of field equations, capacitance calculation of different geometries, boundary value problems – Poisson‘s and Laplace‘s equations in different co-ordinate systems.
Steady electric current: Ohm‘s law, continuity equation, Joule‘s law, resistance calculation. **Static Magnetic field:** Postulates of magnetostatics, Biot-Savart‘s law, Ampere‘s law and applications, vector magnetic potential, magnetic dipole, magnetization, magnetic field intensity and relative permeability, boundary conditions for magnetic field, magnetic energy, magnetic forces, torque and inductance of different geometries. Time varying fields and Maxwell‘s equations: Faraday‘s law of electromagnetic induction, Maxwell‘s equations - differential and integral forms, boundary conditions, potential functions, time harmonic fields and Poynting

theorem. Plane electromagnetic wave: Plane wave in loss less media - Doppler effect, transverse electromagnetic wave, polarization of plane wave, plane wave in lossy media – low-loss dielectrics, good conductors, group velocity, instantaneous and average power densities.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply vector calculus to static electric-magnetic fields in different engineering situations.	√											
2. Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.		√										
3. Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.				√								
4. Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.				√								
5. Calculate electric and magnetic fields from stationary and dynamic charge and current distributions and solve simple electrostatics boundary problems.			√									

Lecture Schedule:

Week 1	**Introduction to Electromagnetics**	
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	CT-1
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**	
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	CT-2
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	CT-3
Class 20	Boundary Conditions and Related Problems	
Class 21	Classification of Magnetic material	

Week 8	**Magnetic Properties**	
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**	CT-4
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**	
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**	CT-5
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	

Text and Ref Books:

1. Engineering Electromagnetics – W. H. HaytJr& John A. Buck; Tata McGraw-Hill Publishing Company Ltd
2. Fields and Waves in Communication Electronics - Simon Ramo; John Wiley & Sons.
3. Fundamentals of Engineering Electromagnetic - D.K. Cheng; Prentice Hall of India Private Ltd.

AEAV 309: Aircraft Avionics systems

3.0 Contact Hour; 3.0 Credit Hour

Pre-requisite: Electromechanical Systems

Rationale:
To learn and familiarize with the basics of electro- magnetic field theories and implement that knowledge in the field of communication.

Objective:
1. To learn the basic of Static electric field
2. To study the different boundary conditions
3. To use the principles Poisson's and Laplace's equations in different co-ordinate systems
4. To understand the basic of Maxwell's equations: Faraday's law of electromagnetic induction

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Explain the generation of AC and DC power and supply in aircraft, bus bar, generator, alternator, fuses and circuit breakers in aircraft power supply.
2. Describe the concept of emergency power supply, aircraft batteries.
3. Evaluate various safety requirements, aircraft electrical wiring and lighting.
4. Explain the performance of Full Authority Digital Engine Control (FADEC) System.
5. Describe the basic aspects of Hydraulic systems, Pneumatic systems, brake system

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcome and Program Outcomes:

Course Outcome (CO) of the Course	Program Outcomes* (Appendix-1)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the generation of AC and DC power and supply in aircraft, bus bar, generator, alternator, fuses and circuit breakers in aircraft power supply.							✓					
2. Describe the Concept of emergency power supply, aircraft batteries					✓							
3. Evaluate various safety Requirements.												
4. Explain the performance of Full Authority Digital Engine Control (FADEC) system.												
5. Describe the basic aspects of Hydraulic systems, Pneumatic systems, brake system			✓									

Lecture Schedule:

Week 1	**Aircraft Electrical Systems**	CT 1
Class 1	AC And DC Power Generations And Supply In Aircraft	
Class 2	Bus Bar,	
Class 3	Generator	
Week 2	**Aircraft Electrical Systems**	
Class 4	Alternator	
Class 5	Fuses And Circuit Breakers in Aircraft Power Supply	
Class 6	Concept of Emergency Power Supply	
Week 3	**Aircraft Power Supply**	
Class 7	Aircraft Batteries, Types, Capacity etc	
Class 8	Auxiliary Power Unit (APU)	
Class 9	Power Supplies, Components of Power Distribution	
Week 4		CT 2
Class 10	External Power Supply	
Class 11	Safety Requirements	
Class 12	Aircraft Electrical Wiring and Lighting	
Week 5	**Aircraft Electronic Systems**	
Class 13	Integrated Cockpit Display System	
Class 14	Introduction, Cockpit Display System	
Class 15	Glass Cockpit, Display Unit	
Week 6	**Engine Control and Monitoring System**	
Class 16	HUD, HDD	
Class 17	HMD	
Class 18	IEEE Smart Sensors	
Week 7	**Emergency Systems**	CT 3
Class 19	Principles of Operation	
Class 20	Engine Indications and Monitoring	
Class 21	Full Authority Digital Engine Control (FADEC) System.	

Week 8		
Class 22	Warning Systems	
Class 23	Fire Detection and Suppression	
Class 24	Emergency Oxygen	
Week 9		
Class 25	Passenger Evacuation	
Class 26	Continue	
Class 27	Continue	
Week 10		CT 4
Class 28	Ice & Rain Protection System	
Class 29	Emergency power sources	
Class 30	Emergency landing	
Week 11	**Airplane control systems**	
Class 31	Push pull rod system	
Class 32	Operating Principles	
Class 33	Cable and pulley system	
Week 12		
Class 34	Power assisted and fully powered flight controls	
Class 35	Digital fly by wire systems	
Class 36	Continue	
Week 13	**Introduction to Aircraft Aerospace**	
Class 37	Hydraulic systems	
Class 38	Pneumatic systems	
Class 39	Brake system, anti-skidding, landing gear systems	
Week 14		
Class 40	Engine Fuel systems	
Class 41	Air conditioning and pressurizing system	
Class 42	Deicing and anti- icing system.	

Text and Ref Books:

1. Aircraft Systems (3rd edition) -- Ian Moir, Allan Seabridge; WILEY Publications.
2. Handbooks of Airframe and Power plant Mechanics; US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995
3. Aircraft Electrical Systems- EHJ Pallette, 3rd edition, Pearson Education.
4. Aircraft Electronics- F Terry White, White Publications.
5. Fundamentals of Aircraft Electronics- Scott Kenney, Avotek Information Resources.
6. Aircraft Communications and Navigation Systems - David Wyatt, Mike Tooley: Routledge

AEAV 313: Digital Signal Processing

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Signal and Systems

Rationale:
To learn and familiarize the discrete signals and systems and also designing various filters

Objective:
1. To study about discrete time systems.
2. To study the design techniques for FIR and IIR digital filters
3. To study the conversion for analogue signal to digital signal in signal processing
4. To study the properties of random signal, digital signal processing

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Explain the basic concepts of signals, signal processing and digital signals;
2. Analyze signals and systems in discrete time, including use of the *z*-transform;
3. Explain the Fourier transform and convolution to filter signals and explain the properties of the discrete-time Fourier transform;
4. Design finite impulse response (FIR) filters to satisfy a desired frequency response
5. Design infinite impulse response (IIR) filters using impulse invariance method and bilinear transformation method
6. Analyze different signals and systems using MATLAB

Course Contents:

Introduction to digital signal processing (DSP): Discrete-time signals and systems, analog to digital conversion, impulse response, finite impulse response (FIR) and infinite impulse response (IIR) of discrete-time systems, difference equation, convolution, transient and steady state response. **Discrete transformations:** Discrete Fourier series, discrete-time Fourier series, discrete Fourier transform (DFT) and properties, fast Fourier transform (FFT), inverse fast Fourier transform. Z transformation - properties, transfer function, poles and zeros and inverse Z transform. Correlation: Circular convolution, auto-correlation and cross correlation.
Digital Filters: FIR filters - linear phase filters, specifications, design using window, optimal and frequency sampling methods. IIR filters – specifications, design using impulse invariant, bi-linear Z transformation, least-square methods and finite precision effects.
Introduction to MATLAB Simulink application in DSP. Implementation of DSP in RADAR Engineering.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic concepts of signals, signal processing and digital signals	√											
2. Analyze signals and systems in discrete time, including use of the *z*-transform		√										
3. Explain the Fourier transform and convolution to filter signals and explain the properties of the discrete-time Fourier transform		√										
4. Design finite impulse response (FIR) filters to satisfy a desired frequency response.			√									
5. Design infinite impulse response (IIR) filters using impulse invariance method and bilinear transformation method			√									
6. Analyze different signals and systems using MATLAB		√										

Lecture Schedule:

Week 1	**Introduction to digital signal processing (DSP)**	
Class 1	Discrete-time signals and systems	CT 1
Class 2	Types of signals	
Class 3	Analog and digital systems	
Week 2	**Conversion of signals**	
Class 4	Basic sampling theorem	
Class 5	Quantization and digitization	
Class 6	Problem solving techniques	

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**	CT 2
Class 10	Significance	
Class 11	Finite impulse response (FIR)	
Class 12	Infinite impulse response (IIR)	
Week 5	**Discrete time system**	
Class 13	Recursive DTS	
Class 14	Non-recursive DTS	
Class 15	Problem solving	
Week 6	**Difference equation**	
Class 16	Solution technique of difference equation	
Class 17	Homogenous solution: theory & problem solving	
Class 18	Particular solution: theory & problem solving	
Week 7	**Structures of LTI systems**	CT 3
Class 19	Direct form 1: theory & problem solving	
Class 20	Direct form 2: theory & problem solving	
Class 21	Problem solving	
Week 8	**Discrete transformations**	
Class 22	Discrete-time Fourier series	
Class 23	Properties of discrete-time Fourier series	
Class 24	Analytical problems on DTFS	
Week 9	**Fourier transform (DFT)**	
Class 25	Properties	
Class 26	Convolution of two signals using DFT	
Class 27	Frequency shifting & modulation	
Week 10	**Inverse fast Fourier transform**	CT 4
Class 28	Properties	
Class 29	Finding the real signal	
Class 30	Demodulation & circular convolution	
Week 11	**Filter design**	
Class 31	Theory of filter design	
Class 32	Design technique of FIR filters	
Class 33	Filter design using window method	

Week 12	**Z transform**	
Class 34	Significance & advantages	
Class 35	Properties of Z transform	
Class 36	Problem solving on various properties	
Week 13	**Inverse Z transform**	
Class 37	Problem solving using properties	
Class 38	One sided Z transform	
Class 39	IIR filters	
Week 14	**Design of IIR filters**	
Class 40	Theory of IIR filter design	
Class 41	Impulse invariance method	
Class 42	Bilinear transformation method	
	Extra Classes	
Class 43	Problem solving notch and low pass filters	
Class 44	Review of the course outline	

Text and Ref Books:

1. Digital Signal Processing – John G.Proakis& Dimitris Manolakis; Prentice Hall.
2. Digital Signal Processing Using MATLAB - Vinay K. Langle& John G. Proakis; CL-Engineering.
3. Digital Signal Processing - Thomas J. Cavicchi; John Wiley & Sons.
4. Digital Signal Processing-A practical approach– Emmanuel C. Ifeachor& Barrie W. Jervis; Prentice Hall.
5. Signal and System (Continuous & Discrete) - Rodger E. Ziemer, W. H. Tranter & D. R. Fannin; Pearson Education.

AEAV 324: Digital Signal Processing Sessional

1.5 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Digital Signal Processing

Rationale:
To learn and familiarize the basics of digital signals as well as the analysis and design of different analog and digital filters.

Objective:

1. Design FIR and IIR filters by MATLAB to meet specific magnitude and phase requirements.
2. Perform Z and inverse Z transforms using the definitions, Tables of Standard Transforms and Properties, and Partial Fraction Expansion
3. Determine if a DT system is linear, time-invariant, causal, and memoryless, determine asymptotic, marginal and BIBO stability of systems given in frequency domain.
4. Design and implement digital filters by hand and by using MATLAB.
5. Use computers and MATLAB to create, analyze and process signals, and to simulate and analyze systems sound and image synthesis and analysis, to plot and interpret magnitude and phase of LTI system frequency responses.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Explain the basic sampling process, quantization to convert the analog signal into digital signal using software and also analytically
2. Apply the theory of modulation, using MATLAB and analyze the voice signal
3. Analyze the solution technique of different control system for varying input signal using MATLAB Simulink
4. Explain the basic theory of Fourier series, Fourier Transform, Z transform and interpret the analytical results using MATLAB.

Course Contents:

Experiment No. 1: Review of Basic MATLAB Functions and recollecting the lessons of Numerical Analysis Sessional

Experiment No. 2: Study of Sampling and Quantization and creating 3d surfaces

Experiment No. 3: Number Conversion Technique and Amplitude Modulation

Experiment No. 4: Review of Basic MATLAB Simulink and processing the signal

Experiment No. 5: Study of z transform and FM, DSBSC modulation and voice signal analysis

Experiment No. 6: Analysis and interpretation of Fourier series and Fourier Transform using MATLAB

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	30%
Lab quiz	25%
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic sampling process, quantization to convert the analog signal into digital signal using software and also analytically	√											
2. Apply the theory of modulation, using MATLAB and analyze the voice signal		√										
3. Analyze the solution technique of different control system for varying input signal using MATLAB Simulink	√											
4. Explain the basic theory of Fourier series, Fourier Transform, Z transform and interpret the analytical results using MATLAB		√										

Text and Ref Books:

1. Digital Signal Processing – John G.Proakis& Dimitris Manolakis; Prentice Hall.
2. Digital Signal Processing Using MATLAB - Vinay K. Langle& John G. Proakis; CL-Engineering.
3. Digital Signal Processing - Thomas J. Cavicchi; John Wiley & Sons.
4. Digital Signal Processing-A practical approach– Emmanuel C. Ifeachor& Barrie W. Jervis; Prentice Hall.
5. Signal and System (Continuous & Discrete) - Rodger E. Ziemer, W. H. Tranter & D. R. Fannin; Pearson Education.

AEAV 329: Measurement and Aircraft Instruments

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None.

Rationale:
The goal of this syllabus is for the student to gain the necessary aeronautical skill, knowledge and experience to meet the requirements of an Instrument Rating with an Airplane category.

Objective:

1. To develop the idea of basic fundamental of instruments, working principles, basic structures classifications, mechanisms and comparisons of instruments.
2. Categorize aircraft flight Instruments according to different use and working mechanisms
3. Comparison between various system and rating different instruments
4. To learn about Temperature Indicating Systems, fuel quantity and flow systems and pitot static flight instruments.
5. Describe and explain the operation of flight instruments incorporating gyroscopes, using words and diagrams the operation of gyro-magnetic compass systems and operation of a flight director system (FDS) to block diagram level.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Identify various aircraft instruments, their use, different errors associated with the instruments and how to minimize such errors.

2. Analyze the functioning of the flight instruments and power plant instruments in the aircraft system with different types of data displays.

3. Explain the working of airspeed, altitude, vertical speed, Mach, TAS, CAS, and IAS measuring system.

4. Analyze the working principle and usage of gyroscope in the aircraft system

5. Analyze the fuel flow and quantity measurement, signal conditioning system and digital data transmission lines.

Course Contents:

Fundamentals: Generalized measurements systems, dimensions and units of measurements, causes and types of experimental errors, error and uncertainty analysis.
Air pollution sampling and measurements; Data acquisition and processing.
Introduction: Introduction to Basic-6 and Basic-T aircraft instruments, applications of instruments in aircraft, functional elements of a measurement system and classification of instruments.

Instrument display and layout: Qualitative, quantitative display, scale range, operating range, type of scales- linear, non-linear, circular, straight, dual displays and digital display; instrument grouping in cockpit.
Transducers: Primary, secondary, mechanical, electrical and optical.
Measurement of non-electrical quantities: Temperature, pressure, flow, level, force and torque.
Pitot-static group of Instruments: ASI, Altimeter, VSI, Mach meter: Construction, operating principle, square law compensation, introduction to Air Data Computer, TAS, CAS, IAS
Aircraft Attitude & Indication system: Gyroscope & properties- Precession & rigidity, Gyro Horizon Indicator, Turn & Bank Indicator, construction and operating principle.
Measurement of Engine RPM: Torque measurement, Tacho probe.
Temperature Measurement: Thermocouple, Radiation pyrometer, PRTD, air temperature sensors- Principle application in aviation.
Fuel flow and quantity measurement: Resistive & Capacitive transducer, aircraft fuel measurement system, compensation for aircraft attitude and non-uniform tank contour.
Basic elements of signal conditioning: Instrumentation amplifier, noise and source of noise, noise elimination compensation, A/D and D/A converters, sample and hold circuits. Data acquisition system.
Digital Data Transmission Lines: Data buses, MIL STD 1553, ARINC 429, Optical data buses.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify various aircraft instruments, their use, different errors associated with the instruments and how to minimize such errors.					√							

2. Analyze the functioning of the flight instruments and power plant instruments in the aircraft system with different types of data displays.		√										
3. Explain the working of airspeed, altitude, vertical speed, Mach, TAS, CAS, and IAS measuring system.	√											
4. Analyze the working principle and usage of gyroscope in the aircraft system	√											
5. Analyze the fuel flow and quantity measurement, signal conditioning system and digital data transmission lines.				√								√

Lecture Schedule:

Week 1	**Fundamentals of Measurement**	
Class 1	Generalized measurements systems	
Class 2	Dimensions and Units of Measurements	
Class 3	Causes and types of errors and uncertainty analysis	
Week 2	**Fundamentals of Measurement**	
Class 4	Data acquisition and processing	
Class 5	Introduction to Basic-6 and Basic-T aircraft instruments	CT 1
Class 6	Applications of instruments in aircraft	
Week 3	**Fundamentals of Measurement and Instrument Display and Layout**	
Class 7	Functional elements of a measurement system and classification of instruments	
Class 8	Quantitative and Qualitative displays. Scale Range and Operating range	
Class 9	Types of scales (Linear, Nonlinear, Circular, Straight, Dual and Digital displays)	
Week 4	**Transducers**	
Class 10	Introduction	CT 2
Class 11	Classification of Transducers	
Class 12	Classification of Transducers	

Week 5	**Measurement of Non Electrical Quantities**	
Class 13	Measurement of temperature	
Class 14	Measurement of pressure, flow and level	
Class 15	Measurement of force and torque	
Week 6	**Pitot Static Group of Instruments**	
Class 16	Construction and operating principle of Air Speed Indicator	
Class 17	Construction and operating principle of Altimeter and Vertical Speed Indicator	
Class 18	Construction and operating principle of Machmeter	
Week 7	**Pitot Static Group of Instruments**	CT 3
Class 19	Square Law Compensation	
Class 20	Introduction to Air Data Computer	
Class 21	QFE, QNE, TAS, CAS and IAS	
Week 8	**Aircraft Attitude and Indication System**	
Class 22	Gyroscope & Properties of Gyroscope (Rigidity & Precession)	
Class 23	Construction and working principle of Gyro Horizon Indicator	
Class 24	Construction and working principle of Turn and Bank Indicator	
Week 9	**Measurement of Engine RPM and Temperature**	
Class 25	Torque measurement	
Class 26	Tacho Probe	
Class 27	Principle application in aviation of Thermocouple	
Week 10	**Temperature Measurement**	CT 4
Class 28	Principle application in aviation of Radiation Pyrometer	
Class 29	Principle application in aviation of PRTD,	
Class 30	Air Temperature Sensors	
Week 11	**Fuel Flow and Quantity Measurement**	
Class 31	Resistive & Capacitive Transducer,	
Class 32	Aircraft Fuel Measurement	
Class 33	Compensation for aircraft attitude and non-uniform tank contour	
Week 12	**Basic Elements of Signal Conditioning**	
Class 34	Instrumentation amplifier, noise and source of noise, noise elimination	

	compensation	
Class 35	A/D Converters	
Class 36	A/D Converters	
Week 13	**Basic Elements of Signal Conditioning**	
Class 37	D/A Converters	
Class 38	Sample and Hold Circuits	
Class 39	Data Acquisition System	
Week 14	**Digital Data Transmission Lines**	
Class 40	Introduction to Data Buses.	
Class 41	MIL STD 1553 and 1773 data buses	
Class 42	ARINC 429, Optical data buses	

Text and Ref Books:

1. Aircraft Instruments and integrated Systems- EHJ Pallet; Pearson Education Publishers.
2. Aircraft Electricity and Electronics- Thomas Eismin; Glencoe.
3. Modern Electronic Instrumentation and Measurement Techniques - Albert D Helfrick; Prentice Hall of India private Ltd.
4. Federal Aviation Agency (FAA) Hand Book of Flying: Flight Instruments.
5. Electrical Electronics Measurement and Instrumentation - A.K. Sawheney; Dhanpat Rai and Company Private Ltd.

AEAV 330: Measurement and Aircraft Instruments Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Measurement and Aircraft Instruments

Rationale:
The student must demonstrate to aeronautical knowledge and skills necessary to obtain an Instrument Rating of any Airplane.

Objective:
1. To learn about different mechanism system and how they works in practical environment
2. Understanding different flight instruments working category
3. Experimenting errors in system and deduce the errors to get better values
4. Prepare and plan any project related to aircraft instrument and demonstrate its working principle

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

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 Contents:

Sessional no.1	Familiarization with Pressure Transducer (Strain Gauge)
Sessional no. 2	Flow Rate Control of Water by Feedback Transducer.
Sessional no. 3	Study of negative temperature coefficient transducer (NTC) and its linearity by feedback method
Sessional no. 4	Errors in measurement and basic statistical sampling

Sessional no. 5	Study of an 8 bit analog to digital converter

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
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.						√						

AEAV 450: Capstone Project/ Integrated Design Project (IDP)

12.00 Contact Hour; 6.00 Credit Hour;

Pre-requisite: Student should complete all courses up to 4th Year

Rationale:
A small scale research project will be undertaken by every final year student. The aim of the project is to introduce them some problems related to engineering and accustoming them with the techniques of investigation, solving the problems, writing a technical report and present the results in the form of thesis and seminar.

Objectives:
1. To be able to design, implement, analyses and synthesize a solution for a given engineering problem using the inherent tools of engineering.
2. To be able to plan, organize, build and utilize systems approach in an engineering project and be able to apply in depth knowledge of a technical topic and practical aspects of engineering.
3. To be able to express, justify and defend their ideas and information in written and oral form according to professional and ethical practices.
4. To be able to apply their personal capabilities in accomplishing the goals throughout the whole process.

Course Outcomes (CO)
Upon completion of the course, the students will be able:

1. To develop the ability to undertake complex problem identification, formulation and solution utilizing a system approach.
2. To design and conduct experiments of complex engineering problems with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.
3. To conduct investigations, devise appropriate measurement, analyze and interpret data and form reliable conclusions.
4. To apply modern engineering and IT tools to find the solution of well-defined Aeronautical engineering problems.
5. To develop the effective all round communication skills.
6. To solve the problems effectively in multi-disciplinary and multi-cultural environment both as a team member and a leader with effective managerial skills.
7. To be able to apply ethical principles in all professional and research work.
8. To develop engineers with universal socio cultural adaptability who can undertake responsibilities in the global arena without compromising on environmental safety.

9. To develop the capacity to undertake life-long learning.

Teaching-learning and
Assessment Strategy: Students are observed and evaluated by their innovative knowledge about engineering solutions.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Attendance	10
Observation and Presentation	90

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.To develop the ability to undertake complex Problem identification, formulation and solution utilizing a system approach.		√										
2.To design and conduct experiments of complex engineering problems with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.			√									
3.To conduct investigations, devise appropriate measurement, analyze and interpret data and form reliable conclusions.				√								
4.To apply modern engineering and IT tools to find the solution of well-defined Aeronautical engineering problems.					√							
5.To develop the effective all round communication skills.										√		

6.To solve the problems effectively in multi-disciplinary and multi-cultural environment both as a team member and a leader with effective managerial skills.									√			
To be able to apply ethical principles in all professional and research work.								√				
To develop engineers with universal socio cultural adaptability who can undertake responsibilities in the global arena without compromising on environmental safety.						√						
To develop the capacity to undertake life-long learning.												√

AEAV 401: Microwave Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Electro- magnetic field theory

Rationale:
Microwave Engineering introduces the student to RF/microwave analysis methods and design techniques. Scattering parameters are defined and used to characterize devices and system behavior. Passive and active devices commonly utilized in microwave subsystems are analyzed and studied. Design procedures are presented along with methods to evaluate device performance.

Objective:

1. Understand important and unique engineering issues at microwave and millimeter wave frequencies,
2. To Learn microwave network theory and the use of scattering matrix,
3. To Learn design criteria for waveguide and coaxial microwave components,
4. To learn the application of these components in the design of useful systems such as radars, receivers, etc.
5. Applying microwave fundamentals to design, fabricate and test a useful microwave component or device, which may be designed using micro-strip line technology.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Apply electromagnetic theory to calculations regarding waveguides and transmission lines.
2. Describe, analyze and design simple microwave circuits and devices e g matching circuits, couplers, antennas and amplifiers.
3. Describe and coarsely design common systems such as radar and microwave transmission links.
4. Describe common devices such as microwave vacuum tubes, high-speed transistors and ferrite devices.
5. Handle microwave equipment and make measurements.

Course Contents:

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:** Mono pole, horn, rhombic and parabolic reflector, array, and Yagi- Udaantenna.
Microwave devices: Klystron, Magnerton, TWT and Twystron are used as microwave oscillators and amplifiers.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Apply electromagnetic theory to calculations regarding waveguides and transmission lines.		√										
2.Describe, analyze and design simple microwave circuits and devices e.g matching circuits, couplers, antennas and amplifiers.	√											
3. Describe and coarsely design common systems such as radar and microwave transmission links.			√									
4. Describe common devices such as microwave vacuum tubes, high-speed transistors and ferrite devices.	√											
5. Handle microwave equipment and make measurements.					√							

Lecture Schedule:

Week 1	**Introduction to Microwave Engineering**	
Class 1	EM Spectrum	CT-1
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	CT-1
Class 5	Distortion less transmission line and related mathematical problems.	
Class 6	Termination of Transmission Line	
Week 3	**Transmission Line**	CT-2
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**	
Class 10	VSWR, ISWR, Insertion Loss	
Class 11	Related mathematical problems regarding last topic	
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**	CT 03
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	CT-4
Class 30	Basic Equation, Antenna region, Antenna Parameter	
Week 11	**Antenna**	
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**	CT-5
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	

Text and Ref 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

AEAV 442: Microwave Engineering Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Digital Signal Processing, Communication Engineering Sessional

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 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 waveguides

Course Outcomes (CO)

1. To understand the practical hands-on experience of various microwave sources & devices and digital
2. Modulations & communications Schemes.
3. Analyzing Microwave signal such as its patterns, beam width, directionality and basic concept of polarization and its properties
4. Evaluating Microwave properties on different materials.
5. Study of wavelengths and knowledge about waveguides for different application.

Course Synopsis:

Experiment No	Experiment Name
Experiment 01	Familiarization with Microwave Training System
Experiment 02	Study of Microwave Signal: Radiation pattern, Beam width and Directionality
Experiment 03	Study of polarization of microwave signal
Experiment 04	Measurement of wavelength (λ), VSWR, reflection coefficient and transmission coefficient (T) using a slotted coaxial transmission line and a microwave generator.
Experiment 05	Study of reflection of microwaves & application of reflection of microwave

Experiment 06	Measurement of wavelengths and wave impedance by a slotted waveguide section

Course Outcomes (CO)

1. To understand the practical hands-on experience of various microwave sources & devices and digital
2. Modulations & communications Schemes.
3. Analyzing Microwave signal such as its patterns, beam width, directionality and basic concept of polarization and its properties
4. Evaluating Microwave properties on different materials.
5. Study of wavelengths and knowledge about waveguides for different application.

Teaching-learning and
Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. To understand the practical hands-on experience of various microwave sources & devices and digital Modulations & communications Schemes	√											
2. Analyzing Microwave signal such as its patterns, beam width, directionality and basic concept of polarization and its properties		√										
3. Evaluating Microwave properties on different Materials			√									

4. Study of wavelengths and knowledge about waveguides for different application				√								

Text and Ref 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

AEAV 411: Control Systems Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None.

Rationale:
This subject is classified and is introduced with a view that the students will be exposed to various types of control systems. More emphasis is given for understanding the basic concepts of control systems. Students are required to know the various components of a control system, basic concepts of stability, time domain and frequency domain characteristics, when they are working in process industries.

Objectives:
1. To prepare engineers who can plan, design and construct instrumentation and control systems.
2. To develop and inculcate the engineer with intellectual, imaginative and engineering skills so as to be able to respond and adapt to change, anticipate and initiate such a change.
3. To provide the graduate with a basis for continuing postgraduate education and self-reliance/employment skills.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Demonstrate an understanding of the fundamentals of linear control systems.
2. Determine and use of linear models of physical systems in forms suitable for use in the analysis and design of control systems.
3. Express and solve system equations in state-variable form (state variable models).
4. Analyze the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.
5. Evaluate the (relative and absolute) stability of a closed-loop control system using Routh criterion.
6. Apply root-locus, frequency response and state variable method technique to analyze and design control systems.

Course Synopsis:

Introduction to control systems. Linear system models: Transfer function, block diagram and signal flow graph (SFG). State variables: SFG to state variables, transfer function to state variable and state variable to transfer function. Feedback control system: Closed loop systems, parameter sensitivity, transient characteristics of control systems, effect of additional pole and zero on the system response and system types and steady state error. Routh stability criterion. Analysis of feedback control system: Root locus method and frequency response method. Design of feedback control system: Controllability and observability, root locus, frequency response and state variable methods. Digital control systems: introduction, sampled data systems, stability analysis in Z-domain.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Demonstrate an understanding of the fundamentals of (feedback) control systems.	√											
2.Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.			√									
3.Analyze and solve system equations in state-variable form (state variable models).		√										
4.Analyze the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.	√											
5.Evaluate the (absolute) stability of a closed-loop control system	√											
6.Apply root-locus, frequency response and state												

variable method technique to analyze and design control systems				√								

Lecture Schedule:

Week 1	Introduction and Mathematical Models of Physical Systems	
Class 1	Introduction to control systems	
Class 2	Differential equations of Physical Systems	
Class 3	Differential equations of Physical Systems	
Week 2	**Introduction and Mathematical Models of Physical Systems**	
Class 4	Transfer Functions	
Class 5	Block Diagram Reduction Methods	CT 1
Class 6	Block Diagram Reduction Methods	
Week 3	**Introduction and Mathematical Models of Physical Systems**	
Class 7	Signal Flow Graphs	
Class 8	Signal Flow Graphs	
Class 9	Application of Mason's Gain Formula	
Week 4	**State Variables**	
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	**Time Response Analysis**	
Class 13	Introduction	CT 2
Class 14	Standard Test Signals	
Class 15	Time Response of First Order Systems	
Week 6	**Time Response Analysis**	
Class 16	Time Response of Second Order Systems	
Class 17	Time Response of Second Order Systems	
Class 18	Effect of adding Pole and Zero to a system	
Week 7	**Concept of Stability**	
Class 19	Concept Of Stability And Necessary Conditions For Stability	CT 03
Class 20	Routh Stability Criterion	
Class 21	Relative Stability Analysis	

Week 8	Root Locus Technique	
Class 22	Introduction	
Class 23	Construction Of Root Locus	
Class 24	Stability Analysis	
Week 9	**Root Locus Technique**	
Class 25	Stability Analysis	
Class 26	Stability Analysis	
Class 27	Stability Analysis	
Week 10	**Frequency Response Analysis**	CT 4
Class 28	Bode Plot	
Class 29	Bode Plot	
Class 30	Stability In Frequency Domain: Nyquist Plot	
Week 11	**Introduction To Design**	
Class 31	Preliminary Considerations Of Classical Design	
Class 32	Design Of Basic Compensators	
Class 33	Design Of Basic Compensators	
Week 12	**Introduction To Design**	
Class 34	Design Of Basic Compensators	
Class 35	Design Of Controllers	
Class 36	Design Of Controllers	
Week 13	**State Variable Analysis And Design**	
Class 37	Concepts And Introduction	
Class 38	State Variable Methods	
Class 39	Controllability And Observability	
Week 14	**Digital Control Systems**	
Class 40	Introduction	
Class 41	Sampled Data Systems	
Class 42	Stability Analysis In Z-Domain	

Text and Ref 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

AEAV 412: Control Systems Engineering Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Laplace Transformation, Ordinary and partial differential equation (theory)

Rationale:
The sessional is needed to study and familiarize the analysis and design techniques for control systems using state space approach, system identification and optimal control.

Objectives:
1. To describe and explain techniques employed in modelling and control of a system.
2. To apply appropriate methods and analyze problem in control system.
3. To design and evaluate the performance of the controlled system.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Know of basic and modern control systems engineering.

2. Explain the properties of the system observing the response of MATLAB.

3. Apply the knowledge of basic control components practically using MATLAB and SIMULINK.

4. Analyze the differences between theoretical knowledge with the practical observations.

5. Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations.

6. Demonstrate mini project related to the subject using know of this sessional.

Course Contents:

Experiment No	Experiment Name
Experiment no. 01	Introduction to MATLAB for control systems
Experiment no. 02	Mathematical modeling of physical systems.
Experiment no. 03	Modeling of physical systems using MATLAB.
Experiment no. 04	Linear time invariant systems and representation.

Experiment no.05	Block diagram reduction
Experiment no. 06	Performance of 1storder and second order systems
Experiment no. 07	Design of PID controllers.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, mini projects, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test/ project	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Know of basic and modern control systems engineering.												√
2. Explain the properties of the system observing the response of MATLAB.										√		
3. Apply the knowledge of basic control components practically using MATLAB and SIMULINK.					√							
4. Analyze the differences between theoretical knowledge with the practical observations.				√								
5. Evaluate the percentage and causes of differences between theoretical knowledge with the practical observations.		√										

6. Demonstrate mini project related to the subject using know of this sessional.											√	

Text and Ref Books:

1. Control Engineering- Norman N. Nise
2. Modern control system- Pearson publication pvt. Ltd.

AEAV 407: Radar Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Electromagnetic field theory, Microwave Engineering

Rationale:
This course is an introduction to radar. It is designed to develop the knowledge and techniques necessary to analyze the performance of radar systems so that ultimately, the student is 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 compute radar parameters
4. To solve problems relating to radar

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Describe theoretical principles of different equipment of RADAR system.

2. Apply basic radar knowledge in handling different radar system in aircraft communication and navigation both in peacetime and wartime scenario.

3. Design and develop basic radar system to contribute the development of society.

4. Analyze and evaluate the performances of different antenna and different radar systems in detection, tracking, weather updates, jamming and electronic counter measures.

Course Contents:

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 measures. Introduction to Airborne Radar.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe theoretical principles of different equipment of RADAR system.	√											
2. Apply basic radar knowledge in handling different radar system in aircraft communication and navigation both in peacetime and wartime scenario .	√											
3. Design and develop basic radar system to contribute the development of society.			√									
4. Analyze and evaluate the performances of different antenna and different radar systems in detection, tracking, weather updates, jamming and electronic counter measures.		√										

Text and Ref 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

AEAV 408: Radar Engineering Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Radar Engineering (Theory)

Rationale:
The aim of this course is to provide the students with an understanding of the fundamental principles, design and analysis of radar systems by the means of practical demonstration of different radars.

Objective:
1. To become familiar with fundamentals of Radar.
2. To gain in depth knowledge about the different types of Radar and their operation.
3. Need for signal detection in Radar and various Radar signal detection techniques.
4. To become familiar with Radio Navigation techniques.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Analyze the performance of simple tracking radar systems
2. Understand the specialist bodies of knowledge within the engineering discipline.
3. Apply problem solving approaches to work challenges and make decisions using sound engineering methodologies.
4. Analysis of the principles of Synthetic Aperture Radar, its use in geophysical remote sensing and
5. surveillance applications, and the digital processing used to form SAR images
6. Explain the principles of radio navigation systems (including secondary radar and GPS)

Course Contents:

Sessional no.1	Detection of stationary targets using parabolic antenna and study the influence of Sensitivity Time Control (STC) on display.
Sessional no. 2	Detection of moving targets using parabolic antenna and estimation of beam- width.
Sessional no. 3	Detection of moving targets using patch antenna.

Sessional no. 4	Study of the effect of short pulses on range.
Sessional no. 5	Study of range resolution and multi- path effect.

Teaching-learning and
Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz Lab viva

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test	**30%**
Lab quiz	**25%**
Lab viva	10%

Mapping of Course Outcomes and Program Outcomes:

	Program Outcomes											
Course Outcomes (CO) of the Course	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the performance of simple tracking radar systems				√								
2. Understand the specialist bodies of knowledge within the engineering discipline.								√				
3. Apply problem solving approaches to work challenges and make decisions using sound engineering methodologies		√										
4. Analysis of the principles of Synthetic Aperture Radar, its use in geophysical remote sensing and surveillance applications, and the digital processing used to form SAR images						√						
5. Evaluation of the principles of radio navigation systems (including secondary radar and GPS)	√											

Text and Ref 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.

AEAV 480 and AEAS 480: Final Year Design and Research Project

12.00 Contact Hour ; 6.00 Credit Hour

Pre-requisite: Student should complete all courses up to 4th Year

Rationale:
To provide experimental and analytical experience for the students.

Objective: To make the graduating engineer familiar with the following skills:
- working systematically
- working in a group
- searching for and utilizing source material
- combining information from different phases of their education
- using efficient methods
- finding efficient solutions

Course Outcomes (CO):

Upon completion of the course, the students will be able:

1. Develop the ability to give an independent, systematic and clear treatment of a certain topic.
2. Apply the ability to independently identify and analyze relevant problems
3. Analyze a practical problem by a systematic use of an appropriate choice of theory and methodologies.
4. Ability to independently acquire and handle academic knowledge through independent studies of relevant literature, and to cultivate the ability to evaluate and briefly account for the central elements in a large literature base.
5. Ability to apply ethical principles in all professional and research work.
6. Develop the capacity to undertake life-long learning.

Teaching-learning and Assessment Strategy: Students are observed and evaluated by their innovative knowledge about engineering solutions.

Linkage of CO with Assessment Methods& their Weights:

CO	Assessment Method	(%)
	Class Assessment	
	Class Attendance	10
1 – 5	Observation and Presentation	90

Minimum attendance: Must attain the regular process of work and thoughts about their project or thesis.

Mapping of Course Outcome and Program Outcomes:

Course Outcome (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
Develop the ability to give an independent, systematic and clear treatment of a certain topic.		√										
Apply the ability to independently identify and analyze relevant problems			√									
Analyze a practical problem by a systematic use of an appropriate choice of theory and methodologies				√								
Ability to independently acquire and handle academic knowledge through independent studies of relevant literature, and to cultivate the ability to evaluate and briefly account for the central elements in a large literature base.					√							
Ability to apply ethical principles in all professional and research work.								√				
Develop the capacity to undertake life-long learning.												√

AEAV 443: Aircraft Communication and Navigation

4.00 Contact Hour; 4.00 Credit Hour;

Pre-requisite: None.

Rationale:
This course is provided to gather knowledge about communication, navigation and guidance systems of an aircraft for their proper implementation in future workplace or studies.

Objectives:
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 (CO)
Upon completion of the course, the students will be able to:

1. Demonstrate an understanding of the fundamentals methods of navigation, radio direction finding, automatic direction finder and radio compass.
2. Analyze various navigation components like VOR, DME, ILS, MLS, Secondary Radar, TCAS etc.
3. Understand the working principle of Doppler navigation, its beam configuration and frequency spectrum analysis.
4. Analyze different radio navigation components such as non-directional beacon and radio direction finding, loop antenna, sense aerial, radio altimeter etc.
5. Analyze the basic operating principle and function of Flight management system.

Course Contents:

Introduction: Block diagram of navigation system, Types of navigation, Coordinate Frames, Coordinate transformation- Direction cosine matrix, Euler angles.
Methods of navigation:
Dead Reckoning (DR) Computation: Position, Radio Fix, LOS distances measurement, ranging, course computation (range & bearing), Inertial Navigation System (INS), Sensors- Accelerometers, Gyroscopes (mechanical, ring laser, fiber optic), Inertial measurement unit (IMU), INS Errors.

Radio Navigation: Non Directional Beacon and Automatic Direction Finder, Loop Antenna, Sense Aerial, Ambiguity Resolve, Limitations; Radio Altimeter, Ground Proximity Warning System; VHF Omni directional Range- Light House Principle, Frequency Spectrum, Wave Equation, Errors and limitations; Distance measuring equipment- DME operation, Mathematical Relations, Signal Equation (Gaussian Pulse), Mode of operation; Instrument Landing System- Mathematical Relations, Antenna Array Arrangement, Beam pattern Geometry of LOC and GS, Development and concepts of Microwave Landing System; Doppler Navigation- Principle of operation, Beam configuration, Frequency Spectrum; Hyperbolic Navigation-LORAN-C; Air Data Navigation; Satellite Navigation.
Secondary Radar: Concept of Secondary Radar, MODE-A,C,S Signal Format and types of transmission, ATC-RBS Interrogation-Reply Pulse, Technical features.
Traffic Alert Collision Avoidance System: Introduction, Basic operating principle, Block diagram and system description, Controls and display.
Flight Management System: Introduction, basic operating principle, block diagram and system description, controls and display.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
Demonstrate an understanding of the fundamentals of methods of navigation radio direction finding, automatic direction finder and radio compass.	√											
Analyze various navigation components like VOR, DME, ILS, MLS, Secondary Radar, TCAS etc.					√							

Understand the working principle of Doppler navigation, its beam configuration and frequency spectrum analysis.	√											
Analyze different radio navigation components such as non-directional beacon and radio direction finding, loop antenna, sense aerial, radio altimeter etc.					√							
Analyze the basic operating principle and system description of Flight management system.	√											

Lecture Schedule:

Week 1	**Introduction/Radio Navigation**	
Class 1	Introduction	
Class 2	Four Methods of Navigation	
Class 3	Loop Antenna and its equation	
Class 4	Coordinate transformation- Direction cosine matrix	
Week 2	**Radio Navigation**	
Class 5	Cause of 180 degrees ambiguity in Loop antenna	
Class 6	How to overcome 180 degrees ambiguity in Loop antenna	CT 1
Class 7	Errors in direction finding and functioning of Radio Altimeter	
Class 8	Continuous	
Week 3	**Radio Ranges**	
Class 9	Working principle of VHF Omni-directional Range (VOR)	
Class 10	Working principle of VHF Omni-directional Range (VOR)	
Class 11	Frequency Spectrum and Wave Equations	
Class 12	Continuous	
Week 4	**Radio Ranges**	
Class 13	Frequency Spectrum and Wave Equations	
Class 14	Frequency Spectrum and Wave Equations	
Class 15	Errors and limitations of VOR	
Class 16	Continuous	
Week 5	**Distance Measuring Equipment**	CT 2
Class 17	DME operation, Mathematical Relations	
Class 18	DME operation, Mathematical Relations	
Class 19	Modes of operation	
Class 20	Continuous	

Week 6	**Distance Measuring Equipment**	
Class 21	Timing Modes, Concept of RADAR mile	
Class 22	Signal Equation of a Gaussian Pulse	
Class 23	Signal Equation of a Gaussian Pulse	
Class 24	Continuous	
Week 7	**Instrument Landing System**	
Class 25	Components of ILS (Ground and Airborne)	
Class 26	Localizer Equations	
Class 27	Indication Systems	
Class 28	Continuous	
Week 8	**Instrument Landing System**	
Class 29	Beam Pattern Geometry of Localizer Transmitter	
Class 30	Beam Pattern Geometry of Localizer Transmitter	CT 3
Class 31	Beam Pattern Geometry of Glide Slope Transmitter	
Class 32	Continuous	
Week 9	**Instrument Landing System**	
Class 33	Development and concept of Microwave Landing System	
Class 34	Development and concept of Microwave Landing System	
Class 35	Development and concept of Microwave Landing System	
Class 36	Continuous	
Week 10	**Doppler Navigation**	
Class 37	Principle of operation	
Class 38	Principle of operation	
Class 39	Beam Configuration	CT 4
Class 40	Continuous	
Week 11	**Doppler Navigation**	
Class 41	Beam Configuration	
Class 42	Frequency Spectrum	
Class 43	Components of Doppler RADAR	
Class 44	Mathematical Problem	
Week 12	**Secondary RADAR**	
Class 45	Concept of Secondary RADAR and Technical Parameters	
Class 46	Modes of Secondary RADAR (A, C, S Signal Format)	
Class 47	Types of transmission & ATC-RBS Interrogation Reply Pulse	
Class 48	Continuous	
Week 13	**Traffic Alert and Collision Avoidance System**	

Class 49	Introduction and basic operating principle	
Class 50	Block diagram and system description	
Class 51	Controls and display	
Class 52	Continuous	
Week 14	**Flight Management System (FMS)**	
Class 53	Introduction and basic operating principle	
Class 54	Block diagram and system description	
Class 55	Control and display	
Class 56	Review of whole syllabus	

Text and Ref 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.

AEAV 444: Aircraft Communication and Navigation Sessional

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite: Aircraft Communication and Navigation (Theory)

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.

Objectives:
1. To demonstrate knowledge and understanding of:
2. Fundamentals of the various 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 (CO)
Upon completion of all sessional, the students will be able to:

1. Know about aircraft communication equipment (RADAR), navigation equipment (DME, ILS, VOR, Radio Altimeter) and controlling equipment (Autopilot).

2. Understand the construction and working principle of the aforementioned equipment by practically observing and operating them.

3. Apply the formulas and equations learned in the theory course in calculating various parameters from the obtained data.

4. Analyze the data obtained from these equipment by plotting graphs or other means.

5. Evaluate the performance of different navigation equipment based on the theoretical knowledge.

6. Design any model related to this subject and demonstrate that model for further lab use.

7. Explain their concept of design of model by proper documents and manual of that model.

Course Contents:

Experiment No	**Experiment Name**
Experiment No 01	Familiarization with DME operation and its terminologies using a DME trainer set.
Experiment No: 02	Familiarization with ILS operation and terminologies and ILS components Testing using an ILS Trainer set.

Experiment No. 03	Familiarization with Radio Altimeter and simulating a return signal through a test set.
Experiment No 04	Familiarization with autopilot operation and its terminologies and autopilot Testing using a Trainer set.
Experiment No. 05	Familiarization with GPS operation and terminologies and GPS Receiver Testing using a GPS Simulator test set.

Teaching-learning and
Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz Lab viva

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Daily lab performance	10%
Lab Attendance	15%
Lab reports	10%
Lab test/ project	**30%**
Lab quiz	**25%**
Lab viva	10%

Text and Ref 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.

5.1.4 Optional / Elective Courses (Avionics Discipline)

AEAV 413: Mobile Cellular Communications

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Communication Engineering

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 (CO)
Upon completion of the course, the students will be able to:

1. Discuss cellular radio concepts
2. Identify various propagation effects
3. To have knowledge of the mobile system specifications.
4. Classify multiple access techniques in mobile communication.
5. Analyze various methodologies to improve the cellular capacity.

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

	Program Outcomes											
Course Outcomes (CO) of the Course	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss cellular radio concepts	✓											
2. Identify various propagation effects		✓										
3. To have knowledge of the mobile system Specifications		✓										
4. Classify multiple access techniques in mobile communication.	✓											
5. Analyze various methodologies to improve the cellular capacity.		✓										

Lecture Schedule:

Week 1	**Introduction**	
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	Frequency reuse	CT-1
Class 5	co-channel interference	

Class 6	cell splitting and components	
Week 3	**Mobile radio propagation**	
Class 7	Propagation characteristics	CT-1
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**	CT-2
Class 13	Fundamentals	
Class 14	spectrum utilization	
Class 15	Continue	
Week 6	**channel assignment**	
Class 16	Fundamentals of channel assignment	
Class 17	Fixed channel assignment	
Class 18	non-fixed channel assignment	
Week 7	**traffic and channel assignment**	
Class 19	Traffic assignment.	
Class 20	Channel assignment	
Class 21	Handoffs	
Week 8	**Diversity Techniques**	
Class 22	Reasons and types	
Class 23	forced handoffs	
Class 24	mobile assisted handoffs	
Week 9	**Diversity Techniques**	
Class 25	dropped call rate	
Class 26	Dropped Calls	
Class 27	Continue	
Week 10	**Diversity Techniques**	
Class 28	Concept of diversity branch	
Class 29	signal paths	CT-4
Class 30	carrier to noise	
Week 11	Digital cellular systems	
Class 31	carrier to interference ratio	

Class 32	Performance	
Class 33	Continue	
Week 12	**Digital cellular systems**	CT-5
Class 34	Global system for mobile	
Class 35	time division multiple access	
Class 36	Continue	
Week 13	**Code division multiple access.**	
Class 37	Code division multiple access.	
Class 38	Continue	
Class 39	Continue	
Week 14	**Revision**	
Class 40	**Revision**	
Class 41	**Revision**	
Class 42	**Revision**	

Text and Ref 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.

AEAV 415: Satellite Communications

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Aircraft electrical Systems, Aircraft Communication and Navigation.

Rationale:
Satellite communication systems carry much of the world's communications traffic, particularly over oceans and are widely used for television distribution and navigation. Increasingly, satellites are also being used for data relay and personal communication systems. This course gives students a broad treatment of the diverse subsystems that make up a complete satellite communication system.

Objective:
1. To enable the student to become familiar with satellites and satellite services.
2. To study of satellite orbits and launching.
3. To study of earth segment and space segment components
4. To study of satellite access by various users.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:
1. Understand the fundamentals of satellite communication system
2. Critically analyze the design requirements and the performance of satellite communication systems
3. Analyzing satellite subsystems
4. Understanding of how a satellite communication system successfully transfers information from one earth station to another.

Course Contents:

Introduction, satellite classification, solution of the space segment, evolution of the ground segment, very large aperture terminal, large and medium size antennas, small antennas, international telecommunication satellite, business service or equivalent VSATs, extra small aperture terminals, non-parabolic satellite antennas, voice-data-video applications, characteristics of satellite networks, VSAT technologies, elements of VSAT networks, regulatory issues, benefits of VSATs, overview of a VSAT network, applications of VSATs, VSAT network configurations, protocols and interfaces, assuring system compatibility requirements, economics of VSAT networks, advanced concepts.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Understand the fundamentals of satellite communication system		✓										
2.Critically analyze the design requirements and the performance of satellite communication systems			✓									
3.Analyzing satellite subsystems		✓										
4. Understanding of how a satellite communication system successfully transfers information from one earth station to another.	✓											

Lecture Schedule:

Week 1	**Introduction &satellite classification**	
Class 1	What is Satellite and What is communication	
Class 2	Development of Satellite communication	
Class 3	Satellite Classification and familiarization with each class	
Week 2	**Solution of the space segment**	
Class 4	What is space segment	
Class 5	Requirements of space segment	CT-1

Class 6	Problems and solutions of Space segment	
Week 3	**Evolution of the ground segment**	
Class 7	What is ground segment	
Class 8	History and evolution of ground segment	
Class 9	Working principles of ground segment	
Week 4	**Very large aperture terminal & large and medium size antennas**	CT-2
Class 10	Requirements of aperture terminal	
Class 11	Equations of apertures	
Class 12	Familiarization of antennas and their size requirements	
Week 5	**Large, medium &small antennas**	
Class 13	Antenna classification	
Class 14	Equation development according to requirements	
Class 15	Equation development according to requirements	
Week 6	**international telecommunication satellite & business service or equivalent VSATs**	
Class 16	International Telecommunication satellite familiarization	
Class 17	Working principles	
Class 18	VSATs	
Week 7	**Extra small aperture terminals, non-parabolic satellite antennas, voice data-video applications**	
Class 19	Extra small aperture terminals familiarization and use	
Class 20	Non parabolic antenna use, application and working principle	
Class 21	Voice data principles	
Week 8	**Characteristics of satellite networks& VSAT technologies**	
Class 22	Satellite network classification	
Class 23	Familiarization with every class	
Class 24	VSAT technologies	
Week 9	**Elements of VSAT networks**	
Class 25	VSAT network coverage	
Class 26	Equipment used	
Class 27	Descriptions of elements	

Week 10	**Regulatory issues, benefits of VSATs & overview of a VSAT network,**	CT-3
Class 28	Regulatory issues	
Class 29	Benefits of VSATs	
Class 30	Overview of networks	
Week 11	**Applications of VSATs &VSAT network configurations**	
Class 31	Applications of VSATs	
Class 32	Network configuration	
Class 33	Network configuration	
Week 12	**Protocols and interfaces**	CT-4
Class 34	VSAT protocols	
Class 35	Interfaces require	
Class 36	Interface familiarization	
Week 13	**Assuring system compatibility requirements**	
Class 37	System compatibility requirements	
Class 38	Requirement descriptions	
Class 39	Requirement descriptions	
Week 14	**Economics of VSAT networks &advanced concepts**	
Class 40	Economic advantages of VSAT	
Class 41	Advanced concepts	
Class 42	Review of whole syllabus	

Text and Ref Books:

1. Digital Satellite Communications - Tri T. Ha; McGraw-Hill International.
2. Satellite Communication Mobile & Fixed Services - Michael J. Miler; Kluwer Academic Publisher.
3. Satellite Communications - T. Pratt, C. Bostian, J. Allnut; John Wiley & Sons Inc.
4. Mobile Communication satellites theory and application – Ton Logadon; McGraw-Hill International.

AEAV 419: Electronic Warfare

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: Electronics-I, Radar Engineering

Rationale:
The purpose of electronic warfare is to deny the opponent the advantage of and ensure friendly unimpeded access to, the EM spectrum. EW can be applied from air, sea, land, and/or space by manned and unmanned systems, and can target humans, communication, radar, or other assets (military and civilian).

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 (CO)
Upon completion of the course, the students will be able to:

1. Understanding basic laws and phenomena in the area of Optoelectronics and Lasers Critically analyze the design requirements and the performance of satellite communication systems

2. Analyze various premises, approaches procedures and results related to optoelectronic systems, Understanding of how a satellite communication system successfully transfers information from one earth station to another.
3. Understanding optical fiber equipment, and data transfer using optical fiber.
4. Determining design criteria for semiconductor optical sources

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understanding basic laws and phenomena in the area of Optoelectronics and Lasers Critically analyze the design requirements and the performance of satellite communication systems		✓										
2. Analyze various premises, approaches procedures and results related to optoelectronic systems, Understanding of how a satellite communication system successfully transfers information from one earth station to another.			✓									
3. Understanding optical fiber equipment and data transfer using optical fiber.		✓										
4.Determining design criteria for semiconductor optical sources	✓											

Lecture Schedule:

Week 1	Modern electronic warfare (EW) systems	
Class 1	warfare (EW) systems: Architecture	CT 01
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.	
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	CT-2
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	Airbrone 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	
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**	CT-3
Class 25	Digital RF memory	
Class 26	Camouflage jamming	
Class 27	Search radar jamming	
Week 10	**High ERP generation**	
Class 28	Photo-detectors	
Class 29	Photoconductors	

Class 30	Junction photo-detectors	
Week 11	**Directed energy weapons**	
Class 31	Stealth technology	
Class 32	Countering stealth technology	
Class 33	Network configuration	
Week 12	**High power microwave weapons**	CT 04
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	

Text and Ref Books:

1. Electronic Defense Systems - FilippoNeri; Artech House Publishers.
2. Electronic warfare in Information Age - D. Curtis Schleher; Artech House Publishers.
3. Electronic Warfare - JPR Browne; Brassey's London

AEAV 421: Optical Fiber Communications

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

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.

Objectives:
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.
6. To explain total internal reflection
7. To introduce the concept of numerical aperture
8. To introduce the concept of modes in waveguides
9. To study the transmission properties of optical fibers
10. To explain the working principle of photo detector
11. To study optical fiber communication system design

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Distinguish Step Index, Graded index fibers and compute mode volume construction and characteristics of optical sources and detectors.
2. Explain the Transmission Characteristics of fiber and Manufacturing techniques of fiber/cable;

3. Classify the construction and characteristics of optical sources and detectors.

Course Contents:

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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Distinguish Step Index, Graded index fibers and compute mode volume construction and characteristics of optical sources and detectors.	✓											
2. Explain the Transmission Characteristics of fiber and Manufacturing techniques of fiber/cable		✓										
3. Classify the construction and characteristics of optical sources and detectors.		✓										

Lecture Schedule:

Week 1	**Introduction**	
Class 1	Introduction to Optical Fiber Communication.	CT-1
Class 2	Light propagation	
Class 3	Continue	
Week 2	**Optical Fiber Theory**	
Class 4	Optical fiber	

Class 5	Ray optics Theory	
Class 6	Mode theory	
Week 3	**characteristics**	
Class 7	Types	
Class 8	transmission characteristics	
Class 9	Continue	
Week 4	**optical fiber**	CT-2
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**	CT 3
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	
Class 21	noise and limitations	
Week 8	**Dispersion**	
Class 22	Transmission limitations	
Class 23	Chromatic dispersion	
Class 24	nonlinear refraction	
Week 9	**Routing**	CT-4
Class 25	Four wave mixing	
Class 26	Laser phase noises	
Class 27	Control	
Week 10	**Optical Amplifier**	
Class 28	Laser	
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**	CT-5
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	Revision.	
Class 42	Revision	

Text and Ref Books:

1. Optical Fiber Communications: Principles & Practice - John M. Senior; Prentice Hall of India.
2. Fiber Optic Communications - D C Agrawal; Wheeler Publishing.
3. Fiber Optic Communication System - Gerd Keiser; McGraw-Hill International.
4. Optical Communication System - John Gower; Prentice Hall of India.

AEAV 435: Computer Networks

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

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. Computer network is a powerful communication medium. It can be used to make the document online enabling other to read and convey their opinions.
5. To increases security as only authorized user can access resource in a computer network.

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. Have a good understanding of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.
2. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
3. Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;
4. Have an understanding of the issues surrounding Mobile and Wireless Networks

Course Contents:
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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Have a good understanding of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.	✓											
2. Analyze the requirements for a given organizational structure and select the most Appropriatenetworkingarchitectureand technologies;		✓										
3. Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;		✓										
4. Have an understanding of the issues surrounding Mobile and Wireless Networks		✓										

Lecture Schedule:

Week 1	**Introduction**	CT 1
Class 1	Switching :	
Class 2	Multiplexing	
Class 3	Continue	
Week 2	**Reference Models**	
Class 4	Iso	
Class 5	Tcp-Ip	
Class 6	Atm	
Week 3	**Different Data Communication Services**	
Class 7	Physical Layer Wired	
Class 8	Wireless Transmission Media	
Class 9	Continue	
Week 4	**Cellular Radio**	CT-2
Class 10	Transmission	
Class 11	Communication Satellites	
Class 12	Continue	
Week 5	**Data Link Layer**	
Class 13	Elementary Protocols	
Class 14	Sliding Window Protocols	
Class 15	Error Detection And Corrections	
Week 6	**Detectors.**	
Class 16	Fundamentals	
Class 17	PIN Photo-Detector	
Class 18	Avalanche Photo-Detectors	
Week 7	**Corrections**	CT 3
Class 19	Hdlc	
Class 20	DLLL Of Internet	
Class 21	DLLL Of ATM	
Week 8	**Access**	
Class 22	Ieece.802	
Class 23	Protocols For Lans	
Class 24	Protocols For Mans	

Week 9	**Routing**	CT 4
Class 25	Switches. Hubs And Bridges.	
Class 26	High Speed LAN Network Layer	
Class 27	Congestion Control	
Week 10	**Internetworking**	
Class 28	Network Layer In Internet	
Class 29	IP Protocol	
Class 30	IP Addresses	
Week 11	**Control Protocol**	
Class 31	Arp	
Class 32	NI In ATM Transport Layer	
Class 33	Transmission Control Protocol	
Week 12	**Adaptation Layer**	
Class 34	Udp	CT-5
Class 35	ATM Adaptation Layer	
Class 36	Application	
Week 13	**Network Security**	
Class 37	Network Security	
Class 38	Email	
Class 39	Domain Name System	
Week 14	**Revision**	
Class 40	Simple Network Management Protocol	
Class 41	HTTP And World Wide Web.	
Class 42	**Revision**	

Text and Ref 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.

AEAV 409: Microprocessor and Interfacing

3.0 Contact Hour; 3.0 Credit Hour;

Pre-requisite: Digital Systems.

Rationale:
The aim of this course is to provide the students' knowledge of microprocessor circuit and interface networks in various project design.

Objective:
1. To provide knowledge of Intel 8086 microprocessor
2. To learn architecture, addressing modes, instruction sets, assembly language programming
3. To be able to design and interrupt different systems
4. To understand peripheral interface, programmable timer, serial communication interface

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about operation of microprocessors;
2. Understand the architecture and system design of a microprocessor;
3. Evaluate various interfaces of microprocessor;
4. Gain knowledge about the performance &design variables for each component of a microprocessor;
5. Understand the basic aspects of microcontrollers.

Course Contents:

Introduction to microprocessors. Intel 8086 microprocessor: Architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: Programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard and display interface. Introduction to micro-controllers.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Gain knowledge about operation of Microprocessors							✓					
2. Understand the architecture and system design of a microprocessor					✓							
3. Evaluate various interfaces of microprocessor;		✓										
4. Gain knowledge about the performance & design variables for each component of a microprocessor;			✓									
5. Understand the basic aspects of Microcontrollers			✓									

Lecture Schedule:

Week 1	Fundamental concept of microprocessor	CT 1
Class 1	Introduction to microprocessors	
Class 2	Properties of microprocessor,	
Class 3	Continue	
Week 2	**Intel 8086 microprocessor**	
Class 4	Architecture	
Class 5	Architecture	
Class 6	Architecture	

Week 3	**Intel 8086 Microprocessor**	
Class 7	Addressing Modes,	
Class 8	Addressing Modes,	
Class 9	Instruction Sets,	
Week 4	**Intel 8086 Microprocessor**	CT 2
Class 10	Instruction Sets,	
Class 11	Instruction Sets,	
Class 12	Assembly Language Programming	
Week 5	**Intel 8086 Microprocessor**	
Class 13	Assembly Language Programming	
Class 14	System Design And Interrupt.	
Class 15	System Design And Interrupt.	
Week 6	**Interfacing**	
Class 16	Programmable Peripheral Interface	
Class 17	Programmable Peripheral Interface	
Class 18	Programmable Peripheral Interface	
Week 7	**Interfacing**	CT 3
Class 19	Programmable Timer	
Class 20	Programmable Timer	
Class 21	Programmable Timer	
Week 8	**Interfacing**	
Class 22	Serial Communication Interface	
Class 23	Serial Communication Interface	
Class 24	Serial Communication Interface	
Week 9	**Interfacing**	
Class 25	Programmable Interrupt Controller	
Class 26	Programmable Interrupt Controller	
Class 27	Programmable Interrupt Controller	
Week 10	**Interfacing**	CT 4
Class 28	Direct Memory Access	
Class 29	Direct Memory Access	
Class 30	Direct Memory Access	
Week 11	**Interfacing**	
Class 31	Keyboard And Display Interface	

Class 32	Keyboard And Display Interface	
Class 33	Keyboard And Display Interface	
Week 12	**Microcontroller**	
Class 34	Introduction	
Class 35	Introduction	
Class 36	Introduction	
Week 13	**Microcontroller**	
Class 37	Introduction	
Class 38	Introduction	
Class 39	Introduction	
Week 14	**Review**	
Class 40	Review	
Class 41	Revie	
Class 42	Review.	

Text and Ref Books:

1. Microprocessor and Interfacing - Douglas V. Hall; Tata McGraw-Hill.

2. Microprocessor and Microprocessor Based System Design - Dr M. Rafiquzzaman; Universal Book Stall New Delhi.

AEAV 417: Optoelectronics

3.0 Contact Hour; 3.0 Credit Hour

Pre-requisite (if any)**:** Electronics- I, Electronics- II

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 (CO):
Upon completion of the course, the students will be able to:

1. Gain knowledge about optical properties of semiconductor;
2. Understand the properties of light;
3. Evaluate various light emitting diode;
4. Gain knowledge about the performance &design variables for stimulated emission and light amplification;
5. Understand the basic aspects of semiconductor lasers.

Course Contents:
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 and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	(100%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcome and Program Outcomes:

Course Outcome (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Gain knowledge about operation of microprocessors					✓							
2.Understand the architecture And system design of a microprocessor					✓							
3.Evaluate various interfaces of microprocessor		✓										
4.Gain knowledge about the performance & design variables for each component of a microprocessor			✓									

5. Understand the basic aspects of microcontrollers			✓									

Lecture Schedule:

Week 1	**Optical Properties In Semiconductor**	
Class 1	Direct And Indirect Band-Gap Materials	CT 1
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**	
Class 7	Photo-Generated Excess Carriers	
Class 8	Photo-Generated Excess Carriers	
Class 9	Minority Carrier Life Time	
Week 4	**Optical Properties In Semiconductor**	CT 2
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, Diffraction And Blackbody Radiation	
Class 17	Polarization, Interference, Diffraction And Blackbody Radiation	
Class 18		
Week 7	**Light Emitting Diode (LED)**	CT 3
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 And Threshold Conditions	
Class 27	Optical Feedback And Threshold Conditions	
Week 10	**Semiconductor Lasers**	CT 4
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 And Schottkey Solar Cells	
Class 36	Silicon And 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	

Text and Ref Books:

1. Optoelectronics – an Introduction - J. Wilson, J.F.B. Hawkes; Prentice Hall of India Private Ltd.
2. Optical Electronics in Modern Communications - AmnonYariv; Oxford University Press.
3. Optical Fiber Communications: Principles & Practice - John M. Senior; Prentice Hall.
4. Introduction to optical Electronics – A. Jones; Harper & Row.
5. Electro-optical System Design for Information Process – L. Wyatt; McGraw-Hill.
6. Modern optical engineering the design of optical sys – J. Smith; SPIE Press McGrawHill.

5.1.5 Courses offered by Avionics Engg. Discipline to Aerospace students

AEAV 451: Avionics Technology

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
This course is provided to gather knowledge about communication, navigation and guidance systems of an aircraft for their proper implementation in future workplace or studies.

Objectives:

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 (CO):

Upon completion of the course, the students will be able to:

1. Understand the air navigation, navigation parameters and principle of different types of navigation.

2. Understand the Coordinate Frames, Coordinate transformation, Frame of Reference.

3. Gain knowledge about Basic-6 and Basic-T aircraft instruments and their applications in aircraft
4. Get acquainted with different Navigational Equipments like ADF, DME, VOR, and ILS and their operation.

5. Understand the Radar Principle, operation, design and its different terminologies.

Course Synopsis:

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 and Assessment Strategy: Lectures, class performances, assignments, mini project, lab viva, final exam.

Linkage of CO with Assessment Methods& their Weights:

CO	Assessment Method	(%)
	Class Assessment	
1	Class Participation	05
	Class Attendance	05
1 – 5	Class Tests/Assignment/Presentation	20
	Exam	
1 – 5	Final exam	70

Mapping of Course Outcome and Program Outcomes:

Course Outcome (CO) of the Course	Program Outcomes* (Appendix-1)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand the air navigation, navigation parameters and principle of different types of navigation.		√										
2. Understand the Coordinate Frames, Coordinate transformation, Frame of Reference.	√											
3. Gain knowledge about Basic-6 and Basic-T aircraft instruments and their applications in aircraft.	√											
4. Get acquainted with different Navigational Equipments like ADF, DME, VOR, and ILS and their operation.					√							
5. Understating the Radar Principle, design and its different terminologies.			√									

Text and Ref Books:

1. Avionics Fundamentals- Jeppesen; Highflyn.
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.

Lecture Schedule:

Week 1	Air Navigation	
Class 1	Introduction to Air Navigation, Phases of flight	CT 1
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	
Class 8	Continue.	
Class 9	Angular transformation	
Week 4	**Types of navigation**	CT 2
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).	
Class 21	Air Data Navigation	
Week 8	**Navigational Equipment**	CT 3
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	
Class 29	Continued	
Class 30	Continued	
Week 11	**Radar System**	CT 4
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	

AEAV 403: Elective and Magnetic Properties of Materials

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

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.

Objectives:
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.
6. To explain total internal reflection

Course Outcomes (CO)
Upon completion of the course, the students will be able to:

1. To provide students with a thorough understanding of the electrical properties and characteristics of various materials, used in the electrical appliances, devices , instruments

2. To provide students with a moderate level understanding of the physics behind the electrical engineering materials.

3. An understanding of the electrical engineering material science essential for them to work in different industries.

Course Synopsis:

Crystal structures: Types of crystals, lattice and basis, Bravais lattice and Miller indices. Classical theory of electrical and thermal conduction: 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 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, ferro electricity, pyro electricity.

Magnetic properties of materials: Magnetic moment, magnetization and relative permitivity, 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.

Introduction to meta-materials.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(100%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. To provide students with a thorough understanding of the electrical properties and characteristics of various materials, used in the electrical appliances, devices , instruments	√											
2. To provide students with a moderate level understanding of the physics behind the electrical engineering materials.												

3. An understanding of the electrical engineering material science essential for them to work in different industries		√										√

Lecture Schedule:

Week 1	**Crystal Structures**	CT 1
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**	CT 2
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	
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**	CT 3
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	
Class 26	Frequency Dependence Of Dielectric Constant, Dielectric Loss	
Class 27	Piezoelectricity, Ferro Electricity, Pyro Electricity.	
Week 10	**Magnetic Properties Of Materials**	CT 4
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	
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	

Text and Ref Books:

1. Continuous and Discrete Signals & Systems - S.S. Soliman& M. D. Srinath; Prentice Hall of India Private Ltd.
2. Signal and System (Continuous & Discrete) - R.E. Ziemer; Pearson Education Asia.
3. Feedback Control System - Phillips &Horbour; Prentice Hall.
4. Signals and Systems- Alan V. Oppenheim and Alan S. Willsky; Prentice Hall.

CHAPTER 6

DETAIL OUTLINE OF UNDERGRADUATE COURSES OFFERED BY OTHER DEPARTMENTS TO AE STUDENTS

Phy 115: Physics I (Waves and Oscillation, Optics and Thermal Physics)

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite (if any): None

Rationale: To learn and familiarize the basics of Waves Optics and Thermal Physics for implementing in engineering design

Objectives:

1. To learn Solve for the solutions and describe the behavior of a damped and driven harmonic oscillator in both time and frequency domains
2. Understand and implement Fourier series.
3. Understand the general motion of a particle in two dimensions so that, given functions x(t) and y(t) which describe this motion, they can determine the components, magnitude, and direction of the particle's velocity and acceleration as functions of time
4. To understand the basic working principle of various energy storage devices like capacitors, inductors and resistors.
5. Analyze under what circumstances an object will start to slip, or to calculate the magnitude of the force of static friction.

Course Outcomes (CO): After completing these course students will be able

1. Define the different parameters such as periodic motion, simple harmonic motion, damped, undamped oscillations, interference, diffraction, polarization and prism, the different laws of thermodynamics.
2. Explain the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding thermodynamics such as kinetic theory, entropy, Carnot engine etc.
3. Solve problems regarding wave motion for different systems, problems regarding interference, diffraction, polarization and prism optical systems, analytical problems regarding thermodynamics related to engineering study.

Course Contents: This course is planned to extend the basic physics in the field of Waves and Oscillations, Geometric optics and Wave mechanics. The different laws, explanation of laws and derivation regarding the course will be introduced. Applications of different laws will be studied.

Teaching-learning and Assessment Strategy: Lecture, Class Performance, Homework, Assignment, Class test, Final examination

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment / Presentation	20
Exam	
Final Exam	70

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define the different parameters such as periodic motion, simple harmonic motion, damped, undamped oscillations, interference, diffraction, polarization and prism, the different laws of thermodynamics	✓											
2. Explain the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding thermodynamics such as kinetic theory, entropy, Carnot engine etc.	✓											
3. Solve problems regarding wave motion for different systems, problems regarding interference, diffraction, polarization and prism optical systems, analytical problems regarding thermodynamics related to engineering study.			✓									

Lecture Schedule:

Week 1	**Waves and oscillations**	CT 1
Class 1	Oscillations: Simple harmonic oscillation, combination	
Class 2	Composition of Simple harmonic motion,	
Class 3	Lissajous figures.	
Week 2	**Waves and oscillations**	
Class 4	Undamped, damped and forced oscillations, resonance.	
Class 5	Wave motion	
Class 6	Transverse and longitudinal nature of waves,	
Week 3	**Waves and oscillations**	
Class 7	Progressive and standing waves	
Class 8	Intensity of a wave,	
Class 9	Energy calculation of progressive and standing waves	
Week 4	**Waves and oscillations**	CT 2
Class 10	Energy calculation of progressive and standing waves	
Class 11	Energy calculation of progressive and standing waves	
Class 12	Energy calculation of progressive and standing waves	
Week 5	**Physical optics**	
Class 13	Combination of lenses:	
Class 14	Equivalent lens	
Class 15	Cardinal points of a lens	
Week 6	**Physical optics**	
Class 16	Power of a lens	
Class 17	Power of a lens	
Class 18	Power of a lens	
Week 7	**Physical optics**	CT 3
Class 19	Astigmatism, coma, distortion	
Class 20	Astigmatism, coma, distortion	
Class 21	Astigmatism, coma, distortion	
Week 8	**Physical optics**	
Class 22	Young’s double slit experiment	
Class 23	Young’s double slit experiment	
Class 24	Young’s double slit experiment	
Week 9	**Thermal physics**	
Class 25	Huygen’s principle and construction	
Class 26	Temperature, Zeroth law of thermodynamics, Thermometers	
Class 27	Temperature, Zeroth law of thermodynamics, Thermometers	

Week 10	**Thermal physics**	CT 4
Class 28	Kinetic theory of gases	
Class 29	Kinetic theory of gases	
Class 30	Kinetic theory of gases	
Week 11	**Thermal physics**	
Class 31	First law of thermodynamics and its applications	
Class 32	Calculation of ratio of specific heats, mean free path	
Class 33	Calculation of ratio of specific heats, mean free path	
Week 12	**Thermal physics**	
Class 34	Calculation of ratio of specific heats, mean free path	
Class 35	Continue	
Class 36	Vander Walls equation of state	
Week 13	**Thermal physics**	
Class 37	Vander Walls equation of state	
Class 38	Reversible and irreversible process	
Class 39	Reversible and irreversible process	
Week 14	**Thermal physics**	
Class 40	Carnot cycle, efficiency, Carton's theorem, and entropy.	
Class 41	Carton's theorem, and entropy.	
Class 42	Entropy	

Text books:

1. Waves & Oscillation by Brijlal and Subramanyam.
2. A text book of Optics by Brijlal and Subramanyam
3. Physics for Engineers- I & II by Dr Gais Uddin
4. Heat and Thermodynamics by- Brijlal and Subramannyam
5. Physics for Engineers Lecture Series by M Ziaul Ahsan

Phy 116: Physics Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre-requisite (if any): None

Rationale: To understand the basics of Waves Optics and Thermal Physics for implementing in engineering design

Objectives:
1. To implement different parameters regarding Waves and Oscillations, optics, Mechanics, electricity and Heat.
2. Understand phenomena regarding Waves and Oscillations, optics Mechanics, electricity and Heat
2. To use the output of the experiment in analyzing systems.

Course Outcomes (CO):

After completing this course students will be able to

1. Define the different parameters regarding Waves and Oscillations, optics, Mechanics, electricity and Heat etc.
2. Explain the different phenomena regarding Waves and Oscillations, optics Mechanics, electricity and Heat etc.
3. Experime nt different phenomena regarding Waves and Oscillations, optics Mechanics, electricity and Heat etc
4. Write a report of any project work.

Course Contents: Different experiments related to course Phy-115 and Phy-117

Teaching-learning and Assessment Strategy: Lectures, lab performances, assignments.

Linkage of CO with Assessment Methods& their Weights:

Assessment	**Percentage (%)**
Quiz	40
Viva	20
Lab performance	40

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define the different parameters regarding Waves and Oscillations, optics, Mechanics, electricity and Heat etc.	✓											
2. Explain the different phenomena regarding Waves and Oscillations, optics Mechanics, electricity and Heat etc.			✓									
3. Experiment different phenomena regarding Waves and Oscillations, optics Mechanics, electricity and Heat etc		✓										
4. Write a report of any project work.		✓										

Text books:

1. Practical Physics by Dr Giasuddin and Md. Sahabuddin.
2. B.Sc. Practical Physics by C. L Arora
3. Practical Physics by S.L. Gupta and V. Kumar

Phy 117: Phy II (Electricity and Magnetism, Modern Physics and Mechanics)

3.00 Contact Hour; 3.00 Credit Hour;
Pre-requisite (if any): None

Rationale: To learn and familiarize the basics of Electricity and Magnetism, Modern Physics and Mechanics for implementing in engineering design

Objective:

1. Describe how static electricity produced and explain electrostatic induction and polarization.
2. Identify the connection between electricity and magnetism.
3. To understand the special relativity and quantum mechanics of atoms and molecules.
4. Analyze mechanics related problems, electric field, potential, resistance, capacitance, dielectric, current, inductance, magnetic field.

Course Outcomes (CO): After completing this course students will be able

1. **Define** the different parameter such as momentum, energy, gravitation, classical and quantum statistics, Coulomb's law, Gauss's law. Ampere's law, Faraday's law, photoelectric effect, Compton Effect, matter wave, atomic model, radioactive decay, fusion, fission etc.
2. **Describe** the classical and quantum statistics, Kepler's law, Gravitational law, Gauss's law, Ampere's law, Faraday's law, different theory regarding modern physics such as special theory of relativity, Compton theory etc.
3. **Apply & Calculate** mechanics related problems, electric field,
4. **Categorize** materials according to magnetic and electric properties of materials, nuclear transformation, and nuclear reaction etc

Course Contents:
This course is planned to extend the basic physics in the field of materials structure, Electricity and modern physics. The different laws, explanation of laws and derivation regarding the course will be introduced. Applications of different laws will be studied.

Teaching-learning and Assessment Strategy: Class Test , Class Tests, Assignments

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment / Presentation	20
Exam	
Final Exam	70

Mapping of course outcome (CO) and program outcome (PO):

Course Outcomes (CO) of this course	Program Outcomes										
	2	3	4	5	6	7	8	9	10	11	12
CO 1	✓										
CO 2		✓									
CO 3	✓	✓									
CO 4	✓										

Lecture Schedule:

Week 1	**Electricity & magnetism**	CT 1
Class 1	Coulomb’s Law, Electric field (E),	
Class 2	Coulomb’s Law, Electric field (E),	
Class 3	Coulomb’s Law, Electric field (E),	
Week 2	**Electricity & magnetism**	
Class 4	Capacitors with dielectrics, Dielectrics-an atomic view	
Class 5	Resistance, Ohm’s Law, atomic view of Ohm’s law, Faradays Law	
Class 6	Electromagnetic induction, Lenz’s Law, induction	
Week 3	**Electricity & magnetism**	
Class 7	Electromagnetic induction, Lenz’s Law	
Class 8	Electromagnetic induction, Lenz’s Law	
Class 9	Electromagnetic induction, Lenz’s Law	
Week 4	**Modern physics**	CT 2
Class 10	Magnetic properties of matter, Hysteresis curve	
Class 11	Magnetic properties of matter, Hysteresis curve	
Class 12	Michelson-Morley’s experiment,	
Week 5	**Modern physics**	
Class 13	Galilean & Lorentz transformation,	

Class 14	Galilean & Lorentz transformation,	
Class 15	Galilean & Lorentz transformation,	
Week 6	**Modern physics**	
Class 16	Effect, Compton effect, de Broglie mater wave, Bohr's	
Class 17	Atomic orbital radius and energy, classification of nucleus, nuclear	
Class 18	Transformation/Radioactive decay, , Nuclear reactions, Fission,	
Week 7	**Modern physics**	CT 3
Class 19	Fusion, Chain reaction, Nuclear reactor.	
Class 20	Linear momentum of a particle, linear momentum of a system of	
Class 21	Particles, conservation of linear momentum, some application	
Week 8	**Mechanics:**	
Class 22	Momentum principle; angular momentum of a particle	
Class 23	Momentum principle; angular momentum of a particle	
Class 24	Momentum principle; angular momentum of a particle	
Week 9	**Mechanics:**	
Class 25	Momentum of a system of particles, Kepler's law of planetary motion	
Class 26	Momentum of a system of particles, Kepler's law of planetary motion,	
Class 27	Momentum of a system of particles, Kepler's law of planetary motion,	
Week 10	**Mechanics:**	CT 4
Class 28	Momentum of a system of particles, Kepler's law of planetary motion,	
Class 29	Momentum of a system of particles, Kepler's law of planetary motion,	
Class 30	Momentum of a system of particles, Kepler's law of planetary motion,	
Week 11	**Mechanics**	
Class 31	The law of universal Gravitation, the motion of planets and satellites,	
Class 32	Introductory quantum mechanics, wave function, uncertainty	
Class 33	Principle, postulates, Schrodinger time independent equation,	
Week 12	**Mechanics**	
Class 34	Of energy.	
Class 35	Expectation value, Probability, Particle in a zero potential, calculation	
Class 36	Expectation value, Probability, Particle in a zero potential, calculation of energy.	
Week 13	**Mechanics:**	
Class 37	Expectation value, Probability, Particle in a zero potential, calculation	
Class 38	Expectation value, Probability, Particle in a zero potential, calculation of energy.	

Class 39	Expectation value, Probability, Particle in a zero potential, calculation of energy.	
Week 14	**Mechanics**	
Class 40	Expectation value, Probability, Particle in a zero potential, calculation of energy.	
Class 41	Expectation value, Probability, Particle in a zero potential, calculation of energy.	
Class 42	Expectation value, Probability, Particle in a zero potential, calculation of energy.	

Text books:

1. Fundamental of Physics by Resnick, Halliday& Walker
2. Concept of Modern Physics by Arthur Beiser
3. Physics for Engineers-I&II by byDrGaisUddin
4. Physics for Engineers Lecture Series by M ZiaulAhsan

CHEM 107: Chemistry (Atomic Structure, Thermo -chemistry and Che mistry of Engineering Materials)

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale:
From this course students will come to know about the atomic structures of different materials, thermal properties of engineering materials and apply them in future learning.

Objectives:

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 chemistry of selective engineering materials.

Course Outcomes (CO): Upon successful completion of the course, the students will be able:

1. To define the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.
2. To define the different types of solutions.
2. To apply different theory on chemical bonding and hybridization to evaluate structure of molecules.
3. To classify and explain basic concepts and basic operations of paints, varnishes, metallic coating, lubricants.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & Their Weights:

Assessment Method	(%)
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Lectures Schedule:

Weeks	Intended topics to be covered	Remarks
1	Concepts of atomic structure, Different atom models	CT 1
	Concepts of atomic structure, Different atom models	
	Quantum numbers	
2	Periodic classification of elements, Periodic properties of elements	
	Periodic classification of elements, Periodic properties of elements	
	Properties and uses of noble gases	
3	Chemical bonding (types, properties, Lewis theory, VBT, MOT)	
	Chemical bonding (types, properties, Lewis theory, VBT, MOT)	
	Chemical bonding (types, properties, Lewis theory, VBT, MOT)	
4	Hybridization and shapes of molecules	CT 2
	Hybridization and shapes of molecules	
	Hybridization and shapes of molecules	
5	Thermo-chemistry	
	Thermo-chemistry	
	Chemical kinetics	
6	Thermo-chemistry	
	Chemical kinetics	
	Chemical kinetics	
7	Chemical equilibrium	
	Chemical equilibrium	
	Chemical equilibrium	
8	Nature, forms and types of corrosion	CT 3
	Nature, forms and types of corrosion	
	electrochemical mechanism and prevention of corrosion	
9	electrochemical mechanism and prevention of corrosion	
	Composition and application of paints	
	Composition and application of paints	
10	varnishes and metallic coatings	
	methods used in applying coatings on metal surface	
	methods used in applying coatings on metal surface	
11	Properties and applications of carbon and graphite	
	Properties and applications of carbon and graphite	

	Properties and applications of carbon and graphite	
12	Properties and applications of carbon and graphite	CT 4
	Lubricants	
	Lubricants	
13	Lubricants	
	Lubricants	
	Plastic	
14	Plastic	
	Plastic	
	Plastic	

Text Book:

1. Principles of Physical Chemistry- Haque & Nawab; Students' Publications.
2. Fundamentals of Physical Chemistry- Samuel H. Maron & Jerome B. Lando; MacMillan Publishing Co., Inc., Newyork.
3. Physical Chemistry P. W. Atkins; Oxford University Press.
4. Essentials of Physical Chemistry- B.S. Bahl& G.D. Tuli; S. Chand and Company Ltd.
5. Introduction to modern inorganic chemistry- S.Z. Haider.
6. Chemistry of engineering materials- Prof. Dr. Md. Monimul Huque.
7. Industrial chemistry- B. K. Sharma.

Chem 108: Chemistry Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Pre -requisite: Chemistry (Atomic Structure, Thermo-chemistry and Chemistry of Engineering Materials)

Rationale:
To learn and familiarize the basics of different parameter and concepts of inorganic chemistry and describe basic chemistry of selective engineering materials

Objectives:

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 chemistry of selective engineering materials.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. Define 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.

2. Explain the different phenomena regarding isodiametric and complex metric titration etc.

3. Estimate zinc, ferrous content in water sample by using various titrimetric methods.

4. Summarize a report of any project work and apply in real life.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment	**Percentage (%)**
Quiz	40
Viva	20
Lab performance	40

Mapping of Course Outcomes (CO)and Program Outcomes (PO):

Course Outcome of the Course	Program Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** 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.	√											
2. **Explain** the different phenomena regarding iodimetric and iodometric method, complexometric titration etc.		√										
3. **Estimate** zinc, ferrous content in water sample by using various titrimetric methods.			√									
4. **Summarize** a report of any project work and apply in real life.				√								

Text and Ref Books:

1. Principles of Physical Chemistry – Haque & Nawab; Students'Publications.
2. Fundamentals of Physical Chemistry- Samuel H. Maron & Jerome B. Lando; MacMillan Publishing Co., Inc., Newyork.
3. Physical Chemistry P. W. Atkins; Oxford University Press.
4. Essentials of Physical Chemistry- B.S. Bahl & G.D. Tuli; S. Chand and Company Ltd.

Math 121: Math I (Differential and Integral Calculus)

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite (if any): None

Rationale: To demonstrate practical applications of Differential Calculus and Integral Calculus and to train the student in problem formalization and in methods of solution.

Objectives:
1. To explain the characteristics of Differential Calculus and Integral Calculus
2. To provide a physical interpretation of the Differential Calculus and Integral Calculus
3. To apply Differential Calculus and Integral Calculus in solving engineering problems
4. To use integral operations for simplification of complex problems

Course Outcomes (CO)

After completing this course students will be able to
1. Define the limit, continuity and differentiability of functions
2. Identify the rate of change of a function with respect to independent variables.
3. Explain the behavior of function.
4. Describe the different techniques of evaluating indefinite and definite integrals.
5. Calculate the length, area, volume and average value related to engineering study.

Course Contents

Differential Calculus: Introduction to differential calculus, continuity and differentiability, successive differentiation, Leibnitz's theorem, general theorems and expansion, indeterminate form, partial differentiation, Euler's theorem, tangent and normal, sub tangent and subnormal in Cartesian and polar coordinates, maxima and minima of functions of single variables, curvature, asymptotes.

Integral Calculus: Introduction to integral calculus, methods of integration, standard integrals, integration by the method of successive reduction and more reduction formulae, definite integrals, evaluation of definite integrals, properties of definite integral and its use, summing series, Walli's formula, improper integrals, Beta function and Gamma function, multiple integral with its application, application of integration: arc length of curves, area under a plane curve, area of the region enclosed by two curves, volume of solid revolution.

Teaching and Learning strategy: Lectures, class test.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment / Presentation	20
Exam	
Final Exam	70

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define the limit, continuity and differentiability of functions.	✓											
2. Identify the rate of change of a function with respect to independent variables.		✓										
3. Explain the behavior of function.	✓											
4. Describe the different techniques of evaluating indefinite and definite integrals.	✓											
5. Calculate the length, area, volume and average value related to engineering study.			✓									

Lecture Schedule:

Week 1	**Differential calculus**	CT 01
Class 1	Introduction to differential calculus	
Class 2	Introduction to differential calculus	
Class 3	Introduction to differential calculus	
Week 2	**Differential calculus**	
Class 4	Successive differentiation	
Class 5	Successive differentiation	
Class 6	Successive differentiation	
Week 3	**Differential calculus**	
Class 7	Continuity and differentiability, successive differentiation	
Class 8	Leibnitz's theorem, general theorems and expansion, indeterminate form	
Class 9	Partial differentiation, Euler's theorem, tangent and normal, sub tangent and	
Week 4	**Differential calculus**	CT 2
Class 10	Functions of single variables, ,	
Class 11	Asymptotes.	
Class 12	Curvature	
Week 5	**Differential calculus**	
Class 13	Improper integrals,	
Class 14	Improper integrals,	
Class 15	Improper integrals,	
Week 6	**Differential calculus**	
Class 16	Improper integrals,	
Class 17	Improper integrals,	
Class 18	Improper integrals,	
Week 7	**Differential calculus**	
Class 19	Beta function	
Class 20	Beta function	
Class 21	Beta function	
Week 8	**Integral calculus**	CT 3
Class 22	Beta function	
Class 23	Beta function	
Class 24	Beta function	
Week 9	**Integral calculus**	
Class 25	Summing series	
Class 26	Summing series	

Class 27	Summing series	
Week 10	**Integral calculus**	
Class 28	Summing series	
Class 29	Summing series, Walli's formula, improper integrals,	
Class 30	Summing series, Walli's formula,	
Week 11	**Integral calculus**	CT 4
Class 31	Area under a plane curve	
Class 32	Area under a plane curve	
Class 33	Area under a plane curve	
Week 12	**Integral calculus**	
Class 34	Area under a plane curve	
Class 35	Area under a plane curve	
Class 36	Area under a plane curve	
Week 13	**Integral calculus**	
Class 37	Volume of solid revolution	
Class 38	Volume of solid revolution	
Class 39	Volume of solid revolution	
Week 14	**Integral calculus**	
Class 40	Volume of solid revolution	
Class 41	Volume of solid revolution	
Class 42	Volume of solid revolution	

Text books:

1. Calculus, by Haward Anton, Stephen Davis
2. Differential and Integral Calculus by Matin Chakraborty
3. A Text Book on Integral Calculus, Mohammad, Bhattacharjee & Latif
4. Differential and Integral Calculus, Das and Mukherjee.

Math 127: Mathematics-II (Vector Analysis, Matrix and Geometry)

3.0 Contact Hour; 3.0 Credit Hour;

Pre-requisite (if any): None

Rationale: To demonstrate practical applications of vector analysis and to train the student in problem formalization and in methods of solution. Matrix method is widely used in engineering problems involving linear equations.

Objective:

1. To explain the characteristics of scalar and vector valued functions and master these in calculations
2. To provide a physical interpretation of the gradient, divergence, curl and related concepts
3. To transform vector valued functions between different coordinate systems
4. To use nabla operations for simplification of vector analytical expressions
5. To be able solve linear equations using matrix. .
6. To be able to do matrix inversion.

Course Outcomes (CO): After completing this course students will be able to

1. Describe the physical explanation of different vector notation.
2. Explain differentiation and integration of vector valued functions in cartesian, cylindrical and spherical geometry.
3. Calculate length, area and volume of objects related to engineering study by using vector.
4. Find the technique to obtained the inverse matrix that solve the system of linear equations.
5. Explain the nature of the vectors in a vector space.
6. Solve the problems of the pair of straight lines, circles, parabola, ellipse etc.
7. Apply the knowledge of geometry in engineering study.

Course Contents Multiplication of vectors by scalars, scalar and vector product of two vectors and their geometrical interpretation, triple products and multiple products, differentiation and integration of vectors along with elementary applications, vector geometry, definition of line, surface and volume integrals, gradient, divergence and curl of point functions, Green's theorem, Gauss's theorem, Stoke's theorem and their applications.

Matrix: Definition of matrix, different types of matrices, algebra of matrices, adjoint and inverse of a matrix, elementary transformations of matrices, matrix, polynomials, Cay- lay-Hamilton theory with uses of rank and nullity, normal and canonical forms, solution of linear equations, definition and properties of vector space, subspaces, basis and dimension, linear dependence and independence of vectors.

Geometry: (2D) - Transformation of coordinates, axes and its uses, pair of straight lines, homogeneous equations of second degree, angle between the pair of straight lines, pair of lines joining the origin to the point of intersection of two given curves, equation of conics and its reduction to standard forms, circles, system of circles, coaxial circles and limiting points, parabola, ellipse and hyperbola (Cartesian and polar coordinates).

(3D)-System of coordinates, direction cosines, projections, equation of planes, straight lines and spheres.

Teaching-learning and Assessment Strategy:

Lecture, Class Performance, Homework, Assignment, Class test, Final examination.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment / Presentation	20
Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Describe the physical explanation of different vector notation.	✓											
2. Explain differentiation and integration of vector valued functions in cartesian, cylindrical and spherical geometry.		✓										
3. Calculate length, area and volume of objects related to engineering study by using vector.			✓									
4. Find the technique to obtained the inverse matrix that solve the system of linear equations.		✓										
5. Explain the nature of the vectors in a vector space.	✓											
6. Solve the problems of the pair of straight lines, circles, parabola, ellipse etc.												
7. Apply the knowledge of geometry in engineering study.	✓											

Lecture schedule

Week 1	**Multiplication of vectors**	
Class 1	Volume integrals, gradient, divergence and curl	CT 01
Class 2	Volume integrals, gradient, divergence and curl	
Class 3	Volume integrals, gradient, divergence and curl	
Week 2	**Multiplication of vectors**	
Class 4	Stoke's theorem	
Class 5	Stoke's theorem	
Class 6	Stoke's theorem	

Week 3	**Multiplication of vectors**	
Class 7	Green's theorem	
Class 8	Green's theorem	
Class 9	Green's theorem	
Week 4	**Multiplication of vectors**	CT 2
Class 10	Volume integrals, gradient, divergence	
Class 11	Volume integrals, gradient, divergence	
Class 12	Volume integrals, gradient, divergence	
Week 5	**Matrix**	
Class 13	Definition of matrix	
Class 14	Adjoint and inverse of a matrix	
Class 15	Adjoint and inverse of a matrix	
Week 6	**Matrix**	
Class 16	Adjoint and inverse of a matrix	
Class 17	Adjoint and inverse of a matrix	
Class 18	Adjoint and inverse of a matrix	
Week 7	**Matrix**	CT 3
Class 19	Cay- lay-Hamilton theory with uses of rank and	
Class 20	Canonical forms	
Class 21	Canonical forms	
Week 8	**Matrix**	
Class 22	Nullity, normal	
Class 23	Nullity, normal	
Class 24	Nullity, normal	
Week 9	**Matrix**	
Class 25	Nullity, normal	
Class 26	Nullity, normal	
Class 27	Nullity, normal	
Week 10	**Geometry**	
Class 28	Transformation of coordinates	
Class 29	Transformation of coordinates	
Class 30	Transformation of coordinates	
Week 11	**Geometry**	CT 4
Class 31	Homogeneous equations second degree	

Class 32	Homogeneous equations second degree	
Class 33	Homogeneous equations second degree	
Week 12	**Geometry**	
Class 34	Homogeneous equations second degree	
Class 35	Direction cosines, projections	
Class 36	Direction cosines, projections	
Week 13	**Geometry**	
Class 37	Direction cosines, projections	
Class 38	Direction cosines, projections	
Class 39	Direction cosines, projections	
Week 14	**Geometry**	
Class 40	Direction cosines, projections	
Class 41	Equations of plane	
Class 42	Equations of plane	

Text books:

1. Vector Analysis, Schaum's outlines, Murray R. Spiegel.
2. Matrices, Frand Ayres, JR.
3. Matrices and Linear Transformations, Mohammad Iman Ali.
4. Elementary Linear Algebra, Howard Anton and Chris Rorres.
5. A Text Book on Co-ordinate Geometry with Vector Analysis, Rahman & Bhattacharjee.
6. College Linear Algebra, Prof Abdur Rahman

Math–129: Mathe matics-III (Ordinary Differential Equations and Partial Differential Equations)

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite (if any): Math-121 (Differential and Integral Calculus)

Rationale: To demonstrate practical applications Ordinary Differential Equations and Partial Differential Equations and their methods of solution.

Objectives:

1. To explain the characteristics of Ordinary Differential Equations and Partial Differential Equations
2. To provide a physical interpretation of the Ordinary Differential Equations and Partial Differential Equations
3. To apply Ordinary Differential Equations and Partial Differential Equations in solving complex problems.
4. To use differential operations for simplification of complex engineering expressions

Course Outcomes (CO): After completing this course students will be able to

1. Identify differential equations of various types
2. Solve different types of differential equations
3. Analyze the classifications of partial differential equations.
4. Apply the boundary value problems in Aeronautical Engineering fields.

Teaching-learning and Assessment Strategy: Lecture, Class Performance, Homework, Assignment, Class test, Final examination

Assessment methods and their weight

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment / Presentation	20
Final exam	70

Mapping of CO and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify differential equations of various types		✓										
2. Solve different types of differential equations		✓										
3. Analyze the classifications of partial differential equations.			✓									
3. Apply the boundary value problems in Aeronautical Engineering fields.	✓											

Lecture Schedule:

Week 1	**Ordinary Differential Equations**	
Class 1	Formulation of differential equations	
Class 2	Formulation of differential equations	
Class 3	Formulation of differential equations	
Week 2	**Ordinary Diffe rential Equations**	
Class 4	Application of ODE	
Class 5	Application of ODE	
Class 6	Application of ODE	
Week 3	**Ordinary Diffe rential Equations**	
Class 7	Legendre's functions and their properties	
Class 8	Legendre's functions and their properties	CT 01
Class 9	Legendre's functions and their properties	
Week 4	**Ordinary Diffe rential Equations**	
Class 10	Solution of Euler's homogeneous linear differential equations	
Class 11	Solution of Euler's homogeneous linear differential equations	
Class 12	Solution of Euler's homogeneous linear differential equations	

Week 5	**Ordinary Differential Equations**	CT 2
Class 13	Solution of general linear equations of second and higher orders with constant co-efficient	
Class 14	Solution of general linear equations of second and higher orders with constant co-efficient	
Class 15	Solution of general linear equations of second and higher orders with constant co-efficient	
Week 6	**Ordinary Diffe rential Equations**	
Class 16	Standard forms of linear equations of higher order	
Class 17	Standard forms of linear equations of higher order	
Class 18	Standard forms of linear equations of higher order	
Week 7	**Ordinary differential equations**	
Class 19	Wave and heat transfer equations,	
Class 20	Wave and heat transfer equations,	
Class 21	Wave and heat transfer equations,	
Week 8	**Ordinary differential equations**	CT 3
Class 22	Continue	
Class 23	Continue	
Class 24	Continue	
Week 9	**Ordinary differential equations**	
Class 25	Nonlinear PDE of order one	
Class 26	Nonlinear PDE of order one	
Class 27	Nonlinear PDE of order one	
Week 10	**Partial differential equations**	
Class 28	Introduction, linear and nonlinear first order equations	
Class 29	Introduction, linear and nonlinear first order equations	
Class 30	Introduction, linear and nonlinear first order equations	
Week 11	**Partial differential equations**	CT 4
Class 31	Continue	
Class 32	Continue	

Class 33	Continue	
Week 12	**Partial differential equations**	
Class 34	Singular and general integrals	
Class 35	Singular and general integrals	
Class 36	Singular and general integrals	
Week 13	**Partial differential equations**	
Class 37	Singular and general integrals	
Class 38	Singular and general integrals	
Class 39	Singular and general integrals	
Week 14	**Partial differential equations**	
Class 40	Singular and general integrals	
Class 41	Singular and general integrals	
Class 42	Singular and general integrals	

Text books:

1. Ordinary and Partial Differential Equations – M.D. Raisinghania.
2. Differential Equations – Schaum's out lines.
3. Differential Equations – B. D. Sharma.
4. Differential Equations – P. N. Chatterjee.
5. Differential Equations with applications–Dr Md. Mustafa Kamal

Math–223: Mathematics-IV (Complex Variable and Laplace Transform)

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite (if any): Math-121 (Dif and Int Calculus) and Math-125 (ODE and PDE)

Rationale: To demonstrate practical applications Complex Variable and Laplace Transform and their methods of solution.

Objectives:

1. To explain the characteristics of Complex Variable and Laplace transform and their methods of solution.
2. To provide a physical interpretation of the Complex Variable and Laplace Transform and their methods of solution.
3. To apply Complex Variable and Laplace Transform and their methods of solution in solving complex problems.
4. To use Complex Variable and Laplace Transform for simplification of complex engineering expressions

Course Outcomes (CO): After completing this course students will be able to

1. Apply the concept of limit, continuity, differentiability and analyticity of complex functions.
2. Categorize and integrate the complex functions by line integrals Cauchy's integral formulae and Cauchy's residue theorem.
3. Describe the technique of Laplace transform and inverse transform of some elementary function.
4. Apply the concept of Laplace transform, they learn the signal procedure

Course Contents

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, line integral of complex functions, Cauchy's integral formula, theorem, Taylor's and Laurent's theorem, singular residues, Cauchy's residue theorem, contour integration.

Laplace Transform: Definition, Laplace transforms of some elementary functions, sufficient conditions for existence of Laplace transform, Laplace transforms of derivatives, unit step function, periodic function, some special theorems on Laplace transform, solutions of differential equations by Laplace transform, evaluation of improper integral, inverse Laplace transform and its properties, partial fractions, Heaviside expansion formula, convolution theorem, application of Laplace transform.

Teaching-learning and Assessment Strategy: Class test, Final

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment /	20
Exam	70

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the concept of limit, continuity, differentiability and analyticity of complex functions**,**	✓											
2. Categorize and integrate the complex functions by line integrals Cauchy's integral formulae and Cauchy's residue theorem.		✓										
3. Describe the technique of Laplace transform and inverse transform of some elementary function.	✓											
4. Apply the concept of Laplace transform, they learn the signal procedure	✓											

Lecture Schedule

Week 1	**Complex variable:**	**Remarks**
Class 1	Complex number system	**CT 1**
Class 2	Complex number system	
Class 3	Complex number system	
Week 2	**Complex variable:**	
Class 4	Limits and continuity of a function of complex variable	

Class 5	Limits and continuity of a function of complex variable	
Class 6	Limits and continuity of a function of complex variable	
Week 3	**Complex variable:**	
Class 7	Cauchy-Riemann equations	
Class 8	Cauchy-Riemann equations	
Class 9	Cauchy-Riemann equations	
Week 4	**Complex variable:**	**CT 2**
Class 10	Line integral of complex functions, Cauchy's integral formula,	
Class 11	Line integral of complex functions, Cauchy's integral formula,	
Class 12	Line integral of complex functions, Cauchy's integral formula,	
Week 5	**Complex variable:**	
Class 13	Taylor's and Laurent's theorem	
Class 14	Taylor's and Laurent's theorem	
Class 15	Taylor's and Laurent's theorem	
Week 6	**Complex variable:**	
Class 16	Singular residues	
Class 17	Singular residues	
Class 18	Singular residues	
Week 7	**Laplace transform**	
Class 19	Singular residues	
Class 20	Singular residues	
Class 21	Singular residues	
Week 8	**Laplace transform**	**CT 3**
Class 22	Cauchy's residue theorem	
Class 23	Cauchy's residue theorem	
Class 24	Cauchy's residue theorem	
Week 9	**Laplace transform**	
Class 25	Contour integration	
Class 26	Contour integration	
Class 27	Contour integration	
Week 10	**Laplace transform**	
Class 28	Laplace transforms of derivatives	
Class 29	Laplace transforms of derivatives	
Class 30	Laplace transforms of derivatives	
Week 11	**Laplace transform**	**CT 4**
Class 31	Laplace transforms of derivatives	
Class 32	Laplace transforms of derivatives	
Class 33	Laplace transforms of derivatives	
Week 12	**Laplace transform**	
Class 34	Periodic function	
Class 35	Periodic function	

Class 36	Periodic function	
Week 13	**Laplace transform**	
Class 37	Periodic function	
Class 38	Periodic function	
Class 39	Periodic function	
Week 14	**Laplace transform**	
Class 40	Application of Laplace Transform.	
Class 41	Heaviside expansion formula	
Class 42	Heaviside expansion formula	

Text books:

1. Theory and Problems of Complex Variables, Murray R Spiegel.
2. Theory and functions of complex variables, Shanti Narayan.
3. Theory and problems of Laplace Transforms, Schaum's outlines series, Murray R. Spiegel.
4. Mathematical Physics, B D Gupta.

MATH-225: Mathematics-V (Fourier Analysis and Statistics)

3.00 Contact Hour; 3.00 Credit Hour ;

Pre-requisite (if any): None

Rationale: To demonstrate practical applications Fourier Analysis and Statistics and their methods of solution.

Objectives:

1. To explain the characteristics of Fourier Analysis and Statistics and their methods of solution.
2. To provide a physical interpretation of the Fourier Analysis and Statistics and their methods of solution.
3. To apply Fourier Analysis and Statistics and their methods of solution in solving complex problems.
4. To use Fourier Analysis and Statistics for simplification of complex engineering expressions

Course Outcomes (CO): After completing this course students will be able to :

1. Explain periodic functions with various periods.
2. Classify and expand different types of functions in Fourier series and analyze them and solving boundary value problem.
3. Evaluate data in easy way in which information can easily be expressed in numerical form Collect and compare data on specific field and analysis, interpretation and finally take the best decision among alternative.
4. Describe sampling theory and different test in which giving concept about future situation.

Course Contents:

Fourier Analysis: Definition and expansion of a function of x , real and complex form of Fourier series, physical applications of Fourier series, finite transform, Fourier Integral, Fourier transforms, inverse Fourier transforms and their uses in solving boundary value problems (Wave equations, heat equations and damped equations).

Statistics: Frequency distribution, measures of central tendency and dispersion, variation, skewness and kurtosis, concept of probability, conditional probability, probability distributions ie. Binomial, Poisson, negative exponential, normal, sampling of mean and standard deviation by normal, Chi-square distributions, sampling theory, hypothesis testing, inference including t-tests, correlation and regression analysis.

Teaching-learning and Assessment Strategy: Lecture, Class Performance, Homework, Assignment, Class test, Final examination

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Class Assessment	
Class Participation	05
Class Assessment	05
HW / Class test / Assignment / Presentation	20
Exam	
Final Exam	70

Mapping of CO and Program Outcomes (PO):

Course Outcomes (CO)	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain periodic functions with various periods.	✓											
2. Classify and expand different types of functions in Fourier series and analyze them and solving boundary value problem.		✓										
3. Evaluate data in easy way in which information can easily be expressed in numerical form Collect and compare data on specific field and analysis, interpretation and finally take the best decision among alternative.			✓									
4. Describe sampling theory and different test in which giving concept about future situation.	✓											

Lecture Schedule Week 1	Fourier Analysis	Remarks
Class 1	Definition and expansion of a function of *x*	CT 1
Class 2	Definition and expansion of a function of *x*	
Class 3	Definition and expansion of a function of *x*	
Week 2	**Fourier Analysis**	
Class 4	real and complex form	
Class 5	real and complex form	
Class 6	real and complex form	
Week 3	**Fourier Analysis**	
Class 7	real and complex form	
Class 8	real and complex form	
Class 9	real and complex form	
Week 4	**Fourier Analysis**	CT 2
Class 10	physical applications	
Class 11	, Fourier Integral	
Class 12	Fourier transforms	
Week 5	**Fourier Analysis**	
Class 13	physical applications	
Class 14	inverse Fourier transforms	
Class 15	inverse Fourier transforms	
Week 6	**Fourier Analysis**	
Class 16	physical applications	
Class 17	finite transform	
Class 18	problems	
Week 7	**Fourier Analysis**	
Class 19	problems	
Class 20	problems	
Class 21	problems	
Week 8	**Statistics**	CT 3
Class 22	Frequency distribution	
Class 23	measures of central tendency	
Class 24	measures of central tendency	
Week 9	**Statistics**	
Class 25	measures of central tendency	
Class 26	concept of probability	
Class 27	concept of probability	
Week 10	**Statistics**	
Class 28	concept of probability	
Class 29	concept of probability	
Class 30	conditional probability	
Week 11	**Statistics**	
Class 31	Binomial, Poisson	
Class 32	Binomial, Poisson	

Class 33	negative exponential	CT 4
Week 12	**Statistics**	
Class 34	negative exponential	
Class 35	sampling of mean	
Class 36	sampling of mean	
Week 13	**Statistics**	
Class 37	correlation and regression analysis	
Class 38	correlation and regression analysis	
Class 39	correlation and regression analysis	
Week 14	**Statistics**	
Class 40	Chi-square distributions	
Class 41	Chi-square distributions	
Class 42	Chi-square distributions	

Text books:

1. Fourier series, Schaum's outlines series, Murray R. Spiegel.
2. Mathematical Physics, B D Gupta.
3. Probability and Statistics for Engineers, Scheaffer & McClave.
4. Statistics and Random Processes, B. Praba, Aruna Chalam and Sujatha.
5. Quality Planning and Analysis, J. M. Juran& F. M. Gryna.
6. Business Statistics, Gupta and Gupta.

HUM – 111: English (Theory)

3.00 Contact Hour; 3.00 Credit Hour ;

Pre-requisite (if any):	None
Rationale:	Basic English Language Course (Compulsory). The basic activities in an effective English Language Arts program is to equip students to combine a variety of sequentially acquired skills to derive meaning from text and other forms of communication.
Objectives:	1. To organize themselves within the shortest possible time to present their ideas and opinions, 2. To understand and speak English quickly and smartly using the techniques learnt in the class 3. To apply the techniques to find out the main points of any long article within a very limited time as well as know the techniques of any effective writing. In short with consistent practice they will be able to overcome language barrier. 4. To communicate through speaking, listening, reading, writing, viewing and representing 5. To use language to shape and make meaning according to purpose, audience and context 6. To think in ways that are imaginative, creative, interpretive and critical
Course Outcomes (CO):	Upon completion of the course, the students will be able to: 1. **Organize** themselves within the shortest possible time to present their ideas and opinions. 2. Speak English quickly and smartly using the techniques learnt in the class. 3. **Apply** the techniques to find out the main points of any long article.
Course Contents	**LANGUAGE** **Introduction to Language** Definition & Function **Methodologies/Approaches of English Teaching-Learning Process** All of the approaches will be shown with merits and demerits **Introduction to Phonetics** English Vowels and consonant sounds. Phonemes and their classifications

GRAMMAR

Types of Sentences:
According to mood, clause, structure, and use of
verbs Conditionals, Emphatic
*All these types of sentences will be shown with examples.
Introduction to Tense
broad classifications and subdivisions
Use of present, Past & Future tense

Use of Main Verbs:

- Missing main verb
- Verbs that require an infinitive in the complement
- Verbs that require an –ing form in the complement
- Verb phrases that require an –ing form in the complement
- Problems with subject – verb agreement

Auxiliaries, Modals & Semi modals
Causatives: Make, Get, Have, Let, Help – usage and wrong usage
Conditionals:
Zero, first, second and third conditions
Active / Passive Sentences:
Structure / formation of active and passive sentences
Forming Questions:
WH, Yes / No & Tag Questions
Problems with **Adve rbs** and Adverb related structures
Adjectives:
Determiners, comparatives and other adjectives
Conjunction:
Use of and, or, but, …. and correlative conjunctions
Prepositions:
Place, time, addition, exception, replacement, example, condition
and unexpected results, cause, purpose, means

READING

Skimming, and Scanning
Techniques of skimming, scanning and generating ideas through purpose reading
How to increase analytical ability
Reading Compre hension
Selected short Stories:
Meeting in the Mosque (A selected part from A Passage to India by E M Forster) : Critical Analysis
The Old Man & the Sea by Earnest Hemingway (An abridged form) : Critical Analysis

WRITING

Writing Strategies:
Principles of effective & creative writing
Paragraph Writing, Analytical / Creative writing
Techniques of writing Précis and Amplifications

GENERAL CORRESPONDENCE & COMMUNICATION/TECH

WRITING

Introduction to General Correspondence

- Purpose and Principles
- How to write formal letters: format and elements of structure

Formal Communication:
Simple official letters
Formal & informal email

Teaching-learning and Assessment Strategy: Lecture, Class Performance, Homework, Assignment, Class test, Presentation, Final examination

Linkage of CO with Assessment Methods & their Weights:

CO	Assessment Method	%
	Class Assessment	
1-3	Class Participation	05
1-3	Class Assessment	05
1-3	HW / Class test / Assignment / Presentation	20
	Exam	
1-3	Final Exam	70

Mapping of Course outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes (Appendix-1)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Organize them within the shortest possible time to present their ideas and opinions.									✓			✓
2. Speak English quickly and smartly using the techniques learnt in the class.										✓		✓
3. Apply the techniques to find out the main points of any long article		✓							✓	✓		✓

Lecture Schedule

Week 1	**Language**	**CT 1**
Class 1	Introduction to Language	
Class 2	Introduction to Language	
Class 3	Practice	
Week 2	**Grammar**	
Class 4	Methodologies/Approaches of English Teaching-Learning Process	
Class 5	Practice	
Class 6	Practice	
Week 3	**Grammar**	
Class 7	Methodologies/Approaches of English Teaching-Learning Process	
Class 8	Verb	
Class 9	Conditionals	
Week 4	**Reading**	**CT 2**
Class 10	Skimming, and Scanning	
Class 11	Practice	
Class 12	Practice	
Week 5	**Reading**	
Class 13	Skimming, and Scanning	
Class 14	Practice	
Class 15	Practice	
Week 6	**Reading**	
Class 16	Reading Comprehension	
Class 17	Practice	
Class 18	Practice	
Week 7	**Reading**	
Class 19	Reading Comprehension	
Class 20	Practice	
Class 21	Practice	
Week 8	**Reading**	**CT 3**
Class 22	Practice	
Class 23	Reading Comprehension	
Class 24	Practice	
Week 9	**Reading**	
Class 25	Practice	
Class 26	Reading Comprehension	

Class 27	Practice	
Week 10	**Reading**	
Class 28	Practice	
Class 29	Reading Comprehension	
Class 30	Practice	
Week 11	**Writing**	
Class 31	Practice	
Class 32	Practice	
Class 33	Practice	
Week 12	**Writing**	
Class 34	Practice	
Class 35	Writing Strategies	
Class 36	Practice	
Week 13	**Writing**	
Class 37	Practice	
Class 38	Writing Strategies	
Class 39	Practice	
Week 14	**Writing**	
Class 40	Practice	
Class 41	Writing Strategies	**CT 4**
Class 42	Practice	

Text books:

1. Introduction to Linguistics – Prof Dr. Maniruzzaman.
2. A Guide to Correct Speech – S M Amanullah
3. Oxford Advanced Learners' Dictionary
4. English Grammar in Use – Raymond & Murphy
5. Prose of Our Time by Ahsanul Hoque, Serajul Islam Chowdhury and M Shamsuddoha.
6. From Paragraph to Essay - Maurice Imhoof and Herman Hudson
7. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.

HUM – 112: English (Sessional)

3.00 Contact Hour; 1.50 Credit Hour ;

Pre-requisite (if any): None

Rationale: English Sessional Course (Compulsory),In their study of English, students continue to develop their critical and imaginative faculties and broaden their capacity for cultural understanding.

Objectives:

1. To learn how to prepare and deliver an effective presentation in English.
2. To prepare and participate in academic discussions, group discussion.
3. To communicate confidently with University staff and fellow students, and also learn to frequently use English in all aspects.
4. To identify ways in which to improve pronunciation of different English words.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Organize** themselves within the shortest possible time to present their ideas and opinions,
2. Speak English quickly and smartly using the techniques learnt in the class
3. **Apply** the techniques to find out the main points of any long article within a very limited time as well as know the techniques of any effective writing. Students will be able to prepare report on any issue and present it in front of others. They will be able to speak fluently on any topic.

Course Contents:

1. Introducing basic skills of language. Primary and secondary skills
2. English Vowel and consonant sounds
3. British and American accents
4. How a speaker should introduce himself to any stranger / unknown person / a crowd.
5. Name, family background, education, experience, any special quality/interest, likings/disliking, etc
6. Talking in peers / in a group on some given situations/ Story telling
7. IELTS speaking - Part 1
8. Asking about a person's home, work, studies, and other familiar social topics
9. Describing any incident they witnessed, describe any picture shown by the teacher

10. Taking participation in any discussion and drawing conclusion and giving recommendation
11. Principles of brain storming. How to think logically.
12. Trying to find out possible solutions, drawing conclusion and giving recommendation
13. Good presentation skills: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc.
14. Techniques of skimming, scanning and generating ideas through purpose reading.
15. How to increase analytical ability.

Teaching-learning and Assessment Strategy: Lecture, Class Performance, Assignment, Group Work, Group/Individual Presentation, Debate/Public Speaking.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	%
Formative Assessment	
Class Participation	05
Class Assessment	05
HW / Assignment / Presentation	20
Testing Listening Skill	10
Testing Speaking Skill	30
Testing Reading Skill	15
Testing Writing Skill	15

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcomes (CO) of this course	Program Outcomes (Appendix-1)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Organize them within the shortest possible time to present their ideas and opinions.									✓			✓
2. Speak English quickly and smartly using the techniques learnt in the class.										✓		✓
3. Apply the techniques to find out the main points of any long article		✓							✓	✓		✓

Text books:

1. Introduction to Linguistics – Prof Dr. Maniruzzaman.
2. A Guide to Correct Speech – S M Amanullah
3. Oxford Advanced Learners' Dictionary
4. English Grammar in Use – Raymond & Murphy
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson
6. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
7. IELTS and TOEFL practice book – Cambridge University Press

HUM 211: Principles of Accounting

3.00 Contact Hour; 3.00 Credit Hour ;

Pre-requisite: None

Rationale: To learn the basic knowledge about the financial and managerial accounting and their applications.

Objectives:

1. To make students familiar with the preparation of accounting reports and applications of accounting information intelligently.
2. To work effectively in the organizations with honesty and integrity.
3. To describe the importance of ethics in financial reporting.
4. To earn knowledge on basic accounting principles and concepts including accounting equation, recording of financial transactions, preparation of financial statement and worksheet etc.

Course Outcomes: Upon successful completion of the course, the students will be able to:

1. Explain the necessity and importance of accounting.
2. Prepare financial report.
3. Analyze and interpretation of financial statements

Course Contents:

Financial Accounting: Objectives and importance of accounting, branches of accounting, accounting as an information system, computerized system and application in accounting. Recording Systems: Double entry mechanism, accounts and their classification, accounting equation, accounting cycle journal, ledger, and trial balance. Preparation of financial statements considering adjusting and closing entries. Accounting concepts and conventions. Financial statements analysis and interpretation: Ration analysis- tests for profitability, liquidity, solvency and overall measure.

Costs and Manage ment Accounting: Cost concept and classification. Segregation of mixed costs. Overhead costs: Meaning and classification, allocation of overhead cost, overhead recovery method. Job order costing: Preparation of job cost sheet and quotation price. Inventory valuation: Absorption costing and variable costing technique. Cost volume profit analysis: Meaning, breakeven analysis, contribution margin approach, sensitivity analysis. Short term investment decision: Relevant and differential Cost analysis. Long term investment decisions: Capital budgeting, various techniques of evaluation of capital investment, investment appraisal under uncertainty, risk management, capital rationing.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Assessment Method	**(%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of CO and PO:

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the necessity and importance of accounting.	✓											
2. Prepare financial report.			✓									
3. Analyze and interpretation of financial statements.				✓								

Lectures Schedule

Weeks	Lectures	Intended topics to be covered	Remarks
1	1	Meaning, history and definition of accounting	CT 01
	2	The users and uses of accounting.	
	3	Importance of ethics in financial reporting	
2	4	The cost principle, monetary unit assumption and the economic entity assumption	
	5	Accounting equation, and define its components	
	6	The effects of business transactions on the accounting equation.	
3	7	Understand the four financial statements and how they are prepared.	
	8	Explain what an account is and how it helps in the recording process.	
	9	Definition of debits and credits and explain their use in recording business transactions.	
4	10	Journal	CT02
	11	T-account, Ledger	
	12	Trial balance	
5	13	Introduction to Adjusting Accounts	
	14	Time period assumption, the accrual basis of accounting	
	15	Adjusting entries for deferrals, adjusting entries for accruals	
6	16	Worksheet.	
	17	Process of COsing the books	
	18	Completion of the Accounting Cycle .	
7	19	Financial Statement Analysis	CT 03
	20	Horizontal analysis	
	21	Vertical analysis	
		Definition, features of managerial	
8	22	accounting. Differences between financial accounting and managerial accounting	
	23	Three classes of manufacturing costs	

	24	costs, difference between a merchandising and a manufacturing balance sheet.	
9	**25**	Job Order Cost Accounting	CT 04
	26	Nature and importance of a job cost sheet	
	27	Distinguish between under- and over applied manufacturing overhead.	
10	**28**	Process Cost Accounting	
	29 **30**	Differences between Process costing and product costing Job order costing and Process costing	
11	**31**	Variable costing	
	32	Absorption costing	
	33	Differences between variable costing and absorption costing through calculation	
12	**34**	Budget	
	35	Master budget	
	36	Sales budget, direct material budget, direct labor budget	
13	**37**	Human factors in budgeting	
	38	Cash budget	
	39	Budget of different projects	
14	**40**	Service department costing	
	41	The need for cost allocation	
	42	Guidelines for cost allocation	

Text Book:

1. Financial Accounting IFRS edition by Weygand, Kimmel & Kieso (3th e)
2. Accounting Principles by Weygandt, Kieso & Kimmel (12th Edition)
3. Managerial Accounting by Garrison, Ray H.; Noreen, Eric W. (10th Edition)

HUM 305: Economics

3.00 Contact Hour; 3.00 Credit Hour;

Pre -requisite: None

Rationale: To learn the basic principle of Microeconomics and Macroeconomics and their application in real life.

Objectives:

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 formulate comparative statics and optimization problems in microeconomics and macroeconomics using matrix algebra and calculus.
4. Students will be able to identify the determinants of various macroeconomic aggregates such as output, unemployment, 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 alternative representations of human behavior in economics.

Course Outcomes (CO): Upon successful completion of the course, the students will be able to:

1. Explain the function of market.
2. Apply the concept of equilibrium to both microeconomics and macroeconomics.
3. Identify key macroeconomic indicators and measures of economics change, growth, and development.
4. Identify and explain major types of market failures.

Course Contents:

Microeconomics: Definition of economics; Fundamentals of economics; Market and government in a modern economy; Basic elements of supply and demand; Choice and utility; indifference curve technique; Analysis of cost; Short run long run theory of production; Analysis of Market; Optimization; Theory of distribution.

Macroeconomics: key concept of macroeconomics; saving, consumption, investment; National income analysis; Inflation, Unemployment; Fiscal and monetary policy. Development: Theories of developments; Economic problem of developing countries; Planning in Bangladesh

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Assessment Methods & their Weights:

Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70

Mapping of CO and PO:

Course Outcomes (CO) of this course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the function of market.	✓											
2. Apply the concept of equilibrium to both microeconomics and macroeconomics.	✓									✓		✓
3. Identify key macroeconomic indicators and measures of economics change, growth, and development.		✓							✓	✓		✓
4. Identify and explain major types of market failures.		✓										

Lecturer Schedule:

Week 1	**Microeconomics**:	CT 1
Class 1	Why do we study it?	
Class 2	Meaning, history and definition of	
Class 3	Economics	
Week 2	**Microeconomics**	
Class 4	Their relative importance in	
Class 5	National economic policy.	
Class 6	Continue	

Week 3	**Microeconomics**	
Class 7	Demand analysis- concept of utility, law of	
Class 8	Diminishing marginal utility.	
Class 9	Continue	
Week 4	**Microeconomics**	CT 2
Class 10	Continue	
Class 11	Continue	
Class 12	Assumptions of economic analysis:	
Week 5	**Microeconomics**	
Class 13	Continue	
Class 14	Continue	
Class 15	Demand function and demand curve,	
Week 6	**Microeconomics**	
Class 16	Movement along and shift of the demand	
Class 17	Continue	
Class 18	Continue	
Week 7	**Microeconomics**	CT 3
Class 19	The nature and slope of a demand curve,	
Class 20	Income effect and substitution effect and	
Class 21	Exceptions.	
Week 8	**Microeconomics**	
Class 22	Elasticity of demand, how to measure	
Class 23	Elasticity of demand, how to measure	
Class 24	Elasticity of demand	
Week 9	**Microeconomics**	
Class 25	Continue	
Class 26	Relationship between elasticity of demand	
Class 27	And total revenue.	
Week 10	**Microeconomics**	CT 4
Class 28	Practical applications of elasticity of	
Class 29	Demand in diverse economic fields.	
Class 30	Continue	
Week 11	Supply analysis – supply function, factors	
Class 31	Influencing supply, elasticity of supply.	
Class 32	Continue	
Class 33	Derivation of market demand curve and market equilibrium.	
Week 12	**Microeconomics**	
Class 34	Derivation of market demand curve and market equilibrium	
Class 35	Derivation of market demand curve and market equilibrium	
Class 36	Derivation of market demand curve and market equilibrium	
Week 13	**Macroeconomics**	
Class 37	Key concept of macroeconomics	
Class 38	Key concept of macroeconomics	
Class 39	National income analysis	
Week 14	**Macroeconomics**	
Class 40	Economic problem of developing countries; Planning in	

	Bangladesh	
Class 41	Economic problem of developing countries; Planning in Bangladesh	
Class 42	Economic problem of developing countries; Planning in Bangladesh	

Text Book:

1. Economics by P. A. Samuelson and W. D. Nordhaus(7th Edition)
2. 2.An Introduction To Positive Economics By R G Lipsey(7th Edition)
3. Introductory Economics by G. F. Stanlake and S. J. Grant (6th Edition)

Hum 421: Society, Culture and Engineering Ethics

3.00 Contact Hour; 3.00 Credit Hour;

Pre-requisite: None

Rationale: Introduce basic sociological perspectives. Provide a clear understanding in social structures and stratification patterns. Discuss the social problems and ways of solving as well as coping with them.

Objectives:

1. Understanding the relation between engineering and society/environment.
2. Develop theoretical knowledge and focus on practical understanding about social and cultural diversity in order to face the ways of life and fit in there
3. Understanding of ethics and responsibility of engineers as professionals.
4. Ability to make ethical judgments and solve problems.
5. Attitudes required from engineers and values shared by engineers.

Course Outcomes:

Upon completion of the course, the students will be able to:

1. Explain the basic perception of profession, professional code of ethics, various moral & social issues, industrial standards and role of professional ethics in engineering field.
2. Practice professional responsibilities of an engineer for safety and risk benefit analysis.
3. Evaluate complex environmental or social issues from various ethical perspectives.
4. Effectively communicate the knowledge and understanding of engineering ethics

Course Contents:

Understanding Sociology and Its Theoretical Background: Introducing Sociology: Science of society. Definition and subject matter of Sociology, Significance of studying sociology, Understanding Changing Society and Culture, Economic Systems:Capitalism, Socialism, Islam, The Informal Economy , The Changing Face of the Workforce, Deindustrialization and Off shoring, Political System, Government, Power, and Authority ,Types of Government : Monarchy, oligarchy, Dictatorship, Democracy, Understanding Social Institutions and Behaviors.

Ethics and Morality and Engineering: An Introduction, Ethical Thoughts, The origin of ethical thought, Ethics and law, Nature of ethical problems, Analysis of Ethical Problems, Types of issues in ethical problem solving, Application to a case study, Conflict problems, Application of problem- solving methods. Concept of profession, Engineering as a profession, Engineering verses other professions. The Rights and Responsibilities of Engineers: Doing The Right Things. Professional responsibilities, Professional rights.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

Assessment Method	**(%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Class Tests/Assignment/Presentation	20
Exam	
Final exam	70
.	

Mapping of Course Outcome and Program Outcomes:

Course Outcome (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic perception of profession, professional code of ethics, various moral & social issues, industrial standards and role of professional ethics in engineering field.								√				
2. Practice professional responsibilities of an engineer for safety and risk benefit analysis						√						
3. Evaluate complex environmental issues from various ethical perspectives.							√					
4. Effectively communicate the knowledge and understanding of										√		

Lecture Schedule:

Lectures	Topics
	Unde rstanding Sociology and Its Theoretical Background
Week1	Introducing Sociology: Science of society. Definition and subject matter of Sociology
Week2	Significance of studying sociology, Understanding Changing Society and Culture
Week3	Economic Systems, Capitalism, Socialism, Islam, The Informal Economy
Week4	The Changing Face of the Workforce, Deindustrialization and Off shoring, Political System, War and Peace
Week5	Government, Power, and Authority, Types of Authority : Traditional, Charismatic,
Week6	Legal- rational Types of Government : Monarchy, oligarchy, Dictatorship, Democracy
Week7	Understanding Social Institutions and Behaviors: Families: Definitions and Compositions, Changes and alternatives of family: Causes and impact of society.
	Ethics and Morality and Engineering
Week8	An Introduction, Ethical Thoughts, The origin of ethical thought, Ethics and law
Week9	Nature of ethical problems, Analysis of Ethical Problems, Types of issues in ethical problem solving
Week10	Application to a case study, Conflict problems, Application of problem-solving methods
Week11	Concept of profession, Engineering as a profession, Engineering verses other professions
Week12	The Rights and Responsibilities of Engineers: Doing The Right Things.
Week13	Professional responsibilities, Professional rights, Whistle-blowing. Environmental ethics
Week14	Computer ethics, Ethics and Research, Doing the right things, Avoiding impediments to ethical behavior, Professional success.

Text Books:

1. Charles B. Fleddermann. 2012. *Engineering Ethics*. 4th edition New Jersey, NJ: Pearson Education
2. Engineering Ethics, 1st Edition, Gail Baura
3. Richard T. Schaefer. 2013. *Sociology in Modules*. 2nd edition New York, NY: McGraw-Hill.

SHOP 108: Workshop Technology Sessional – I

1.50 Contact Hour; 0.75 Credit Hour ;

Pre -requisite (if any)**:** None.

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.

Objectives:

1. To know about Foundry Shop: Study of Foundry Shop: Patterns, Molds, Cores.
2. To create molding by using molding sand.
3. To analyze metal melting and Casting inspection of casting and casting defects.
4. To know about Electric arc welding and analyze the procedure of arc welding.
5. To know about Gas welding and analyze the procedure of Gas welding.
6. To know about Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and analyze the procedure of these both.
7. Impart knowledge to students in the latest technological topics on Production and Industrial Engineering and to provide them with opportunities in taking up advanced topics in the field of study.
8. 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 (CO):

Upon completion of the course, the students will be able to:

1. Explain about Foundry Shop**:** Study of Foundry Shop: Patterns, Molds, Cores.

2. Create molding by using molding sand.

3. Analyze metal melting and Casting inspection of casting and casting defects.

4. Describe about Electric arc welding and **analyze** the procedure of arc welding.

5. Explain about Gas welding and **analyze** the procedure of Gas welding.

6. Describe Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and **analyze** the procedure of these both.

Course Contents:

Foundry: Introduction to foundry, hand tools and equipment; Patterns: function, pattern making;
Molding: molding materials sand preparation, types of mold, procedure; Cores: types, core making materials; Metal melting and casting; Inspection of casting and casting defects.
Sheet metal working and other operations like cutting, shearing, f illing, sawing and contouring; **Metal joints:** riveting, grooving, soldering, welding; Welding practice: welding processes, electric arc - steel, aluminum; Types of electrode;

Welding defects: visual, destructive and non-destructive tests of welding. Gas welding and equipment; Types of flame, flame cutting; Welding of different types of materials; Gas welding defects; Test of gas welding; Welding of aircraft materials.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

	Assessment Method	**(%)**
	Class Assessment	
	Class Participation	05
	Class Attendance	05
	Class Tests/Assignment/Presentation	20
	Exam	
	Final exam	70

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

Course Outcome (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain about Foundry Shop**:** Study of Foundry Shop: Patterns, Molds, Cores.	√											
2. Create molding by using molding sand.									√			
3. Analyze metal melting and Casting inspection of casting and casting defects.						√						
4. Describe Electric arc welding and **analyze** the procedure of arc welding.												√

5. Explain about Gas welding and **analyze** the procedure of Gas welding.												√
6. Describe Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding and **analyze** the procedure of these both.						√						

Text and Ref Books:

1. Machine Shop Practice – James Anderson; W. A. Chapman.
2. Shop Theory –Anderson & Tatro.

SHOP 112: Workshop Technology Sessional –II

1.50 Contact Hour; 0.75 Credit Hour;

Pre-requisite (if any)**:** Workshop Technology Sessional – I

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).

Objectives:

1. To Know about Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine.
2. To create part by doing different operations in Engine Lathe.
3. To learn to operate Milling machine to create a job.
4. To learn to operate shaper machine to create a gear.
5. To learn to use CNC Milling machine to manufacture a part automatically by using a CAD drawing.
6. To integrate the concept of machine design with fabrication.
7. To critically analyze the feasibility of manufacturing specific pieces.
8. To operate machines safely.
9. To Work effectively with others.
10. To conduct themselves ethically and responsibly in a machine shop context.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Explain Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine.

2. Create a part by doing different operations in Engine Lathe.

3. Use Milling machine to create a job.

4. Use shaper machine to create a gear.

5. Use CNC Milling machine to manufacture a part automatically by using a CAD drawing.

Course Contents:

Tools: common bench and hand tools, holding tools, hammers, cutting tool materials, cutting tool shapes, marking and layout tools, measuring tools, cutting tools, machine tools, Bench work on jobs;

Practices on machine tools: drilling machine, lathe machine, shaper machine, milling machine, grinding machine, bending, debarring and finishing operations and contour-cutter machines. Discuss operations like turning, tapering, boring, drilling, threading and gear cutting; Indexing operations and various types of indexing on milling machines.

Introduction to composite materials: plastics, ceramics and adhesives etc.

NC and CNC-machining; Principles and programming basics.

1. Study of different operations in Engine Lathe and manufacturing a part.
2. Study of Milling Machine.
3. Study of Shaper machine.
4. Manufacturing a job using Bench, Drilling Machine and Grinding Machine.
5. Study of CNC Milling Machine.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of CO with Assessment Methods& their Weights:

Assessment Method	**(%)**
Class Assessment	
Class Participation	05
Class Attendance	05
Viva/ lab report	20
Quiz	70

Mapping of Course Outcomes and Program Outcomes:

Course Outcome (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain Lathe machine, Milling machine, Shaper Machine, CNC Milling Machine.					√							
2. Create a part by doing different operations in Engine Lathe.			√									

3. Use Milling machine to create a job.					√							
4. Use shaper machine to create a gear.					√							
5. Use CNC Milling machine to manufacture a part automatically by using a CAD drawing.					√							√

Text Books:

1. Machine Shop Practice – James Anderson; W. A. Chapman.
2. Shop Theory –Anderson & Tat