SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

BHAI JAITA SUBHARTI ENGINEERING COLLEGE

ORDINANCE No. V (2A) RELATING TO

BACHELOR OF TECHNOLOGY (B.Tech.) PROGRAMME

(Effective from the Session – 2023-24)

General

1. This ordinance may be called **"Ordinance Relating to Bachelor of Technology (B.Tech)"** Programme**.**

2. It shall come enforced with immediate effect from session 2023-24.

3. This supersedes the previous Ordinance relating to Bachelor of Technology (B.Tech) Programme ordinance no. [V (2A)].

4. The degree "Bachelor of Technology" acronym as B.Tech shall be of four years (eight semesters) in the branches of Engineering prevalent in the institute at a point of time based on Choice Based Credit System (CBCS) as per AICTE guidelines.

CHAPTER – 1

1.1 Introduction

Bhai Jaita Subharti Engineering College is a constituent Institute of Swami Vivekanand Subharti University, Meerut has been established in 2019 with the vision we make every decision to support the career and personal development of our learners. Our curriculum, teaching and services demonstrate that we value the diverse profiles of our learners. The University boasts of highly qualified, dedicated and competent faculty from all walks of life, world class infrastructure, fully equipped Laboratories with latest state-of-the-art equipment and a huge library with recent knowledge resources including e-resources. Swami Vivekanand Subharti University providing a safe and healthy working environment for teaching and non-teaching employees, students, and visitors etc.

1.2 Vision

To become a dynamic, demand driven, quality conscious, efficient and innovative institute capable of becoming active partner in the techno-economic growth of the Nation and to provide world class technological education and research inputs to the society.

1.3 Mission

Strive to create centre of excellence in specialized areas of technology and enable its academic beneficiaries to become competent professionals capable of providing sustainable solutions to challenging problems of the society and industry.

1.4 Programme Educational Objectives (PEOs):

The Programme Educational Objectives of B.Tech. programmes are:

PEO1. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms

PEO2. To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise

PEO3. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, design and implementation skills

PEO4. To prepare graduates who will thrive to pursue life-long learning to fulfill their goals

1.5 Programme Outcomes (POs):

Engineering programmes are designed to prepare graduates to attain the following program outcomes:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineeringproblems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge andresearch methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, andmodern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge toassess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professionalengineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilitiesand norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member orleader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with theengineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **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 and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability toengage in independent and life-long learning in the broadest context of technological change.

CHAPTER-2

Eligibility for Admission

2.1 (i) An applicant is eligible for admission in the 1 Year of the B.Tech. programme provided that, he/she should be at least 17 years on 31 December of the year of Admission. The upper age limit for taking admission in Under Graduate Programme will be 30 years.

An applicant should have passed intermediate examination or an equivalent examination from any recognized board/university with Physics, Mathematics and Chemistry as compulsory subjects.
The admission shall be considered purely on the basis of merit in the University entrance test and counseling conducted by the university. The applicant who have 45 % of marks (40 % for SC/ST) [as per AICTE norms*] or more in the above mentioned three subjects and not less than 45 % marks (40 % for SC/ST) in the optional subjects will be considered for direct admission against seats, which might not have been filled up through the examination and counseling.

The applicant who has obtained a two/three year Engineering Diploma with Minimum (45 %) aggregate marks from a recognized Institute/University will be considered eligible for direct admission in the second year of the B.Tech programmes.

The applicant having a three year B.Sc. degree with Mathematics with a minimum of 40 % marks in aggregate from a recognized university will be considered eligible for direct admission in the second year of the B.Tech programmes. Provided that the students belonging to B.Sc. Stream, shall clear the subjects Engineering Graphics/Engineering Drawing and Engineering Mechanics of the First Year Engineering Programme along with the Second year subjects.

Provided that the students belonging to B.Sc. Stream shall be considered only after filling the supernumerary seats in this category with students belonging to the Diploma Stream.

6 Subject to moderation in accordance with the guidelines of AICTE

2.2 The B.Tech. programme is available in the following discipline:

(i) Aerospace Engineering

2.3 Selected candidates shall be allocated a discipline from those listed in clause 2.2 on the basis of merit, choice and counseling.

2.4 Request for change in discipline may be considered on the basis of merit in the entrance examination provided that the seat remains vacant after the last date for admission in B.Tech. programme.

2.5 After 2nd Semester, a student can apply for change of branch which shall be considered on the following grounds:

1. Availabilities of seats in branch as per sanctioned intake by AICTE.

(ii) The students should have passed 1st and 2nd Semester examination without any carry over paper.

1. The branch from which the students will be shifted must not fall below 75 % of its sanctioned intake.

2.6 The change of discipline shall be allowed only once during the programme.

CHAPTER-3

Teaching Course

3.1 The programme will be of four years duration, divided in to eight semesters.

3.2 The duration of the B. Tech. programme for the candidates admitted in semester I will be four academic years (eight semesters).

3.3 The duration of the B. Tech. programme for the candidates admitted in semester III (lateral entry) will be three academic years (six semesters).

3.4 Annual academic calendar shall be published by the University.

3.5 There shall be normally 14 weeks of teaching in every semester.

3.6 Study & evaluation scheme is enclosed as an Annexure A.

CHAPTER-4

Curriculum/Structure

4.1 The programme shall be spread over four academic years, spread over eight semesterscomprising actual teaching for a minimum of 90 days in each semester.

4.2 The programme focuses on the following aspects:

- Competency
- Entrepreneurship
- Skill Enhancement
- Value Added Courses
- Extracurricular activities

4.3 Choice Based Credit System (CBCS) :

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising Professional/Program Core Courses (PC), Professional/Program Elective Courses (PE), Engineering Science Courses (ES), Basic Sciences Courses (BS), Humanities and Social Sciences including Management Courses (HS) Mandatory Courses(MC) and Open Elective Courses (OE). The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student"s performance in examinations, the UGC has formulated the guidelines to be followed.

4.3.1 Structure of Undergraduate programs

The four year B. Tech. programme compromise of courses divided in seven distinct areas, namely: Professional/Program Core Courses (PC), Professional/Program Elective Courses (PE), Engineering Science Courses (ES), Basic Sciences Courses (BS), Humanities andSocial Sciences including Management Courses (HS) Mandatory Courses (MC) and OpenElective Courses (OE). All the courses offered in first year B. Tech. programs are categorized as

„Common Courses" for all the academic programs. Credits assigned and curricularcomponents of the B. Tech. curriculum are given in Annexure A.

Professional/Program Core Courses (PC)

The departmental core consists of courses considered essential for a chosen Engineering/Science discipline including, Engineering design, Seminar, Industrial Training and Project (PROJ).

Professional/Program Elective Courses (PE)

The students are required to complete a specific number of elective courses. Every department offers a wide variety of elective courses to students providing them opportunity to discover their academic interest and enhancing their engagement in learning process.

Open Elective Courses (OE)

The Open Electives courses are offered by different academic departments to the students of all disciplines. A wide range of elective courses is available with each branch. When a student opts elective courses offered in his/her program it will be termed as OE.

Humanities and Social Sciences including Management Courses (HS)

The Humanities, Social Sciences and Management Courses consist of courses considered essential for a B.Tech. program to inculcate the essence of technical writing, communication skills, economics and analysis, management and professional ethics & human values.

Basic Sciences Courses (BS)

The Applied Sciences and Mathematics Courses consist of courses considered essential for a B.Tech. program to build the foundation for learning of engineering core courses.

Engineering Science Courses (ES)

The students are required to complete a minimum number of Allied engineering courses (majority of them taught as common courses) offered by engineering departments other than his/her parent department. These courses expose the student with wide spectrum knowledge of allied engineering domain connected to the main engineering stream of the course of study of the students of concerned departments.

Mandatory Courses (MC)

The mandatory courses considered essential for a B.Tech. programme to inculcate the essence of Environmental Sciences, Induction program, Indian Constitution, Essence of Indian Knowledge Tradition etc.

4.4<u>Induction Program</u>

Three weeks duration Induction program for students to be offered right at the start of the first year. These activities are listed under following 7 heads:

1 Physical and Health
2 Culture
3 Literature and Media
4 Social Service
5 Self development
6 Nature and Environment
7 Innovation

4.5 The academic calendar shall be as follows: -

I , III , V, VII Semester (Odd)	Session - 1st Aug. to 30th Nov Exam - 1st Dec. to 20th Dec.
II, IV, VI, VIII Semester (Even)	Session - 1st Jan. to 10th May Exam - 1st May to 20th May

CHAPTER-5

Attendance

5.1 The students are expected to attend all the classes and should not have less than 75 % attendance in theory as well as in practical classes, wherever held, to become eligible to appear for the university examination. Short fall in attendance can, however be condoned in deserving cases to the extent of 10 % by the Principal. If the short fall is more than 10 % but not more than 15 %, the Principal may recommend deserving cases to the Vice Chancellor for condo-nation. The order of the Vice Chancellor in this regard shall be final.

CHAPTER-6

Examination

All Courses offered by FET will have an evaluation system within two components as:

1. Continuous Comprehensive Assessment (CCA) accounting for 30% of the final grade that a student gets in a course, and

2. End-Semester Examination (ESE) accounting for the remaining 70% of the final grade that the student gets in a course.

A student will have to pass both the components i.e. CCA and ESE separately to become eligible to be declared successful in a course.

6.1 Continuous Comprehensive Assessment (CCA)

Award of Sessional Marks:

Sessional marks for theory subjects and practicals and shall be awarded as per the breakup of sessional marks given below:-

Theory Subjects :

(a) Class test will comprise two mid-term test of equal weightage. -**20 Marks**

(b) Marks for regular class attendance - **10 Marks**

2. Practical :

(a) Two–mid-term viva-voce test of equal weightage. - **5 Marks**

1. Teacher"s assessment (including 5 marks for regular attendance) based on lab record attendance - **10 Marks**

5. Make-up test may be held for those students who fail to appear in any one of the mid-term class test due to genuine unavoidable reasons, provided prior permission was consented from the Principal.

6. A maximum of 10 marks in each subject shall be awarded for attending classes (theory/practical) as per the following norms:

1. 85 % or more attendance	10 Marks
2. 80 % or more but less than 85 % attendance	09 Marks
3. 75 % or more but less than 80 % attendance	08 Marks
4. 70 % or more but less than 75 % attendance	07 Marks
5. 65 % or more but less than 70 % attendance	06 Marks
6. 60 % or more but less than 65 % attendance	05 Marks
7. 51 % or more but less than 60 % attendance	04 Marks
8. 50 % attendance	01 Marks
9. Less than 50 % attendance	0 Marks

6.2 **Award of General Proficiency Marks:**

The marks in General Proficiency shall be awarded on the following basis:-

(i) Co-curricular & Extra-curricular activities (games, sports, cultural and literary activities etc.) **50%**

(ii) Discipline inside and outside the college campus (including 10 marks for regular attendance) **50%**

6.3 The marks for seminar, industrial training and educational tour shall be awarded on the following basis:

(i)	Write-up/Report	50%
(ii)	Presentation	50%

6.4 END SEMESTER EXAMINATION (ESE)

The remaining 70% of the final grade of the student in a course will be assessed on the basis of an end semester examination (ES) that will be for three hours duration and will cover the entire syllabus of the course. The question papers for the ESE will be got set by the Controller of Examinations (COE) of the Swami Vivekanand Subharti University (SVSU) by a selected faculty panel.

6.5 The entire programme has to completed within a maximum of seven years from the date of original admission in the programme by those students who are admitted in the first year and within six years by those admitted directly in the Second Year, [Vide clause 2.1 (iv, v)]

CHAPTER-7

Paper Setting

7.1 The work of setting the end semester examination papers and evaluation of scripts and conduct of the end semester practical examination shall be assigned to the course teachers as well as to outsiders, ordinarily in the ratio of 50:50 for internal and external valuation respectively.

Results

7.2 The result shall be prepared at the end of each academic year of the programme by aggregating the marks obtained in the theory and practical examinations in all the semesters of the programme till date.

(a) The minimum passing marks in each theory subject (including sessional marks) shall be 40% and 50% in aggregate. The minimum pass marks in a project/ Practical subject (including sessional marks if any), Seminars, Industrial Training and Educational Tour, Viva-Voce etc. shall be 50%.

(b) If a student obtained 40% marks in at least 50% of the papers (ignoring fractions) including project report, he/she will be provisionally promoted to the next year with carryover papers and will have to appear & obtain pass marks in carryover papers along with the subsequent regular examinations for the relevant semester.

(c) If a candidate fails in only one head/subject and having passed in all other head/subject of the given examination of the year than his/her deficiency of maximum five (05) marks may be fulfilled by grace marks after fulfilling the conditions given below:

7.3 If a candidate fails in only one head/subject and having passed in all other heads/subjects of the given examination of a **semester*/year**, then his/her deficiency of marks may be fulfilled by grace marks under the following conditions:-

(i) Grace marks is not a matter of right of the student but is the discretion of the University.

(ii) Provided that the candidate has appeared in the main examination of the concerned programme and falls short of pass marks by not more than five (05) marks in theory paper only. Benefit of above mentioned shall not be given to the candidate who had appeared in supplementary/special examination/carry over examination.

(iii) Further, benefit of grace marks may be given only to the candidate who will pass the entire concerned examination of the **semester*/year** after awarding the grace marks and not for the purpose of promoting the student to next year with back papers or for improvement of division or percentage.

(iv) If in a head/subject of an examination passing in Theory, Practical or sessional exams separately is mandatory, then the benefit of grace marks shall be given only in Theory examination of the University examination.

(v) The award of grace marks permissible shall be on the basis of 1 grace mark for every 05 marks secured by an examinee over and above the minimum passing aggregate marks of all subjects of the year.

7.4 Awarding of Grace Marks shall be done as given below:-

Aggregate Marks Obtained over & above minimum passing marks	Permissible Grace Marks
1-5	1
6-10	2
11-15	3
16-20	4
21-25	5

Total number of Grace Marks given to the student will be marked with astrick (*) at the bottom of the mark sheet.

* Grace Mark in semester examination will be considered hereinafter.

A student not covered by clause 7.2 (a) to (c) above shall have the following options to complete his/her programme -

(i) He/ she may take admission on payment of full annual programme fee and repeat the entire year of study. He /She shall be treated as a regular student. Or

(ii) He /She may pay only University exam fee for the End Semester Examination and appear in the End Semester University exams directly. He /She shall not be allowed to attend classes and the Sessional marks obtained earlier shall be retained. Or

(iii) He /She may pay half of the annual programme fee and attend classes. The sessional marks obtained by him/her earlier shall be retained. There will not be any requirement of minimum attendance for appearing in the University examination

7.5 A student will not be promoted to the next academic year if the carryover papers are more than 50% at one point of time.

Evaluation under Grading Assessment

7.6 The minimum Grade/ Grade Point required to pass each paper in a semester examination under CBCS shall be Grade D/ Grade Point 4 in each theory paper/ Practical/Project (wherever applicable) in External Examination and Internal Assessment separately.

Calculation Criteria

7.7 To implement the following grading system, the colleges/campuses shall use the following UGC recommended 10 point grading system:

Marks (%)	Letter Grades	Grade Points (G)
85-100	A++ (Outstanding)	10
75 to < 85	A+ (Excellent)	9
70 to <75	A (Very Good)	8
65 to <70	B+ (Good)	7
60 to <65	B (Above Average)	6
50 to <60	C (Average)	5
40 to <50	D (Pass)	4
0 to <40	F (Fail)	0
	AB (Absent)	0

7.8 Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

$$(Si) = \sum (Ci \times Gi) / \sum Ci,$$

where Ci is the number of credits of the i_{th} programme and Gi is the grade point scored by the student in the ith programme.

$$CGPA = \sum (Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts

CHAPTER-8

Power to Modify

8.1 In the event of any emergent situation, if any deviation is considered necessary, the Vice-Chancellor is authorized to modify the ordinance. Subjected to subsequent ratification by the executive council.

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SWAMI VIVEKANAND
SUBHARTI UNIVERSITY, MEERUT

EVALUATION SCHEME

B.TECH.

(Aerospace Engineering)

W.E.F. SESSION 2023-24

BHAI JAITA SUBHARTI ENGINEERING COLLEGE
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FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B.Tech Ist Year/Ist Semester (Common to all branches)
w.e.f academic Session 2023-24

SEMESTER I

3-WEEKS INDUCTION PROGRAMME in the beginning of the session

S. No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	KAS-101/ KAS-102	Engineering Physics/ Engineering Chemistry	BS	3	1	0	20	10	30	-	70	-	100	4
2	KAS-103	Engineering Mathematics-I	BS	3	1	0	20	10	30	-	70	-	100	4
3	KEEE-101/ KCSE-101	Basic Electrical & Electronics Engineering/ Programming For Problem Solving	ES	3	1	0	20	10	30	-	70	-	100	4
4	KME-151/ KME-152	Engineering Graphics & Design Lab/Workshop Practices Lab	ES	1	0	4	-	-	-	15	-	35	50	3
5	KAS-151/ KAS-152	Engineering Physics Lab/ Engineering Chemistry Lab	BS	0	0	3	-	-	-	15	-	35	50	1
6	KEEE-151/ KCSE-151	Basic Electrical& Electronics Engineering Lab/Programming for Problem Solving Lab	ES	0	0	3	-	-	-	15	-	35	50	1
7	KHU-101	Design Thinking Lab	HS	0	0	2	-	-	-	15	-	35	50	1
8	KAU-101*	IDEA Lab Workshop	AU	2	0	4	-	-	-	15	-	35	50	0
Total													**550**	**18**

***Compulsory Qualifying Audit Course**

Abbreviation Used:

BS: Basic Science Course
ES: Engineering Science Course
HS: Humanities and Social Sciences including Management Course
AU: Audit Course

FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B.Tech Ist Year/2nd Semester (Common to all branches)
w.e.f academic Session 2023-24

SEMESTER II

S No.	Course Code	Course Name	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	KAS-201/ KAS-202	Engineering Physics/ Engineering Chemistry	BS	3	1	0	20	10	30	-	70	-	100	4
2	KAS-203	Engineering Mathematics II	BS	3	1	0	20	10	30	-	70	-	100	4
3	KEEE- 201/ KCSE-201	Basic Electrical& Electronics Engineering/ Programming For Problem Solving	ES	3	1	0	20	10	30	-	70	-	100	4
4	KME-251 / KME-252	Engineering Graphics & Design Lab/Workshop Practices Lab	ES	1	0	4	-	-	-	15	-	35	50	3
5	KHU- 201	Professional English	HS	2	0	0	20	10	30	-	70	-	100	2
6	KAS-251/ KAS-252	Engineering Physics Lab/ Engineering Chemistry Lab	BS	0	0	3	-	-	-	15	-	35	50	1
7	KEEE-251/ KCSE-251	Basic Electrical& Electronics Engineering Lab/Programming for Problem Solving Lab	ES	0	0	3	-	-	-	15	-	35	50	1
8	KHU- 251	Professional English Lab	HS	0	0	2	-	-	-	15	-	35	50	1
9	KHU-202	Universal Human Values-II: Understanding Harmony and Ethical Human Conduct	HS	2	1	0	20	10	30	-	70	-	100	3
10	KAU-202*	Sports and Yoga/NSS or NCC	AU	0	0	3	-	-	-	100	-	-	100	0
Total													**800**	**23**

***Compulsory Qualifying Audit Course**

Abbreviation Used:

BS: Basic Science Course
ES: Engineering Science Course
HS: Humanities and Social Sciences including Management Course
AU: Audit Course

SUBHARTIINSTITUTEOFTECHNOLOGYAND ENGINEERING

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B.Tech. 2nd Year/3rd and 4th Semester (Aerospace Engg.)

w.e.f academic Session 2024-25

SEMESTER III														
S.No	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
THEORY SUBJECTS														
1	KAE-301	Engineering Mechanics	PCC	3	1	0	20	10	30	-	70	-	100	4
2	KAE-302	Aero Engineering Thermodynamics	PCC	3	1	0	20	10	30	-	70	-	100	4
3	KOE-3**/ KAS-303	Science Based Open Elective/ Mathematics-III	ES/BS	3	1	0	20	10	30	-	70	-	100	4
4	KAE-303	Introduction to Aerospace	PCC	3	0	0	20	10	30	-	70	-	100	3
5	KAE-304	Materials Engineering	PCC	3	0	0	20	10	30	-	70	-	100	3
6	KHU-305 /KAS-304	Soft Skills*/ Environmental Science *	HS/BS	3	0	0	20	10	30	-	70	-	100	3
PRACTICALS														
7	KAE-351	Engg. Mechanics Lab	PCC	0	0	2	-	-		15	-	35	50	1
8	KAE-352	Aero Engineering Thermodynamics Lab	PCC	0	0	2	-	-	-	15	-	35	50	1
9	KCC-351	Internship Assessment/Mini Project	4 WEEKS	-	-	-	-	-	-	100	-	-	100	2
	TOTAL												**850**	**25**

* **May be offered through NPTEL**

SUBHARTIINSTITUTEOFTECHNOLOGYAND ENGINEERING

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B.Tech 2nd Year/4th Semester (Aerospace Engg.)

w.e.f academic Session 2024-25

SEMESTER IV														
S.No.	**CourseCode**	**CourseTitle**	**Course Type**	**Periods**			**CCA**				**ESE**		**Total**	**Credit**
				L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KAE-401	WIND Tunnel	PCC	3	0	0	20	10	30	-	70	-	100	3
2	KAE-402	Fluid Mechanics&FluidMachines	PCC	3	1	0	20	10	30	-	70	-	100	4
3	KAE-403	StrengthofMaterials	PCC	3	1	0	20	10	30	-	70	-	100	4
4	KOE-4**/ KAS-403	Science-Based Open Elective/Mathematics-III	ES/BS	3	1	0	20	10	30	-	70	-	100	4
5	KAE-404	Principles of Flight	PCC	3	0	0	20	10	30	-	70	-	100	3
6	KHU-405/ KAS-404	Soft Skills/ Environmental Science	HS/BS	3	0	0	20	10	30	-	70	-	100	3
7	KAE-452	Fluid Mechanics & FluidMachines lab	PCC	0	0	2	-	-	-	15	-	35	50	1
	TOTAL												**650**	**22**

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B. TECH. AEROSPACE ENGINEERING

YEAR 3RD, SEMESTER-V

S. NO.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS				TOTAL MARKS	CREDIT
							CCA			ESE		
				L	T	P	CT	AT	TOTAL			
		THEORY SUBJECTS										
1	KAE - 501	Aerodynamics –I	PCC-20	3	0	0	20	10	30	70	100	3
2	KAE - 502	Aircraft Structure-I	PCC-22	3	0	0	20	10	30	70	100	3
3	KAE - 503	Aerospace Propulsion –I	PCC-24	3	0	0	20	10	30	70	100	3
4	KAE - 504	Aircraft Material	PCC-26	3	0	0	20	10	30	70	100	3
5	KAE - 505	UAV system and Design	PEC-1	3	0	0	20	10	30	70	100	3
6	KOE - 501	Open Elective	OEC-1	3	0	0	20	10	30	70	100	3
		PRACTICALS										
7	KAE - 551	Aerodynamics –I	PCC-21	0	0	2	10	05	15	35	50	1
8	KAE - 552	Aircraft Structure-I	PCC-23	0	0	2	10	05	15	35	50	1
9	KAE - 553	Aerospace Propulsion –I	PCC-25	0	0	2	10	05	15	35	50	1
10	KAE - 554	Aircraft Material Lab	PCC-27	0	0	2	10	05	15	35	50	1
		TOTAL									**700**	**22**

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B. TECH. AEROSPACE ENGINEERING

YEAR 3RD, SEMESTER-VI

S. NO.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS				TOTAL MARKS	CREDIT
							CCA			ESE		
				L	T	P	CT	AT	TOTAL			
		THEORY SUBJECTS										
1	KAE -601	Avionics System	PCC-28	3	0	0	20	10	30	70	100	3
2	KAE -602	High Speed Aerodynamics	PCC-30	3	0	0	20	10	30	70	100	3
3	KHU - 601-632	Slot For HSMC	HSMC-4	3	0	0	20	10	30	70	100	3
4	KAE -603	Electric Propulsion	PEC-2	3	0	0	20	10	30	70	100	3
5	KOE - 601	Open Elective	OEC-2	3	0	0	20	10	30	70	100	3
		PRACTICALS										
6	KAE -651	Avionics System Lab	PCC-29	0	0	2	10	05	15	35	50	1
7	KAE -654	CFD Simulation Lab	PCC-31	0	0	4	10	05	15	35	50	1
	KAE -655	Computer Aided Engineering Lab	PCC-32	0	0	4	10	05	15	35	50	1
8	KAE -656	Advanced Designing Lab	PCC-33	0	0	4	20	10	30	70	100	2
		TOTAL									**700**	**20**

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B. TECH. AEROSPACE ENGINEERING

YEAR 4TH, SEMESTER-VII

S. NO.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS				TOTAL MARKS	CREDIT
							CCA			ESE		
				L	T	P	CT	AT	TOTAL			
		THEORY SUBJECTS										
1	KAE - 701	Introduction to Cryogenic	PEC-3	3	0	0	20	10	30	70	100	3
2	KAE - 702	Missile Aerodynamics	PEC-4	3	0	0	20	10	30	70	100	3
3	KAE - 703	Helicopter System Maintenance	PEC-5	3	0	0	20	10	30	70	100	3
4	KOE - 701	Open Elective	OEC-3	3	0	0	20	10	30	70	100	3
5	KHU - 701-732	Slot For HSMC	HSMC-5	3	0	0	20	10	30	70	100	3
6	KAE - 751	Project Stage-I	PCC-34	0	0	10	--	--	100	150	250	5
		TOTAL									**750**	**20**

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B. TECH. AEROSPACE ENGINEERING

YEAR 4TH, SEMESTER-VIII

S. NO.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK		MARKS					TOTAL MARKS	CREDIT
							CCA			ESE		
				L	T	P	CT	AT	TOTAL			
		THEORY SUBJECTS										
1	KAE - 801	Rocket missile Designing	PEC-6	3	0	0	20	10	30	70	100	3
2	KAE -802	Satellite Technology	PEC-7	3	0	0	20	10	30	70	100	3
3	KOE - 007-008	Open Elective	OEC-4	3	0	0	20	10	30	70	100	3
4	KOE -009-010	Open Elective	OEC-5	3	0	0	20	10	30	70	100	3
		PRACTICALS										
5	KAE- 851	Project Stage-II	PCC-35	0	0	18			150	300	450	9
		TOTAL									**850**	**21**

COURSETYPENOMENCLATURE

Course Code	Definitions
BS	Basic Science Courses
ES	Engineering Science Courses
HS	Humanities and Social Sciences including Management courses
PCC	Professional core courses
AU	Audit Course

The Mini Project or internship (4 weeks) will be done during summer break after 4th Semester and will be assessed during V semester.

PROGRAME CORE ELECTIVE COURSES (PCC)
[Aerospace Engineering]

Sr. No	Course Code	Course Title
	KAE-301	Engineering Mechanics
	KAE-302	Aero Engineering Thermodynamics
	KAE-303	Introduction to Aerospace
	KAE-304	MaterialsEngineering
	KAE-351	Engg. Mechanics Lab
	KAE-352	Aero Engineering Thermodynamics Lab
	KAE-401	WIND Tunnel
	KAE-402	Fluid Mechanics&FluidMachines
	KAE-403	StrengthofMaterials
	KAE-404	Principles of Flight
	KAE-452	Fluid Mechanics & FluidMachines lab
	KAE - 501	Aerodynamics –I
	KAE - 502	Aircraft Structure-I
	KAE - 503	Aerospace Propulsion –I
	KAE - 504	Aircraft Material
	KAE - 551	Aerodynamics –I
	KAE - 552	Aircraft Structure-I
	KAE - 553	Aerospace Propulsion –I
	KAE - 554	Aircraft Material Lab

	KAE -601	Avionics System
	KAE -602	High Speed Aerodynamics
	KAE -603	Electric Propulsion
	KAE -651	Avionics System Lab
	KAE -654	CFD Simulation Lab
	KAE -655	Computer Aided Engineering Lab
	KAE -656	Advanced Designing Lab
	KAE - 701	Introduction to Cryogenic
	KAE - 702	Missile Aerodynamics
	KAE - 703	Helicopter System Maintenance
	KAE - 751	Project Stage-I
	KAE - 801	Rocket missile Designing
	KAE -802	Satellite Technology
	KAE- 851	Project Stage-II

HUMANITIES, SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)

S.No	Subject Code	Subject Name
1	KHU-501/KHU-601/KHU-701	Humanities, Social Science including Management Courses
2	KHU-502/KHU-602/KHU-702	Foundational Course in Humanities (Development of Societies/Philosophy)
3	KHU-503/KHU-603/KHU-703	Education, Technology and Society
4	KHU-504/KHU-604/KHU-704	History of Science and Technology in India
5	KHU-505/KHU-605/KHU-705	Nyaya Logic Epistemology
6	KHU-506/KHU-606/KHU-706	Political and Economic Thought for a Humane Society
7	KHU-507/KHU-607/KHU-707	State, Nation Building and Politics in India
8	KHU-508/KHU-608/KHU-708	Psychological Process
9	KHU-509/KHU-609/KHU-709	Positive Psychology
10	KHU-510/KHU-610/KHU-710	Application of Psychology
11	KHU-511/KHU-611/KHU-711	Sociology, Society and Culture
12	KHU-512/KHU-612/KHU-712	Epochal Shift
13	KHU-513/KHU-613/KHU-713	Values and Ethics
14	KHU-514/KHU-614/KHU-714	Ethics and Holistic Life
15	KHU-515/KHU-615/KHU-715	Folk and Vernacular Expressive Tradition and Popular Culture
16	KHU-516/KHU-616/KHU-716	Universal Human Conduct
17	KHU-517/KHU-617/KHU-717	Gender Culture and Development
18	KHU-518/KHU-618/KHU-718	Introduction to Women's and Gender Studies

19	KHU-519/KHU-619/KHU-719	Advance Course in Peace Research
20	KHU-520/KHU-620/KHU-720	Contemporary India in Globalized Era: Challenges of Democracy and Development
21	KHU-521/KHU-621/KHU-721	Making Indian Culture: Epistemic Traditions, Literature and Performative Arts
22	KHU-522/KHU-622/KHU-722	Universal Human Values 2: Understanding Harmony
23	KHU-523/KHU-623/KHU-723	Human Relations at Work
24	KHU-524/KHU-624/KHU-724	Sanskrit Bhasa
25	KHU-525/KHU-625/KHU-725	Language and Communication
26	KHU-526/KHU-626/KHU-726	Language and Linguistics
27	KHU-527/KHU-627/KHU-727	Understanding Society and Culture through Literature
28	KHU-528/KHU-628/KHU-728	Fundamentals of Linguistics
29	KHU-529/KHU-629/KHU-729	Elements of Literature
30	KHU-530/KHU-630/KHU-730	Humanities and Multiple Dimensions of Ecology
31	KHU-531/KHU-631/KHU-731	Film Appreciation
32	KHU-532/KHU-632/KHU-732	Law and Engineering

MANDATORY COURSES:

1. KMC – 301/401/501 - Constitution of India
2. KMC- 302/402 Universal Human Values- I (During Induction program)
3. KMC- 303/403 Environment Science
4. KMC- 304/404 Essence of Indian Knowledge Tradition
5. KMC- 305/405 Learning an art form (During induction program)

- Syllabus will prepare as per scheduled

SEMESTER III

KAE-301	**ENGINEERING MECHANICS**	**3L:1T:2P**	**4credits**

Objectives:

- To understand the nature of forces, law of motion, free body diagram, and friction force developed on body.
- To understand the concept of centre of gravity of different geometries such as bars,cantilevers,beams,shafts,cylindersandspheresforvarioustypesofsimpleloads

- ——TocalculatetheMoment of Inertia of different shapes like circular ring, disc, cylinder, sphere and cone.

UNIT-I: (8hours)

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, and distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.

Friction: Friction force: Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

UNIT-II: (8hours)

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

UNIT-III: (8hours)

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

UNIT-IV: (10hours)

Kinematicsof rigidbody: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.

Kinetics of rigid bodies: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V: (6hours)

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.

Text/References:

- —J.L.Meriamand L.G.Kraige,"EngineeringMechanics:Dynamics",Wiley, 2011.

- —M. F. Beatty, “Principles of Engineering Mechanics”, Springer Science & Business Media,1986.
- —Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
- —Vela Murali, “Engineering Mechanics”, Oxford University Press (2010).

CourseOutcomes:

After completing this course, the students should be able to understand the

- ——Proficient Analysis of Two-Dimensional Force Systems:
- ——Comprehensive Understanding of Friction in Equilibrium Systems:
- ——Expertise in Beam and Truss Analysis:
- ——Advanced Calculation of Centroid and Moment of Inertia:
- ——Thorough Understanding of Kinematics, Kinetics, and Stress-Strain Relationships:

KAE-302	Aero Engineering Thermodynamics	3L:1T:2P	4credits

Objectives:

- —To learn about law’s of thermodynamics, work and heat interactions, and balance of energy between system and its surroundings.
- —To learn about application of 2nd law to various energy conversion devices.
- —To learn about the Available and unavailable energy and the relationship between the pressure, volume, temperature, enthalpy, and entropy.
- — To understand the term pure substances in brief.
- —To understand about the 2stroke, 4 stroke petrol & diesel engine and efficiency of cycle.

UNIT-I **(8 hours)**

Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic view points, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, electrical, magnetic, gravitational, spring and shaft work.

Zeroth law of thermodynamics: Concept of Temperature and its' measurement, Temperature scales. First law of thermodynamics: First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system andcontrol volume. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc.

UNIT-II **(8 hours)**

Second law of thermodynamics: Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and its corollaries, Thermodynamic Temperature Scale, PMM-II. Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT-III **(5 hours)**

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Helmholtz & Gibb's function. ***Thermodynamic relations:*** Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve.

UNIT-IV **(10 hours)**

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gasmixtures, Compressibility charts- Properties of two phase systems - Const. temperature

andConst.pressureheatingofwater; Definitionsofsaturatedstates;P-v-T surface;UseofsteamtablesandR134atables;Saturationtables;Superheatedtables;Identificationofstates& determinationofproperties,Mollier'schart.

UNIT-V **(9 hours)**

Introduction of IC engine. Classification and parts of IC engine. Two stroke and four stroke diesel and petrol engine. Air standard cycle (Otto, Diesel cycle & Dual Cycle). Efficiency of Otto, Diesel cycle

Outcomes:

- —After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
- —The students will be able to understand the principle of the increase of entropy, isentropic efficiency for compressors, turbines, and nozzles.
- — Students can evaluate changes in thermodynamic properties of substances.
- — The students will be able to differentiate 2 stroke, 4 stroke and understand the function of diesel and petrol engine.
- —The students will be able to use the Mollier'schart.
- —Students can evaluate the relationship of units.

TextBooks:

- Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals ofThermodynamics*,John Wileyand Sons.
- Jones,J.B.andDuggan,R.E.,1996, *EngineeringThermodynamics*,Prentice-Hallof India
- Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*,JohnWileyand Sons.
- Nag,P.K,1995,*EngineeringThermodynamics*,TataMcGraw-HillPublishingCo. Ltd.
Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
- Engineering Thermodynamics by Onkar Singh, New Age International.
- Engineering Thermodynamics by CP Arora.

- Engineering Thermodynamics by Rogers, Pearson. 11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.

KAE-303	**INTRODUCTION TO AEROSPACE**	**3L:0T:0P**	**3 credits**

Course Objectives:

- Study the basic concepts off lying.
- Understand about the air craft structures and materials.
- Acquire the knowledge of aircraft power plants.

UNIT-I **(8 hours)**

HISTORICAL EVALUATION: History of Aviation, Early development of Airplanes, Biplanes and Monoplanes, history of Spaceflight, development of space vehicle.

CONFIGURATIONS: Anatomy of flight vehicles, components of an Airplanes and their function, configuration of space vehicle, Earth's atmosphere and gravitational field, Bluff bodies v/s Streamlined body, Airfoil ,lift generation, significance of L/D ratio, Aerodynamic forces.

UNIT-II **(10 hours)**

AIRPLANE STRUCTURES AND MATERIALS: General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallicand N on metallic materials, use of aluminum alloy, titanium, stainless steel and composite materials. Stresses and strains – Hooke's law – Stress –strain diagrams –elastic constants.

UNIT-III **(10 hours)**

POWER PLANTS: Basic ideas about piston, turboprop and jet engines – Use of propeller and jets for thrust production – Comparative merits, principles of operation of rocket, types of rockets and typical applications, Exploration into space.

PROPULSION: Classification and essential features of propulsion, Jet propulsion, general characteristics of rocket engines, theory of propulsion, elementary gas dynamics, Spacecrafts and Aircraft performance.

UNIT-IV **(10 hours)**

INSTRUMENTS AND NAVIGATION: Basic Instrumentation, Electronics (DC Electronics, AC Electronics, Semiconductors, Electro-Optics and Digital Electronics),Sensing devices, bridge circuits,

Optical devices and Introduction to Computer Based Data Acquisition, Measurements in Aerodynamics, Flight Structures, Flight Control, Principles of Navigation, Celestial, Radio, and Inertial Navigation Schemes, Navigational and Guidance Requirements for Orbital, Planetary, and Atmospheric Entry Missions.

Course Outcomes:

- Learn the Atmospheric parameter changes with altitude.
- Ability to identify the types & classifications of components and control systems.
- An ability to differentiate the types of fuse lage and constructions.
- Understand the basic concepts of flight and different types of Engines and working principles.
- Understand measurement technology, usage of new instruments and real time applications in engineering studies.
- Understand the basic flight operation.

Text Books/ Reference Books:

1. Shevel,'FundamentalsofFlight',PrenticeHall,1989.
2. G.D.Merrill,'PrincipleofGuidedMissileDesign',VanNostrandCo.,INC.,1977.
3. J.D.Anderson,'IntroductiontoFlight',McGraw-Hill,2000.
4. A.C.Kermode,'FlightwithoutFormulae',Pitman,1970.

KAE-304	MaterialsEngineering	3L:0T:0P	3credits

Objectives:

- Understandingofthecorrelationbetweentheinternalstructureofmaterials,theirmechanicalpropertiesandvariousmethodstoquantifythe IrmechanicalintegrityandfailurecriteriaLearn how to construct and interpret phase diagrams and understand the phase transformations in binary systems.
- Toprovideadetailedinterpretationofequilibriumphasediagrams
- Learningaboutdifferentphasesandheattreatmentmethodstotailorthepropertiesof Fe-Calloys.

UNIT – I **(8 hours)**

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

UNIT – II **(8 hours)**

MechanicalPropertymeasurement:Tensile,compressionandtorsiontests;Young'smodulus,relations between true and engineering stress-strain curves, generalized Hooke's law, yieldingand yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell,Brinelland Vickersand theirrelation to strength.

UNIT – III **(8 hours)**

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximumnormalstress, Mohr-CoulombandModifiedMohr-Coulomb;Fracturemechanics: Introductionto Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using theModified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

UNIT – IV **(8 hours)**

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binaryphase diagrams and microstructure development; eutectic, peri-tectic, peri-tectoid andmonotecticreactions. IronIron-carbidephasediagramandmicrostructuralaspectsofledeburite, austenite, ferriteand cementite, cast iron.

UNIT – V **(6 hours)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermaltransformation diagrams for Fe-C alloys and microstructure development. Continuous coolingcurvesandinterpretationoffinalmicrostructuresandproperties-austempering,martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and inductionhardening,vacuum and plasmahardening.

UNIT – VI **(8 hours)**

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey,white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel;AluminumandAl-Cu–Mgalloys-NickelbasedsuperalloysandTitaniumalloys.

CourseOutcomes:

- Student will be able to identify crystal structures for various materials and understand the

defects in such structures.

- Understand how to tailor material properties of ferrous andnon-ferrous alloys.
- How to quantify mechanical integrity and failure in materials.

TextBooks:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition,Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall ofIndiaPrivateLimited, 4thIndian Reprint,2002.
3. V.Raghavan,"MaterialScienceandEngineering',PrenticeHallofIndiaPrivateLimited,1999.

KAE-351	ENGINEERING MECHANICS LAB	0L:0T:2P	1 CREDITS

OBJECTIVES:

1. To understand the vectorial and scalar representation of forces and moments
2. To describe static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions
3. To analyze the properties of surfaces & solids in relation to moment of inertia.
4. To illustrate the laws of motion, kinematics of motion and their interrelationship.
5. To comprehend the effect of Friction on general plane motion

List of Experiments: (At least 6 of the followings)

1. To verify the law of parallelogram of forces.
2. To study the equilibrium of a body under three forces
3. To determine the coefficient of friction of a flat surface.
4. To determine the deflection of beam (simple supported beam)
5. Experiment based on analysis of truss.

6. To conduct the tensile/ compression test and determine the ultimate tensile strength, percentage elongation for a mild steel specimen.
7. To conduct the Impact-tests (Izod / Charpy) on Impact testing machine to find the Impact Strength of the specimen.

Course Learning Outcomes (CLO):

1. Ability to install strain gages on several metallic (steel and aluminum) structural components and systems, and collect data from the strain gages
2. Ability to perform column buckling tests using wood specimens
3. Ability to perform aggregate analysis, prepare and test concrete cylinders and a reinforced concrete beam
4. Ability to design and conduct an experiment
5. Ability to compare experimental results to the theoretical results and write technical reports
6. Ability to work in a team

Text books/ Reference books: As per recommendation of concern instructor/ supervisor.

KAE-352	Aero Engineering Thermodynamics Lab	0L:0T:2P	1 CREDITS

Objectives:

- To understand the construction, working, and applications of fire tube boilers & water tube boilers
- To study the internal combustion (I.C.) engine, its classification, and the functions of its components
- To understand the construction, working principles, and performance characteristics of a two-stroke & four-stroke petrol engine.
- To understand the construction, working principles, and performance characteristics of a two-stroke & four-stroke diesel engine
- To prepare a heat balance sheet for a diesel & petrol engine test rig.

List of Experiments: (At least 6 of the followings)

1) Study of Fire Tube boiler.
2) Study of Water Tube boiler.

3) Study the I.C. Engine, classification and their parts.
4) Study and working of Two stroke petrol Engine.
5) Study and working of Two stroke Diesel Engine.
6) 4. Study and working of Four stroke petrol Engine.
7) Study and working of Four stroke Diesel Engine.
8) 5. Study the Indicated H.P. of I.C. Engine by Morse Test.
9) Prepare the heat balance sheet for Diesel Engine test rig.
10) Prepare the heat balance sheet for Petrol Engine test rig.

Course Outcomes:

- Students will be able to understand the different components and their functions in a fire & water tube boiler.
- Students will explore his Knowledge of the operational cycle and combustion process in two-stroke & four -stroke petrol engines.
- Enhance his Ability to measure and calculate the indicated horsepower of an I.C. engine.

FOURTH SEMESTER

KAE-401	WIND TUNNEL	3L:0T:0P	3 credits

Course Objectives:

- Understand the concepts of aerodynamics and types of wind tunnels.
- Understand the calibrations and its functions used in wind tunnels.
- Understand the different approaches of measurements.
- Apply the concept of aerodynamics in of advance wind tunnel.

UNIT-I: **(8hours)**

Wind Tunnel as a Tool: Typesofwindtunnels, special purposewindtunnels.

Wind Tunnel Design: Testsection,diffuser,fansection,fandesign,returnpassage, cooling, the breather-vibration, test section flow quality, effuser design, wind tunnelconstruction,energyratio,finalform.Test section, diffuser, fan section, fan design, return passage, cooling, the breather-vibration, test section flow quality, Effuser design, wind tunnel construction, energy ratio,finalform.

UNIT-II: **(10 hours)**

InstrumentationandCalibrationofTestSection

Measurement of pressure, velocity, turbulence, flow angularity, hot wire anemometry, laservelocitymeter,dataacquisition,flowvisualizationtechniques,windtunnelcalibration.

UNIT-III: (10 hours)

ModelForces,MomentandPressureMeasurement Windtunnelbalances-Internal&Externalbalances,designofwindtunnelbalances,Wakesurveymethod .

UNIT-IV: (10 hours)

WindTunnelCorrection

Method of Images, boundary corrections, buoyancy corrections, wake blockage, solidblockage-(2-D&3-Dcorrections).

UNIT-V: (8 hours)

Non-AeronauticalUsesofWindTunnel

Application in wind engineering, Surface vehicle testing, testing of buildings for windforces,pollution,otherapplicationsatlow Reynold numbers.

Course Outcomes:

- Learnthebasic concept ofWindtunnelanditsprinciples
- Understandthevarioustypesofwindtunnelsanditsfunctions
- Acquiretheknowledgeofcalibrationandmeasurementtechniques.
- Learntheadvancedtypesofwindtunnel
- Learnabouttheaerodynamicflow
- Learnaboutthedifferenttypesofforces

Text Books:/Reference Books:

1. LowspeedwindtunneltestingW.E.RaeandA.Pope,JohnWiley.
2. MeasurementofAirflow:PankhrustandOwer,PergamonPress.
3. Pope,A.,andGoin,L.,"HighSpeedWindTunnelTesting",JohnWiley,1985.
4. Bradsaw"ExperimentalFluidMechanics".
5. ShorttermcourseonFlowvisualizationtechniques,NAL,2009

KAE-402	Fluid Mechanics & Fluid Machines	3L:1T:2P	4credits

Objectives:

- Understand the fundamental properties of fluids and their dimensions, including mass density, specific volume, specific gravity, viscosity, compressibility, and surface tension.

- Describe fluid kinematics, including streamlines, path lines, and streak lines, and classify flows based on steadiness, uniformity, and nature (laminar/turbulent, rotational/irrotational).
- Explain boundary layer concepts, including definition, thickness, and characteristics for laminar and turbulent flow, and understand boundary layer transition and separation.
- Describe the basics of turbo machinery, including hydrodynamic forces on vanes and velocity diagrams, and understand the principles and classifications of hydraulic turbines.
- Classify centrifugal and reciprocating pumps based on their working principles and understand specific characteristics such as barometric head, efficiencies, and performance curves.

UNIT-I **(6 hours)**

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, massdensity,specificvolume,specificgravity,viscosity,compressibilityandsurfacetension,vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT-II **(8 hours)**

Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three dimensional flows. Fluid dynamics: **Surface and body forces** –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT-III **(10 hours)**

Boundary Layer Concepts*:* Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Closed conduit flow*:* Reynold's experiment- Darcy Weisbach equationMinor losses in pipes-pipes in series and pipes in parallel- total energy linehydraulic gradient line. Measurement of flow: pitot tube, venturimeter, and orifice meter, Flow nozzle

Needfordimensionalanalysis–methodsofdimensionanalysis–Similitude–typesofsimilitudeDimensionlessparameters–applicationofdimensionless parameters–Model

analysis.

UNIT-IV **(10 hours)**

Basics of turbo machinery*:* Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines*:* Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

Performance of hydraulic turbines*:* Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-V **(6 hours)**

Centrifugal pumps*:* Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH

Reciprocating pumps*:* Working, Discharge, slip, indicator diagrams

CourseOutcomes:

Uponcompletionofthis course,studentswill beableto

- Apply various pressure measurement techniques such as piezometer, U-tube manometer, and differential manometer to measure atmospheric, gauge, and vacuum pressures.
- Apply the equation of continuity for both one-dimensional and three-dimensional flows, and analyze fluid dynamics using Euler's and Bernoulli's equations along streamlines.
- Apply the Darcy-Weisbach equation for closed conduit flow and analyze minor losses in pipes, as well as determine the total energy line and hydraulic gradient line. Understand measurement techniques using pitot tube, venturimeter, and orifice meter.
- Analyze the performance of hydraulic turbines using geometric similarity and specific quantities, interpret characteristic curves, and discuss turbine governing mechanisms and issues like cavitation and water hammer.
- Describe the working principles of centrifugal and reciprocating pumps, analyze pump performance using specific speed and characteristic curves, and discuss factors affecting

pump efficiency and operation.

Text Books :

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

References :

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.

2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.

3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

KAE-403	Strength of Materials	3L:1T:0P	4 credits

Objectives:

- Understand the concepts of elasticity and plasticity, including types of stresses and strains, Hooke's law, stress-strain diagrams, and factors influencing material behavior under different loading conditions.
- Define beams and their types, and explain shear force and bending moment concepts. Develop shear force and bending moment diagrams for different types of beams under various loading conditions.
- Explain the theory of simple bending, derive bending equations, and determine bending stresses. Understand shear stress distribution across various beam sections and calculate shear stresses for different types of cross-sectional shapes.
- Introduce principal stresses and strains, and explain their determination using analytical and graphical methods. Describe various theories of failure, including Maximum Principal Stress Theory, Maximum Principal Strain Theory, and Von Mises Theory.
- Discuss the theory of pure torsion and its assumptions. Derive equations for torsional

stress, polar section modulus, and power transmission in shafts. Explain combined bending and torsion effects and their implications on shaft design.

UNIT – I **(6 hours)**

Simple Stresses & Strains : Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – compositebars. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II **(10 hours)**

Shear Force and Bending Moment : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III **(8 hours)**

Flexural Stresses : Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, and T sections, composite beam Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV **(8 hours)**

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.

Theories of Failure: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT – V **(8 hours)**

Torsion of Circular Shafts : Theory of pure torsion – Derivation of Torsion /L– Assumptions

made in the theory of pure torsionθequations : T/J = q/r = N – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells.

Outcomes:

After completing this course, the students should be able to

- Calculate stress and strain in materials, interpret stress-strain diagrams for mild steel, and apply concepts of working stress and factor of safety in engineering design. Understand the effects of temperature on material behavior and calculate strain energy and resilience under various loading conditions.
- Construct shear force and bending moment diagrams for cantilever, simply supported, and overhanging beams subjected to point loads, uniformly distributed loads (UDL), and uniformly varying loads. Analyze the relationship between shear force, bending moment, and loading rates along the length of a beam.
- Calculate bending stresses using the bending equation and determine section modulus for rectangular, circular, I, T, angle, and channel sections. Analyze shear stress distribution and calculate shear stresses across different beam sections to understand their structural behavior.
- Construct Mohr's circle of stresses and determine principal stresses and strains for complex loading conditions. Evaluate different failure theories and apply them to analyze material failure under various stress states and loading conditions.
- Calculate torsional stresses in circular shafts and determine the power transmitted by shafts under torsional loading. Design shafts considering combined bending and torsion effects using theories of failure. Analyze stress and strain in thin cylindrical and spherical shells and determine changes in diameter and volume under internal pressure.

TEXT BOOKS:

- Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
- R. Subramanian, Strength of Materials, Oxford University Press, 2007.

- Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi 2005.
- Solid Mechanics, by Popov.
- Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
- Strength of Materials – W.A. Nash, TMH.

REFERENCES :

- Strength of Materials -By Jindal, Umesh Publications.
- Analysis of structures by Vazirani and Ratwani.
- Mechanics of Structures Vol –I by H.J.Shah and S.B.Junnarkar, Charotar Publishing House Pvt. Ltd.
- Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
- Strength of Materials by S.S.Rattan, Tata McGraw Hill Education Pvt. Ltd.
- Fundamentals of Solid Mechancis by M.L.Gambhir, PHI Learning Pvt. Ltd
- Strength of Materials by R.K Rajput, S.Chand & Company Ltd.

KAE-404	**Principles of Flight**	**3L:0T:0P**	**3 Credits**

Objectives:

- Understand the basic principles of flight: Students should develop a foundational understanding of the principles and concepts that govern flight, including the four forces of flight (lift, weight, thrust, and drag) and their interactions.
- Comprehend aerodynamic principles: Students should gain knowledge of aerodynamic principles.
- Explain the factors influencing aircraft performance: Students should be able to analyze and explain the factors that affect aircraft performance, such as airspeed, altitude, temperature, and air density. They should understand how these factors impact aircraft behavior and capabilities.
- Apply principles of flight-to-flight operations: Students should be able to apply their knowledge of flight principles to real-world flight scenarios. They should be able to make informed decisions regarding aircraft operations, including takeoff, landing, maneuvering,

and understanding the limitations of the aircraft.

UNIT – I **(6 hours)**

Introduction to Aerodynamics:

- Definition and branches of aerodynamics
- Basic concepts: air, atmosphere, and airflow
- Forces acting on an aircraft: lift, weight, thrust, and drag

Properties of Air:

- Characteristics of air: density, pressure, temperature, and humidity
- Atmospheric layers and their variations
- Effects of altitude on air properties

Bernoulli's Principle:

- Bernoulli's equation and its application to fluid flow
- Relationship between airspeed, pressure, and airflow
- Application of Bernoulli's principle to lift generation

UNIT – II **(6 hours)**

Newton's Laws of Motion:

- Newton's three laws and their application to flight
- Inertia, acceleration, and action-reaction pairs
- Forces acting on an aircraft and their effects

Lift and the Wing:

- Wing shape and airfoil characteristics
- Generation of lift: Bernoulli's principle, angle of attack, and camber
- Lift coefficient and lift equation
- Factors affecting lift: airspeed, wing area, and air density

Drag and Thrust:

- Types of drag: parasite drag, induced drag, and form drag
- Factors influencing drag: airspeed, shape, surface roughness, and parasite drag components (skin friction and pressure drag)
- Thrust generation: propellers, jet engines, and rockets

Stability and Control:

- Longitudinal, lateral, and directional stability
- Control surfaces: ailerons, elevators, rudder, and flaps
- Control inputs and their effects on aircraft motion

UNIT – III **(8 hours)**

Aircraft Performance:

- Level flight performance: power required and power available
- Climb, descent, and maneuvering performance
- Range, endurance, and specific fuel consumption

Flight Instruments:

- Introduction to basic flight instruments
- Indicated airspeed, true airspeed, and groundspeed
- Altimetry and altitude measurements
- Heading and navigation instruments

UNIT – IV **(6 hours)**

Introduction to Aerodynamic Forces on Different Aircraft Types:

- Fixed-wing aircraft: airplanes and gliders
- Rotary-wing aircraft: helicopters and autogyros
- Other aircraft types: airships, balloons, and drones

Outcomes:

After completing this course, the students should be able to

- Demonstrate a solid understanding of the principles and concepts that govern flight, including the four forces of flight (lift, weight, thrust, and drag) and their interactions.
- Explain and apply the principles of aerodynamics, including the Bernoulli's principle, angle of attack, airfoil characteristics, and the generation of lift.
- Analyze and evaluate the factors that influence aircraft performance, such as airspeed, altitude, temperature, and air density, and understand their impact on aircraft behavior and capabilities.
- Apply the principles of stability and control to analyze and explain aircraft stability characteristics, including longitudinal, lateral, and directional stability.
- Access and analyze the impact of weight and balance on aircraft stability, control, and performance, and understand the importance of maintaining proper weight distribution.

- Apply the principles of flight to practical flight operations, including takeoff, landing, maneuvering, and understanding the limitations of the aircraft.

TEXT BOOKS:

- Introduction to Flight" by John D. Anderson Jr
- Fundamentals of Flight" by Richard S. Shevell
- Aerodynamics for Engineers" by John J. Bertin and Russell M. Cummings

KAE-452	Fluid Mechanics&Fluid Machines	0L:0T:2P	1credits

Objectives:

- To experimentally validate Bernoulli's theorem by demonstrating the relationship between pressure, velocity, and elevation in a flowing fluid.
- To study the force exerted by a fluid jet on stationary and moving vanes and to understand the principles of momentum transfer.
- To calibrate a Venturimeter, orifice meter and determine its coefficient of discharge.
- To evaluate the performance characteristics of a Pelton wheel, Kaplan & Francis turbine.
- To assess the performance characteristics of a single stage centrifugal pump.

List of Experiments: (At least 8 of the following)

1) Verification of Bernoulli's Theorems
2) Impact of jets on Vanes.
3) Calibration of Venturimeter.
4) Calibration of Orifice meter.
5) Performance Test on Pelton Wheel.
6) Performance Test on Francis Turbine.
7) Performance Test on Kaplan Turbine.
8) Performance Test on Single Stage Centrifugal Pump.
9) Performance Test on Multi Stage Centrifugal Pump.
10) Performance Test on Reciprocating Pump.

11) Determination of friction factor for a given pipe line.

12) Determination of loss of head due to sudden contraction in a pipeline.

Course Outcomes:

After completion of this Students will be able to

- Measure and analyze pressure variations in fluid flow, enhancing understanding of energy conservation in fluid systems.
- Calculate the impact force of a jet on different vane shapes, improving understanding of momentum transfer in fluid dynamics.
- Perform accurate flow rate measurements and calibrate flow measuring devices effectively.
- Measure flow rates using an orifice meter and analyze the relationship between flow rate and pressure drop.
- Measure and analyze the efficiency and power output, improving understanding of reaction turbine operation.
- Measure and interpret the performance data of Kaplan turbines, enhancing knowledge of adjustable blade turbines.

SEMESTER V

KAE-501 AERODYNAMICS-I L T P C 3-1-0-4

Course Objectives:

1. Understand the basics of aerodynamics, aerofoil and wing characteristics
2. Calculate forces and moments acting on aerofoils and wing sunde ri deal flow conditions.
3. Design a propeller and determine aerodynamic interaction effects between different. Components of aircraft.
4. Study the Conformal Transformation

Detailed Syllabus

Unit-I 8L

Introductory Topics for Aerodynamics: Properties of fluid, units, dimensions, form ofmatter, pressure, temperature, density, viscosity, specific heats and relations, enthalpy, entropy, atmosphere-ISA, types of flow,1-D flow equations, conservation of mass, momentum, energy, equation of state, pressure coefficient. Description of properties in a moving fluid, local and material rate of change. Streamlines, Pathlines, Streak lines, Reynolds Transport theorem, Vorticity and circulation. Laws of vortexmotion. Translation, rotationan drate of deformation of fluid particles.

Unit-II 8L

Potential Flow: Potential flow, velocity potential, stream function, Laplace equation, flowsingularities-Uniform flow. source, sink, doublet, Vortex, Non lifting and lifting flow over acylinderKutta-Joukows kit heorem. Magnus effect, circulation.

Unit-III 10L

Finite Wing Theory: Vortex motions, vortex line, vortex tube, vortex sheet; Circulation; Kelvin and Helmhotz theorem; Biot-Savart‘s law, applications, Rankine‘s vortex; Flow pastfinitewings,vortexmodelofthewingandboundvortices;Induceddrag;Prandtl‘sliftinglinetheory; Elliptic wing. Influence of taper and twist applied to wings, effect of sweep backwings; Deltawings, primary and secondary vortex; Elements of lifting surface theory. Source Panel Vortex panel and Vortex lattice methods.

Unit-IV 9L

Flow Past Non-Lifting Bodies and Interference Effects: Flow past non-lifting bodies, method of singularities; Wing body interference; Effect of propeller on wings and bodies and tail unit; Flow over airplane as a whole.

Unit-V

Conformal Transformation: Conformal transformation, Kutta-Zhukovaskytrans formation-circle to straight line, circle to ellipse, circle to symmetric aerofoil, circle to chamber edaero foil, circle to circulararc.

CourseOutcomes:

CO-1 Understandfundamentalsandknowthenon-dimensionalizationofaerodynamicforcesand moments; familiarwithairfoilnomenclatureandairfoilcharacteristics.

CO-2 UnderstandconformalmappingandJowkowskitransformationofairfoiltoacircularcylinder

CO-3 Understandplanepotentialflowandapplytoaerodynamicproblemsofacademicandpracticalinterest.

CO-4 Understandtheconformaltransformation

CO-5 Understandtheflowpastnonliftingbodiesandinterferenceeffects

CO-6 Understandtheconceptoffinitewing

Text Books:

1. E. L. Houghton and P. W. Carpenter, ―Aerodynamics for Engineering Students, EdwardArnoldPublishersLtd.,London,5thEdition,1982,

KAE-502

AIRCRAFT STRUCTURE-I

L T
3-1-

Course Objectives:

1. Understand various structural elements
2. Understandstaticallydeterminateandindeterminatestructuralanalysis.
3. Understand various energy method
4. Able to understand columns with various end condition

Detailed Syllabus

Unit-I	Statically Determinate Structures: Analysis of plane, Truss-Methodofjoints,3D Truss, Plane frames, Composite beam. Statically Indeterminate Structures: ProppedCantilever-Fixed-Fixedbeams-Clapeyron'sThreeMomentEquation–MomentDistributionMethod.	6L
Unit-II	Energy Methods: Strain Energy due to axial, bending and Tensional loads – Castiglione's theorems-Maxwell's Reciprocal theorem, Unit load method-application to beams, trusses, frames, rings, etc.	8L
Unit-III	Columns:Columnswithvariousendconditions–Euler'sColumncurve–Rankin'sformula-Columnwithinitialcurvature-Eccentricloading–Southwellplot–Beamcolumn.	10L
Unit-IV	Failure Theory: Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory –Distortion Theory – Maximum Strain energy theory – Application to aircraft Structural problems.	9L

Course Outcomes:

CO-1	Analysis structural elements in aircraft.
CO-2	Solve three moment equation and moment distribution.
CO-3	To make simplified analysis of a/c structures & apply energy methods.

CO-4	Understand and solve the column problems.
CO-5	Apply failure theories for various loading conditions
CO-6	Apply the concept of columns in a manufacturing

Text Books:

1. Donaldson,B.K.,"AnalysisofAircraftStructures-AnIntroduction",McGraw-Hill,1993.

Reference Books:

2. Timoshenko,S.,"StrengthofMaterials",Vol.IandII,PrincetonD.VonNostrandCo,1990

KAE-503	AEROSPACE	L T P C 3-1-0-4

PROPULSION-I

Course Objectives:

1. Know the fundamentals of gas turbines and its components.
2. Know the design and performance of subsonic and supersonic inlets
3. Know the different types of combustion chambers and factors affecting the combustors.
4. Know the different types of combustion chambers and factors affecting the combustors.
5. Study the types of nozzles and flow conditions in nozzles and types of compressors and their working principle

Detailed Syllabus

Unit-I	**Fundamentals of Gas Turbine 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 – Methods of thrust augmentation – Characteristics of turboprop, turbo fan and turbojet –Performance characteristics
Unit-II	**Subsonic and Supersonic Inlets for Jet Engines:** Internal flow and Stall in subsonic inlets –Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and eternal deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration–Models of inlet operation.
Unit-III	**Combustion Chambers:** Classification of combustion chambers – Important factors affectingcombustionchamberdesign–Combustionprocess– Combustionchamberperformance–Effectofoperatingvariablesonperformance– Flametubecooling–Flamestabilization–Useofflameholders–Numericalproblems.
Unit-IV	**Nozzles:** Theory of flow in is entropic nozzles–nozzles and choking–Nozzle throat conditions –Nozzle efficiency –Losses in nozzles– Over expanded and under – expanded nozzles-Ejectorandvariableareanozzles–Interactionofnozzleflowwithadjacentsurfaces– Thrustreversal.
Unit-V	**Compressors:**Principleofoperationofcentrifugalcompressor– Workdoneandpressurerise–Velocity diagrams – Diffuser vane design considerations – Concept of pre whirl, rotation stallandsurge–Elementarytheoryofaxialflowcompressor– Velocitytriangles–degreeofreaction – Three dimensional – Air angle distributions for free vortex and constant reaction designs –Compressorbladedesign– CentrifugalandAxialcompressorperformancecharacteristics.

Course Outcomes:

CO-1	Understandtheworkingprincipleofgasturbineengines,thermodynamiccyclesandperformancecharacteristicsofgasturbineengines
CO-2	Understandtheinternalflowandexternalcharacteristicsneartheinlets.Startingproblems and different modes of operation in supersonic inlets.
CO-3	Understand the types and working methods in combustion chambers. The flame stabilization and flame techniques
CO-4	Understand the flow through nozzle, choking, losses I nozzle, variable are a nozzle and thrust vector control.
CO-5	Know the types and working principles of compressors, velocity diagrams, blade design and performance characteristics of compressors.
CO-6	To know the formula for a gas turbine engine

Text Books:

1. P.G.Hill&C.R.Peterson,' Mechanics&ThermodynamicsofPropulsion',Addison–WesleyLongmanINC,**1999**.

Reference Books:

1. Cohen, H.Rogers, G.F.C.andSaravanamuttoo, H.I.H.,'GasTurbineTheory',Longman,**1989**.

KAE-504 **AIRCRAFT MATERIAL** **L T P C**

3-0-0-4

Course Objectives:

1. Introduction to Aircraft Materials
2. Material Selection Criteria
3. Material Properties and Testing
4. Material Behavior and Failure Analysis

Detailed Syllabus

Unit-I **8L**

Introduction to Aircraft Materials
- Importance of materials in aircraft design and performance
- Classification of aircraft materials: metals, composites, polymers, and ceramics
- Material selection criteria based on properties, performance, and application

Metals Used in Aircraft Construction
- Types of metallic materials used in aircraft (e.g., aluminum alloys, steel, titanium)
- Properties and characteristics of aircraft metals
- Heat treatment and alloying techniques for enhancing material properties
- Fatigue and corrosion considerations in metallic aircraft materials

Unit-II **10L**

Composite Materials in Aircraft
- Introduction to composite materials and their advantages in aerospace applications
- Fiber reinforcement types: carbon fiber, glass fiber, aramid fiber
- Matrix materials: thermoset and thermoplastic polymers
- Manufacturing processes for composite aircraft structures (e.g., layup,

	autoclave curing) - Material properties and behavior of composite materials Polymer Materials in Aircraft - Properties and characteristics of polymer materials used in aircraft (e.g., thermoplastics, elastomers) - Applications of polymers in aircraft components (e.g., seals, gaskets, insulation) Polymer material selection factors and considerations	
Unit-III	Ceramics and Ceramic Matrix Composites - Introduction to ceramics and their properties - High-temperature applications of ceramics in aircraft (e.g., turbine components) - Ceramic matrix composites and their advantages in aerospace applications Material Testing and Characterization - Mechanical testing of aircraft materials (e.g., tensile testing, hardness testing, impact testing) - Non-destructive testing techniques (e.g., ultrasonic testing, X-ray inspection) - Material characterization methods (e.g., microscopy, spectroscopy) - Material performance evaluation and data analysis	**10L**
Unit-IV	Material Selection and Design Considerations - Material selection criteria for specific aircraft components and systems - Material compatibility and joining techniques (e.g., welding, bonding) - Design considerations for materials used in different aircraft structures (e.g., fuselage, wings, landing gear)	**10L**
Unit-V	Sustainability and Recycling of Aircraft Materials - Sustainable material choices in aircraft design and manufacturing - Recycling and disposal considerations for aircraft materials - Life cycle assessment and environmental impact of aircraft materials Emerging Trends in Aircraft Materials - Advancements in material technologies for aircraft (e.g., additive manufacturing, nano materials) - Lightweight materials and their impact on aircraft performance - Future directions and research in aircraft materials Case Studies and Practical Applications - Case studies of material selection and usage in specific aircraft models - Analysis of real-world challenges and lessons learned - Application of material knowledge to solve practical problems	**10L**

Course Outcomes:

CO-1	Knowledge of Aircraft Materials
CO-2	Understanding of Material Selection Criteria
CO-3	Proficiency in Material Properties and Testing
CO-4	Analysis of Material Behavior and Failure

CO-5 Knowledge of Metal Alloys and Heat Treatment

CO-6 Familiarity with Composite Materials

Text Books:/Reference Books:

1. Aircraft Materials and Analysis" by Tariq Siddiqui
2. Aircraft Structures for Engineering Students" by T.H.G. Megson
3. Materials for Aircraft Structures" by Mike Hirst

KAE-505 **UAV SYSTEM AND DESIGN** **L T P C**

3-1-0-4

Course Objectives:

1. Understand UAV Fundamentals
2. Learn UAV Design Principles
3. Develop UAV System Integration Skills
4. Gain Knowledge of UAV Regulations and Safety

Detailed Syllabus

Unit-I **8L**

Introduction to UAVs
- Overview of UAVs and their applications
- Historical development and current trends in UAV technology
- Regulatory and ethical considerations

UAV System Architecture
- Components of a UAV system: airframe, propulsion, avionics, payload, and ground control station
- Integration and interconnections of UAV subsystems
- Trade-offs and design considerations for system architecture

Unit-II **10L**

UAV Aerodynamics
- Basic principles of aerodynamics applied to UAV design
- Airfoil selection and wing design considerations
- Stability and control of UAVs
- Effect of aerodynamic forces on flight performance

UAV Propulsion Systems
- Types of propulsion systems used in UAVs: electric, internal combustion engines, hybrid systems
- Selection criteria for propulsion systems based on mission requirements
- Power management and energy efficiency considerations

Unit-III	UAV Sensors and Payloads - Overview of sensors and payloads commonly used in UAVs (e.g., cameras, LiDAR, thermal sensors) - Payload integration and mounting considerations - Data acquisition, processing, and analysis UAV Autonomy and Flight Control - Principles of UAV flight control and autonomous operation - Sensor integration for navigation, obstacle detection, and collision avoidance - Flight control algorithms and software implementation - Flight testing and verification of autonomous capabilities	**10L**
Unit-IV	UAV Communication and Data Link - Wireless communication technologies for UAV control and data transmission - Link budget analysis and range considerations - Data link security and encryption UAV System Integration and Testing - System integration techniques and considerations - Pre-flight checks and system validation - Flight testing methodologies and data collection - Safety procedures and risk management	**10L**
Unit-V	UAV Design Optimization - Design optimization methodologies for UAVs - Trade-off analysis for weight, performance, endurance, and mission-specific requirements - Multi-objective optimization and Pareto front analysis UAV Regulations and Ethical Considerations - Regulatory framework for UAV operations - Flight restrictions, airspace regulations, and licensing requirements - Privacy and ethical considerations in UAV operations - Environmental impact and sustainability aspects	**10L**

Course Outcomes:

CO-1	Understanding of UAV Systems:
CO-2	Proficiency in UAV Design
CO-3	Knowledge of UAV Regulations and Safety
CO-4	Competence in UAV System Integration
CO-5	Proficiency in UAV Mission Planning and Control
CO-6	Skills in UAV Prototyping and Testing

Text Books:/Reference Books:

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1. Introduction to UAV Systems" by Paul Fahlstrom and Thomas Gleason
2. UAV Systems Engineering" by Mohinder S. Grewal, Angus P. Andrews, and Chris J. Bartone
3. Small Unmanned Aircraft: Theory and Practice" by Randal W. Beard and Timothy W. McLain

KAE-551

AERODYNAMICS-I LAB

Course Objectives:

1. **Understandthebehaviorofflowpropertiesoverdifferentmodelsusingsubsonicwindtunnel.**
2. **Demonstrate experimentally the pressure distribution over circular, symmetric and cambered air foils and evaluate lift and drag.**
3. **Illustrate flow visualization studies at low speeds over different aerodynamic bodies.**

Detailed Syllabus

List of Experiments

1.Calibration of subsonic wind tunnel

2. Pressure Distribution-Cylinder

3. Pressure Distribution-Symmetric Airfoil

4. Pressure Distribution-Cambered Airfoil

5. Force measurement using wind tunnel balance.

6. Flow over a Flat Plate

7. Flow visualization studies in low speed over cylinder

8. Flow Visualization Studies - Airfoil Flow visualization studies in low speed over airfoil at different angles of incidence.

9. Wake analysis over a cylinder and airfoils

10.Blower Test Rig; Efficiency ofblowertestrigfor3differentvanesettings.

11.Axial Flow Compressor; Efficiency of axial flow compressor

12.Centrifugal Flow Compressor

Course Outcomes:

CO-1	Understandfundamentalsandknowthenon-dimensionalizationofaerodynamicforcesand moments; familiar with air foil nomenclature and airfoil characteristics.
CO-2	UnderstandconformalmappingandJowkowskitransformationofairfoiltoacircularcylinder
CO-3	Understandplanepotentialflowandapplytoaerodynamicproblemsofacademicandpracticalinterest.
CO-4	Understand the concept of Flow VisualizationStudies-AirfoilFlowvisualizationstudiesinlowspeedoverairfoilatdifferentanglesofincidence.
CO-5	Understand the working principal of Axial Flow Compressor
CO-6	Understand the working principal of Centrifugal Flow Compressor

Text Books:

1. E. L. Houghton and P. W. Carpenter, ―Aerodynamics for Engineering Students, EdwardArnoldPublishersLtd.,London,5thEdition,1982,

KAE - 552

AIRCRAFT STRUCTURE-I LAB

L T P C
0-0-3-2

Course Objectives:

1. Determine young's modulus of steel using mechanical extensor meters.
2. Determineyoung'smodulusofsteelusingElectricalextensometers.
3. Findthedeflectionofbeamsatvariousendcondition
4. VerifyMaxwell'sreciprocaltheoremandprincipleofsuperposition

Detailed Syllabus

List of Experiments

1. DeterminationofYoung'smodulusofsteelusingmechanicalextensometers.
2. DeterminationofYoung'smodulusofaluminumusingelectricalextensometers
3. Deflectionofbeamswithvariousendconditions.
4. VerificationofMaxwell'sReciprocaltheorem&principleofsuperposition
5. Column-TestingandSouth-well'splot.
6. Shearcentrelocationforopensectionsandclosedsections7.Unsymmetricalbendingofbeams
7. 8.Stresses in circular discs and beams using photo elastic techniques9.Vibrationsofbeams
8. 10.Wagnerbeam-Tensionfieldbeam

Course Outcomes:

CO-1	Understandthebasicconceptsofmaterialandscienceandreal experiencegettingtodetermineayoung'smodulusvalueofAluminum.
CO-2	Understandthedifferenceofaccuracyandprecisionvaluefrombothmechanicalandelectricalextensometer.
CO-3	Determinethedeflectionofsimplysupportedbeamsandbetterunderstandoftypesof beams and application.
CO-4	Understand the concept of Unsymmetrical bending of beams
CO-5	UnderstandtheStressesincirculardiscsandbeamsusingphotoelastictechniques
CO-6	Understand the concept of Vibrations of beams

Text Books:

1. Donaldson,B.K.,"AnalysisofAircraftStructures-AnIntroduction",McGraw-Hill,1993

Reference Books:

1. Timoshenko,S.,"StrengthofMaterials",Vol.IandII,PrincetonD.VonNostrandCo,1990

KAE - 553

AEROSPACE PROPULSION-I LAB

L T P C
0-0-3-2

Course Objectives:

1. Study air craft piston engine, and jet engines
2. Study about forced Convective Heat transfer
3. Study about free Convective heat transfer
4. Study Combustion performance in a jet engine combustion chamber

List of Experiments

1. Study of an aircraft piston engine and jet engines and its components
2. Study of forced convective heat transfer.
3. Study of free convective heat transfer.
4. Cascade testing of a model of axial compressor blade row
5. Determination of heat of combustion of aviation fuel
6. Combustion performance studies in a jet engine combustion chamber
7. Study of free jet
8. Study of wall

Course Outcomes:

CO-1 Gainknowledgeaboutthevarioussystemsofaircraftpistonengine,jetenginesandshowthe systemsontheenginesavailableintheLab

CO-2 Understandtheconceptofforcedconvectiveheattransferandperformexperimentontheheat transferapparatus

CO-3 Understandtheconceptoffreeconvectionheattransferandperformexperimentontheheattr ansferapparatus

CO-4 Understand and apply the Determination of heat of combustion of aviation fuel

CO-5	Understand and apply the Determination of heat of combustion of aviation fuel
CO-6	Understand the concept of Study of wall

Text Books:

P.G.Hill&C.R. Peterson,'Mechanics &ThermodynamicsofPropulsion',Addison–WesleyLongmanINC,**1999**.

Reference Books:

Cohen ,H. Rogers,G.F.C.andSaravanamuttoo,H.I.H.,'GasTurbineTheory',Longman,**1989**.

SEMESTER IV

KAE-601	**AVIONIS SYSTEM**	**L T P C** **3-1-0-4**

Course Objectives:

1. Understand the needs for avionics for both Civil and military aircraft
2. Introduce various digital electronic principles and working operations of digital circuit.
3. Integrate the digital electronic swith cockpit equipments
4. Understand the various principles in flight desk and cockpit panels.

Detailed Syllabus

Unit-I	**Avionics technology:** Processors, Memory Devices, Digital Data Buses –MIL-STD-1553B,ARINC429,ARINC629,FiberOpticBuses,LRUarchitecture foravionicspackaging,software,environmentaleffects,differencei navionicsarchitectureofcommercialandmilitaryaircraft.	**8L**
Unit-II	**Sensors:** Air Data Sensing – Use of pitot static probe, static probe to derive air dataindications; Role of Air Data Computer (ADC), Magnetic Sensing – Magnetic HeadingReference System (MHRS),Inertial Sensing – Position Gyros, Rate Gyros, Accelerometers,RadarSensing– RadarAltimeter(RADALT),DopplerRadar,WeatherRadar.	**10L**
Unit-III	**Display:** Comparison of earlier flight deck (Electromechanical type instruments) tomodernflightdeck(glassfightdeck),CathodeRayTube(CRT),ActiveMatrixLiquidCrystalDisplay (AMLCD),Head Down Display (HDD), Head Up Display (HUD), Helmet Mounted Display(HMD),Integrated Stand by Instrument System(ISIS).	**10L**

Unit-IV	**Communication:** HF,U/VHF,SatelliteCommunication,AirTrafficControl(ATC) Transponder, Traffic Collision& Avoidance System (TCAS), Identification of Friend&Foe(IFF).	**10L**
Unit-V	**Navigation: A**utomatic direction finding, very high frequency omni-range (vor), distance measuring equipment (dme), tactical air navigation (tacan), vortac (vor+tacan) satellite navigation system-global positioning system (gps), differential gps instrument landing system (ils), transponder landing system (tls),micro wave landing system(mls), astronavigation. **Automatic flight control system:** longitudinal, lateral &directionautopilot	**10L**

Course Outcomes:

CO-1	Successfulcompletionofcoursestudentsacquirestheabilitytounderstandthee xistingsolutionsaviationelectronicequipmentandsystems.
CO-2	The student acquires knowledge about the structures of various types of avionics equipmentandsystems.
CO-3	The knowledge that allow students to opt for other aviation issues to understand theelectronic aviation equipment and systems, and for those who want to specialize in theseissuesarefundamentaltotheacquiredknowledgeforfurtherwork
CO-4	Shouldtoknowaboutthesensorandtheirapplication
CO-5	Understand the concept of automatic flight control system
CO-6	Understand the communication radars

Text Books:/Reference Books:
Reference/Text Books:

1. Ian Moir, Allan Sea bridge, 'Civil Avionics Systems', AIAA Education Series.IanMoir&AllanSeabridge,'AircraftSystem',JohnWiley.

KAE-602 **HIGHSPEED AERODYNAMICS** **LT P C**
3-0-0-0

Course Objectives:

1. Study the basic governing equations of compressible flows and its parameters.
2. Study the effects of Shock and Expansion waves on aerodynamic characteristics.
3. Learn about the experimental methods to study about compressible flows.

Detailed Syllabus

Unit-I	**ONE DIMENSIONAL COMPRESSIBLE FLOWS** Review of Thermodynamics. Definition of Compressibility, Review of Governing equations. Stagnation conditions, Speed of sound, Mach number, flow regimes, shock waves. Alternative forms of Energy equations, Normal shock relations, Hugonoit equation, One dimensional flow with heat addition and onedimensional flow with friction.	**8L**
Unit-II	**OBLIQUE SHOCK AND EXPANSION WAVES** ObliqueshockRelations. Relations strong and weak shock solutions, Shock polar. Regular reflection from a solid boundary. Pressure deflection diagrams, Intersections of shock wave. Expansion waves. Prandtl – Meyer Expansion. Shock Expansiontheory. Detached shock in front of blunt body. Expansion. Shock Expansion theory. Detachedshockinfrontofbluntbody.	**10L**
Unit-III	**SUBSONICCOMPRESSIBLEANDSUPERSONICLINEARISEDFLOWOVER** AIRFOIL Introduction - Velocity potential equation –small perturbation equation - Prandtl-Glauert compressibility corrections - Critical Mach number - Drag divergence Mach number -Arearule-Supercriticalairfoil.Linearizedsupersonicpressurecoefficient-Improvedcompressibility correction factors, Application to airfoil. conical flowsphysical aspects, DeltaWingAerodynamics.	**10L**
Unit-IV	**FLOWTHROUGHNOZZLESANDVARIABLEAREADUCTS** Area-velocity relation, Isentropic flow through Convergent – Divergent nozzles. Choked flowconditions. Normal shock. Under and Over expansion conditions. Flow through diffusers –wave reflections from a free boundary. Method of Characteristics Application to supersonicwindtunnelsandrocketengine.	**10L**
Unit-V	EXPERIMENTALAERODYNAMICS Model testing in wind tunnels and types of wind tunnels. Pressure, Temperature, Velocitymeasurements – Hotwire and Laser – Doppler anemometer. Force measurements – Windtunnel balances. Scale effects and corrections, wall interferences, Flow visualizationtechniques-schilerenandshadowgraphmethods.	**10L**

Course Outcomes:		**Level**
CO-1	Understandthecompressibleflowparameterseffectingflowbehavior.	
CO-2	Able to design nozzle, diffuser and variable area ducts to obtain requiredaerodynamicoutputs.	
CO-3	Able to understand experimental techniques to find aerodynamic characteristics ofdifferentgeometries.	

CO-4	Understand the high speed aerodynamic
CO-5	Understand the FLOWTHROUGHNOZZLESANDVARIABLEAREADUCTS
CO-6	To know about the EXPERIMENTAL AERODYNAMICS

Text Books:/Reference Books:

Reference/Text Books:

1. Anderson,J.D.,FundamentalofAerodynamics,McGraw-HillInternationalthirdeditionSingapore2001.
2. Anderson, J .D., Modern Compressible Flow with Historical Perspective, Mc Graw-Hill InternationalthirdeditionSingapore-
2004.3.W.E.Rae&AllenPope,Lowspeedwindtunneltesting,JohnWilley&sonsRadhakrishnan,E,E.,GasDynamics,PrenticeHall ofIndia,1995.2.HodgeB.K&KoenigKCompressibleFluid Dynamics with Computer Application, Prentice Hall, 1995 3. Clancy, L.J., Aerodynamics, Pitman,1986,Macmillan,1985

KAE -651 **AVIONICS SYSTEMLAB** **L T P C 0-0-3-2**

Course Objectives:

1. Study the communication and navigation equipment
2. Understand the various principles in flight desk and cockpit panels.
3. Integrate the digital electronics with cockpit equipment
4. Introduce various digital electronic principles and working operations of digital circuit.

List of Experiments

DIGITALELECTRONICS

1. Addition/Subtraction of binary numbers.
2. Multiplexer/De multiplexe Circuits.
3. Encoder/Decode Circuits.
4. Timr Circuits, Shift Registers, Binary Comparator Circuits.

MICROPROCESSORS

5. Addition and Subtraction of 8-bit and 16-bit numbers.
6. Sorting of Datain Ascending & Descending order.
7. Sumofagivenserieswithandwithoutcarry.
8. GreatestinagivenseriesMulti-byteadditioninBCDmode.
9. Interfaceprogrammingwith4digit7segmentDisplaySwitchesLED's.
10. 16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave by Digital to Analog Converter.

AVIONICS DATA BUSES

11. Study of Different Avionics DataBuses.
12. MIL-Std–1553 DataBuses Configuration with Message transfer.
13. MIL-Std–1553 Remote Terminal Configuration

Course Outcomes:

CO-1	Awareness of communication and navigation systems and their applications
CO-2	Apply basic concepts to a/c instruments for efficient output.
CO-3	Should identify the real time applications of Microprocessor in aircraft
CO-4	Learn about the circuit diagram
CO-5	Understand the microprocessor principal and their theory
CO-6	Understandtheconceptofdatabuses

KAE -655

COMPUTER AIDED ENGINEERING SIMULATION LAB

L T P C
0-0-3-2

Course Objectives:

1. Understand the drawing with curves like parabola, spiral, involutes
2. Understand the three view of simple solids.
3. Creation of 3D models of simple objects.
4. Understand a simple steel truss.

List of Experiments

1. Study of capabilities of software for drafting and modelling- Co-ordinate system- Creation of simple figures like polygon and general multi line figures
2. Drawing a title block with necessary text and projection symbols
3. Drawing of curves like parabola, spiral, involutes using Bsplineor cubic spline
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone. etc
5. Drawing of front view, side view and top view of objects from the given pictorial views
6. Drawing of a plan of residential building
7. Drawing of a simple steel truss
8. Drawing sectional views of prism, pyramid, cylinder, cone. etc,
9. Drawing isometric projection of simple objects
10. Creation of 3D models of simple objects and obtaining 2D

Course

CO-1	Draw the different curves with Bsplineor cubics pline method
CO-2	Draw the front view, side view and top view of solids.
CO-3	Obtaining 2D and multi view drawing of 3D models.
CO-4	Understand the concept of Drawing of a simple steel truss
CO-5	Understand the concept of Drawingofaplanofresidentialbuilding
CO-6	Understand the Creation of 3 D models of simple objects and obtaining 2D and multiview

KAE -656

Advanced Designing Lab

L T P C
0-0-3-2

Course Objectives:

1. Identify the constraints in a mission and select the power plant for the aircraft.
2. Estimate the performance parameters and size the control surfaces
3. Estimate loads on different aircraft components.

List of Experiments

1. Introduction: Simulation classification, Objectives, concepts and types of models.

2. Modelling: 6-DOF models for aerospace vehicle with prescribed control surface inputs.

3. Control systems–Mechanical (structural), hydraulic and theirmodelling. Block diagram representation of systems.

4. Dynamics of aerospace vehicles: Pilot station inputs, Cues for the pilot–Visual, biological and stick force.

5. Virtualsimulation.Fly-by-Wiresystemsimulation.

6. Uncertainty Modelling & Simulation: Characterization of uncertainty in model parameters and inputs, use of simulation to propagate the uncertainty to system response, Monte-Carlosimulation.Simulationofstiffsystems–differential algebraic equations.

7. Applications: Modelling and simulation methodologies for a complex engineering system simulation, aerospace system simulation.

8. Model Building Techniques: Parameter identification, system identification. Least SquareEstimation, Maximum likelihood estimation. Modelling and simulation of thermal systems. Discrete system modelling and simulation.

Course Outcomes:

CO-1	Conduct trade-off between the conflicting demands of different disciplines by performingadetailedpreliminarydesignofacompleteaircraft
CO-2	Decidemissionspecificwingloadingfortheaircraft.
CO-3	Decidemissionspecificwingloadingfortheaircraft.
CO-4	Learnabouttheadvancesoftware
CO-5	Gaintheadvancedesigningabilityintheirskills
CO-6	Toknowaboutthecontrolsystem

SEMESTER VII

KAE – 701 **Introduction to Cryogenic**

Sr. No.	Content	Total Hrs
1	**Cryogenic Refrigeration System:** Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule–Thomson refrigeration systems, expansion engine and cold gas refrigeration systems, Philips refrigerators,	15

	Importance of regenerator effectiveness for the Philips refrigerators, Gifford single volume refrigerator, Gifford double volume refrigerators analysis, COP, FOM ,regenerators ,pulse tube refrigerators , various types of pulse tube refrigerator	
2	**Refrigerators using solids as working media:** Magnetic cooling, magnetic refrigeration systems, thermal; valves, nuclear demagnetization	5
3	**Gas liquefaction systems:** Introduction, thermodynamically ideal systems, joule Thomson effect, liquefaction systems such as Linde Hampton, precooled Linde Hampson ,linde dual pressure ,cascade, Claude ,Kapitza ,Heyland systems using expanders, comparison of liquefaction systems .liquefaction systems for neon ,hydrogen & helium	12
4	**Adsorbents**: various adsorbents, salient features – properties, determination of mass of absorbents for the adsorption of gases	5
5	**Adsorption processes:** Physical principles of adsorption, BET equation for single and multiple layer , Use of sorption process in cryogenics static and dynamic arrangement for the sorption processes, Adsorption columns, PSA and VSA adsorption systems, isotherms, reactivisation	5

Reference Books:

1. Cryogenic Systems, Barron, McGraw Hill Book Co.
2. Theory and design of cryogenic systems : A.Arkherov
3. Cryogenic process engineering Timmerchand & Flynn
4. "Theory and design of cryogenic systems", Mikulin, MIR Publication, 2002

Course Outcome:

After learning the course the students should be able to:

Know about different methods of producing cryogenic temperature, types of cryocoolers, Liquefaction of gases.

KAE - 703 **HELICOPTER SYSTEM MAINTENANCE** **L T P C**

3-0-0-0

Course Objectives:

1. Introduction to Helicopter Systems
2. Knowledge of System Components
3. Maintenance Practices and Procedures
4. Safety and Compliance

Detailed Syllabus

Unit-I	Introduction to Helicopter Systems - Overview of helicopter systems and their functions - Classification of helicopter systems: airframe, propulsion, electrical, hydraulic, avionics, etc. - Roles and responsibilities of helicopter maintenance technicians Helicopter Airframe Maintenance - Airframe inspection techniques and procedures - Structural repair and modification for helicopters - Corrosion prevention and control measures for helicopter airframes	**8L**
Unit-II	Helicopter Power plant Maintenance - Overview of helicopter power plant systems (e.g., engines, transmission, rotor systems) - Inspection, servicing, and troubleshooting of helicopter engines - Maintenance and repair of helicopter transmission and rotor systems Helicopter Electrical Systems Maintenance - Introduction to helicopter electrical systems (e.g., wiring, lighting, generators, batteries) - Inspection, testing, and troubleshooting of helicopter electrical systems - Maintenance and repair of helicopter electrical components	**10L**
Unit-III	Helicopter Hydraulic Systems Maintenance - Overview of helicopter hydraulic systems (e.g., hydraulic power packs, actuators, controls) - Inspection, servicing, and troubleshooting of helicopter hydraulic systems - Maintenance and repair of helicopter hydraulic components Helicopter Avionics Systems Maintenance - Introduction to helicopter avionics systems (e.g., navigation, communication, instrument systems) - Inspection, testing, and troubleshooting of helicopter avionics systems - Maintenance and repair of helicopter avionics components	**10L**
Unit-IV	Helicopter Fuel Systems Maintenance - Overview of helicopter fuel systems and components - Inspection, servicing, and troubleshooting of helicopter fuel systems - Maintenance and repair of helicopter fuel system components Helicopter Landing Gear Systems Maintenance - Introduction to helicopter landing gear systems and components - Inspection, servicing, and troubleshooting of helicopter landing gear systems	**10L**

Unit-V	Helicopter Safety Equipment Maintenance - Inspection and maintenance of helicopter safety equipment (e.g., emergency exits, flotation devices, survival equipment) - Compliance with regulatory requirements for helicopter safety equipment Helicopter Maintenance Documentation and Record-Keeping - Documentation requirements for helicopter maintenance activities - Recording and tracking of maintenance tasks and inspections - Compliance with aviation regulations and standards for maintenance records.	**10L**

Course Outcomes:

CO-1	Knowledge of Helicopter Systems
CO-2	Proficiency in System Inspections
CO-3	Competence in Maintenance and Repair
CO-4	Familiarity with Maintenance Documentation
CO-5	Compliance with Safety Regulations .
CO-6	Proficiency in Component Removal and Installation

Text Books:/Reference Books:

1. Helicopter Maintenance" by Joseph Schafer
2. Practical Helicopter Maintenance" by John J. Heywood
3. Helicopter Maintenance, Repair, and Overhaul" by Harry A. Kinnison and Tariq Siddiqui

KAE - 702 **MISSILE AERODYNAMICS** **L T P C**

3-0-0-0

Course Objectives:

1.	Understanding of Missile Aerodynamic Principles
2.	Knowledge of Missile Flight Regimes
3.	Proficiency in Missile Configuration Analysis
4.	Competence in Missile Stability and Control Analysis

DetailedSyllabus

Unit-I	Introduction to Missile Aerodynamics - Overview of missile aerodynamics and its importance in missile design and performance - Classification of missiles based on their aerodynamic characteristics and mission profiles - Roles and challenges of aerodynamics in missile flight Missile Flight Regimes and Environments - Various flight regimes of missiles: boost, cruise, terminal, reentry, etc. - Atmospheric conditions and their effects on missile aerodynamics (e.g., altitude, temperature, density) - Aerodynamic considerations in different flight environments (e.g., low-speed, supersonic, hypersonic)	**8L**
Unit-II	Missile External and Internal Flow - External flow characteristics and flow phenomena around missile bodies - Boundary layer development and flow separation on missile surfaces - Internal flow considerations in missile components (e.g., propulsion system, guidance system) Aerodynamic Forces and Moments - Fundamentals of aerodynamic forces (lift, drag) and moments (pitch, yaw, roll) on missiles - Coordinate systems and reference frames for aerodynamic analysis - Calculation and estimation of aerodynamic coefficients	**10L**
Unit-III	Missile Stability and Control - Stability and control principles in missile flight - Longitudinal, lateral, and directional stability and control mechanisms - Effect of control surfaces and control laws on missile maneuverability Aerodynamic Design Considerations - Design factors affecting missile aerodynamics (e.g., shape, fineness ratio, control surface placement) - Aerodynamic shaping techniques for reducing drag and improving maneuverability - Trade-offs between aerodynamic performance, stealth, and other mission requirements	**10L**
Unit-IV	Supersonic and Hypersonic Aerodynamics - Aerodynamic challenges and phenomena in supersonic and hypersonic missile flight - Shock waves, wave drag, and flow compressibility effects - Aerodynamic heating and thermal protection considerations	**10L**

	at high speeds Missile Aerodynamic Testing and Simulation - Wind tunnel testing techniques for missile aerodynamics - Computational fluid dynamics (CFD) simulation methods for missile analysis - Data acquisition and analysis for aerodynamic performance evaluation	
Unit-V	Aerodynamic Performance Optimization - Aerodynamic performance metrics and measures (e.g., lift-to-drag ratio, range, maneuverability) - Techniques for aerodynamic performance optimization (e.g., shape optimization, control system design) - Multi-objective optimization and trade-off analysis in missile aerodynamics Missile Aerodynamic Stability in Challenging Scenarios - Aerodynamic stability considerations during launch, separation, and maneuvering - Aerodynamic stability in high-altitude, high-speed, and extreme flight conditions - Stability augmentation and control system design for improved stability Emerging Trends in Missile Aerodynamics - Advancements in missile aerodynamics research and technology	**10L**

CourseOutcomes:

CO-1	Understanding of Missile Aerodynamic Principles
CO-2	Knowledge of Missile Performance Parameters
CO-3	Proficiency in Aerodynamic Analysis
CO-4	Competence in Missile Stability and Control
CO-5	Familiarity with Missile Trajectory and Guidance
CO-6	Understanding of High-Speed Aerodynamics

TextBooks:/ReferenceBooks:

1. Missile Aerodynamics" by Jack N. Nielsen
2. Fundamentals of Missile Aerodynamics" by Mark K. Hinders
3. Modern Missile Guidance" by Rafael Yanushevsky

SEMESTER VIII

KAE – 801	**ROCKET MISSILE TECHNOLOGY**	**L T P C 3-0-0-0**

Sr. No.	**Content**	**Total Hrs**
	General Aerodynamics Design Considerations	
1	Introduction Missile, Missile Classifications, Types of Design and Control	**3**
	Aerodynamics Characteristics of Airframe Components	
2	Introduction, Bodies of Revolution, Forebody: Conical, Ogival, Hemispherical and other shapes, Mid-Section and Boattail, General Aerodynamics of Airfoil, Aspect ratio, wing planform, Airfoil sections, Wing area, Subsonic characteristics of Airfoil, Aerodynamics Controls & Jet Controls	**10**
	Missile Performance	
3	Introduction, Friction drag, Pressure drag, induced drag, Interference drag, Boost- Glide Trajectory, Boost - Sustain Trajectory, Long range Cruise Trajectory, Long range Ballistic Trajectory, Maneuvering Flight: Flat turns, Pull- ups & Relation between Maneuverability & Static stability margin	**10**

4	**Power Plant design considerations** Introduction, Fundamentals of Rocket engines, Rocket motor design considerations **Rocket Propellants:-** **Liquid Propellants** Propellant loading tolerances, inventory & concept of ullage, Volume versus mass loading & Loading measurement and control, Outage control, Fundamentals of liquid rocket combustion chamber, Injectors, propellant feed lines, propellant tank outlet design.	5
5	**Solid Propellants** Igniter & Ignition system, Single base propellants - Double base propellants - Composite propellants – CMBD propellants - and their ingredients, Introduction to different fuels and oxidizers of composite propellants, Manufacturing techniques of solid propellant, Properties of solid propellant and solid propellant Grain design Fundamentals of combustion of solid propellants	20

Reference Books:

1. Missile Configuration Design by S. S. Chin, McGraw-Hill Book Company, Inc
2. Rocket Propulsion Elements", George P. Sutton and Oscar Biblarz, Wiley-Interscience
3. Propellants and Pressurization system by Elliot Ring

Course Outcome:

After learning the course the students should be able to:

Understand basic terms and fundamentals of Rocket Propellants and missiles.

KAE -802	**Satellite Technology**	**L T P C** **3-0-0-0**

Course Objectives:

1. Understanding of Spaceflight Navigation Principles
2. Knowledge of Spacecraft Guidance Systems
3. Familiarity with Orbit Determination Techniques
4. Ability to Perform Navigation Analysis

Detailed Syllabus

Unit-I **8L**

Introduction to Space Flight Navigation and Guidance
- Overview of space flight navigation and guidance systems
- Importance of accurate navigation and precise guidance in space missions
- Historical perspective and milestones in space navigation and guidance

Celestial Navigation
- Celestial reference frames and coordinate systems
- Celestial navigation techniques: star trackers, inertial navigation systems, and celestial landmarks
- Determination of spacecraft position and attitude using celestial observations

Inertial Navigation
- Principles of inertial navigation and its applications in space flight
- Gyroscopes and accelerometers for attitude determination and velocity measurement
- Error sources and error compensation techniques in inertial navigation systems

Unit-II **10L**

Orbit Determination and Propagation
- Techniques for orbit determination and prediction
- Two-line element sets (TLE) and orbit propagation models
- Error analysis and uncertainty estimation in orbit determination

Global Navigation Satellite Systems (GNSS)
- Overview of GNSS systems (e.g., GPS, GLONASS, Galileo)
- GNSS signal acquisition, tracking, and processing
- Integration of GNSS with other navigation sensors for enhanced accuracy

Spacecraft Guidance and Trajectory Design

	- Principles of spacecraft guidance and trajectory optimization - Trajectory planning for various space missions (e.g., launch, interplanetary transfers, rendezvous) - Guidance techniques for orbital maneuvers and rendezvous operations	
Unit-III	Attitude Determination and Control - Attitude sensors and measurement techniques (e.g., sun sensors, star trackers, magnetometers) - Attitude determination algorithms and Kalman filtering - Attitude control systems and control laws for spacecraft stabilization Autonomous Navigation and Relative Navigation - Autonomous navigation techniques for space missions - Relative navigation methods for spacecraft proximity operations (e.g., docking, formation flying) - Sensor fusion and data fusion algorithms for multi-sensor navigation Mission Design and Navigation Constraints - Navigation constraints in space mission design - Gravity field modeling and its impact on spacecraft navigation - Navigation challenges in deep space missions and near-planetary operations	**10L**
Unit-IV	Error Analysis and Uncertainty Quantification - Error sources in space navigation and guidance - Error propagation and analysis techniques - Uncertainty quantification and risk assessment in space navigation Spacecraft Tracking and Telemetry - Ground-based and space-based tracking systems - Telemetry data collection and processing - Orbit determination using tracking data and tracking network design Emerging Technologies in Space Navigation and Guidance - Advanced navigation sensors and techniques (e.g., laser ranging, optical navigation) - Autonomous navigation using artificial intelligence and machine learning - Navigation challenges and solutions for future space missions (e.g., lunar exploration, interplanetary travel)	**10L**

Course Outcomes:

CO-1	Understanding of Spaceflight Navigation Principles

CO-2	Proficiency in Spacecraft Guidance Systems
CO-3	Knowledge of Orbit Determination Techniques
CO-4	Skills in Trajectory Planning and Optimization
CO-5	Ability to Perform Navigation Analysis
CO-6	Ability to Perform Navigation Analysis

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TextBooks:/ReferenceBooks:

1. Spacecraft Attitude Determination and Control" by James R. Wertz and Wiley J. Larson
2. Fundamentals of Astrodynamics and Applications" by David A. Vallado
3. Spacecraft Dynamics and Control: A Practical Engineering Approach" by Marcel J. Sidi