INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)

Dundigal, Hyderabad - 500 043, Telangana

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

BACHELOR OF TECHNOLOGY
AERONAUTICAL ENGINEERING

ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABI UNDER AUTONOMOUS STATUS

B.Tech Regular Four Year Degree Programme

(for the batches admitted from the academic year 2016- 2017)

&

B.Tech (Lateral Entry Scheme)

(for the batches admitted from the academic year 2017 - 2018)

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

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"Take up one idea.
Make that one idea your life-think of it, dream of it, live on that idea. Let the brain muscles, nerves, every part of your body be full of that idea and just leave every other idea alone.
This is the way to success"

Swami Vivekananda

PRELIMINARY DEFINITIONS AND NOMENCLATURES

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two main semesters i.e., (one odd + one even) and one supplementary semester.

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F) in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry, Biology etc., are considered to be foundational in nature.

Betterment: Betterment is a way that contributes towards improvement of the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Branch: Means specialization in a program like B.Tech degree program in Civil Engineering, B.Tech degree program in Computer Science and Engineering etc.

Certificate course: It is a course that makes a student gain hands-on expertise and skills required for holistic development in a specific area/field.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Commission: Means University Grants Commission (UGC), New Delhi.

Continuous Internal Examination: It is an examination conducted towards sessional assessment.

Course: A course is a subject offered by a department for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture/tutorial hour per week.

Credit point: It is the product of grade point and number of credits for a course.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources in the process of study for a degree.

Detention in a course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for any semester can apply in writing in prescribed format before commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Course (MOOC): MOOC courses inculcate the habit of self learning. MOOC courses would be additional choices in all the elective group courses.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Professional Elective: It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, Bachelor of Technology (B.Tech) degree program / PG degree program: M.Tech/ MBA.

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her final year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for the theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a Program.

Regulations: The regulations, common to all B.Tech programs offered by Institute are designated as "IARE Regulations R-16" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. The odd Semester starts usually in July and even semester in December.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

S/he: Means "she" and "he" both.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means the Jawaharlal Nehru Technological University Hyderabad, Hyderabad.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of the odd or even semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

FOREWORD

The autonomy is conferred to Institute of Aeronautical Engineering (IARE), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like J N T University Hyderabad (JNTUH), Hyderabad and AICTE. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system** and **monitoring mechanism**, independent of the affiliating University but under its observance.

IARE is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the institute and recommendations of the JNTUH to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the institute to order to produce a quality engineering graduate to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications needed are to be sought at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the college and brighter prospects of engineering graduates.

PRINCIPAL

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

ACADEMIC REGULATIONS

B.Tech. Regular Four Year Degree Programme
(for the batches admitted from the academic year 2016 - 17)
&
B.Tech. (Lateral Entry Scheme)
(for the batches admitted from the academic year 2017 - 18)

For pursuing four year undergraduate Bachelor Degree programme of study in Engineering (B.Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

1.0. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEI's) are changing from the conventional course structure to Choice Based Credit System (CBCS) along with introduction to semester system at first year itself. The semester system helps in accelerating the teaching-learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises of lectures / tutorials / laboratory work / field work / project work / comprehensive Examination / seminars / assignments / alternative assessment tools / presentations / self-study etc. or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.

The CBCS permits students to:

1. Choose electives from a wide range of elective courses offered by the departments.
2. Undergo additional courses of interest.
3. Adopt an interdisciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2.0 MEDIUM OF INSTRUCTION

The medium of instruction shall be English for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course structure, in accordance with the prescribed syllabi.

3.0 TYPES OF COURSES

Courses in a programme may be of three kinds: **Foundation / Skill, Core and Elective.**

3.1 Foundation / Skill Course:

Foundation courses are the courses based upon the content leads to enhancement of skill and knowledge as well as value based and are aimed at man making education. Skill subjects are those areas in which one needs to develop a set of skills to learn anything at all. They are fundamental to learning any subject.

3.2 Core Course:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

3.3 Elective Course:

Electives provide breadth of experience in respective branch and applications areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student’s proficiency/skill.

An elective may be discipline centric (Professional Elective) focusing on those courses which add generic proficiency to the students or may be chosen from an unrelated discipline called as “Open Elective”.

There are six professional elective groups; students can choose not more than two courses from each group. Overall, students can opt for four professional elective courses which suit their project work in consultation with the faculty advisor/mentor. Nevertheless, one course from each of the two open electives has to be selected. A student may also opt for more elective courses in his area of interest.

4.0 SEMESTER STRUCTURE

Each academic year is divided into three semesters, TWO being MAIN SEMESTERS (one odd + one even) and ONE being a SUPPLEMENTARY SEMESTER. Main Semesters are for regular class work. Supplementary Semester is primarily for failed students i.e. registration for a course for the first time is generally not permitted in the supplementary semester. However, the following cases are exempted:

4.1 Students admitted under Lateral Entry Scheme in the subjects ‘Audit Course’, ‘Advanced Programming Lab’ and ‘Value Added Course’.

4.2 Students admitted under Lateral Entry Scheme shall register ‘Environmental Studies’ course in supplementary semester and pass the subject by the end of VI semester for the award of the degree. This is a non-credit and mandatory course for students admitted under Lateral Entry Scheme.

4.3 Students admitted on transfer from JNTU affiliated institutes, Universities and other institutes in the subjects in which they are required to earn credits so as to be on par with regular students as prescribed by concerned ‘Board of Studies’.

4.4 Each main semester shall be of 21 weeks (Table 1) duration and this period includes time for registration of courses, course work, examination preparation and conduct of examinations.

4.5 Each main semester shall have a minimum of 90 working days; out of which number of contact days for teaching / practical are 75 and 15 days for conduct of exams and preparation.

4.6 The supplementary semester shall be a fast track semester consisting of eight weeks and this period includes time for registration of courses, course work, examination preparation, conduct of examinations, assessment and declaration of final results.

4.7 All subjects may not be offered in the supplementary semester. The student has to pay a stipulated fee prescribed by the Institute to register for a course in the supplementary semester. The supplementary semester is provided to help the student in not losing an academic year. It is optional for a student to make use of supplementary semester. **Supplementary semester is a special semester and the student cannot demand it as a matter of right** and will be offered based on availability of faculty and other institute resources.

4.8 The institute may use **supplementary semester** to arrange add-on courses for regular students and / or for deputing them for practical training / FSI. A student can register for a maximum number of 15 credits during a supplementary semester.

4.0.1 The registration for the Summer Semester (May – July) provides an opportunity to students to clear their backlogs ('F' grade) or who are prevented from appearing for SEE examinations due to shortage of attendance less than 65% in each course ('SA' Grade) in the earlier semesters or the courses which he / she could not register (Drop/Withdraw) for some reason.

Students will not be permitted to register for more than 15 credits (both I and II Semester) in the Summer Semester. Students are required to register for Summer Semester courses are to pay a nominal fee in within the stipulated time.

It will be optional for a student to get registered in the course(s) of Summer Semester; otherwise, he / she can opt to appear directly in supplementary examination. However, if a student gets registered in a course of Summer Semester, then it will be compulsory for a student to fulfil attendance criteria (≥90%) of Summer Semester and he / she will lose option to appear in immediate supplementary examination.

The students who have earlier taken an SEE Examination and register afresh for the Summer Semester will revoke the CIA marks secured by them in their regular/earlier attempt in the same course. Once revoked, the students shall not seek restoration of the CIA marks.

Summer Semester will be at an accelerated pace and will be at double the rate of normal semester e.g. one credit of course shall require two hours/week so that the total contact hours are maintained same as in normal semester.

Instructions and guidelines for the summer semester course:

- A minimum of 36 to 40 hours will be taught by the faculty for every course.
- The students registered and having sufficient percentage of attendance for the course alone will be permitted to write the examination.
- The assessment procedure in a summer semester course will also be similar to the procedure for a regular semester course.
- Student shall register for the Summer Semester as per the schedule given in academic calendar.
- Once registered, students will not be allowed to withdraw from a summer semester.

4.0.2 The academic calendar shown in Table 1 is declared at the beginning of the academic year.

Table 1: Academic Calendar

FIRST SEMESTER (21 weeks)	I Spell Instruction Period	8 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation and Practical Examinations	1 week	
	Semester End Examinations		2 weeks
Semester Break and Supplementary Exams			2 weeks
SECOND SEMESTER (21 weeks)	I Spell Instruction Period	8 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation & Practical Examinations	1 week	
	Semester End Examinations		2 weeks
Summer Vacation, Supplementary Semester and Remedial Exams			8 weeks

5.0 REGISTRATION / DROPPING / WITHDRAWAL

5.1. Each student has to compulsorily register for course work at the beginning of each semester as per the schedule mentioned in the Academic Calendar. It is absolutely compulsory for the student to register for courses in time. The registration will be organized departmentally under the supervision of the Head of the Department.

5.2. IN ABSENTIA registration will not be permitted under any circumstance.

5.3. At the time of registration, students should have cleared all the dues of Institute and Hostel in the previous semesters, paid the prescribed fees for the current semester and not been debarred from institute for a specified period on disciplinary or any other ground.

5.4. The student has to normally register for a minimum of 20 credits and may register up to a maximum of 30 credits, in consultation with HOD/faculty mentor. On an average, a student is expected to register for 25 credits.

5.5. **Dropping of Courses:** Within one week after the last date of first internal assessment test or by the date notified in the academic calendar, the student may in consultation with his / her faculty mentor/adviser, drop one or more courses without prejudice to the minimum number of credits as specified in clause 5.4. The dropped courses are not recorded in the Grade Card. Student must complete the dropped subject by registering in the supplementary semester / forthcoming semester in order to earn the required credits. Student must complete the dropped subject by registering in the supplementary semester / forthcoming semester in order to earn the required credits.

5.6. **Withdrawal from Courses:** A student is permitted to withdraw from a course by the date notified in the academic calendar. Such withdrawals will be permitted without prejudice to the minimum number of credits as specified in clause 5.4. A student cannot withdraw a course more than once and withdrawal of reregistered subjects is not permitted.

5.7. After **Dropping and / or Withdrawal** of courses, minimum credits registered shall be 20.

6.0 UNIQUE COURSE IDENTIFICATION CODE

Every course of the B.Tech program will be placed in one of the nine groups of courses as listed in the Table 2. The various courses and their two-letter codes are given below;

Table 2: Group of Courses

S. No	Branch	Code
1	Aeronautical Engineering	AE
2	Computer Science and Engineering	CS
3	Information Technology	IT
4	Electronics and Communication Engineering	EC
5	Electrical and Electronics Engineering	EE
6	Mechanical Engineering	ME
7	Civil Engineering	CE
8	Humanities and Basic Sciences	HS
9	Miscellaneous	MS

7.0 CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Foundation / Skill Courses, Core Courses, Elective Courses, Laboratory Courses, Audit Courses, Mandatory Courses, Comprehensive Examination, Ideation and Product Development , Internship and Project work. The list of elective courses may include subjects from allied disciplines also.

Contact Periods: Depending on the complexity and volume of the course, the number of contact periods per week will be assigned. Each Theory and Laboratory course carries credits based on the number of hours/week as follows:

- **Contact classes (Theory):** 1 credit per lecture hour per week, 1 credit per tutorial hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 Practical hours, 2 credits for 3 or 4 practical hours per week.
- **Project Work:** 1 credit for 4 hours of project work per week.
- **Ideation and Product Development :** 1 credit for 2 hours per week

7.1 Credit distribution for courses offered is shown in Table 3.

Table 3: Credit distribution

S. No	Course	Hours	Credits
1	Theory Course (Core and Foundation)	3 / 4	3 / 4
2	Elective Courses	3	3
3	MOOC Courses	-	2
4	Laboratory Courses	2 / 3	1 / 2
5	Audit Course / Mandatory Course	-	0
6	Comprehensive Examination	-	1
7	Ideation and Product Development	-	1
8	Summer Internship	-	0
9	Full Semester Internship (FSI) Project Work	-	16
10	Project Work	-	10

7.2 Course Structure

Every program of study shall be designed to have 38 - 42 theory courses and 20 - 26 laboratory courses. Every course of the B.Tech program will be placed in one of the eight categories with minimum credits as listed in the Table 4. In addition, a student has to carry out a Ideation and Product Development , project work and comprehensive Examination.

Table 4: Category Wise Distribution of Credits

S. No	Category	Subject Area and % of Credits	Average No. of Credits
1	Humanities and Social Sciences (HS), including Management.	HS (05% to 10%)	10
2	Basic Sciences (BS) including Mathematics, Physics and Chemistry.	BS (15% to 20%)	28
3	Engineering Sciences (ES), including Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Computer Engineering.	ES (15% to 20%)	28
4	Professional Subjects - Core (PC), relevant to the chosen specialization/branch.	PC (30% to 40%)	96
5	Professional Subjects - Electives (PE), relevant to the chosen specialization/branch.	PE (10% to 15%)	12
6	Open Subjects - Electives (OE), from other technical and/or emerging subject areas.	OE (05% to 10%)	06
7	Project Work or Full Semester Internship, Ideation and Product Development , Comprehensive Examination.	10% to 15%	12 - 18
8	Mandatory Courses / Audit Courses.	MC / AC	Non-Credit
TOTAL			**192**

7.3 Semester wise course break-up

Following are the **TWO** models of course structure out of which any student shall choose or will be allotted with one model based on their academic performance.

i. Full Semester Internship (FSI) Model and

ii. Non Full Semester Internship (NFSI) Model.

7.4 For Four year regular program (FSI Model):

In the FSI Model, out of the selected students - half of students shall undergo Full Semester Internship in VII semester and the remaining students in VIII semester. In the Non FSI Model, all the selected students shall carry out the course work and Project work as specified in the course structure. A student who secures a minimum CGPA of 7.5 up to IV semester with no current arrears and maintains the CGPA of 7.5 till VI Semester shall be eligible to opt for FSI.

Semester	No. of Theory Courses	No. of Lab Courses	Total Credits
I Semester	5 Foundation	4	24
II Semester	5 Foundation	4	24
III Semester	5 + Mandatory Course (2 Core + 3 Foundation)	3	25
IV Semester	5 + Audit Course (3 Core + 2 Foundation)	3	25
V Semester	6 (5 Core + 1 Professional Elective)	3	29
VI Semester	6 (3 Core + 1 Professional Elective + 1 Open Elective + 1 Foundation)	3 + Ideation and Product Development	28
VII Semester	Full Semester Internship (FSI)		16
VIII Semester	4 (3 Core + 1 Professional Elective)	3 + Comprehensive Examination	21
Total	**36 (16 Foundation + 16 Core + 3 Professional Electives + 1 Open Electives) + Mandatory Course + Audit course**	**22 + Comprehensive Examination + Ideation and Product Development + FSI**	**192**

7.5 For Four year regular program (Non FSI Model):

Semester	No. of Theory Courses	No. of Lab Courses	Total Credits
I Semester	5 Foundation	4	24
II Semester	5 Foundation	4	24
III Semester	5 + Mandatory Course (2 Core + 3 Foundation)	3	25
IV Semester	5 + Audit Course (3 Core + 2 Foundation)	3	25
V Semester	6 (4 Core + 1 Skill 1 Professional Elective)	3	25
VI Semester	5 (3 Core + 1 Professional Elective + 1 Open Elective)	3 + Ideation and Product Development	25
VII Semester	5 (3 Core + 1 Professional Elective + 1 Open Elective)	3	24
VIII Semester	3 (2 Core + 1 Professional Elective)	Project Work + Comprehensive Examination	20
Total	**39 (15 Foundation + 01 Skill + 17 Core + 4 Professional Electives + 2 Open Electives) + Mandatory Course + Audit Course**	**23 + Ideation and Product Development + Comprehensive Examination + Project work**	**192**

7.6 For Three year lateral entry program (FSI Model):

Semester	No. of Theory Courses	No. of Lab Courses	Total Credits
III Semester	5 + Mandatory Course (2 Core + 3 Foundation)	3	25
IV Semester	5 + Audit course (3 Core + 2 Foundation)	3	25
V Semester	6 (5 Core + 1 Professional Elective)	3	29
VI Semester	6 (3 Core + 1 Professional Elective + 1 Open Elective + 1 Foundation)	3 + Ideation and Product Development	28
VII Semester	Full Semester Internship (FSI)		16
VIII Semester	4 (3 Core + 1 Professional Elective)	3 + Comprehensive Examination	21
Total	**26 (6 Foundation + 16 Core + 3 Professional Electives + 1 Open Electives) + Mandatory Course + Audit Course**	**14 + Comprehensive Examination + Ideation and Product Development + FSI**	**144**

7.7 For Three year lateral entry program (Non FSI Model):

Semester	No. of Theory Courses	No. of Lab Courses	Total Credits
III Semester	5 + Mandatory Course (2 Core + 3 Foundation)	3	25
IV Semester	5 + Audit Course (3 Core + 2 Foundation)	3	25
V Semester	6 (4 Core + 1 Skill + 1 Professional Elective)	3	25
VI Semester	5 (3 Core + 1 Professional Elective + 1 Open Elective)	3 + Ideation and Product Development	25
VII Semester	5 (3 Core + 1 Professional Elective + 1 Open Elective)	3	24
VIII Semester	3 (2 Core + 1 Professional Elective)	Project Work + Comprehensive Examination	20
Total	**29 (05 Foundation + 17 Core + 4 Professional Electives + 2 Open Electives + 1 Skill) + Mandatory Course + Audit Course**	**15 + Ideation and Product Development + Comprehensive Examination + Project work**	**144**

7.8 Course wise break-up for the total credits (FSI Model):

Total Theory Courses (36) Core Courses (16) + Foundation Courses (11+ 5) + Professional Electives (03) + Open Elective (01)	16 @ 4 credits + 11 @ 4 credits + 05 @ 3 credits + 03 @ 3 credits + 01 @ 3 credits	134
Total Laboratory Courses (16 + 08)	16 @ 2 credits + 08 @ 1 credit	40
Comprehensive Examination	1 @ 1 credit	01
Ideation and Product Development	1 @ 1 credit	01
Full Semester Internship (FSI)	1 @ 16 credits	16
TOTAL CREDITS		**192**

7.9 For Four year regular program (Non FSI Model):

Total Theory Courses (38) Core Courses (16) + Foundation Courses (11+ 5) + Professional Electives (04) + Open Electives (02) + Skill (01)	14 @ 4 credits + 02 @ 3 credits + 11 @ 4 credits + 05 @ 3 credits + 04 @ 3 credits + 02 @ 3 credits + 01 @ 3 credits	142
Total Laboratory Courses (15 + 08)	15 @ 2 credits + 08 @ 1 credit	38
Comprehensive Examination	1 @ 1 credit	01
Ideation and Product Development	1 @ 1 credit	01
Project work	1 @ 10 credits	10
TOTAL CREDITS		**192**

7.10 For three year lateral entry program (FSI Model):

Total Theory Courses (26) Core Courses (16) + Foundation Courses (5+2) + Professional Electives (03) + Open Electives (01)	14 @ 4 credits + 02 @ 3 credits + 05 @ 4 credits + 02 @ 3 credits + 03 @ 3 credits + 01 @ 3 credits	100
Total Laboratory Courses (11 + 04)	11 @ 2 credits + 04 @ 1 credit	26
Comprehensive Examination	1 @ 1 credit	01
Ideation and Product Development	1 @ 1 credit	01
Full Semester Internship	1 @ 16 credits	16
TOTAL CREDITS		**144**

7.11 For three year lateral entry program (Non FSI Model):

Total Theory Courses (28) Core Courses (16) + Foundation Courses (5+1) + Professional Electives (04) + Open Electives (02) + Skill (01)	14 @ 4 credits + 02 @ 3 credits + 05 @ 4 credits + 01 @ 3 credits + 04 @ 3 credits + 02 @ 3 credits + 01@ 3 credits	106
Total Laboratory Courses (11 + 04)	11 @ 2 credits + 04 @ 1 credit	26
Comprehensive Examination	1 @ 1 credit	01
Ideation and Product Development	1 @ 1 credit	01
Project work	1 @ 10 credits	10
TOTAL CREDITS		**144**

8.0 EVALUATION METHODOLOGY

8.1 Theory Course:

Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two sessional examinations or the marks scored in the make-up examination conducted.

8.1.1 Semester End Examination (SEE):

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows.

Two full questions with 'either' 'or' choice will be drawn from each unit. Each question carries 14 marks. There could be a maximum of three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

8.1.2 Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty/teacher handling the course as given in Table-5. CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz / Alternative Assessment Tool (AAT).

Table-5: Assessment pattern for Theory Courses

COMPONENT	THEORY		TOTAL MARKS
Type of Assessment	CIE Exam (Sessional)	Quiz / AAT	
Max. CIA Marks	25	05	30

8.1.2.1 Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Internal Examination.

8.1.2.2 Quiz / Alternative Assessment Tool (AAT)

Two Quiz exams shall be online examination consisting of 20 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in the testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quizzes for every course.

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the Alternative Assessment Tool (AAT) in place of two quizzes. This AAT enables faculty to design own assessment patterns during the CIA. However, the usage of AAT is completely optional. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, the AAT converts the classroom into an effective learning centre. The AAT may include seminars, assignments, term paper, open ended experiments, micro-projects, five minutes video, MOOCs etc.

However, it is mandatory for a faculty to obtain prior permission from the concerned HOD and spell out the teaching/assessment pattern of the AAT prior to commencement of the classes.

8.2 Laboratory Course:

8.2.1 Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment. The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

8.2.2 All the drawing related courses are evaluated in line with laboratory courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test for 10 marks in each semester.

8.3 MOOC Courses:

Meeting with the global requirements, to inculcate the habit of self learning and in compliance with UGC guidelines, MOOC (Massive Open Online Course) courses have been introduced as electives.

8.3.1 The proposed MOOC courses would be additional choices in all the elective groups subject to the availability during the respective semesters and respective departments will declare the list of the courses at the beginning of the semester. Course content for the selected MOOC courses shall be drawn from respective MOOCs links or shall be supplied by the department. Course will be mentored by faculty members and Assessment & Evaluation of the courses shall be done by the department.

8.3.2 There shall be one Mid Continuous Internal Examination (Quiz exam for 30 marks) after 8 weeks of the commencement of the course and semester end examination (Descriptive exam for 70 marks) shall be done along with the other regular courses.

8.3.3 Two credits will be awarded upon successful completion of each MOOC courses. Students need to complete three such MOOC courses to compensate any two elective courses (one open and one professional) having three credits.

8.3.4 Students interested in doing MOOC courses shall register the course title at their department office at the start of the semester against the courses that are announced by the department.

8.4 Audit Courses (AC) / Mandatory Courses (MC):

These courses are among the compulsory courses and do not carry any credits.

a) Gender Sensitivity is a mandatory course in III semester for all the students.

b) The student has to choose one audit course at the beginning of IV semester under self study mode. By the end of VI semester, all the students (regular and lateral entry students) shall complete the audit course.

c) The students will have four chances in total to clear the audit / mandatory course. Further, the student has an option to change the audit course in case if s/he is unable to clear the audit course in the first two chances. However, the audit course should be completed by VI semester and its result will be given in the VI semester grade sheet.

d) Audit / Mandatory courses will not carry any credits; but, a pass in each such course after attaining required CIE and SEE requirements during the programme shall be necessary requirement for the student to qualify for the award of Degree. Its result shall be declared with "Satisfactory" or "Not Satisfactory" performance.

8.5 Value Added Courses:

The value added courses are audit courses in nature offered through joint ventures with various organizations provide ample scope for the students as well as faculty to keep pace with the latest technologies pertaining to their chosen field of studies. A plenty of value added programs will be proposed by the departments one week before the commencement of class work. The students are given the option to choose the courses according to their desires and inclinations as they choose the desired items in a cafeteria. The expertise gained through the value added programs should enable them to face the formidable challenges of the future and also assist them in exploring new opportunities. Its result shall be declared with "Satisfactory" or "Not Satisfactory" performance.

8.6 Comprehensive Examination

The comprehensive Examination is aimed at assessing the students understanding of various Foundation, Skill and Core courses studied till the end of VII semester and is intended to test the students' grasp of the chosen field of study.

The Comprehensive Examination consists of two parts. Part A is a written examination and part B is the oral examination. The written examination shall be objective type of one hour duration and shall have 50 marks and is to be conducted by the concerned department under the supervision of Dean Academics. Oral examination shall be conducted by the department and carry 50 marks. The examination shall be conducted during the VIII semester.

8.7 Ideation and Product Development

The Ideation and Product Development shall be carried out either during VI semester along with other lab courses by having regular weekly slots. Students will take Ideation and Product Development batch wise and the batches will be divided as per the guidelines issued. The topic of Ideation and Product Development should be so selected that the students are enabled to complete the work in the stipulated time with the available resources in the respective laboratories. The scope of the Ideation and Product Development could be handling part of the consultancy work, maintenance of the existing equipment, development of new experiment setup or can be a prelude to the main project with a specific outcome. Ideation and Product Development report will be evaluated for 100 marks in total. Assessment will be done by the supervisor/guide for 30 marks based on the work and presentation/execution of the Ideation and Product Development . Subdivision for the remaining 70 marks is based on report, presentation, execution and viva-voce. Evaluation shall be done by a committee comprising the Ideation and Product Development supervisor, Head of the department and an examiner nominated by the Principal from the panel of experts recommended by Chairman, BOS in consultation with Head of the department.

8.8 Project work

In the non-FSI Model, the project work shall be evaluated for 100 marks out of which 30 marks for internal evaluation and 70 marks for semester end evaluation. The project work shall be spread over in VII semester and in VIII semester. The project work shall be somewhat innovative in nature, exploring the research bent of the mind of the student. A project batch shall comprise not more than three students.

At the end of VII semester, students should submit synopsis summarizing the work done in VII semester. The project is expected to be completed by the end of VIII semester. In VII semester, a first mid review is conducted by Project Review Committee (PRC) (on the progress) for 10 marks.

In VIII semester, a second mid review is conducted by PRC (on the progress) for 10 marks. On completion of the project, a third evaluation is conducted for award of internal marks of another 10 marks before the report is submitted, making the total internal marks 30.

The end semester examination shall be based on the report submitted and a viva-voce exam for 70 marks by a committee comprising the Head of the department, project supervisor and an external examiner nominated by the Principal. A minimum of 40% of maximum marks shall be obtained to earn the corresponding credits.

8.9 Full Semester Internship (FSI)

FSI is a full semester internship programme carries 16 credits. During the FSI, student has to spend one full semester in an identified industry / firm / organization and has to carry out the internship as per the stipulated guidelines of that industry / firm / organization and the institute.

Following are the evaluation guidelines:

- Quizzes: 2 times
- Quiz #1 - About the industry profile, weightage: 5%
- Quiz #2 - Technical-project related, weightage: 5%
- Seminars - 2 times (once in six weeks), weightage: 7.5% + 7.5%
- Viva-voce: 2 times (once in six weeks), weightage: 7.5% + 7.5%
- Project Report, weightage: 15%
- Internship Diary, weightage: 5 %
- Final Presentation, weightage: 40%

FSI shall be open to all the branches with a ceiling of maximum 10% distributed in both semesters. The selection procedure is:

- Choice of the students
- CGPA (> 7.5) up to IV semester
- Competency Mapping / Allotment

9.0 MAKE-UP EXAMINATION

The make-up examination facility shall be available to students who may have missed to attend CIE exams in one or more courses in a semester for valid genuine reasons. The make-up examination shall have comprehensive online objective type questions. The syllabus for the make-up examination shall be the whole syllabus covered till the end of the semester under consideration and will be conducted at the end of the semester.

10.0 ATTENDANCE REQUIREMENTS AND DETENTION POLICY

10.1 It is desirable for a candidate to put on 100% attendance in each course. In every course (theory/laboratory), student has to maintain a minimum of 75% attendance including the days of attendance in sports, games, NCC and NSS activities to be eligible for appearing in Semester End Examination of the course.

10.2 For cases of medical issues, deficiency of attendance in each course to the extent of 10% may be condoned by the College Academic Committee (CAC) on the recommendation of Head of the department if their attendance is between 75% to 65% in every course, subjected to submission of medical certificates, medical case file and other needful documents to the concerned departments.

10.3 The basis for the calculation of the attendance shall be the period prescribed by the institute by its calendar of events. For late admission, attendance is reckoned from the date of admission to the program. However, in case of a student having less than 65% attendance in any course, s/he shall be detained in the course and in no case such process will be relaxed.

10.4 A candidate shall put in a minimum required attendance at least three (3) theory courses for getting promoted to next higher class / semester. Otherwise, s/he shall be declared detained and has to repeat semester.

10.5 Students whose shortage of attendance is not condoned in any subject are not eligible to write their semester end examination of that courses and their registration shall stand cancelled.

10.6 A prescribed fee shall be payable towards condonation of shortage of attendance.

10.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

10.8 Any student against whom any disciplinary action by the institute is pending shall not be permitted to attend any SEE in that semester.

11.0 CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

11.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

11.2 Question papers may be moderated for the coverage of syllabus, pattern of questions by a Semester End Examination Committee chaired by Head of the Department one day before the commencement of semester end examinations. Internal Examiner shall prepare a detailed scheme of valuation.

11.3 The answer papers of semester end examination should be evaluated by the internal examiner immediately after the completion of exam and the award sheet should be submitted to COE in a sealed cover before the same papers are kept for second evaluation by external examiner.

11.4 In case of difference of more than 15% of marks, the answer paper shall be re-evaluated by a third examiner appointed by the Examination Committee and marks awarded by this examiner shall be taken as final.

11.5 COE shall invite 3 - 9 external examiners to evaluate all the end-semester answer scripts on a prescribed date(s). Practical laboratory exams are conducted involving external examiners.

11.6 Examinations Control Committee shall consolidate the marks awarded by internal and external examiners and award grades.

12.0 SCHEME FOR THE AWARD OF GRADE

12.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures

i. Not less than 35% marks for each theory course in the semester end examination, and

ii. A minimum of 40% marks for each theory course considering both internal and semester end examination.

12.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Lab / Comprehensive Examination / Ideation and Product Development / Project, if s/he secures

i. Not less than 40% marks for each Lab / Comprehensive Examination / Ideation and Product Development / Project course in the semester end examination,

ii. A minimum of 40% marks for each Lab / Comprehensive Examination / Ideation and Product Development / Project course considering both internal and semester end examination.

12.3 If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

13.0 LETTER GRADES AND GRADE POINTS

13.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10-point grading system with the following letter grades as given in the Table-6.

Table-6: Grade Points Scale (Absolute Grading)

Range of Marks	Grade Point	Letter Grade
100 – 90	10	S (Superior)
89 – 80	9	A+ (Excellent)
79 – 70	8	A (Very Good)
69 – 60	7	B+ (Good)
59 – 50	6	B (Average)
49 – 40	5	C (Pass)
Below 40	0	F (Fail)
Absent	0	AB (Absent)
Authorized Break of Study	0	ABS

13.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: “S”, “A+”, “A”, “B+”, “B”, “C”.

13.3 A student obtaining Grade F shall be considered Failed and will be required to reappear in the examination.

13.4 For non credit courses, ‘Satisfactory’ or “Not Satisfactory” is indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

13.5 “SA” denotes shortage of attendance (as per item 10) and hence prevention from writing Semester End Examination.

13.6 “W” denotes **withdrawl** from the exam for the particular course.

13.7 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

14.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,

$$SGPA = \sum_{i=1}^{n}(C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and n represent the number of courses in which a student is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m}(C_j S_j) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester.

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

15.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA

15.1 Illustration for SGPA

Course Name	Course Credits	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 x 8 = 24
Course 2	4	B+	7	4 x 7 = 28
Course 3	3	B	6	3 x 6 = 18
Course 4	3	S	10	3 x 10 = 30
Course 5	3	C	5	3 x 5 = 15
Course 6	4	B	6	4 x 6 = 24
	20			**139**

$$Thus, SGPA = 139 / 20 = 6.95$$

15.2 Illustration for CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit: 20 SGPA: 6.9	Credit: 22 SGPA: 7.8	Credit: 25 SGPA: 5.6	Credit: 26 SGPA: 6.0
Semester 5	**Semester 6**		
Credit: 26 SGPA: 6.3	Credit: 25 SGPA: 8.0		

$$Thus,\ CGPA = \frac{20x6.9\ +\ 22x7.8\ +\ 25x5.6\ +\ 26x6.0\ +\ 26x6.3\ +\ 25x8.0}{144} = 6.73$$

16.0 PHOTOCOPY / REVALUATION

A student, who seeks the re-valuation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s), within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

17.0 PROMOTION POLICIES

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no. 10.

17.1 For students admitted into B.Tech (Regular) program

17.1.1 A student will not be promoted from II semester to III semester unless s/he fulfills the academic requirement of securing 24 credits from I and II semesters examinations, whether or not the candidate takes the examinations.

17.1.2 A student will not be promoted from IV semester to V semester unless s/he fulfills the academic requirement of securing 37 credits upto III semester **or** 49 credits upto IV semester, from all the examinations, whether or not the candidate takes the examinations.

17.1.3 A student shall be promoted from VI semester to VII semester only if s/he fulfills the academic requirements of securing 62 credits upto V semester **or** 74 credits upto VI semester from all the examinations, whether or not the candidate takes the examinations.

17.1.4 A student shall register for all the 192 credits and earn all the 192 credits. Marks obtained in all the 192 credits shall be considered for the award of the Grade.

17.2 For students admitted into B.Tech (lateral entry students)

17.2.1 A student will not be promoted from IV semester to V semester unless s/he fulfills the academic requirement of securing 25 credits upto IV semester, from all the examinations, whether or not the candidate takes the examinations.

17.2.2 A student shall be promoted from VI semester to VII semester only if s/he fulfills the academic requirements of securing 38 credits upto V semester **or** 50 credits upto VI semester from all the examinations, whether or not the candidate takes the examinations.

17.2.3 A student shall register for all the 144 credits and earn all the 144 credits. Marks obtained in all the 144 credits shall be considered for the award of the Grade.

18.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of the B.Tech degree.

18.1 Student shall register and acquire minimum attendance in all courses and secure 192 credits for regular program and 144 credits for lateral entry program.

18.2 A student of a regular program, who fails to earn 192 credits within eight consecutive academic years from the year of his/her admission with a minimum CGPA of 4.0, shall forfeit his/her degree and his/her admission stands cancelled.

18.3 A student of a lateral entry program who fails to earn 144 credits within six consecutive academic years from the year of his/her admission with a minimum CGPA of 4.0, shall forfeit his/her degree and his/her admission stands cancelled.

19.0 BETTERMENT OF MARKS IN THE COURSES ALREADY PASSED

Students who clear all the courses in their first attempt and wish to improve their CGPA shall register and appear for betterment of marks for one course of any theory courses within a period of subsequent two semesters. The improved marks shall be considered for classification / distinction but not for ranking. If there is no improvement, there shall not be any change in the original marks already awarded.

20.0 AWARD OF DEGREE

20.1 Classification of degree will be as follows:

CGPA $\geq$ 7.5	CGPA $\geq$ 6.5 and < 7.5	CGPA $\geq$ 5.0 and < 6.5	CGPA $\geq$ 4.0 and < 5.0	CGPA < 4.0
First Class with Distinction	**First Class**	**Second Class**	**Pass Class**	**Fail**

20.2. In order to extend the benefit to the students with one/two backlogs after either VI semester or VIII semester, GRAFTING option is provided to the students enabling their placements and fulfilling graduation requirements. Following are the guidelines for the Grafting:

a. Grafting will be done among the courses within the semester shall draw a maximum of 7 marks from the any one of the cleared courses in the semester and will be grafted to the failed course in the same semester.

b. Students shall be given a choice of grafting only once in the 4 years program, either after VI semester (Option #1) or after VIII semester (Option #2).

c. Option#1: Applicable to students who have maximum of TWO theory courses in V and / or VI semesters.

Option#2: Applicable to students who have maximum of TWO theory courses in VII and / or VIII semesters.

d. Eligibility for grafting:

   i. Prior to the conduct of the supplementary examination after the declaration of VI or VIII semester results.

   ii. S/he must appear in all regular or supplementary examinations as per the provisions laid down in regulations for the courses s/he appeals for grafting.

   iii. The marks obtained by her/him in latest attempt shall be taken into account for grafting of marks in the failed course(s).

20.3 Student, who clears all the courses upto VII semester, shall have a chance to appear for Quick Supplementary Examination to clear the failed courses of VIII semester.

20.4 By the end of VI semester, all the students (regular and lateral entry students) shall complete one of the audit course and mandatory course with acceptable performance.

20.5 In case, a student takes more than one attempt in clearing a course, the final marks secured shall be indicated by * mark in the grade sheet.

All the candidates who register for the semester end examination will be issued grade sheet by the institute. Apart from the semester wise grade sheet, the institute will issue the provisional certificate and consolidated grade sheet subject to the fulfillment of all the academic requirements.

21.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

21.1 A candidate is normally not permitted to break the study. However, if a candidate intends to temporarily discontinue the program in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the program in a later respective semester, s/he shall apply to the Principal in advance. Such application shall be submitted before the last date for payment of examination fee of the semester in question and forwarded through the Head of the department stating the reasons for such withdrawal together with supporting documents and endorsement of his / her parent / guardian.

21.2 The institute shall examine such an application and if it finds the case to be genuine, it may permit the student to temporarily withdraw from the program. Such permission is accorded only to those who do not have any outstanding dues / demand at the College / University level including tuition fees, any other fees, library materials etc.

21.3 The candidate has to rejoin the program after the break from the commencement of the respective semester as and when it is offered.

21.4 The total period for completion of the program reckoned from the commencement of the semester to which the candidate was first admitted shall not exceed the maximum period specified in clause 18.0. The maximum period includes the break period.

21.5 If any candidate is detained for any reason, the period of detention shall not be considered as ‘Break of Study’.

22.0 TERMINATION FROM THE PROGRAM

The admission of a student to the program may be terminated and the student is asked to leave the institute in the following circumstances:

a. The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.

b. A student shall not be permitted to study any semester more than three times during the entire Program of study.

c. The student fails to satisfy the norms of discipline specified by the institute from time to time.

23.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the institute / if any case of indiscipline / malpractice is pending against him, the results of the candidate will be withheld. The issue of the degree is liable to be withheld in such cases.

24.0 GRADUATION DAY

The institute shall have its own annual Graduation Day for the award of Degrees to students completing the prescribed academic requirements in each case, in consultation with the University and by following the provisions in the Statute. The college shall institute prizes and medals to meritorious students and award them annually at the Graduation Day. This will greatly encourage the students to strive for excellence in their academic work.

25.0 DISCIPLINE

Every student is required to observe discipline and decorum both inside and outside the institute and not to indulge in any activity which will tend to bring down the honor of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations he/she shall be liable for punitive action as prescribed by the Institute from time to time.

26.0 GRIEVANCE REDRESSAL COMMITTEE

The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

27.0 TRANSITORY REGULATIONS

A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

a) Four Year B.Tech Regular course:

A student who is following Jawaharlal Nehru Technological University (JNTUH) curriculum and detained due to shortage of attendance at the end of the first semester shall join the autonomous batch of first semester. Such students shall study all the courses prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

A student who is following JNTUH curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute courses will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits up to previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

b) Three Year B.Tech program under Lateral Entry Scheme:

A student who is following JNTUH curriculum and detained due to shortage of attendance at the end of the first semester of second year shall join the autonomous batch of third semester. Such students shall study all the courses prescribed for the batch in which the student joins and considered on par with Lateral Entry regular candidates of Autonomous stream and will be governed by the autonomous regulations.

A student who is following JNTUH curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester of second year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute courses are offered in place of them as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits up to previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

c) Transfer candidates (from non-autonomous college affiliated to JNTUH):

A student who is following JNTUH curriculum, transferred from other college to this institute in third semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute courses are offered in their place as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be the sum of the credits upto previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

d) Transfer candidates (from an autonomous college affiliated to JNTUH):

A student who has secured the required credits upto previous semesters as per the regulations of other autonomous institutions shall also be permitted to be transferred to this institute. A student who is transferred from the other autonomous colleges to this institute in third semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The total number of credits to be secured for the award of the degree will be the sum of the credits upto previous semester as per the regulations of the college from which he is transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

28.0 REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body shall come into force and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

AERONAUTICAL ENGINEERING

COURSE STRUCTURE

I SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHS001	English for Communication	HS	Foundation	3	-	-	3	30	70	100
AHS002	Linear Algebra and Ordinary Differential Equations	BS	Foundation	3	1	-	4	30	70	100
AHS005	Engineering Chemistry	BS	Foundation	3	-	-	3	30	70	100
AHS007	Applied Physics	BS	Foundation	3	1	-	4	30	70	100
AME001	Engineering Drawing	ES	Foundation	2	-	3	4	30	70	100
PRACTICAL										
AHS101	Communication Skills Laboratory	HS	Foundation	-	-	2	1	30	70	100
AHS103	Engineering Chemistry Laboratory	BS	Foundation	-	-	2	1	30	70	100
ACS113	IT Workshop	ES	Foundation	-	-	3	2	30	70	100
AME101	Basic Workshop	ES	Foundation	-	-	3	2	30	70	100
TOTAL				**14**	**02**	**13**	**24**	**270**	**630**	**900**

II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AME002	Engineering Mechanics	ES	Foundation	3	1	-	4	30	70	100
AHS003	Computational Mathematics and Integral Calculus	BS	Foundation	3	1	-	4	30	70	100
AHS008	Modern Physics	BS	Foundation	3	1	-	4	30	70	100
AHS009	Environmental Studies	HS	Foundation	3	-	-	3	30	70	100
ACS001	Computer Programming	ES	Foundation	3	-	-	3	30	70	100
PRACTICAL										
AHS102	Computational Mathematics Laboratory	BS	Foundation	-	-	2	1	30	70	100
AHS105	Engineering Physics Laboratory	BS	Foundation	-	-	2	1	30	70	100
ACS101	Computer Programming Laboratory	ES	Foundation	-	-	3	2	30	70	100
AME102	Computer Aided Engineering Drawing Practice	ES	Foundation	-	-	3	2	30	70	100
TOTAL				**15**	**03**	**10**	**24**	**270**	**630**	**900**

III SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHS011	Mathematical Transform Techniques	BS	Foundation	3	1	-	4	30	70	100
AAE001	Introduction to Aerospace Engineering	PC	Core	3	-	-	3	30	70	100
AAE002	Theory of Structures	PC	Core	3	1	-	4	30	70	100
AAE003	Fluid Mechanics and Hydraulics	ES	Foundation	3	1	-	4	30	70	100
AEE018	Basic Electrical and Electronics Engineering	ES	Foundation	3	1	-	4	30	70	100
AHS017	Gender Sensitivity	MC	Perspective	-	-	-	-	-	-	-
PRACTICAL										
AAE101	Mechanics of Solids Laboratory	ES	Foundation	-	-	3	2	30	70	100
AAE102	Fluid Mechanics and Hydraulics Laboratory	ES	Foundation	-	-	3	2	30	70	100
AEE103	Basic Electrical and Electronics Engineering Laboratory	ES	Foundation	-	-	3	2	30	70	100
TOTAL				**15**	**04**	**09**	**25**	**240**	**560**	**800**

IV SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHS004	Complex Analysis and Probability Distribution	BS	Foundation	3	1	-	4	30	70	100
AME003	Thermodynamics	ES	Foundation	3	1	-	4	30	70	100
AAE004	Low Speed Aerodynamics	PC	Core	3	1	-	4	30	70	100
AAE005	Aircraft Materials and Production	PC	Core	3	-	-	3	30	70	100
AAE006	Analysis of Aircraft Structures	PC	Core	3	1	-	4	30	70	100
	Audit Course	AC	Perspective	-	-	-	-	-	-	-
PRACTICAL										
AAE103	Aerodynamics Laboratory	PC	Core	-	-	3	2	30	70	100
AAE104	Aerospace Structures Laboratory	PC	Core	-	-	3	2	30	70	100
AAE105	Aircraft Materials and Production Laboratory	PC	Core	-	-	3	2	30	70	100
TOTAL				**15**	**04**	**09**	**25**	**240**	**560**	**800**

V SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AAE007	Aircraft Propulsion	PC	Core	3	-	-	3	30	70	100
AAE008	High Speed Aerodynamics	PC	Core	3	1	-	4	30	70	100
AAE009	Finite Element Methods	PC	Core	3	1	-	4	30	70	100
AAE010	Aircraft Systems and Controls	PC	Core	3	-	-	3	30	70	100
AAE011	Aircraft Performance	PC	Core	3	-	-	3	30	70	100
	Professional Elective - I Available and Selected MOOC Courses	PE	Elective	3	-	-	3	30	70	100
AHS106	Research and Content Development	HS	Skill	-	-	2	1	30	70	100
PRACTICAL										
AAE106	Computer Aided Aircraft Engineering Drawing	PC	Core	-	-	3	2	30	70	100
AAE107	Flight Controls Laboratory	PC	Core	-	-	3	2	30	70	100
TOTAL				**18**	**02**	**08**	**25**	**270**	**630**	**900**

VI SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AAE012	Space Propulsion	PC	Core	3	1	-	4	30	70	100
AAE013	Computational Aerodynamics	PC	Core	3	1	-	4	30	70	100
AAE014	Aircraft Stability and Control	PC	Core	3	1	-	4	30	70	100
	Professional Elective - II Available and Selected MOOC Courses	PE	Elective	3	-	-	3	30	70	100
	Open Elective – I Available and Selected MOOC Courses	OE	Elective	3	-	-	3	30	70	100
	Value Added Course - I	AC	Skill	-	-	-	-	-	-	-
AAE201	Ideation and Product Development	-	Skill	-	-	2	1	30	70	100
PRACTICAL										
AAE108	Aerospace Propulsion Laboratory	PC	Core	-	-	3	2	30	70	100
AAE109	Computational Aerodynamics Laboratory	PC	Core	-	-	3	2	30	70	100
AAE110	Computer Aided Manufacturing Laboratory	PC	Core	-	-	3	2	30	70	100
TOTAL				**15**	**03**	**11**	**25**	**270**	**630**	**900**

VII SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AAE015	Aerospace Structural Dynamics	PC	Core	3	1	-	4	30	70	100
AAE016	Space Mechanics	PC	Core	3	1	-	4	30	70	100
AAE017	Flight Vehicle Design	PC	Core	3	1	-	4	30	70	100
	Professional Elective - III Available and Selected MOOC Courses	PE	Elective	3	-	-	3	30	70	100
	Open Elective – II Available and Selected MOOC Courses	OE	Elective	3	-	-	3	30	70	100
	Value Added Course - II	AC	Skill	-	-	-	-	-	-	-
PRACTICAL										
AAE111	Computational Structural Analysis Laboratory	PC	Core	-	-	3	2	30	70	100
AAE112	Flight Vehicle Design Laboratory	PC	Core	-	-	3	2	30	70	100
AAE113	Aerospace Structural Dynamics Laboratory	PC	Core	-	-	3	2	30	70	100
AAE301	Project Work (Phase – I)	PC	Core	-	-	-	-	-	-	-
TOTAL				**15**	**03**	**09**	**24**	**240**	**560**	**800**

VIII SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AAE018	Flights Controls Theory	PC	Core	3	-	-	3	30	70	100
AAE019	Aviation Management	PC	Core	3	-	-	3	30	70	100
	Professional Elective - IV Available and Selected MOOC Courses	PE	Elective	3	-	-	3	30	70	100
PRACTICAL										
AAE401	Comprehensive Examination	PC	Skill	-	-	-	1	-	100	100
AAE302	Project Work (Phase- II)	PC	Core	-	-	4	10	30	70	100
TOTAL				**09**	**00**	**04**	**20**	**120**	**380**	**500**

PROFESSIONAL ELECTIVES

GROUP- I: AEROSPACE STRUCTURAL ENGINEERING

Course Code	Course Title
AAE501	Advanced Solid Mechanics
AAE502	Experimental Stress Analysis
AAE503	Fatigue and facture mechanics
AAE504	Design and Analysis of Composite Structures
AAE505	Aeroelasticity
AAE506	Unmanned Air Vehicles

GROUP- II: AERODYNAMICS / FLUID FLOWS

Course Code	Course Title
AAE507	Ground Vehicle Aerodynamics
AAE508	Advanced Computational Aerodynamics
AAE509	Experimental Aerodynamics
AAE510	Hypersonic Aerodynamics
AAE511	High angle of attack aerodynamics
AAE512	Helicopter Aerodynamics

GROUP- III: AEROSPACE PROPULSION SYSTEMS

Course Code	Course Title
AAE513	Theory of Combustion
AAE514	Turbo Machinery
AAE515	Heat Transfer
AAE516	Cryogenics
AAE517	Aero Engine Design
AAE518	Rocket and Missiles

GROUP- IV: AEROSPACE DESIGN AND MANUFACTURING ENGINEERING

Course Code	Course Title
AAE519	Precision Engineering
AAE520	Non Destructive Testing
AAE521	CAD / CIM
AAE522	Composites Fabrication and Machining
AAE523	Mechanism and Machine Design
AAE524	Production Design and Development

GROUP- V: AVIATIONS

Course Code	Course Title
AAE525	Avionics and Instrumentation
AAE526	Air Transportation System
AAE527	Airport Planning and Management
AAE528	Airworthiness and Certifications
AAE529	Flight Scheduling and Operations
AAE530	Airport Operations

GROUP- VI: FLIGHT DYNAMICS AND CONTROL

Course Code	Course Title
AAE531	Spacecraft Attitude and Control
AAE532	Automatic Control of Aircraft
AAE533	Flight Simulation
AAE534	Orbital Mechanics
AAE535	Space Dynamics
AAE536	Atmospheric Re-entry Vehicle

OPEN ELECTIVE-I

Course Code	Course Title
AME551	Elements of Mechanical Engineering
ACE551	Disaster Management
ACE552	Geospatial Techniques
ACS551	Principles of Operating System
ACS552	JAVA Programming
AEC551	Embedded System Design
AME552	Introduction to Automobile Engineering
AME553	Introduction to Robotics
AAE551	Aerospace Propulsion and Combustion*
Note: * indicates that subject not offered to the students of Aeronautical Engineering department.	

OPEN ELECTIVES- II

Course Code	Course Title
AEC552	Fundamentals of Image Processing
ACS553	Fundamentals of Database Management Systems
AIT551	Basics of Information Security and Cryptography
AHS551	Modeling and Simulation
AHS552	Research Methodologies
AEE551	Energy from Waste
AAE552	Finite Element Analysis
AME554	Basic Refrigeration and Air-Conditioning
AAE553	Launch Vehicles and Controls*
Note: * indicates that subject not offered to the students of Aeronautical Engineering department.	

AUDIT COURSES

Course Code	Course Title
AHS601	Intellectual Property Rights
AHS602	Total Quality Management
AHS603	Professional Ethics and Human Values
AHS604	Legal Sciences
AHS605	Clinical Psychology
AHS606	English for Special Purposes
AHS607	Entrepreneurship
AHS608	Any Foreign Language
AHS609	Design History
AHS017	Gender Sensitivity

VALUE ADDED COURSES - I

Course Code	Course Title
AAE801	Machine Learning Applications
AAE802	Aircraft Modeling
AAE803	Aircraft Interior Design
AAE804	Parametric Solid Modeling

VALUE ADDED COURSES - II

Course Code	Course Title
AAE805	Aircraft Navigation Systems
AAE806	High Temperature Materials
AAE807	Aerospace Structural Health Monitoring System
AAE808	Airborne Radar Systems

SYLLABUS
(I –VIII Semesters)

ENGLISH FOR COMMUNICATION

I Semester: AE / CE / ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS001	Skill	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Communicate in an intelligible English accent and pronunciation.
II. Effectively use the four language skills i.e., Listening, Speaking, Reading and Writing.
III. Develop the art of writing simple English with correct spelling, grammar and punctuation.

UNIT-I	LISTENING SKILL	Classes: 08

Significance, essentials, barriers and effectiveness of listening; Listening to dialogues, conversation, discussions, monologues; Listening to sounds, silent letters, stressed syllables in English; Listening for the gist of the text, for identifying the topic, general meaning and specific information; Listening for multiple choice questions, positive and negative comments for interpretation

Note: Instructions in theory and practice in the lab

UNIT-II	SPEAKING SKILL	Classes: 10

Significance, essentials, barriers and effectiveness of speaking; Simple oral or casual interaction, dialogue, conversation; Debates: Differences between disagreeing and being disagreeable; Brief presentations; Role plays; Generating talks based on visual or written prompts; Addressing a small group or a large formal gathering; Speaking about present, past experiences and future plans; Arguing outs a topic without verbal fights; Paper presentation.

Note: Instructions in theory and practice in the lab

UNIT-III	READING SKILL	Classes: 09

Techniques of reading: Skimming, scanning, intensive and extensive reading; Reading comprehension: Exercises for multiple choice questions and contextual meaning – Values in Dr. Kalam.

Vocabulary enrichment and grammar exercises based on selective readings: Swami Vivekananda: Chicago Speech, 1893; Passages for intellectual and emotional comments; Reading for the gist of a text, for specific information, for information transfer and interpretation.

UNIT-IV	WRITING SKILL	Classes: 08

Significance, essentials and effectiveness of writing; Writing emails; Writing paragraphs: Comparing, contrasting, presentations with an introduction, body and conclusion; Writing formal and informal letters: Letter of invitation, accepting, declining, requesting, complaint, seeking information; Cover letter enclosing a CV.

UNIT-V	VOCABULARY AND GRAMMAR	Classes: 10

Punctuation, parts of speech, articles, prepositions, tenses, concords, phrasal verbs; Forms of verbs: Regular and irregular, direct and indirect speech, change of voice; prefixes, suffixes, Synonyms, antonyms, one word substitutes, idioms and phrases, technical vocabulary.

Text Books:

1. Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles Practices", Oxford University Press, New Delhi, 3rd Edition , 2015.

Reference Books:

1. Norman Whitby, "Business Benchmark: Pre-Intermediate to Intermediate – BEC Preliminary",
2. Cambridge University Press, 2nd Edition, 2008.
3. Devaki Reddy, Shreesh Chaudhary, "Technical English", Macmillan, 1st Edition, 2009.
4. Rutherford, Andrea J, "Basic Communication Skills for Technology", Pearson Education, 2nd Edition,
5. 2010
6. Raymond Murphy, "Essential English Grammar with Answers" Cambridge University Press, 2nd
7. Edition.

Web References:

1. https://www.edufind.com
2. https://www.myenglishpages.com
3. https://www.grammar.ccc.comment.edu
4. https://www.owl.english.prudue.edu

E-Text Books:

1. https://www.bookboon.com/en/communication-ebooks-zip
2. https://www.bloomsbury-international.com/images/ezone/ebook/writing-skills-pdf.pdf
3. https://www.americanenglish.state.gov/files/ae/resource_files/developing_writing.pdf
4. https://www.learningenglishvocabularygrammar.com/files/idiomsandphraseswithmeaningsandexamplespdf.pdf
5. https://www.robinwood.com/Democracy/GeneralEssays/CriticalThinking.pdf

Course Home Page:

LINEAR ALGEBRA AND ORDINARY DIFFERENTIAL EQUATIONS

I Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS002	Foundation	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Analyze and solve linear system of equations by using elementary transformations.
II. Apply differential equations on real time applications
III. Determine the maxima and minima of functions of several variables by using partial differential coefficients.

UNIT-I	THEORY OF MATRICES	Classes: 08

Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew-Hermitian and unitary matrices; Elementary row and column transformations, elementary matrix, finding rank of a matrix by reducing to Echelon form and normal form; Finding the inverse of a matrix using elementary row/column transformations: Gauss-Jordan method; Solving of linear system of equations by LU decomposition method.

UNIT-II	LINEAR TRANSFORMATIONS	Classes: 10

Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Linear transformation; Eigen values and Eigen vectors of a matrix; Properties of Eigen values and Eigen vectors of real and complex matrices; Diagonalization of matrix.

UNIT-III	DIFFERENTIAL EQUATIONS OF FIRST ORDER AND THEIR APPLICATIONS	Classes: 08

Solution of first order linear differential equations by exact, non exact, linear equations; Bernoulli equation.

Applications of first order differential equations: Orthogonal trajectories; Newton's law of cooling; Law of natural growth and decay.

UNIT-IV	HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS	Classes: 10

Linear differential equations of second and higher order with constant coefficients, non-homogeneous term of the type $f(x)=e^{ax}, \sin ax, \cos ax$ and $f(x)=x^n, e^{ax}v(x), x^n v(x)$; Method of variation of parameters; Applications to electrical circuits and simple harmonic motion.

UNIT-V	FUNCTIONS OF SINGLE AND SEVERAL VARIABLES	Classes: 09

Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof; Functions of several variables: Partial differentiation, chain rule, total derivative, Euler's theorem, functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with

constraints; Method of Lagrange multipliers.
Text Books:
1. E Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2013.
Reference Books:
1. RK Jain, S R K Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016. 2. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-1", Tata Mc Graw Hill Education, 1st Edition, 2009. 3. Srimanthapal, Suboth C. Bhunia, "Engineering Mathematics", Oxford Publishers, 3rd Edition, 2015.
Web References:
1. https://www.efunda.com/math/math_home/math.cfm 2. https://www.ocw.mit.edu/resources/#Mathematics 3. https://www.sosmath.com/ 4. https://www.mathworld.wolfram.com/
E-Text Books:
1. https://www.e-booksdirectory.com/details.php?ebook=10166 2. https://www.e-booksdirectory.com/details.php?ebook=7400re
Course Home Page:

ENGINEERING CHEMISTRY

<table>
<tr><td colspan="9">I Semester: Common for all Branches</td></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">AHS005</td><td rowspan="2">Foundation</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 45</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 45</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Apply the electrochemical principles in batteries.
II. Understand the fundamentals of corrosion and development of different techniques in corrosion control.
III. Analysis of water for its various parameters and its significance in industrial applications.
IV. Improve the fundamental science and engineering principles relevant to materials.

UNIT-I	ELECTROCHEMISTRY AND BATTERIES	Classes: 10

Electrochemistry: Basic concepts of electrochemistry; Conductance: Specific, equivalent and molar conductance and effect of dilution on conductance; Electrochemical cells: Galvanic cell (daniel cell); Electrode potential; Electrochemical series and its applications; Nernst equation; Types of electrodes: Calomel electrode, quinhydrone electrode; Batteries: Classification of batteries, primary cells (dry cells) and secondary cells (lead-acid battery, Ni-Cd cell), applications of batteries, numerical problems.

UNIT-II	CORROSION AND ITS CONTROL	Classes: 08

Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions.

UNIT-III	WATER TECHNOLOGY	Classes: 09

Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement.

Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.

UNIT-IV	MATERIALS CHEMISTRY	Classes: 10

Materials chemistry: Polymers-classification with examples, polymerization-addition, condensation and co-polymerization; Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics; Preparation, properties and applications of polyvinyl chloride, Teflon, Bakelite and Nylon-6, 6; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers:

Characteristics of fibers, preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples; Properties: Viscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples.

UNIT-V	FUELS AND COMBUSTION	Classes: 08

Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.

Text Books:

1. P. C. Jain, Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 15th Edition, 2015.
2. Shasi Chawla, "Text Book of Engineering Chemistry", Dhantpat Rai Publishing Company, New Delhi, 1st Edition, 2011.

Reference Books:

1. B. Siva Shankar, "Engineering Chemistry", Tata Mc Graw Hill Publishing Limited, 3rd Edition, 2015.
2. S. S. Dara, Mukkanti, "Text of Engineering Chemistry", S. Chand & Co., New Delhi, 12th Edition, 2006.
3. C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5th Edition, 2013.
4. R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.

Web References:

1. https://www.tndte.com
2. https://www.nptel.ac.in/downloads
3. https://www.scribd.com
4. https://www.cuiet.info
5. https://www.sbtebihar.gov.in
6. https://www.ritchennai.org

E-Text Books:

1. https://www.Corrosion.ksc.nasa.gov/electrochem_cells.htm
2. https://www.science.uwaterloo.ca/~cchieh/cact/applychem/watertreatment.html
3. https://www.acs.org/content/acs/en/careers/college-to-career/areas-of-chemistry/polymer-chemistry.html
4. https://www.darvill.clara.net/altenerg/fossil.htm
5. https://www.Library.njit.edu/research helpdesk/subject guides/chemistry.php

Course Home Page:

APPLIED PHYSICS

I Semester: AE / CE / ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS007	Foundation	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes:45	Tutorial Classes:15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Develop the strong fundamentals of system of forces and friction.

II. Strengthen the knowledge of theoretical and technological aspects of dynamics of rigid bodies.

III. Correlate the principles with applications of the dielectric and magnetic materials.

IV. Enrich the knowledge in acoustics and ultrasonics.

UNIT-I	DIELECTRIC AND MAGNETIC PROPERTIES	Classes: 09

Dielectric Properties: Basic definitions, electronic, ionic and orientation polarizations-qualitative; Internal field in solids; Magnetic properties: Basic definitions, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, domain theory of ferro magnetism on the basis of hysteresis curve.

UNIT-II	ACOUSTICS AND ULTRASONICS	Classes: 09

Acoustics: Reverberation, reverberation time, Sabine's formula (qualitative), absorption coefficient, measurement of absorption coefficient, factors affecting acoustics of an auditorium and their remedies; Ultrasonics: Introduction; Generation of ultrasonic waves; Magnetostriction method, piezoelectric method, properties, applications.

UNIT-III	EQUILIBRIUM OF SYSTEM OF FORCES	Classes: 09

Introduction, basic concepts, system of forces, coplanar concurrent forces, force systems in plane, parallel forces in plane.

Force systems in space, couples, resultant, Lami's theorem, triangle law of forces, polygon law of forces, condition of equilibrium.

UNIT-IV	FRICTION	Classes: 09

Friction: Types of friction, limiting friction, laws of friction, angle of repose, equilibrium of body laying on rough inclined plane, application of friction, ladder friction, wedge friction, screw friction.

UNIT-V	DYNAMICS OF RIGID BODIES - MOMENT OF INERTIA	Classes: 09

Rotational motion, torque, angular momentum, relation between torque and angular momentum, angular momentum of system of particles, moment of inertia, expression for moment of inertia, radius of gyration, theorems on moment of inertia, moment of inertia of thin rod, rectangular lamina, circular disc.

Text Books:

1. Dr. K. Vijaya Kumar, Dr. S Chandralingam , " Modern Engineering Physics", S.Chand & Co, New Delhi, 1st Edition, 2010.
2. R. C Hibbler, "Engineering mechanics", Prentice Hall, 12th Edition, 2009.

Reference Books:

1. R. K. Gaur, S. L. Gupta, “Engineering Physics”, Dhanpat Rai Publications, 8th Edition, 2001.
2. Timoshenko, D. H. Young, "Engineering mechanics", Tata McGraw Hill, 5th Edition, 2013.
3. Hitendra K Malik, A. K. Singh, “Engineering Physics”, McGraw Hill Education, 1st Edition, 2009.
4. S. S. Bhavikatti, "A text book of Engineering mechanics", New age international, 1st Edition, 2012.

Web References:

1. http://link.springer.com
2. http://www.intechopen.com
3. http://www.iitg.ernet.in/rkbc/me101/Presentation/L01-03.pdf
4. http://www.vssut.ac.in/lecture_notes/lecture1423904717.pdf

E-Text Books:

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.freeengineeringbooks.com/Civil/Engineering-Mechancs-Books.php
4. http://www.textbooksonline.tn.nic.in/books/11/stdxi-voc-ema-em-2.pdf

Course Home Page:

ENGINEERING DRAWING

<table>
<tr><td colspan="9">I Semester: AE / CE / ME</td></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">AME001</td><td rowspan="2">Foundation</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>2</td><td>-</td><td>3</td><td>4</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 30</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: 45</td><td colspan="3">Total Classes: 75</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Understand the basic principles of engineering drawing and construction of curves used in engineering field.
II. Apply the knowledge of interpretation of projection in different quadrants.
III. Understand the projections of solids, when it is inclined to both planes simultaneously.
IV. Convert the pictorial views into orthographic view and vice versa.
V. Create intricate details of components through sections and develop its surfaces.

UNIT-I	FUNDAMENTALS OF ENGINEERING DRAWING, SCALES AND CURVES	Classes: 09

Introduction to engineering drawing: Drawing instruments and accessories, types of line, lettering practice and rules of dimensioning, geometrical constructions, basic geometrical shapes; Scales: Types of scales, units of length and their conversion, construction of scales, plain scale, diagonal scale, vernier scale; Curves used in engineering practice and their constructions; Conic sections, construction of ellipse parabola and hyperbola, special curves, construction of cycloid, epicycloids, hypocycloid and involutes.

UNIT-II	ORTHOGRAPHIC PROJECTION, PROJECTION OF PLANES	Classes: 09

Orthographic projection: Principles of orthographic projections, conventions, first and third angle projections, projection of points, projection of lines, lines inclined to single plane, lines inclined to both the planes, true lengths and traces; Projection of planes: Projection of regular planes, planes inclined to one plane, planes inclined to both planes, projection of planes by auxiliary plane projection method.

UNIT-III	PROJECTION OF SOLIDS	Classes: 09

Projection of solids: Projections of regular solid, prisms, cylinders, pyramids, cones.

Solids inclined to one plane, solids inclined to both planes, projection of solid by auxiliary plane projection method.

UNIT-IV	DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS	Classes: 09

Development of surfaces: Development of lateral surface of right regular solids, prisms, cylinders, pyramids and cones; Isometric projections: Principle of isometric projection, isometric scale, isometric projections and isometric views, isometric projections of planes, prisms, cylinders, pyramids, and cones.

UNIT-V	TRANSFORMATION OF PROJECTIONS	Classes: 09

Transformation of projections: Conversion of isometric views to orthographic views and conversion of orthographic views to isometric views.

Text Books:
1. N.D. Bhatt, "Engineering Drawing", Charotar Publications, 49th Edition, 2012. 2. C. M.Agrawal, Basant Agrawal, "Engineering Drawing'', Tata McGraw Hill, 2nd Edition, 2013.
Reference Books:
1. K. Venugopal, "Engineering Drawing and Graphics",New Age Publications,2nd Edition, 2010. 2. Dhananjay. A. Johle, "Engineering Drawing",Tata McGraw Hill, 1st Edition, 2008. 3. K. C. John, "Engineering Drawing", PHI Learning Private Limited", 2nd Edition, 2009.
Web References:
1. https://nptel.ac.in/courses/112103019/ 2. https://nptel.ac.in/courses/112103019/14
E-Text Book:
1. https://books.google.co.in/books/about/Engineering_Drawing.html?id=_hdOU8kRb2AC
Course Home Page:

COMMUNICATION SKILLS LABORATORY

I Semester: AE / CE / ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS101	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The course enables the students to:

I. Improve their ability to listen and comprehend a given text.
II. Upgrade the fluency and acquire a functional knowledge of English Language.
III. Enrich thought process by viewing a problem through multiple angles.

LIST OF EXPERIMENTS

Week-l LISTENING SKILL

a. Listening to conversations and interviews of famous personalities in various fields, listening practice related to the TV talk shows, news.
b. Listening for specific information, listening for summarizing information.

Week-2 LISTENING SKILL

a. Listening to films of short duration and monologues for taking notes, listening to answer multiple choice questions.
b. Listening to telephonic conversations; Listening to native Indian, British and American speakers to analyze intercultural differences.

Week-3 SPEAKING SKILL

a. Functions of English Language; Introduction to phonetics, exercises on pronunciation, symbols of phonetics.
b. Speaking exercises involving the use of stress and intonation, improving pronunciation through tongue twisters.
c. Tips on how to develop fluency, body language and communication; Introducing oneself: Talking about yourself others, leave taking.

Week-4 SPEAKING SKILL

a. Just a minute (JAM) sessions, public speaking, situational conversation/role-play.
b. Greetings for different occasions with feedback preferably through video recording; Speaking about present, past experiences and future plans; Acting as a compere and news reader.

Week-5 READING SKILL

a. Reading anecdotes to predict the content, reading for interpretation.
b. Suggested reading: Short stories and poem; Critical reading.

Week-6	READING SKILL
a. Reading for information transfer; Reading newspaper and magazine articles, memos, letters, notices and minutes for critical commentary. b. Reading selective autobiographies.	
Week-7	**READING SKILL**
a. Reading brochures, advertisements, pamphlets for improved presentation. b. Reading comprehension exercises with critical and analytical questions based on context.	
Week-8	**WRITING SKILL**
a. Writing messages, leaflets, notice; Writing tasks; Flashcard. b. Filling gaps while listening short stories.	
Week-9	**WRITING SKILL**
a. Write a slogan related to the image. b. Write a short story of 6-10 lines based on the hints given.	
Week-10	**WRITING SKILL**
a. Writing a short story on their own; Writing a review on: Video clippings on inspirational speeches. b. Writing a review on short films, advertisements, recipe and recently watched film.	
Week-11	**THINKING SKILL**
a. Practice in preparing thinking blocks to decode diagrammatical representations into English words, expressions, idioms, proverbs. b. Argumentative skills; Debates.	
Week-12	**THINKING SKILL**
a. Inculcating interest in English using thinking blocks. b. Making pictures and improvising diagrams to form English words, phrases and proverbs.	
Reference Books:	
1. Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles Practices", Oxford University Press, New Delhi, 3rd Edition, 2015. 2. Rhirdion, Daniel, "Technical Communication", Cengage Learning, New Delhi, 1st Edition, 2009.	
Web References:	
1. http://learnenglish.britishcouncil.org 2. http://www.esl-lab.com/ 3. http://www.elllo.org/	
Course Home Page:	

ENGINEERING CHEMISTRY LABORATORY

I Semester: AE / CE / ME								
Course Code	Category	Hours / Week			Credit	Maximum Marks		
AHS103	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 28				Total Classes: 28		

OBJECTIVES:

The course should enable the students to:

I. Comprehend the experimental results.

II. Analyze, interpret, and draw conclusions from data.

LIST OF EXPERIMENTS

Week-l	**INTRODUCTION TO CHEMISTRY LABORATORY**
Introduction to chemistry laboratory. Do's and Don'ts in chemistry laboratory.	
Week-2	**VOLUMETRIC ANALYSIS**
Batch I: Estimation of hardness of water by EDTA method. Batch II: Estimation of dissolved oxygen in water.	
Week-3	**VOLUMETRIC ANALYSIS**
Batch I: Estimation of dissolved oxygen in water Batch II: Estimation of hardness of water by EDTA method	
Week-4	**VOLUMETRIC ANALYSIS**
Batch I: Estimation of Mno_2 in pyrolusite. Batch II: Determination of copper in brass.	
Week-5	**VOLUMETRIC ANALYSIS**
Batch I: Determination of copper in brass Batch II: Estimation of Mno_2 in pyrolusite	
Week-6	**INSTRUMENTATION**
Batch I: Conductometric titration of strong acid vs strong base. Batch II: Potentiometric titration of strong acid vs strong base.	
Week-7	**INSTRUMENTATION**
Batch I: Potentiometric titration of strong acid vs strong base. Batch II: Conductometric titration of strong acid vs strong base.	
Week-8	**INSTRUMENTATION**
Batch I: Conductometric titration of mixture of acids vs strong base. Batch II: Potentiometric titration of weak acid vs strong base.	

Week-9	INSTRUMENTATION
Batch I: Potentiometric titration of weak acid vs strong base. Batch II: Conductometric titration of mixture of acids vs strong base.	
Week-10	**PHYSICAL PROPERTIES**
Batch I: Determination of viscosity of sample oil by Redwood / Oswald’s viscometer. Batch II: Determination of surface tension of lubricants	
Week-11	**PHYSICAL PROPERTIES**
Batch I: Determination of surface tension of lubricants. Batch II: Determination of viscosity of sample oil by Redwood / Oswald’s viscometer.	
Week-12	**PREPARATION OF ORGANIC COMPOUNDS**
Batch I: Preparation of Aspirin. Batch II: Preparation of Thiokol rubber.	
Week-13	**PREPARATION OF ORGANIC COMPOUNDS**
Batch I: Preparation of Thiokol rubber Batch II: Preparation of Aspirin	
Week-14	**REVISION**
Revision.	
Reference Books:	
1. Vogel’s, “Quantitative Chemical Analaysis”, Prentice Hall, 6th Edition, 2000. 2. Gary D.Christian, “Analytical Chemistry”,Wiley India, 6th Edition, 2007.	
Web References:	
http://www.iare.ac.in	
Course Home Page:	

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS:

S. No	Name of the Apparatus	Apparatus Required	Quantity
1	Analytical balance	04	100 gm
2	Beaker	30	100 ml
3	Burette	30	50 ml
4	Burette Stand	30	Metal
5	Clamps with Boss heads	30	Metal
6	Conical Flask	30	250 ml
7	Conductivity cell	10	K=1
8	Calomel electrode	10	Glass
9	Digital Potentiometer	10	EI
10	Digital Conductivity meter	10	EI
11	Digital electronic balance	01	RI
12	Distilled water bottle	30	500 ml
13	Funnel	30	Small
14	Glass rods	30	20 cm length
15	Measuring Cylinders	10	10 ml
16	Oswald Viscometer	30	Glass
17	Pipette	30	20 ml
18	Platinum Electrode	10	PP
19	Porcelain Tiles	30	White
20	Reagent bottle	30	250 ml
21	Standard Flask	30	100 ml
22	Stalagmo meter	30	Glass

IT WORKSHOP

I Semester: AE / CE / ME								
Course Code	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**		
ACS113	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	3	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

OBJECTIVES:

The course should enable the students to:

I. Provide technical training to the students on productivity tools like word processors, spreadsheets, presentations.
II. Make the students know about the internal parts of a computer.
III. Learn about networking of computers and use internet facility for browsing and searching.

LIST OF EXPERIMENTS

Week-1	**NETWORK CONNECTIONS**
IP configurations, connecting devices in LAN through bridge, hub, switch. Wi-Fi, Li-Fi and bluetooth settings; Crimping: Crossover, strait over.	
Week-2	**TROUBLESHOOTING**
Hardware troubleshooting, software troubleshooting.	
Week-3	**BLOG CREATION**
Creating blogs import the data into blogs, blog templates, and blog design.	
Week-4	**SKYPE INSTALLATION**
Skype installation and usages of Skype.	
Week-5	**CYBER HYGIENE**
Install Antivirus software; Configure their personal firewall and windows update on their computer.	
Week-6	**MS WORD**
Basic text editing, text formatting, paragraph formatting, style formatting, page formatting.	
Week-7	**MS WORD**
Working with graphics and pictures, tables, mail merge, customizing and expanding word.	
Week-8	**MS EXCEL**
Introduction to working with cells, rows, and columns, introduction to formulas and calculations, working with formulas and functions; Formatting: Formatting data, cells, rows and columns; Editing: Cells, rows, columns and worksheets.	
Week-9	**MS EXCEL**
Maintaining worksheets, the what-if analysis, adding images and graphics, charts and diagrams, creating data lists, managing data, pivot tables and charts.	
Week-10	**MS POWER POINT**
PowerPoint screen, working with slides, add content, work with text, working with tables.	

Week-11	MS POWER POINT
Graphics, slide animation, reordering slides, adding sound to a presentation.	
Week-12	**MICROSOFT OUTLOOK**
Introduction to Microsoft Outlook: Navigating outlook, sending and receiving messages, formatting messages, adding tables and other elements to messages, inserting graphics and images into e-mails, working with messages, organizing mail, advanced mail features, address books and contacts, using the calendar, reminders, tasks, notes, social media and outlook, sharing.	

Reference Books:

1. Peter Norton, "Introduction to Computers", Tata Mc Graw Hill Publishers, 6th Edition, 2010.
2. Scott Muller, Que, "Upgrading and Repairing", Pearson Education, PC's 18th Edition, 2009.

Web References:

1. http://www.cl.cam.ac.uk/teaching/1011/CompFunds
2. http://www.bibcol.com
3. http://www.tutorialspoint.com/computer_fundamentals
4. http://www.craftsmanspace.com

Course Home Page:

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE:
System Software: Linux / Windows 7.
Application Software's: MS Office and TeXworks 0.6.1on LaTeX 2e (Open Source)

HARDWARE:
30 numbers of Intel Desktop Computers with 2 GB RAM 2.7GHz Processor.
Dot Matrix Printers: 02

BASIC WORKSHOP

I Semester: AE / CE / ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AME101	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 45				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Identify and use of tools, types of joints in carpentry, fitting, tin smithy and plumbing operations.
II. Understand of electrical wiring and components.
III. Observation of the function of lathe, shaper, drilling, boring, milling, grinding machines.

LIST OF EXPERIMENTS

Week-1 CARPENTRY

Batch I: Preparation of lap joint as per given dimensions.
Batch II: Preparation of dove tail joint as per given taper angle.

Week-2 CARPENTRY

Batch I: Preparation of dove tail joint as per given taper angle.
Batch II: Preparation of lap joint as per given dimensions.

Week-3 FITTING

Batch I: Make a square fit for given sizes.
Batch II: Make a straight fit for given dimensions.

Week-4 FITTING

Batch I: Make a straight fit for given dimensions.
Batch II: Make a square fit for given sizes.

Week-5 TIN SMITHY

Batch I: Prepare the development of a surface and make a round tin.
Batch II: Prepare the development of a surface and make a rectangular tray.

Week-6 TIN SMITHY

Batch I: Prepare the development of a surface and make a rectangular tray.
Batch II: Prepare the development of a surface and make a round tin.

Week-7 FOUNDRY

Batch I: Prepare a wheel flange mould using a given wooden pattern.
Batch II: Prepare a bearing housing using a aluminum pattern.

Week-8 FOUNDRY

Batch I: Prepare a bearing housing using a aluminum pattern.
Batch II: Prepare a wheel flange mould using a given wooden pattern.

Week-9	**HOUSE WIRING**
Batch I: Make an electrical connection to demonstrate domestic voltage and current sharing. Batch II: Make an electrical connection to control one bulb with two switches-stair case connection.	
Week-10	**HOUSE WIRING**
Batch I: Make an electrical connection to control one bulb with two switches-stair case connection. Batch II: Make an electrical connection to demonstrate domestic voltage and current sharing.	
Week-11	**BLACK SMITHY**
Batch I: Prepare S-bend for given MS rod using open hearth furnace. Batch II: Prepare J-bendof given MS rod using open hearth furnace	
Week-12	**BLACK SMITHY**
Batch I: Prepare J-bend of given MS rod using open hearth furnace. Batch II: Prepare S-bend for given MS rod using open hearth furnace.	
Week-13	**DEMONSTRATION OF WELDING AND PIPE PLUMBING JOINTS**
Batch I: Demonstration of arc welding and gas welding, Batch II: Preparation of pipe plumbing joints.	
Week-14	**DEMONSTRATION OF MACHINE TOOLS**
Batch I: Familiarization of drilling, milling and grinding machines and its working. Batch II: Familiarization of central lathe and shaping machine and it's working	
Week-15	**DEMONSTRATION OF MACHINE TOOLS**
Batch I: Familiarization of drilling, milling and grinding machines and its working. Batch II: Familiarization of central lathe and shaping machine and it's working	

Reference Books:

1. K. C. John, "Mechanical Workshop Practice", PHI, 2nd Edition, 2010.
2. H.S. Bawa, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2nd Edition 2009.
3. S. K. Hajra Choudhury, A. K. Hajra Choudhury, "Elements of Workshop Technology", Media Promoters, 1st Edition, 2009.

Web References:

http://www.iare.ac.in

Course Home Page:

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS:

S.No	EQUIPMENT DESCRIPTION	QUANTITY
1.	Carpentry vice, fitting vice	8 sets
2.	Standard wood Working tool.	8 sets
3.	Models of carpentry, fitting, black smithy.	1 No
4.	Standard fitting working tool.	5 Nos
5.	Standard black smithy working tool.	1 set
6.	Standard electrical working tool	4 sets
7.	Open hearth furnace.	1Nos
8.	Arc welding transformer with cables and holders.	1 set
9.	Welding accessories like welding shield, chipping hammer, wire brush.	1 set
10.	Moulding table, foundry tools.	1 No
11	Furnace with blower.	1 No
12	Oxygen and acetylene gas cylinders, blow and other welding outfit.	1each
13	Power tool cutter.	1 No

LIST OF CONSUMABLES REQUIRED FOR A BATCH OF 30 STUDENTS:

S. NO	DESCRIPTION	QUANTITY
1	Standard wood piece 300x50x25 mm.	3 Nos
2	Standard mild steel Specimen 50x50x8 mm.	3 Nos
3	Mild steel rod 200x10 mm.	3 Nos
4	Galvanized sheet 180x70 mm.	8 sheets
5	Galvanized sheet 130x170 mm.	8 sheets
6	Electrical holders.	6 Nos
7	Electrical bubs 40W.	6 Nos
8	Electrical switches (Two way and single way)	6 Nos
9	Florescent tube light	2 Nos
10	Electrical wire insulated.	1 bundle 160 gauge
11	Moulding sand.	50 kg
12	Mild steel rod	50 meters
13	Mild steel flat	50 meters

ENGINEERING MECHANICS

<table>
<tr><td colspan="9">II Semester: AE / CE / ME</td></tr>
<tr><th rowspan="3">Course Code</th><th rowspan="3">Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th>CIA</th><th>SEE</th><th>Total</th></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>AME002</td><td>Foundation</td><td colspan="7"></td></tr>
<tr><td>Contact Classes:45</td><td>Tutorial Classes: 15</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 60</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Develop the ability to work comfortably with basic engineering mechanics concepts required for analyzing static structures.
II. Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free body diagrams and accurate equilibrium equations.
III. Identify and model various types of loading and support conditions that act on structural systems, apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem.
IV. Solve the problem of equilibrium by using the principle of work and energy in mechanical design and structural analysis.
V. Apply the concepts of vibrations to the problems associated with dynamic behavior.

UNIT-I	KINEMATICS OF PARTICLES RECTILINEAR MOTION	Classes: 12

Kinematics of particles rectilinear motion: Motion of a particle, rectilinear motion, motion curves, rectangular components of curvilinear motion, kinematics of rigid body, types of rigid body motion, angular motion, fixed axis rotation.

UNIT-II	KINETICS OF PARTICLE	Classes: 15

Kinetics of particle: Introduction, definitions of matter, body, particle, mass, weight, inertia, momentum, Newton's law of motion, relation between force and mass, motion of a particle in rectangular coordinates, D'Alembert's principle, motion of lift, motion of body on an inclined plane, motion of connected bodies.

UNIT-III	IMPULSE AND MOMENTUM, VIRTUAL WORK	Classes: 11

Impulse and momentum: Introduction; Impact, momentum, impulse, impulsive forces, units, law of conservation of momentum, Newton's law of collision of elastic bodies.

Coefficient of restitution, recoil of gun, impulse momentum equation; Virtual work: Introduction, principle of virtual work, applications, beams, lifting machines, simple framed structures.

UNIT-IV	WORK ENERGY METHOD	Classes: 12

Work energy method: Law of conservation of energy, application of work energy, method to particle motion and connected system, work energy applied to connected systems, work energy applied to fixed axis rotation.

UNIT-V	MECHANICAL VIBRATIONS	Classes: 10

Mechanical vibrations: Definitions and concepts, simple harmonic motion, free vibrations, simple and compound pendulum, torsion pendulum, free vibrations without damping, general cases.

Text Books:

1. R. C. Hibbler, "Engineering Mechanics", Prentice Hall, 12th Edition, 2009.
2. Timoshenko, D. H.Young, "Engineering Mechanics", Tata Mc Graw hill, 5th Edition, 2013.

Reference Books:

1. S. Bhavikatti, "A Text Book of Engineering Mechanics", New Age International, 1st Edition, 2012.
2. A. K. Tayal, "Engineering Mechanics", Uma Publications, 14th Edition, 2013.
3. R. K. Bansal "Engineering Mechanics", Laxmi Publication, 8th Edition, 2013.
4. BasudebBhattacharya, "EngineeringMechanics", Oxford UniversityPress, 2nd Edition, 2014.
5. K.Vijay Reddy, J. Suresh Kumar, "Singer's Engineering Mechanics Statics and Dynamics", B S Publishers, 1st Edition, 2013.

Web References:

1. https://en.wikipedia.org/wiki/Dynamics_(mechanics)
2. https://www.youtube.com/playlist?list=PLUl4u3cNGP62esZEwffjMAsEMW_YArxYC

E-Text Books:

1. http://www.freeengineeringbooks.com/Civil/Engineering-Mechanics-Books.php
2. http://www.textbooksonline.tn.nic.in/books/11/stdxi-voc-ema-em-2.pdf
3. http://www.faadooengineers.com/threads/17024-Engineering-mechanics-pdf-Free-Download

Course Home Page:

COMPUTATIONAL MATHEMATICS AND INTEGRAL CALCULUS

II Semester: AE / CE / ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS003	Foundation	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes:15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Enrich the knowledge of solving algebraic, transcendental and differential equation by numerical methods.
II. Apply multiple integration to evaluate mass, area and volume of the plane.
III. Analyze gradient, divergence and curl to evaluate the integration over a vector field.
IV. Understand the Bessels equation to solve them under special conditions with the help of series solutions.

UNIT-I	ROOT FINDING TECHNIQUES AND INTERPOLATION	Classes: 09

Root finding techniques: Solving algebraic and transcendental equations by bisection method, method of false position, Newton-Raphson method; Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton's forward interpolation, Newton's backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange's interpolation.

UNIT-II	CURVE FITTING AND NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	Classes: 08

Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares; Taylor's series method; Step by step methods: Euler's method, modified Euler's method and Runge-Kutta method for first order differential equations.

UNIT-III	MULTIPLE INTEGRALS	Classes: 10

Double and triple integrals; Change of order of integration.

Transformation of coordinate system; Finding the area of a region using double integration and volume of a region using triple integration.

UNIT-IV	VECTOR CALCULUS	Classes: 08

Scalar and vector point functions; Gradient, divergence, curl and their related properties; Solenoidal and irrotational vector point functions; Scalar potential function; Laplacian operator; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.

UNIT-V	SPECIAL FUNCTIONS	Classes: 10

Gamma function, properties of gamma function; Ordinary point and regular singular point of differential equations; Series solutions to differential equations around zero, Frobenius method about zero; Bessel's differential equation: Bessel functions properties, recurrence relations, orthogonality, generating function, trigonometric expansions involving Bessel functions.

Text Books:

1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.

Reference Books:

1. R K Jain, S R K Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016.
2. S. S. Sastry, "Introduction Methods of Numerical Analysis", Prentice-Hall of India Private Limited, 5th Edition, 2012.

Web References:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resources/#Mathematics
3. http://www.sosmath.com/
4. http://www.mathworld.wolfram.com

E-Text Books:

1. http://www.keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktu-ebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks

Course Home Page:

MODERN PHYSICS

II Semester: AE / CE / ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS008	Foundation	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes:45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Develop strong fundamentals of crystal structures and properties.
II. Meliorate the knowledge of theoretical and technological aspects of lasers and optical fibers.
III. Correlate principles with applications of the x-ray diffraction and defects in crystals.
IV. Enrich knowledge in modern engineering principles of interference and diffraction.

UNIT-I	CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES	Classes: 12

Crystallography and crystal structures: Space lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, directions and planes in crystals, Miller indices, interplanar spacing of orthogonal crystal systems, atomic radius, coordination number and packing factor of SC, BCC, FCC, NaCl and diamond structures.

UNIT-II	X-RAY DIFFRACTION AND DEFECTS IN CRYSTALS.	Classes: 15

X-ray diffraction: Bragg's law, Laue method, powder method and applications; Defects in crystals: Concepts of point defects, vacancies, substitutional, interstitial, frenkel, schottky defects, line defects and Burger's vector.

UNIT-III	LASERS AND SENSORS	Classes: 10

Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, ruby laser, semiconductor diode laser and applications of lasers.

Sensors: Introduction, basic principles, sensor materials and applications: principle of pressure, optical, acoustic and thermal sensing.

UNIT-IV	FIBER OPTICS	Classes: 12

Fiber optics: Principle and construction of an optical fiber, acceptance angle, numerical aperture, types of optical fibers (Single mode, multimode, step index, graded index), attenuation in optical fibers, application of optical fibers and optical fiber communication system with block diagram.

UNIT-V	INTERFERENCE AND DIFFRACTION	Classes: 11

Interference: Phase difference, path difference, coherence, conditions for constructive and destructive interference, interference in thin films due to reflected light, Newton rings experiment. Diffraction: Introduction, differences between interference and diffraction, types of diffraction, Fraunhofer diffraction due to single slit, N-slits, diffraction grating experiment.

Text Books:

1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", S. Chand & Co. New Delhi, 1st Edition, 2010.
2. Rajendran, "Engineering Physics", Tata Mc Graw Hill Book Publishers, 1st Edition, 2010.

Reference Books:

1. P. K. Palanisamy, “Engineering Physics”, Scitech Publishers, 4th Edition, 2014.
2. R. K. Gaur, S. L. Gupta, “Engineering Physics”, Dhanpat Rai Publications, 8th Edition, 2001.
3. A. J. Dekker, “Solid State Physics”, Macmillan India ltd, 1st Edition, 2000.
4. Hitendra K. Malik, A. K. Singh, “Engineering Physics”, McGraw Hill Education, 1st Edition, 2009.

Web References:

1. http://link.springer.com/book
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

E-Text Books:

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

Course Home Page:

ENVIRONMENTAL STUDIES

II Semester: Common for all Branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS009	Foundation	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyze the interrelationship between living organism and environment.
II. Understand the importance of environment by asse ssing its impact on the human world.
III. Enrich the knowledge on themes of biodiversity, natural resources, pollution control and waste management.

UNIT-I	ENVIRONMENT AND ECOSYSTEMS	Classes: 08

Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles; Biomagnifications.

UNIT-II	NATURAL RESOURCES	Classes: 08

Natural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT-III	BIODIVERSITY AND BIOTIC RESOURCES	Classes: 10

Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation; Hot spots of biodiversity.

Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National biodiversity act.

UNIT-IV	ENVIRONMENTAL POLLUTION, POLLUTION CONTROL TECHNOLOGIES AND GLOBAL ENVIRONMENTAL	Classes: 10

Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary; Concepts of bioremediation; Global environmental problems and global efforts: Climate change, ozone depletion, ozone depleting substances, deforestation and desertification; International conventions / protocols: Earth summit, Kyoto protocol and Montreal protocol.

UNIT-V	ENVIRONMENTAL LEGISLATIONS AND SUSTAINABLE DEVELOPMENT	Classes: 09

Environmental legislations: Environmental protection act, air act1981, water act, forest act, wild life act, municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rules, Environmental impact assessment(EIA);

Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building.
Text Books:
1. Benny Joseph, “Environmental Studies”, Tata Mc Graw Hill Publishing Co. Ltd, New Delhi, 1st Edition, 2006. 2. Erach Bharucha, “Textbook of Environmental Studies for Under Graduate Courses”, Orient Black Swan, 2nd Edition, 2013. 3. Dr. P. D Sharma, “Ecology and Environment”, Rastogi Publications, New Delhi, 12th Edition, 2015.
Reference Books:
1. Tyler Miller, Scott Spoolman, “Environmental Science”, Cengage Learning, 14th Edition, 2012. 2. Anubha Kaushik, “Perspectives in Environmental Science”, New Age International, New Delhi, 4th Edition, 2006. 3. Gilbert M. Masters, Wendell P. Ela, “Introduction to Environmental Engineering and Science, Pearson, 3rd Edition, 2007.
Web References:
1. https://www.elsevier.com 2. https://www. libguides.lib.msu.edu 3. https://www.fao.org 4. https://www nrc.gov 5. https://www istl.org 6. https://www.ser.org 7. https://www.epd.gov. 8. https://www.nptel.ac.in
E-Text Books:
1. http://www.ilocis.org 2. http://www.img.teebweb.org 3. http://www.ec.europa.eu 4. http://www.epa.ie 5. http://www.birdi.ctu.edu.vn
Course Home Page:

COMPUTER PROGRAMMING

II Semester: **AE / CE / ME**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACS001	Foundation	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn adequate knowledge by problem solving techniques.
II. Understand programming skills using the fundamentals and basics of C Language.
III. Improve problem solving skills using arrays, strings, and functions.
IV. Understand the dynamics of memory by pointers.
V. Study files creation process with access permissions.

UNIT-I	INTRODUCTION	Classes: 10

Introduction to computers: Computer systems, computing environments, computer languages, creating and running programs, algorithms, flowcharts; Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types; Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions, formatted input and output.

UNIT-II	CONTROL STRUCTURES, ARRAYS AND STRINGS	Classes: 10

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements; Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays; Strings concepts: String handling functions, array of strings.

UNIT-III	FUNCTIONS AND POINTERS	Classes: 09

Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directives.

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers.

UNIT-IV	STRUCTURES AND UNIONS	Classes: 08

Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, passing structures through pointers, self referential structures, unions, bit fields, type def, enumerations; Dynamic memory allocation: Basic concepts, library functions.

UNIT-V	FILES	Classes: 08

Files: Streams, basic file operations, file types, file opening modes, file input and output functions, file status functions, file positioning functions, command line arguments.

Text Books:

1. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.
2. B. A. Forouzan, R. F. Gillberg, "C Programming and Data Structures", Cengage Learning, India, 3rd Edition, 2014.

Reference Books:

1. W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd Edition, 1988.
2. Yashavant Kanetkar, "Exploring C", BPB Publishers, 2nd Edition, 2003.
3. E. Balagurusamy, "Programming in ANSI C", Mc Graw Hill Education, 6th Edition, 2012.
4. Schildt Herbert, "C: The Complete Reference", Tata Mc Graw Hill Education, 4th Edition, 2014.
5. R. S. Bichkar, "Programming with C", Universities Press, 2nd Edition, 2012.
6. Dey Pradeep, Manas Ghosh, "Computer Fundamentals and Programming in C", Oxford University Press, 2nd Edition, 2006.

Web References:

1. https://www.bfoit.org/itp/Programming.html
2. https://www.khanacademy.org/computing/computer-programming
3. https://www.edx.org/course/programming-basics-iitbombayx-cs101-1x-0
4. https://www.edx.org/course/introduction-computer-science-harvardx-cs50x

E-Text Books:

1. http://www.freebookcentre.net/Language/Free-C-Programming-Books-Download.htm
2. http://www.imada.sdu.dk/~svalle/courses/dm14-2005/mirror/c/
3. http://www.enggnotebook.weebly.com/uploads/2/2/7/1/22718186/ge6151-notes.pdf

MOOC Course

1. https://www.alison.com/courses/Introduction-to-Programming-in-c
2. http://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-effective-programming-in-c-and-c-january-iap-2014/index.htm

Course Home Page:

COMPUTATIONAL MATHEMATICS LABORATORY

II Semester: AE / CE / ME									
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS102	Foundation	L	T	P	C	CIE	SEE	Total
		-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The course should enable the students to:

I. Train the students how to approach for solving engineering problems.
II. Understand the concepts of algebra, calculus and numerical solutions using MATLAB software.
III. Enrich the knowledge in MATLAB and can apply for project works.

LIST OF EXPERIMENTS

Week-l BASIC FEATURES

a. Features and uses.
b. Local environment setup.

Week-2 ALGEBRA

a. Solving basic algebraic equations.
b. Solving system of equations.
c. Two dimensional plots.

Week-3 CALCULUS

a. Calculating limits.
b. Solving differential equations.
c. Finding definite integral.

Week-4 MATRICES

a. Addition, subtraction and multiplication of matrices.
b. Transpose of a matrix.
c. Inverse of a matrix.

Week-5 SYSTEM OF LINEAR EQUATIONS

a. Rank of a matrix.
b. Gauss Jordan method.
c. LU decomposition method.

Week-6 LINEAR TRANSFORMATION

a. Characteristic equation.
b. Eigen values.
c. Eigen vectors.

Week-7	DIFFERENTIATION AND INTEGRATION

a. Higher order differential equations.
b. Double integrals.
c. Triple integrals.

Week-8	INTERPOLATION AND CURVE FITTING

a. Lagrange polynomial.
b. Straight line fit.
c. Polynomial curve fit.

Week-9	ROOT FINDING

a. Bisection method.
b. Regula false method.
c. Newton Raphson method.

Week-10	NUMERICAL DIFFERENTION AND INTEGRATION

a. Trapezoidal, Simpson's method.
b. Euler method.
c. Runge Kutta method.

Week-11	3D PLOTTING

a. Line plotting.
b. Surface plotting.
c. Volume plotting.

Week-12	VECTOR CALCULUS

a. Gradient.
b. Divergent.
c. Curl.

Reference Books:

1. Cleve Moler, "Numerical Computing with MATLAB", SIAM, Philadelphia, 2nd Edition, 2008.
2. Dean G. Duffy, "Advanced Engineering Mathematics with MATLAB", CRC Press, Taylor & Francis Group, 6th Edition, 2015.

Web Reference:

http://www.iare.ac.in

Course Home Page:

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: Microsoft Windows 7 and MATLAB – V 8.5, which is also R2015a

HARDWARE: 30 numbers of Intel Desktop Computers with 2 GB RAM

ENGINEERING PHYSICS LABORATORY

II Semester: AE / ME / CEs								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS105	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 28				Total Classes: 28		

OBJECTIVES:

The course should enable the students to:

I. Enrich the concept of rigidity modulus and frequency.
II. Enlighten the real time application of interference, diffraction and optical fibers.
III. Upgrade practical knowledge in magnetic induction, LED and LASER.

LIST OF EXPERIMENTS

Week- l — INTRODUCTION TO PHYSICS LABORATORY

Introduction to physics laboratory. Do's and Don'ts in physics lab.

Week- 2 — MEASURING INSTRUMENTS AND TORSIONAL PENDULUM

Batch I: Measurement of thickness of a wire and radius of a disc.
Batch II: Determination of rigidity modulus of material of string-Torsional pendulum.

Week-3 — MEASURING INSTRUMENTS AND TORSIONAL PENDULUM

Batch I: Determination of rigidity modulus of material of string-Torsional pendulum.
Batch II: Measurement of thickness of a wire and radius of a disc.

Week-4 — STEWART AND GEE'S METHOD AND FREQUENCY OF LONGITUDINAL WAVES

Batch I: Magnetic field along the axis of current carrying coil-Stewart and Gee's method.
Batch II: Determining frequency of longitudinal waves

Week-5 — STEWART AND GEE'S METHOD AND FREQUENCY OF LONGITUDINAL WAVES

Batch I: Determining frequency of longitudinal waves.
Batch II: Magnetic field along the axis of current carrying coil-Stewart and Gee's method.

Week-6 — FREQUENCY OF TRANSVERSE WAVES AND LASER DIFFRACTION

Batch I: Calculating frequency of transverse waves.
Batch II: Wavelength of laser source-diffraction grating.

Week-7 — FREQUENCY OF TRANSVERSE WAVES AND LASER DIFFRACTION

Batch I: Wavelength of laser source-diffraction grating.
Batch II: Calculating frequency of transverse waves.

Week-8 — SPECTROMETER AND DISPERSIVE POWER

Batch I: Adjustments and minimum deviation in spectrometer.
Batch II: Dispersive power of material of prism.

Week 9	SPECTROMETER AND DISPERSIVE POWER
Batch I: Dispersive power of material of prism. Batch II: Adjustments and minimum deviation in spectrometer.	
Week-10	**NEWTON'S RINGS AND OPTICAL FIBER**
Batch I: Newton's rings-Radius of curvature of plano convex lens. Batch II: Evaluation of numerical aperture of given fiber.	
Week-11	**NEWTON'S RINGS AND OPTICAL FIBER**
Batch I: Evaluation of numerical aperture of given fiber. Batch II: Newton's rings-Radius of curvature of plano convex lens.	
Week-12	**LED CHARACTERISTICS AND LASER CHARACTERISTICS**
Batch I : V-I characteristics of LED. Batch II : Study of L-I characteristics of laser diode.	
Week-13	**LED CHARACTERISTICS AND LASER CHARACTERISTICS**
Batch I : Study of L-I characteristics of laser diode. Batch II : V-I characteristics of LED.	
Week-14	**REVISION**
Revision.	

Reference Books:

1. C. L. Arora, "Practical Physics", S.Chand & Co., New Delhi, 3rd Edition, 2012.
2. Vijay Kumar, Dr. T. Radhakrishna, "Practical Physics for Engineering students", S M enterprises, 2nd Edition, 2014.
3. R. K. Shukla, Anchal Srivatsava, "Practical Physics", New age International, 2nd Edition, 2011.

Web References:

1. http://www.iare.ac.in

Course Home Page:

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS:

S.No	Name of the Component	Qty	Range
1	Melde's arrangement	10	Tuning fork frequency: 80-90Hz, DC coil 4 – 6 V, 2-3 A
2	Weight box	10	1mg-100g
3	Meter scale	10	1m
4	Stewart and Gees's set	10	Coil 2, 50, 200 turns
5	DC Ammeter	10	Digital Meter DC 0-20V
6	Battery eliminator	10	DC 2 A.
7	Laser source with retort and round stand	10	Semiconductor laser 670 nm
8	Grating	20	15000 LPI
9	Measuring tape	10	1m
10	Torsional Pendulum	10	Brass disc 1000gms wt, 1m steel wire with diameter 0.05 cm
11	Stop watch	20	+/- 1s
12	Screw gauge	10	+/- 0.001cm
13	Vernier calipers	10	+/- 0.01cm
14	Newtons travelling microscope	10	X10
15	Sodium Vapour Lamp	20	700 W
16	Transformer Sodium Vapour Lamp	10	1 KW
17	Numerical aperture kit	10	Optical power meter 660 nm
18	Bending loss tubes	10	Dia – 4 cm, 6 cm, 8 cm, 10 cm
19	Spectrometer	10	LC 1', Ramsden eye piece
20	Glass prisms	20	Crown glass prisms, 30mm x 30mm
21	Mercury lamp	20	Mercury bulb 160 W
22	LED boards	10	I/P 0-10V DC, Resistors 1k Ω-4K Ω
23	Digital ammeter	10	Digital Meter DC 0-20 mA
24	Digital voltmeter	10	Digital Meter DC 0-20V
25	Probes	10	Dia – 4 mm
26	Laser Diode boards	10	I/P 0-10V DC, Resistors 1k Ω-4K Ω

COMPUTER PROGRAMMING LABORATORY

II Semester: Common for AE / CE / ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACS101	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Formulate problems and implement algorithms using C programming language.
II. Develop programs using decision structures, loops and functions.
III. Learn memory allocation techniques using pointers.
IV. Use structured programming approach for solving of computing problems in real world.

LIST OF EXPERIMENTS

Week-1 OPERATORS AND EVALUATION OF EXPRESSIONS

a. Write a C program to check whether a number is even or odd using ternary operator.
b. Write a C program to perform the addition of two numbers without using + operator.
c. Write a C program to evaluate the arithmetic expression ((a + b / c * d - e) * (f - g)). Read the values a, b, c, d, e, f, g from the standard input device.
d. Write a C program to find the sum of individual digits of a 3 digit number.
e. Write a C program to read the values of x and y and print the results of the following expressions in one line:
   i. (x + y) / (x - y)
   ii. (x + y)(x - y)

Week-2 CONTROL STRUCTURES

a. Write a C program to find the sum of individual digits of a positive integer.
b. A Fibonacci sequence is defined as follows: The first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
d. A character is entered through keyboard. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if-else and switch case. The following table shows the range of ASCII values for various characters.

Characters	**ASCII values**
A – Z	65 – 90
a – z	97 – 122
0 – 9	48 – 57
Special symbols	0 – 47, 58 – 64, 91 – 96, 123 – 127

e. If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Write a C program to determine how much profit or loss incurred in percentage.

Week-3	CONTROL STRUCTURES

a. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use switch statement).
b. Write a C program to calculate the following sum:

$$sum = 1 - x^2/2! + x^4/4! - x^6/6! + x^8/8! - x^{10}/10!$$

c. Write a C program to find the roots of a quadratic equation.
d. Write a C program to check whether a given 3 digit number is Armstrong number or not.
e. Write a C program to print the numbers in triangular form

```
1
1  2
1  2  3
1  2  3  4
```

Week-4	ARRAYS

a. Write a C program to find the second largest integer in a list of integers.
b. Write a C program to perform the following:
   i. Addition of two matrices
   ii. Multiplication of two matrices
c. Write a C program to count and display positive, negative, odd and even numbers in an array.
d. Write a C program to merge two sorted arrays into another array in a sorted order.
e. Write a C program to find the frequency of a particular number in a list of integers.

Week-5	STRINGS

a. Write a C program that uses functions to perform the following operations:
   i. To insert a sub string into a given main string from a given position.
   ii. To delete n characters from a given position in a given string.
b. Write a C program to determine if the given string is a palindrome or not.
c. Write a C program to find a string within a sentence and replace it with another string.
d. Write a C program that reads a line of text and counts all occurrence of a particular word.
e. Write a C program that displays the position or index in the string S where the string T begins, or 1 if S doesn't contain T.

Week-6	FUNCTIONS

a. Write C programs that use both recursive and non-recursive functions
   i. To find the factorial of a given integer.
   ii. To find the greatest common divisor of two given integers.
b. Write C programs that use both recursive and non-recursive functions
   i. To print Fibonacci series.
   ii. To solve towers of Hanoi problem.
c. Write a C program to print the transpose of a given matrix using function.
d. Write a C program that uses a function to reverse a given string.

Week-7	POINTERS

a. Write a C program to concatenate two strings using pointers.
b. Write a C program to find the length of string using pointers.
c. Write a C program to compare two strings using pointers.
d. Write a C program to copy a string from source to destination using pointers.
e. Write a C program to reverse a string using pointers.

Week-8	STRUCTURES AND UNIONS

a. Write a C program that uses functions to perform the following operations:
   i. Reading a complex number
   ii. Writing a complex number
   iii. Addition and subtraction of two complex numbers
   iv. Multiplication of two complex numbers. Note: represent complex number using a structure.
b. Write a C program to compute the monthly pay of 100 employees using each employee's name, basic pay. The DA is computed as 52% of the basic pay. Gross-salary (basic pay + DA). Print the employees name and gross salary.
c. Create a Book structure containing book_id, title, author name and price. Write a C program to pass a structure as a function argument and print the book details.
d. Create a union containing 6 strings: name, home_address, hostel_address, city, state and zip. Write a C program to display your present address.
e. Write a C program to define a structure named DOB, which contains name, day, month and year. Using the concept of nested structures display your name and date of birth.

Week-9	ADDITIONAL PROGRAMS

a. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: $1+x+x^2+x^3+\ldots\ldots\ldots\ldots+x^n$. For example: if n is 3 and x is 5, then the program computes 1+5+25+125. Print x, n, the sum. Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too.
b. 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.
c. Write a C program to convert a Roman numeral to its decimal equivalent. E.g. Roman number CD is equivalent to 400.

Week-10	PREPROCESSOR DIRECTIVES

a. Define a macro with one parameter to compute the volume of a sphere. Write a C program using this macro to compute the volume for spheres of radius 5, 10 and 15 meters.
b. Define a macro that receives an array and the number of elements in the array as arguments. Write a C program for using this macro to print the elements of the array.
c. Write symbolic constants for the binary arithmetic operators +, -, *, and /. Write a C program to illustrate the use of these symbolic constants.

Week-11	FILES

a. Write a C program to display the contents of a file.
b. Write a C program to copy the contents of one file to another.
c. Write a C program to reverse the first n characters in a file, where n is given by the user.
d. Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are put in the third file.
e. Write a C program to count the no. of characters present in the file.

Week-12	COMMAND LINE ARGUMENTS

a. Write a C program to read arguments at the command line and display it.
b. Write a C program to read two numbers at the command line and perform arithmetic operations on it.
c. Write a C program to read a file name at the command line and display its contents.

Reference Books:

1. Yashavant Kanetkar, "Let Us C", BPB Publications, New Delhi, 13th Edition, 2012.
2. Oualline Steve, "Practical C Programming", O'Reilly Media, 3rd Edition, 1997.
3. King K N, "C Programming: A Modern Approach", Atlantic Publishers, 2nd Edition, 2015.
4. Kochan Stephen G, "Programming in C – A Complete Introduction to the C Programming Language", Sam's Publishers, 3rd Edition, 2004.
5. Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994

Web References:

1. https://www.sanfoundry.com/c-programming-examples
2. https://www.geeksforgeeks.org/c
3. https://www.cprogramming.com/tutorial/c
4. https://www.cs.princeton.edu

Course Home Page:

COMPUTER AIDED ENGINEERING DRAWING PRACTICE

<table>
<tr><td colspan="10">II Semester: AE/ CE/ ME</td></tr>
<tr><td rowspan="1">Course Code</td><td>Category</td><td colspan="3">Hours /Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">AME102</td><td rowspan="2">Foundation</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>3</td><td>2</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: Nil</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: 45</td><td colspan="3">Total Classes: 45</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Understand the basic principles of engineering drawing.
II. Understand the intersection of solids in different quadrants.
III. Convert the pictorial views into orthographic view and vice versa.
IV. Create intricate details of components through sections and develop its surfaces.
V. Understand the perspective projection of solids through vanishing and visual ray method.

UNIT-I	AutoCAD AND DVELOPMENT OF SURFACES WITH SECTIONAL VIEW	Classes: 09

Introduction to AutoCAD: Geometrical construction; Sections and sectional views, sections of right regular solids, prisms, pyramids, cylinders and cones, auxiliary views, development of surfaces, development of surfaces of right regular solids prisms, pyramids, cylinders and cones.

UNIT-II	INTERSECTION OF SOLIDS	Classes: 09

Intersection of solids: Intersection of prism versus prism, cylinder versus prism, cylinder versus cylinder and cylinder versus cone.

UNIT-III	ISOMETRIC PROJECTIONS	Classes: 09

Isometric projections**:** Principles of isometric projections, isometric scale, isometric views, conventions. Isometric views of lines, planes, simple and compound solids, isometric views of objects having spherical parts.

UNIT-IV	TRANSFORMATION OF PROJECTIONS	Classes: 09

Transformation of projections: Conversion of isometric views to orthographic views, conventions for simple objects; Construction of orthographic projections for given isometric projections.

UNIT-V	PERSPECTIVE PROJECTIONS	Classes: 09

Perspective projections: Perspective view of points, lines, plane figures and simple solids, vanishing point method and visual ray method.

Text Books:

1. N.D. Bhatt, “Engineering Drawing”, Charotar Publications, 49th Edition, 2012.
2. C. M. Agrawal, Basant Agrawal, “Engineering Drawing’’, Tata McGraw Hill, 2nd Edition, 2013.

Reference Books:

1. K. Venugopal, “Engineering Drawing and Graphics”, New Age Publications, 2nd Edition, 2010.
2. S. Trymbaka Murthy, “Computer Aided Engineering Drawing”, I.K. Publishers, 3rd Edition, 2011.
3. A. K. Sarkar, A. P. Rastogi, “Engineering Graphics with AutoCAD”, PHI Learning, 1st Edition, 2010.

Web References:

1. http://nptel.ac.in/courses/112103019/
2. http://freevideolectures.com/Course/3420/Engineering-Drawing

E-Text Book:

1. https://books.google.co.in/books/about/Engineering_Drawing.html?id=_hdOU8kRb2AC

Course Home Page:

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE:
System Software: Microsoft Windows 7.
Application Software: AutoCAD R2015.

HARDWARE:
30 numbers of Intel Desktop Computers with 2 GB RAM 2.7GHz Processor.
Dot Matrix Printers: 02

MATHEMATICAL TRANSFORM TECHNIQUES

III Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHS011	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Express non periodic function to periodic function using Fourier series and Fourier transforms.
II. Apply Laplace transforms and Z-transforms to solve differential equations.
III. Formulate and solve partial differential equations.

UNIT-I	FOURIER SERIES	Classes: 09

Definition of periodic function, determination of Fourier coefficients; Fourier expansion of periodic function in a given interval of length 2π; Fourier series of even and odd functions; Fourier series in an arbitrary interval; Half- range Fourier sine and cosine expansions.

UNIT-II	FOURIER TRANSFORMS	Classes: 08

Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms.

UNIT-III	LAPLACE TRANSFORMS	Classes: 10

Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace transform, function of exponential order, first and second shifting theorems, change of scale property, Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of periodic functions.

Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and applications.

UNIT-IV	Z –TRANSFORMS	Classes: 09

Z-transforms: Elementary properties, inverse Z-transform, convolution theorem, formation and solution of difference equations.

UNIT-V	PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS	Classes: 09

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equation by Lagrange method; Charpit's method; method of separation of variables; One dimensional heat and wave equations under initial and boundary conditions.

Text Books:

1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10^{th} Edition, 2010.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42^{nd} Edition, 2013.

Reference Books:

1. S. S. Sastry, "Introduction methods of numerical analysis", Prentice-Hall of India Private Limited, 5th Edition, 2005
2. G. Shanker Rao, "Mathematical Methods", I. K. International Publications, 1st Edition, 2011.

Web References:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://www.ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E-Text Books:

1. https://www.keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktu-ebook- download.html
2. https://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks

Course Home Page:

INTRODUCTION TO AEROSPACE ENGINEERING

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE001	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the historical evolution of airplane and types of aircrafts along with exploration of space environment.
II. Discuss various aerodynamic forces acting on aircraft components and related principles.
III. Explain the performance and stability of aircraft for different mission segments of flight.
IV. Study the various types of satellite systems and subsystems with human exploration into space.

UNIT-I	HISTORY OF FLIGHT AND SPACE ENVIRONMENT	Classes: 08

Balloons and dirigibles, heavier than air aircraft, commercial air transport; Introduction of jet aircraft, helicopters, missiles; Conquest of space, commercial use of space; Different types of flight vehicles, classifications exploring solar system and beyond, a permanent presence of humans in space; Earth's atmosphere, the standard atmosphere; The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity; Environmental impact on spacecraft, space debris; Planetary environments.

UNIT-II	INTRODUCTION TO AERODYNAMICS	Classes: 08

Anatomy of the airplane, helicopter; Understanding engineering models; Aerodynamic forces on a wing, force coefficients; Generating lift, moment coefficients; Aerodynamic forces on aircraft – classification of NACA airfoils, aspect ratio, wing loading, mach number, centre of pressure and aerodynamic centre-aerofoil characteristics-lift, drag curves; Different types of drag.

UNIT-III	FLIGHT VEHICLE PERFORMANCE AND STABILITY	Classes: 10

Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric maneuvers, turns, sideslips, takeoff and landing.

Flight vehicle Stability, static stability, dynamic stability; Longitudinal and lateral stability; Handling qualities of the airplanes.

UNIT-IV	INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS, POWER PLANTS	Classes: 10

General types of construction, monocoque, semi-monocoque; Typical wing and fuselage structure; Metallic & non-metallic materials, use of aluminum alloy, titanium, stainless steel and composite materials; Basic ideas about engines, use of propeller and jets for thrust production; Principles of operation of rocket, types of rockets.

UNIT-V	SATELLITE SYSTEMS ENGINEERING HUMAN SPACE EXPLORATION	Classes: 09

Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, the Soviet and US missions; The mercury, Gemini, Apollo (manned flight to the moon), Skylab, apollo-soyuz, space Shuttle; International space station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, flight safety; Indian effort in aviation, missile and space technology.

Text Books:

1. Anderson J. D, “Introduction to Flight”, McGraw-Hill, 5th Edition, 1989.
2. Newman D, “Interactive Aerospace Engineering and Design”, McGraw-Hill, 1st Edition, 2002.

Reference Books:

1. Kermode, A. C, “Flight without Formulae”, McGraw Hill, 4th Edition, 1997.
2. Barnard R.H and Philpot. D.R, “Aircraft Flight”, Pearson, 3rd Edition, 2004.
3. Swatton P. J, “Flight Planning”, Blackwell Publisher, 6th Edition, 2002.

Web References:

1. https://www.aerospaceengineering.es/book/
2. https://www.ne.nasa.gov/education/
3. https://nptel.ac.in

E-Text Books:

1. https://www.e-booksdirectory.com/
2. https://www.adl.gatech.edu/extrovert/Ebooks/ebook_Intro.pdf
3. https://www.academia.edu/7950378/Introduction_to_Flight_-_Anderson_5th_Ed.

Course Home Page:

THEORY OF STRUCTURES

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE002	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand various aspects of mechanics of materials as applied to engineering problems in a systematic manner stressing the fundamentals.

II. Analyze problems on thermal stresses, shear force, bending moment and deflection of beams

III. Discuss the equilibrium and compatibility conditions for two-dimensional and three-dimensional elastic bodies.

UNIT-I	INTRODUCTION	Classes: 10

Mechanical properties of materials; Stresses and strains; Hooke's law, elastic constant, relation between modulii, working stress, factor of safety, poisons ratio ; bars of varying cross section; Thermal stresses. Torsion of solid and hollow circular shafts and shear stress variations; Power transmission in shafts; Shear force and bending moment diagrams for different types of beams with various loads.

UNIT-II	STRESSES IN BEAMS	Classes: 09

Bending stresses and Shear stress variation in beams of symmetric and un-symmetric sections; Beams of uniform strength; Flexural stresses: Bending equations, calculation of bending stresses for different sections of beams like I, L, T, C, angle section.

UNIT-III	BEAMS AND COLUMNS	Classes: 09

Deflection of beams by Double integration method, Macaulay's method, moment area method, conjugate beam method; Principle of superposition.

Columns, types of columns, Euler's formula instability of columns, Rakine's and Jonson's formula, Eigen values and Eigen modes, concept of beam-column.

UNIT-IV	REDUNDANT STRUCTURES	Classes: 08

Trusses, perfect frames, analysis of trusses; Determinate and indeterminate structures, order of redundancy; Redundant analysis, analysis of determinate structures, area movement method, Clayperons method, slope deflection method, moment distribution method.

UNIT-V	THEORY OF ELASTISITY	Classes: 09

Equilibrium and compatibility conditions and constitute relations for elastic solid and plane: generalized plane strain cases Airy's stress function

Stress on inclined planes, stress transformations determination of principal stresses and strains by analytical method and graphical method - Mohr's circles and its constructions.

Text Books:

1. R. K Bansal, "Strength of Materials", Laxmi publications, 5th Edition, 2012.
2. T. H. G. Megson, "Aircraft Structures for Engineering Students", Butterworth-Heinemann Ltd, 5th Edition, 2012.
3. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, 3rd Edition, 1993.

Reference Books:

1. Dym, C. L, Shames, I. H, "Solid Mechanics", McGraw Hill, Kogakusha, Tokyo, 7th Edition, 2007.
2. Stephen Timoshenko, "Strength of Materials", Vol I & II, CBS Publishers and Distributors, 3rd Edition, 2004.
3. R. K. Rajput, "Strength of Materials", S. Chand and Co., 1st Edition, 1999.
4. Timoshenko, S, Young, D. H. "Elements of Strength of Materials", T. Van Nostrand Co. Inc., Princeton N.J, 4th Edition, 1977.

Web References:

1. www.nptel.ac.in/courses/112107147/
2. www.vssut.ac.in/lecture_notes/lecture1423904647.pdf
3. www.web.mit.edu/emech/dontindex-build/

E-Text Books:

1. www.e-booksdirectory.com/listing.php?category=456
2. www.esag.harvard.edu/rice/e0_Solid_Mechanics_94_10.pdf
3. www.itiomar.it/pubblica/dispense/MECHANICAL%20ENGINEERING%20HANDBOOK/

Course Home Page:

FLUID MECHANICS AND HYDRAULICS

III Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE003	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Illustrate about the basic properties of a fluid, hydrostatic forces on submerged bodies and different manometers.

II. Derive the basic principles of a fluid-continuity, momentum, Euler and Bernoulli's equations.

III. Explain the concept of boundary layer theory and importance of Prandtl's boundary layer theory.

IV. Understand the flow through pipes and their losses for different geometries.

UNIT-I	**FLUID PROPERTIES AND FLUID STATICS**	**Classes: 09**

Density, specific weight, specific gravity, surface tension and capillarity, Newton's law of viscosity, incompressible and compressible fluid, numerical problems; Hydrostatic forces on submerged bodies - Pressure at a point, Pascal's law, pressure variation with temperature and height, center of pressure plane, vertical and inclined surfaces; Manometers - simple and differential Manometers, inverted manometers, micro manometers, pressure gauges and numerical problems. Buoyancy - Archimedes principle, metacenter, Meta centric height calculations; Stability.

UNIT-II	**FLUID KINEMATICS AND BASIC EQUATIONS OF FLUID FLOW ANALYSIS**	**Classes: 08**

Stream line, path line, streak line, stream surface, stream tube, classification of flows, steady, unsteady, uniform, non-uniform, laminar, turbulent flows, one dimensional approximation, examples of real 1-D flows, two dimensional approximation, 2-D flow in wind tunnel; Continuity equations for 1-D and 2-D flows both compressible and incompressible, stream function for two dimensional incompressible flows; Vortices, irrotational flow, velocity potential function.

UNIT-III	**FLUID DYNAMICS**	**Classes: 10**

Basic laws for a system in integral form: Reynolds transport theorem, Conservation of mass, Newton's 2nd law; Application of the basic laws for a control volume; Kinematics; Motion of a fluid particle; Fluid deformation; Differential analysis of fluid motion: Continuity equation, Differential momentum equation, Surface and body forces, substantive derivative, local derivative and convective derivative, momentum equation, Euler's and Bernoulli's equation, phenomenological basis of Naviers- stokes equation, introduction to vortex flows, flow measurements : pressure, velocity and mass flow rate, viscosity, pivot-static tube, venture meter and orifice meter, viscometers.

Statement of Buckingham's π- theorem, similarity parameters - Reynolds number, Froude number, concepts of geometric, kinematic and dynamic similarity, Reynolds number as a very approximate measure of ratio of inertia force and viscous force.

UNIT-IV	**BOUNDARY LAYER THEORY AND PIPE FLOW**	**Classes: 09**

Boundary layer - introductory concepts of boundary layer, large Reynolds number flows and Prandtl's boundary layer hypothesis Pressure drag and skin friction drag; Pipe flow - Reynolds experiment, Darcy's equation, major and minor losses in pipes and numerical problems. Flow between parallel plates, flow through long tubes –fully developed flow, Turbulent flow, variation of friction factor with Reynolds's Number, Moody's chart.

UNIT-V	TURBO MACHINERY	Classes: 09
Introduction and classification of fluid machines: Turbo machinery analysis; The angular momentum principle; Euler turbo machine equation; Velocity triangles; Application to fluid systems - Working principle overview of turbines, fans, pumps and compressors.		

Text Books:

1. Shames I H, "Mechanics of Fluids", Kogakusha, Tokyo, 7^{th} Edition, 2007.
2. R. K Bansal, "Fluid mechanics and hydraulic machines", Laxmi publications ltd, 9^{th} Edition, 2011.
3. Robert W Fox, Alan T McDonald, "Introduction to fluid Mechanics", John Wiley and Sons, 6^{th} Edition, 1995.
4. Streeter V. L, Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9^{th} Edition, 1983.

Reference Books:

1. Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2^{nd} Edition, 1987.
2. Milne Thompson L M, "Theoretical Hydrodynamics", MacMillan, 5^{th} Edition, 1968.
3. Ratha krishnan. E, "Fundamentals of Fluid Mechanics", Prentice-Hall, 5^{th} Edition, 2007.
4. Som S. K, Biswas. G, "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd Edition, 2004.

Web References:

1. https://nptel.ac.in/courses/112105171/1
2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf
3. https://www.fkm.utm.my/~syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf
4. https://www.scribd.com/doc/16605891/Fluid-Mechanics

E-Text Books:

1. https://bookboon.com/en/engineering-fluid-mechanics-ebook
2. https://www.slideshare.net/asifzhcet/fluid-mechanics-and-hydraulic-machines-dr-r-k-bansal
3. https://eprints.staffs.ac.uk/222/1/engineering-fluid-mechanics%5B1%5D.pdf
4. https://www.engr.uky.edu/~acfd/me330-lctrs.pdf

Course Home Page:

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

III Semester: AE / ME / CE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE018	Foundation	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15		Practical Classes: Nil			Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand Kirchhoff laws and their application in series and parallel electric circuits.
II. Discuss principle and operation of measuring instruments.
III. Analyze the characteristics of alternating quantities, DC machines and AC machines.
IV. Illustrate the V-I characteristics of various diodes and bi-polar junction transistor.

UNIT - I	ELECTRIC CIRCUITS, ELECTROMAGNETISM AND INSTRUMENTS	Classes: 09

Electrical Circuits: Basic definitions, types of elements, Ohm's Law, resistive networks, inductive networks, capacitive networks, Kirchhoff's Laws, Series, parallel circuits and star delta transformations, simple problems, Faradays law of electromagnetic induction; Instruments: Basic principles of indicating instruments, permanent magnet moving coil and moving iron instruments.

UNIT - II	DC MACHINES	Classes: 08

Principle of operation DC Generator, EMF equation, types, DC motor types, torque equation applications, three point starter.

UNIT - III	ALTERNATING QUANTITIES AND AC MACHINES	Classes: 10

Alternating quantities: sinusoidal AC voltage, average, RMS, form and peak factor, concept of three phase alternating quantity; Transformer: Principle of operation, EMF equation, losses, efficiency and regulation.

Three phase induction motor: Principle of operation, slip, slip - torque characteristics, efficiency and applications; Alternator: Principle of operation, EMF Equation, efficiency, and regulation by synchronous impedance method.

UNIT - IV	SEMICONDUCTOR DIODE AND APPLICATIONS	Classes: 09

Semiconductor diode: P-N Junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, Zener diode as a voltage regulator.

UNIT - V	BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS	Classes: 09

Bipolar junction: DC characteristics, CE, CB, CC configurations, biasing, load line, Transistor as an amplifier.

Text Books:

1. A Chakrabarti, “Circuit Theory”, Dhanpat Rai Publications, 6th Edition, 2004.
2. K S Suresh Kumar, “Electric Circuit Analysis”, Pearson Education, 1st Edition, 2013.
3. Willianm Hayt, Jack E Kemmerly S.M.Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill, 7th Edition, 2010.
4. J P J Millman, C C Halkias, Satyabrata Jit, “Millman‟s Electronic Devices and Circuits”, Tata McGraw Hill, 2nd Edition, 1998.
5. R L Boylestad, Louis Nashelsky, “Electronic Devices and Circuits”, PEI/PHI, 9th Edition, 2006.
6. V K Mehta, Rohit Mehta, “Principles of electrical engineering”, S CHAND, 1st Edition, 2003.

Reference Books:

1. David A Bell, “Electric Circuits”, Oxford University Press, 9 th Edition, 2016.
2. M Arshad, “Network Analysis and Circuits”, Infinity Science Press, 9 th Edition, 2016.
3. A Bruce Carlson, “Circuits”, Cengage Learning, 1st Edition, 2008.
4. M Arshad, “Network Analysis and Circuits”, Infinity Science Press, 9th Edition, 2016.
5. A Bruce Carlson, “Circuits”, Cengage Learning, 1st Edition, 2008

Web References:

1. https://www.kuet.ac.bd/webportal/ppmv2/uploads/1364120248DC%20Machines2.pdftextofvideo.nptel.iitm.ac.in
2. https://www.eleccompengineering.files.wordpress.com/2014/08/a-textbook-of-electrical-technology-volume-ii-ac-and-dc-machines-b-l-thferaja.pdf
3. https://www.geosci.uchicago.edu/~moyer/GEOS24705/Readings/Klempner_Ch1.pdf
4. https://www.ibiblio.org/kuphaldt/electricCircuits/DC/DC.pdf
5. https://www.users.ece.cmu.edu/~dwg/personal/sample.pdf.
6. https://www.djm.cc/library/Principles_of_Alternating_Current_Machinery_Lawrence_edited.pdf

E-Text Books:

1. https://www.kisi.deu.edu.tr/aytac.goren/ELK2015/w10.pdfwww.bookboon.com.
2. https://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j-introduction-to-electronics-signals-and-measurement-spring-2006/lecture-notes/19_bjt_1.pdf.
3. https://www.google.co.in/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=half+and+full+wave+rectifier+pdf.
4. https://www.leka.lt/sites/default/files/vaizdai/concepts-in-electric-circuits.pdf.
5. https://www.ktustudents.in

Course Home Page:

MECHANICS OF SOLIDS LABORATORY

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE101	Foundation	-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand basic knowledge on the mechanical behavior of materials like aluminum, mild steel, and cast iron.
II. Adopt with the experimental methods to determine the mechanical properties of materials.

LIST OF EXPERIMENTS

Week	Experiment
Week-1	BRINELL HARDNESS TEST

Determination of Brinell number of a given test specimen.

Week-2	ROCKWELL HARDNESS TEST

Determination of hardness number of different specimens such as steel, brass, copper and aluminum.

Week-3	TENSION TEST

Study the behavior of mild steel and various materials under different loads.
To determine
a) Tensile
b) Yield strength
c) Elongation
d) Young's modulus

Week-4	TORSION TEST

Determine of Modulus of rigidity of various specimens.

Week-5	IZOD IMPACT TEST

Determination the toughness of the materials like steel, copper, brass and other alloys using Izod test

Week-6	CHARPY IMPACT TEST

Determine the toughness of the materials like steel, copper, brass and other alloys using Charpy test.

Week-7	COMPRESSION TEST ON SHORT COLUMN

Determine the compressive stress on material.

Week-8	COMPRESSION TEST ON LONG COLUMN

Determine Young's modulus of the given long column.

Week-9	TESTING OF SPRINGS

Determine the stiffness of the spring and the Modulus of rigidity of wire material.

Week-10	DEFLECTION TEST FOR SSB AND CANTILEVER BEAM

Determine the Young's modulus of the given material with the help of deflection of SSB and cantilever beam.

Week-11	REVIEW - I

Spare session for additional repetitions and review.

Week-12	REVIEW - II
Spare session for additional repetitions and review.	
Reference Books:	
1. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, 3rd Edition, 1993. 2. R. S Kurmi, Gupta, "Strength of Materials", S. Chand, 24th Edition, 2005. 3. William Nash, "Strength of Materials", Tata McGraw Hill, 4th Edition, 2004.	
Web References:	
1. https://nptel.ac.in/courses/112107147/ 2. https://vssut.ac.in/lecture_notes/lecture1423904647.pdf 3. https://web.mit.edu/emech/dontindex-build/	
Course Home Page:	

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S No	Details of Equipment	Quantity Required
1	Hardness Testing Machine	1
2	Universal Testing Machine	1
3	Impact Testing Machine	1
4	Compression testing machine	1
5	Spring testing machine	1
6	Torsion Test rig	1
7	Simply supported and cantilever beam	1

FLUID MECHANICS & HYDRAULICS LABORATORY

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE102	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Gain knowledge on working of centrifugal pumps, positive displacement pumps, hydraulic turbines centrifugal blowers and steam turbines.

II. Compare performance of various machines at different operating points.

III. Knowledge of various flow meters and the concept of fluid mechanics.

LIST OF EXPERIMENTS

Week	Experiment
Week-1	**CALIBRATION**
Calibration of Venturimeter and orifice meter.	
Week-2	**PIPE FLOW LOSSES**
Determination of pipe flow losses in rectangular and circular pipes	
Week-3	**BERNOULLI'S THEOREM**
Verification of Bernoulli's theorem.	
Week-4	**REYNOLDS EXPERIMENT**
Determination of Reynolds Number of fluid flow	
Week-5	**IMPACT OF JET ON VANES**
Study Impact of jet on Vanes.	
Week-6	**CENTRIFUGAL PUMPS**
Performance test on centrifugal pumps.	
Week-7	**RECIPROCATING PUMPS**
Performance test on reciprocating pumps.	
Week-8	**PELTON WHEEL TURBINE**
Performance test on piston wheel turbine.	
Week-9	**FRANCIS TURBINE**
Performance test on Francis turbine.	
Week-10	**FLOW THROUGH WEIRS**
Rate of discharge Flow through Weirs	
Week-11	**FLOW THROUGH NOTCH**
Flow through rectangular and V-Notch	
Week-12	**FLOW THOUGH ORIFICE MOUTH PIECE**
Flow analysis of different shapes of mouth pieces	

Reference Books:
1. Yuan S W, “Foundations of fluid Mechanics”, Prentice-Hall, 2nd Edition, 1987. 2. Milne Thompson L M, “Theoretical Hydrodynamics”, MacMillan, 5th Edition, 1968. 3. Rathakrishnan. E, “Fundamentals of Fluid Mechanics”, Prentice-Hall, 5th Edition, 2007. 4. Som S. K., Biswas. G, “Introduction to fluid mechanics and fluid machines”, Tata McGraw-Hill, 2nd Edition, 2004.
Web References:
1. https://nptel.ac.in/courses/112105171/1 2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf 3. https://www.fkm.utm.my/~syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf 4. https://www.scribd.com/doc/16605891/Fluid-Mechanics
Course Home Page:

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S No	Details of Equipment	Quantity Required	Experiment Number
1	Venturimeter setup	1	1
2	Orifice meter setup	1	1
3	Pipe friction setup	1	2
4	Flow through Weirs and notches	1	10, 11
5	Reynolds Apparatus	1	4
6	Bernoulli’s Apparatus	1	3
7	Centrifugal pump	1	6
8	Reciprocating pump	1	7
9	Pelton wheel turbine	1	8
10	Francis turbine	1	9
11	Flow through External Mouthpiece	1	12
12	Impact on Jet of Vanes	1	5

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

III Semester: AE / ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE103	Foundation	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Analysis of basic concepts of electric circuits.
II. Study the performance of DC machines and AC machines.
III. Understand the characteristics of electronic components.

LIST OF EXPERIMENTS

Week - 1	**KIRCHOFF'S CURRENT LAW AND VOLTAGE LAW**
Verification of Kirchhoff's current and voltage laws.	
Week - 2	**OHMS LAW**
Verification of ohms law.	
Week - 3	**OPEN CIRCUIT CHARACTERISTICS OF DC SHUNT GENERATOR**
Magnetization characteristics of DC shunt generator.	
Week - 4	**SWINBURNE'S TEST**
Predetermination of efficiency (Swinburne's test) of DC shunt machine.	
Week - 5	**OPEN CIRCUIT AND SHORT CIRCUIT TEST**
Open circuit and short circuit test on single phase transformer.	
Week - 6	**BRAKE TEST ON THREE PHASE INDUCTION MOTOR**
Study the performance characteristics of three phase induction motor by brake test.	
Week - 7	**REGULATION OF ALTERNATOR**
Determine the regulation of alternator using synchronous impedance method.	
Week - 8	**PN JUNCTION DIODE**
PN junction diode characteristics.	

Week - 9	**ZENER DIODE**
Zener diode characteristics.	
Week - 10	**HALF WAVE RECTIFIER CIRCUIT**
Half wave rectifier circuit.	
Week - 11	**FULL WAVE RECTIFIER CIRCUIT**
Full wave rectifier circuit.	
Week - 12	**TRANSISTOR**
Transistor common emitter characteristics.	
Week - 13	**TRANSISTOR**
Transistor common base characteristics.	
Week - 14	**CRO**
Study of CRO.	

Reference Books:

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 2004.
2. N C Jagan, C Lakshminarayana", Network Analysis", B S Publications J
3. J P J Millman, C C Halkias, Satyabrata Jit, "Millman"s Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition, 1998.
4. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI/PHI, 9th Edition, 2006.

Web References:

1. https://www.nptel.ac.in/Courses/117106108
2. https://www.gnindia.dronacharya.info/EEEDept/labmanuals.html
3. https://www.textofvideo.nptel.iitm.ac.in
4. https://www.textofvideo.nptel.iitm.ac.in/

Course Home Page:

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 36 STUDENTS:

S. No	Name of the Equipments	Range	Quantity
1	RPS	0-30V DC	20
2	CRO		5
3	1-ϕ Transformer	3KVA	4
4	3-ϕ Induction Motor	--	1
5	1-ϕ Variac	(0-230/270V,15A)	4
6	3-ϕ Variac	(0-440V/470V,15A)	4
7	DC Shunt Motor-Generator Set	--	2
8	Ammeter	(0-2.5/5A)MI	7
9	Ammeter	(0-10/20 A)MI	7
10	Voltmeter	(0-150/300V)MI	10
11	Voltmeter	(0-300/600V)MI	10
12	Wattmeter	(5/10A,75/150/300V) LPF	4
13	Wattmeter	(10/20A,150/300/600V) UPF	4
14	Control Panels	--	2
15	Tachometers	(0-9999 RPM)	3
16	Resistors	150Ω,470Ω,1kΩ,2.2kΩ,10kΩ, 47kΩ,100kΩ,1MΩ	100
17	Capacitors	0.lμF,10μF,100μF	100
18	Diode	1N4007	100
19	Zener Diode	4.7V	100
20	Transistors	BC107	50
21	Decade Resistance Box	10Ω-10MΩ	20
22	Voltmeter	0-20V	25
23	Ammeter	0-200 μA, 0-10 μA, 0-1 mA, 0-10 mA	30
24	Bread Board	--	15
25	Trainer Kits	--	18
26	Connecting Wires	--	--

COMPLEX ANALYSIS AND PROBABILITY DISTRIBUTION

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS004	Foundation	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic theory of complex functions to express the power series.
II. Evaluate the contour integration using Cauchy residue theorem.
III. Enrich the knowledge of probability on single random variables and probability distributions.

UNIT-I — COMPLEX FUNCTIONS AND DIFFERENTIATION — Classes: 10

Complex functions differentiation and integration: Complex functions and its representation on argand plane, concepts of limit, continuity, differentiability, analyticity, Cauchy-Riemann conditions and harmonic functions; Milne-Thomson method.

UNIT-II — COMPLEX INTEGRATION — Classes: 10

Line integral: Evaluation along a path and by indefinite integration; Cauchy's integral theorem; Cauchy's integral formula; Generalized integral formula; Power series expansions of complex functions and contour Integration: Radius of convergence.

UNIT -III — POWER SERIES EXPANSION OF COMPLEX FUNCTION — Classes: 09

Expansion in Taylor's series, Maclaurin's series and Laurent series. Singular point; Isolated singular point; Pole of order m; Essential singularity; Residue: Cauchy Residue Theorem.

Evaluation of Residue by Laurent Series and Residue Theorem.

Evaluation of integrals of the type

1. $\int_{0}^{2\Pi} f(\cos\theta, \sin\theta)\,d\theta$ 2. $\int_{-\infty}^{\infty} f(x)\,dx$,

Bilinear Transformation.

UNIT-IV — SINGLE RANDOM VARIABLES — Classes: 09

Random variables: Discrete and continuous, probability distributions, mass function-density function of a probability distribution; Mathematical expectation; Moment about origin, central moments, moment generating function of probability distribution.

UNIT-V — PROBABILITY DISTRIBUTIONS — Classes: 07

Binomial, Poisson and normal distributions and their properties.

Text Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition, 2014.

2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 42nd Edition, 2012.

Reference Books:

1. Churchill, R.V. and Brown, J.W, “Complex Variables and Applications”, Tata Mc Graw-Hill, 8th Edition, 2012.
2. A. K. Kapoor, “Complex Variables Principles and Problem Sessions”, World Scientific Publishers, 1st Edition, 2011.
3. Murray Spiegel, John Schiller, “Probability and Statistics”, Schaum’s Outline Series, 3rd Edition, 2010.

Web References:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://mathworld.wolfram.com/

E-Text Books:

1. https://keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktu-ebook-download.html
2. https://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks.

Course Home Page:

THERMODYNAMICS

III Semester: ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AME003	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Understand the laws of thermodynamics and determine thermodynamic properties, gas laws.

II. Apply Knowledge of properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.

III. Understand the direction law and concept of increase in entropy of universe.

IV. Understand the working of ideal air standard, vapor cycles and evaluate their performance in open systems like steam power plants, internal combustion engines, gas turbines and refrigeration systems.

UNIT-I	BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS	Classes : 09

Basic concepts: System, control volume, surrounding, boundaries, universe, types of systems, macroscopic and microscopic viewpoints, concept of continuum, thermodynamic equilibrium, state, property, process, cycle, reversibility, quasi static process, irreversible process, causes of irreversibility, various flow and non flow processes ,energy in state and in transition, types-work and heat, point and path function, Zeroth law of thermodynamics, concept of quality of temperature, Principles of thermometry, reference points, constant volume gas thermometer, ideal gas scale, PMMI Joule's experiments, first law of thermodynamics, corollaries first law applied to a process, applied to a flow system, steady flow energy equation.

UNIT-II	SECOND LAW OF THERMODYNAMICS	Classes : 09

Limitations of the first law: thermal reservoir, heat engine, heat pump, parameters of performance, second Law of thermodynamics, Kelvin Planck and Clausius statements and their equivalence, Corollaries, PMM of second kind, Carnot's principle, Carnot cycle and its specialties, thermodynamic scale of temperature, Clausius inequality, Entropy, principle of Entropy increase, availability and irreversibility, thermodynamic potentials, Gibbs and Helmholtz functions, Maxwell relations, elementary treatment of the Third Law of thermodynamics.

UNIT-III	PURE SUBSTANCES	Classes: 09

Pure substances: Phase transformations, T-S and H-S diagrams, P-V-T surfaces, triple point at critical state properties during change of phase, dryness fraction, Mollier charts, various thermodynamic processes and energy transfer, steam calorimeter.

Perfect gas laws: Equation of state, specific and universal gas constants, throttling and free expansion processes, deviations from perfect gas model, Vander Waals equation of state.

UNIT-IV	MIXTURES OF PERFECT GASES	Classes: 09

Mixtures of perfect gases: Mole fraction, mass friction, gravimetric and volumetric analysis, volume fraction, Dalton's law of partial pressure, Avogadro's laws of additive volumes, and partial pressure, equivalent gas constant, internal energy, enthalpy, specific heats and entropy of mixture of perfect gases; psychometric properties, dry bulb temperature, wet bulb temperature, dew point temperature, thermodynamic wet bulb temperature, specific humidity, relative humidity, saturated air, vapour pressure, degree of saturation, adiabatic saturation, Carrier's equation, Psychometric chart.

UNIT-V	POWER CYCLES	Classes : 09
Power cycles: Otto, Diesel, Dual combustion cycles, description and representation on P-V and T-S diagram, thermal efficiency, mean effective pressures on air standard basis, comparison of cycles, introduction to Brayton cycle and Bell Coleman cycle.		
Text Books:		
1. P. K. Nag, “Engineering Thermodynamics”, Tata McGraw-Hill, 4th Edition, 2008. 2. Yunus Cengel, Michael A. Boles, “Thermodynamics-An Engineering Approach”, Tata McGraw-Hill, 7th Edition, 2011.		
Reference Books:		
1. J. B. Jones, R. E. Dugan, “Engineering Thermodynamics”, Prentice Hall of India Learning, 1st Edition, 2009. 2. Y. V. C. Rao, “An Introduction to Thermodynamics”, Universities Press, 3rd Edition, 2013. 3. K. Ramakrishna, “Engineering Thermodynamics”, Anuradha Publishers, 2nd Edition, 2011. 4. Holman. J.P, “Thermodynamics”, Tata McGraw-Hill, 4th Edition, 2013.		
Web References:		
1. https://en.wikipedia.org/wiki/Thermodynamics 2. https://en.wikipedia.org/wiki/Laws_of_thermodynamics 3. http://www.livescience.com/50776-thermodynamics.html 4. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf		
E-Text Book:		
1. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf 2. http://www.ebookdownloadz.net/2014/08/engineering-thermodynamics-by-pknag.html		
Course Home Page:		

LOW SPEED AERODYNAMICS

IV Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE004	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the basics of aerodynamics, aerofoil and wing characteristics

II. Calculate forces and moments acting on aero foils and wings under ideal flow conditions.

III. Design a propeller and determine aerodynamic interaction effects between different components of aircraft.

UNIT-I	INTRODUCTORY TOPICS FOR AERODYNAMICS	Classes: 09

Potential flow, velocity potential, stream function, Laplace equation, flow singularities-Uniform flow, source, sink, doublet, Vortex, Non lifting and lifting flow over a cylinder Kutta-Joukowski theorem.

UNIT-II	THIN AEROFOIL THEORY	Classes: 09

Aerofoil nomenclature, aerodynamic characteristics, centre of pressure and aerodynamic centre; Wing of infinite aspect ratio, C_L-α- diagram for a wing of infinite aspect ratio, generation of lift, starting Vortex, Kutta's trailing edge condition; Thin aerofoil theory; Elements of panel method; High lift airfoils, High lift devices.

UNIT-III	FINITE WING THEORY	Classes: 12

Vortex motions, vortex line, vortex tube, vortex sheet; Circulation; Kelvin and Helmhotz theorem; Biot-Savart's law, applications, Rankine's vortex; Flow past finite wings, vortex model of the wing and bound vortices; Induced drag; Prandtl's lifting line theory; Elliptic wing.

Influence of taper and twist applied to wings, effect of sweep back wings; Delta wings, primary and secondary vortex; Elements of lifting surface theory. Source Panel Vortex panel and Vortex lattice methods.

UNIT-IV	FLOW PAST NON-LIFTING BODIES AND INTERFERENCE EFFECTS	Classes: 08

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	BOUNDARY LAYER THEORY	Classes: 07

Introduction to boundary layer, laminar and turbulent boundary layer, transition, boundary layer on flat plate, displacement thickness, momentum thickness, energy thickness, effect of curvature, temperature boundary layer.

Text Books:

1. E. L. Houghton and P. W. Carpenter, "Aerodynamics for Engineering Students", Edward Arnold Publishers Ltd., London, 5th Edition, 1982,
2. J. D. Anderson, "Fundamentals of Aerodynamics", McGraw Hill Book Co., New York, 5th Edition, 1985.
3. John J. Bertin and Russell M. Cummings, "Aerodynamics for Engineering Students", Pearson, 5th Edition, 2009.

Reference Books:
1. L. J. Clancy, "Aerodynamics", Pitman, 1st Edition, 1986. 2. L. H. Milne, S. Thomson, "Theoretical Aerodynamics", Dover, 2nd Edition, 1985. 3. K. Karamcheti, " Principles of Ideal-Fluid Aerodynamics", Krieger Pub Co; 2nd edition, 1980.
Web References:
1. https://www.loc.gov/rr/scitech/tracer-bullets/aerodynamicstb.html 2. https://www.myopencourses.com/subject/aerodynamics-2 3. https://tocs.ulb.tu-darmstadt.de/211658790.pdf 4. https://www.princeton.edu/~stengel/MAE331Lecture3.pdf
E-Text Books:
1. https://bookboon.com/en/a-first-course-on-aerodynamics-ebook 2. https://airspot.ru/book/file/22/houghton_aerodynamics_for_engineering_students.pdf 3. https://www.adl.gatech.edu/extrovert/Ebooks/ebook_Lowspeed.pdf 4. https://rahauav.com/Library/Aerodynamic/Aerodynamics%20for%20engineering%20students_6th_www.rahauav.com.pdf
Course Home Page:

AIRCRAFT MATERIALS AND PRODUCTION

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE005	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Study the composition of microstructures of metals and alloys with their applications in aerospace industry.

II. Discuss the various manufacturing processes and selection of process for suitable applications.

III. Understand the working principles and applications of conventional and unconventional machining along with their advantages and disadvantages.

IV. Demonstrate the importance of composites with their applications in different areas of aerospace industry.

UNIT-I | AIRCRAFT ENGINEERING MATERIALS | Classes: 09

Engineering materials Steels, study of iron, iron carbon phase diagram, heat treatment-annealing, normalizing, hardening and tempering of Aluminum and steel, Non-Ferrous metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Corrosion - Types of Corrosions - Prevention – Protective Treatments.

UNIT-II | CASTING, WELDING AND INSPECTION TECHNIQUES | Classes: 09

General principles of various casting processes Sand casting, die-casting, centrifugal casting, investment casting, Shell molding types; Principles and equipment used in arc welding, gas welding, resistance welding, solid, laser welding, and electron beam welding, soldering and brazing techniques. Need for NDT, ultrasonic testing, Radiographic testing, Flight testing.

UNIT-III | SHEET METAL PROCESSES IN AIRCRAFT INDUSTRY | Classes: 09

Sheet metal operations: shearing, punching, super plastic forming; operations in bending like stretch forming spinning drawing.

Riveting, types and techniques, equipment, fasteners, integral tanks, final assembly of aircraft, Jigs and Fixtures, stages of assembly, aircraft tooling concepts.

UNIT-IV | CONVENTIONAL AND UNCONVENTIONAL MACHINING PROCESSES | Classes: 09

General working principles, applications and operations of lathe, shaper, milling machines, grinding, drilling machine, computer numeric control machining.
Working principles and applications of abrasive jet machining, ultrasonic machining, Electric discharge machining and electro chemical machining, laser beam, electron beam, plasma arc machining.

UNIT-V | AIRCRAFT COMPOSITES | Classes: 09

Introduction, Physical metallurgy, Wrought aluminum alloys, Cast aluminum alloys, Production of semi-fabricated forms, Aerospace applications, Plastics and rubber, Introduction to fiber reinforced plastics, glass and carbon composites; Fibers and resins; Characteristics and applications, Classification of aircraft materials; Materials used for aircraft components, Application of composite materials, Super alloys, indigenized alloys, emerging trends in aerospace materials.

Text Books:

1. S. Kalpakjian, Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley 5th Edition, 1991.
2. S. C. Keshu, K. K Ganapathy, "Aircraft production technology and management", Interline Publishing House, Bangalore, 3rd Edition, 1993.
3. Douglas F. Horne, "Aircraft production technology", Cambridge University Press, 1st Edition, 1986.

Reference Books:

1. S. C. Keshu, K. K Ganapathy, "Air craft production techniques", Interline Publishing House, Bangalore, 3rd Edition, 1993.
2. R. K. Jain, "Production technology", Mc Graw Hill, 1st Edition, 2002.
3. O. P. Khanna, M. Lal, "Production technology", Dhanpat Rai Publications, 5th Edition, 1997.

Web References:

1. https://nptel.ac.in/courses/112107145/
2. https://nptel.ac.in/courses/112105126/

E-Text Books:

1. https://books.google.co.in/books?id=6wFuw6wufTMC&redir_esc
2. https://royalmechanicalbuzz.blogspot.in/2015/04/manufacturing-engineering-by-kalpakjian.html

Course Home Page:

ANALYSIS OF AIRCRAFT STRUCTURES

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE006	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the aircraft structural components and its behavior under different loading conditions.
II. Obtain knowledge in plate buckling and structural instability of stiffened panels for airframe structural analysis.
III. Explain the thin walled section and structural idealization of panels and differentiate from the type of loads carried.
IV. Solve for stresses and deflection in aircraft structures like fuselage, wing and landing gear.

UNIT-I	INTRODUCTION TO AIRCRAFT STRUCTURAL COMPONENTS AND ENERGY METHODS	Classes: 10

Aircraft Structural components and loads, functions of structural components, airframe loads; Types of structural joints, type of loads on structural joints; Aircraft inertia loads; Symmetric manoeuvre loads, gust loads. Monocoque and semi monocoque structures, stress in thin and thick shells; Introductions to energy principles, castiglianos theorems, maxiwells reciprocal theorem, unit load method, Rayleigh Ritz method, total potential energy method, flexibility method.

UNIT-II	THIN PLATE THEORY, STRUCTURAL INSTABILITY	Classes: 09

Analysis of thin rectangular plates subject to bending, twisting, distributed transverse load, combined bending and in-plane loading: Thin plates having small initial curvature, energy methods of analysis.
Buckling of thin plates: Elastic, inelastic, experimental determination of critical load for a flat plate, local instability, instability of stiffened panels, failure stresses in plates and stiffened panels. Tension field beams- complete diagonal tension, incomplete diagonal tension, post buckling behavior.

UNIT-III	BENDING, SHEAR AND TORSION OF THIN WALLED BEAMS	Classes: 10

Unsymmetrical bending: Resolution of bending moments, direct stress distribution, position of neutral axis; Deflections due to bending: Approximations for thin walled sections, temperature effects; Shear loaded thin walled beams: General stress, strain and displacement relationships, direct stress and shear flow system, shear centre, twist and warping.

Torsion of beams of closed section: Displacements associated with Bredt-Batho shear flow; Torsion of open section beams; Warping of cross section, conditions for zero warping; Bending, shear, torsion of combined open and closed section beams.

UNIT-IV	STRUCTURAL IDEALIZATION	Classes: 08

Structural idealization: Principal assumptions, idealization of panel, effect on the analysis of thin walled beams under bending, shear, torsion loading- application to determining deflection of open and closed section beams. Fuselage frames - bending, shear and torsion.

UNIT-V	ANALYSIS OF FUSELAGE, WING AND LANDING GEAR	Classes: 08
Wing spar and box beams, tapered wing spar, open and closed sections beams, beams having variable stringer areas; wings – three boom shell in bending, torsion and shear, tapered wings, deflections, cutouts in wings; Cutouts in fuselages; Fuselage frame and wing rib; principle of stiffener, web constructions. Landing gear and types; Analysis of landing gear.		

Text Books:

1. T. H. G. Megson, "Aircraft Structures for Engineering Students", Butterworth-Heinemann Ltd, 5th Edition, 2012.
2. E. H. Bruhn, "Analysis and Design of Flight vehicles Structures", Tri-state off set company, USA, 4th Edition, 1965.

Reference Books:

1. B. K. Donaldson, "Analysis of Aircraft Structures - An Introduction", Mc Graw Hill, 3rd Edition, 1993.
2. S. Timoshenko, "Strength of Materials, Vols I and II", Princeton D. Von Nostrand Co., Reprint, 1977.

Web References:

1. https://nptel.ac.in/courses/112101095/
2. https://www.scribd.com/doc/244154727/theory-of-structures-timoshenko-pdf

E-Text Books:

1. https://www.freeengineeringbooks.com/AeroSpace/Aircraft-Structures-Books.php
2. https://docs.google.com/file/d/0Bw8MfqmgWLS4RlNqaE1oUzdOajQ/view?pref=2&pli=1

Course Home Page:

AERODYNAMICS LABORATORY

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE103	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand the behavior of flow properties over different models using subsonic wind tunnel.
II. Demonstrate experimentally the pressure distribution over circular, symmetric and cambered airfoils and evaluate lift and drag.
III. Illustrate flow visualization studies at low speeds over different aerodynamic bodies.

LIST OF EXPERIMENTS

Week-1	**CALIBRATION**
Calibration of subsonic wind tunnel.	
Week-2	**PRESSURE DISTRIBUTION-CYLINDER**
Pressure distribution over cylinder.	
Week-3	**PRESSURE DISTRIBUTION-SYMMETRIC AIRFOIL**
Pressure distribution over symmetric airfoil.	
Week-4	**PRESSURE DISTRIBUTION-CAMBERED AIRFOIL**
Pressure distribution over cambered airfoils.	
Week-5	**FORCE MEASUREMENT**
Force measurement using wind tunnel balance.	
Week-6	**FLOW OVER A FLAT PLATE**
Flow over a flat plate	
Week-7	**FLOW VISUALIZATION**
Flow visualization studies in low speed over cylinder	
Week-8	**FLOW VISUALIZATION STUDIES - AIRFOIL**
Flow visualization studies in low speed over airfoil at different angles of incidence.	
Week-9	**WAKE ANALYSIS**
Wake analysis over a cylinder and airfoils	
Week-10	**BLOWER TEST RIG**
Efficiency of blower test rig for 3 different vane settings.	
Week-11	**AXIAL FLOW COMPRESSOR**
Efficiency of axial flow compressor	
Week-12	**CENTRIFUGAL FLOW COMPRESSOR**
Efficiency of centrifugal flow compressor	

Reference Books:
1. L. J. Clancy, “Aerodynamics”, Pitman, 1st Edition, 1986. 2. Alan pope, “ Low Speed Wind Tunnel Testing”, John Wiley, 2nd Edition, 1999. 3. N. M. Komerath, “Low Speed Aerodynamics”, Extrovert, 1st Edition, 2012.
Web References:
1. www.loc.gov/rr/scitech/tracer-bullets/aerodynamicstb.html 2. www.myopencourses.com/subject/aerodynamics-2 3. www.tocs.ulb.tu-darmstadt.de/211658790.pdf 4. www.princeton.edu/~stengel/MAE331Lecture3.pdf
Course Home Page:

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S. No	Details of Equipment	Quantity Required
1	Sub sonic Wind tunnel with flow visualization	2
2	Wings of various NACA airfoil sections (Symmetrical and Cambered airfoils)	4
3	Blower test rig	1
4	Axial Flow compressor	1
5	Centrifugal flow compressor	1
6	Aerodynamic models of three dimensional bodies	2

AEROSPACE STRUCTURES LABORATORY

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE104	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Provide basic knowledge on the mechanical behavior of materials like aluminum, mild steel, and cast iron.
II. Visualize the crack detection using various NDT methods and also discuss the changing strength due to these defects.
III. Understand the concept of locating the shear centre for open and closed section of beams.
IV. Obtain buckling strength of both long and short columns using different elastic supports.

LIST OF EXPERIMENTS

Week-1 DIRECT TENSION TEST

Tensile testing using UTM, mechanical and optical extensometers, stress strain curves and strength test or various engineering materials.

Week-2 DEFLECTION TEST

Stress and deflections of beams for various end conditions, verification of Maxwell's theorem

Week-3 BUCKLING TEST

Compression tests on long columns, Critical buckling loads.

Week-4 BUCKLING TEST

Compression tests on short columns, Critical buckling loads, south well plot.

Week-5 BENDING TEST

Unsymmetrical Bending of a Beam.

Week-6 SHEAR CENTRE FOR OPEN SECTION

Shear Centre of an open Section beam.

Week-7 SHEAR CENTRE FOR CLOSED SECTION

Shear Centre of a closed Section beam.

Week-8 WAGNER'S THEOREM

Wagner beam – Tension field beam.

Week-9 SANDWICH PANEL TENSION TEST

Fabrication and determine the young's modulus of a sandwich structures.

Week-10 NON-DESTRUCTIVE TESTING

Study of non-destructive testing procedures using dye penetration,

Week-11 NON-DESTRUCTIVE TESTING

Magnetic particle inspection and ultrasonic techniques.

Week-12	VIBRATION TEST
Determination of natural frequency of beams under free and forced vibration using.	
Reference Books:	
1. Megson, T.H.G., Aircraft Structures for Engineering Students, 4th Edition., Elsevier, 2007, ISBN 0-750-667397. 2. Peery, D.J. and Azar, J.J., Aircraft Structures, McGraw-Hill , 2nd Edition, , 1982, ISBN 0-07-049196-8. 3. Bruhn. E.H, "Analysis and Design of Flight Vehicles Structures", Tri-state Off-set Company, USA, 1965. 4. Lakshmi Narasaiah, G., Aircraft Structures, BS Publications, 2010.	
Web References:	
1. httpa://nptel.ac.in/courses/112101095/ 2. https://www.scribd.com/doc/244154727/theory-of-structures-timoshenko-pdf	
Course Home Page:	

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S No	Details of Equipment	Quantity Required
1	Universal Testing Machine	1
2	Beam deflection test rigs	1
3	Unsymmetrical Bending of a Beam	1
4	Mechanical Extensometer	1
5	Vibration test equipment	1
6	Test rig for determination of shear centre	1
7	Dye penetration test setup	1
8	Magnetic particle inspection setup	1
9	Ultrasonic test setup	1
10	Wagner beam Setup	1
11	Buckling of struts setup	1

AIRCRAFT MATERIALS AND PRODUCTION LABORATORY

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE105	Core	-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic conventional machining operation using for aircraft structural members production.
II. Illustrate other unconventional machining techniques required for aircraft production.
III. Perform the basic computer numerical control machining operation required for aircraft production technology.

LIST OF EXPERIMENTS

Week-1	**BASIC METALLURGY -I**
Preparation and study of microstructure of pure materials like Cu and Al. Hardenability of steels by Jominy End Quench test	
Week-2	**BASIC METALLURGY -II**
Study of microstructures of non-ferrous alloys. Study of microstructure of heat treated steel.	
Week-3	**LATHE OPERATIONS**
Introduction- lathe machine, plain turning, Step turning & grooving, Taper turning-compound rest/offset method & Drilling using lathe, External threading-Single start	
Week-4	**SHAPING & SLOTTING**
Shaping-V-Block & Slotting-Keyways.	
Week-5	**GRINDING & MILLING**
Grinding-Cylindrical /Surface/Tool & cutter. Milling-Polygon /Spur gear, Gear hobbing-Helical gear.	
Week-6	**DRILLING**
Drilling, reaming, counter boring, Counter sinking Taping.	
Week-7	**CNC MACHINING**
Basic operations, Introduction to CNC programming.	
Week-8	**WELDING PROCESSES I**
Gas Welding, Brazing, Electric and Black smithy, Soldering.	
Week-9	**WELDING PROCESS II**
Arc welding. Spot welding, Seam welding, TIG welding and MIG Welding.	
Week-10	**BASIC CASTING**
Casting of plaster of Paris using different dies.	
Week-11	**RIVETING ALUMINUM SHEETS**
Spot and Blind Rivets on aluminum sheets.	

Week-12	EXAMINATIONS
Internal and external examinations.	

Reference Books:

1. Keshu S. C, Ganapathy K. K, “Air Craft Production Techniques”, Interline Publishing House, Bangalore, 3rd Edition, 1993.
2. R. K Jain-Khanna, “Production technology”, Mc Graw Hill, 1st Edition, 2002.
3. O. P Khanna, Lal. M. Dhanpat Rai, “Production technology, 5th Edition, 1997.

Web References:

1. https://nptel.ac.in/courses/112107145/
2. https://nptel.ac.in/courses/112105126/

Course Home Page:

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S. No	Details of Equipment	Quantity Required
1	Metallurgic Micro Scope	1
2	Image Analyzer With Hcl P4 System	1
3	Disc Polisher	1
4	ASME Grain Size Measurement 10x Eye Piece	1
5	Trinocular with Video Camera	1
6	Mounting Press	1
7	Belt Polisher	1
8	Muffle Furnace	1
9	Rockwell Hardness Test	1
10	Milling machine	1
11	CNC Turning centre	1
12	Gas welding and Brazing equipment	1
13	Arc welding equipment	1
14	Soldering machine	1
15	TIG welding machine	1
16	MIG welding machine	1
17	Lathe Machine	1
18	Sloting Machine	1
19	Riveting tools	5 sets
20	Drilling machine	1
21	Shaping Machine	1

AIRCRAFT PROPULSION

V Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE007	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyze parametric cyclic analysis, performance parameters, efficiency, specific impulse of all air breathing engines.
II. Know the design and performance of subsonic and supersonic inlets, types of combustion chambers and factors affecting the combustors.
III. Discuss the types of nozzles, flow conditions in nozzles, interaction of nozzle flow with adjacent surfaces and thrust reversal
IV. Explain different types of compressors and turbines, work done, velocity diagrams and stage efficiency calculations.

UNIT-I | AIR-BREATHING ENGINES | Classes: 10

Classification, operational envelopes; Description and function of gas generator, turbojet, turbofan, turboprop, turbo shaft, ramjet, scramjet, turbojet/ramjet combined cycle engine; Engine thrust, takeoff thrust, installed thrust, thrust equation; Engine performance parameters, specific thrust, specific fuel consumption and specific impulse, thermal efficiency, propulsive efficiency, engine overall efficiency and its impact on aircraft range and endurance; Engine cycle analysis and performance analysis for turbojet, turbojet with afterburner, turbofan engine, turboprop engine.

UNIT-II | INLETS AND COMBUSTION CHAMBERS | Classes: 10

Internal flow and stall in subsonic inlets, relation between minimum area ratio and eternal deceleration ratio, diffuser performance, supersonic inlets, starting problem on supersonic inlets, shock swallowing by area variation; Classification of combustion chambers, combustion chamber performance, effect of operating variables on performance, flame stabilization.

UNIT-III | NOZZLES | Classes: 08

Theory of flow in isentropic nozzles, nozzles and choking, nozzle throat conditions, nozzle efficiency, losses in nozzles.

Over expanded and under expanded nozzles, ejector and variable area nozzles, interaction of nozzle flow with adjacent surfaces, thrust reversal.

UNIT-IV | COMPRESSORS | Classes: 09

Principle of operation of centrifugal compressor and axial flow compressor, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant reaction designs of axial flow compressor, performance characteristics of centrifugal and axial flow compressors, stage efficiency calculations, cascade testing.

UNIT-V | TURBINES | Classes: 08

Principle of operation of axial flow turbines, limitations of radial flow turbines, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant angle designs, performance characteristics, sample ramjet design calculations, flame stability problems in ramjet combustors, integral ram rockets.

Text Books:
1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison Wesley Longman INC, 1999. 2. Mattingly J.D., "Elements of Propulsion: Gas Turbines and Rocket", AIAA, 1991.
Reference Books:
1. Cohen, H.Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1989. 2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
Web References:
1. https://nptel.ac.in/courses/101101002/ 2. https://nptel.ac.in/courses/112106073/
E-Text Books:
1. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118806778.html 2. https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems 3. https://www.crcpress.com/Aircraft-Propulsion-and-Gas-Turbine-Engines/ElSayed/p/book/9780849391965
Course Home Page:

HIGH SPEED AERODYNAMICS

V Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE008	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil			Total Classes: 60			

OBJECTIVES:

The course should enable the students to:

I. Understand the effect of compressibility at high-speeds and the ability to make intelligent design decisions.
II. Explain the dynamics in subsonic, transonic and supersonic flow regimes in both internal and external geometries.
III. Analyze the airfoils at subsonic, transonic and supersonic flight conditions using the perturbed flow theory assumption.
IV. Formulate appropriate aerodynamic models to predict the forces and performance of realistic three-dimensional configurations.

UNIT-I	INTRODUCTION TO COMPRESSIBLE FLOWS	Classes: 10

Basic concepts: Introduction to compressible flow, brief review of thermodynamics and fluid mechanics, integral forms of conservation equations, differential conservation equations, continuum postulates, acoustic speed and mach number, governing equations for compressible flows.

UNIT-II	SHOCK AND EXPANSION WAVES	Classes: 10

Shocks and expansion waves: Development of governing equations for normal shock, stationery and moving normal shock waves, applications to aircrafts, supersonic wind tunnel, shock tubes, shock polars, supersonic pitot probes; oblique shocks, governing equations, reflection of shock, Prandtl-Meyer expansion flow, shock expansion method for flow over airfoil, introduction to shock wave boundary layer interaction.

UNIT-III	ONE DIMENSIONAL AND QUASI ONE DIMENSINAL FLOW	Classes: 08

Quasi one dimensional flow: Isentropic flow in nozzles, area Mach relations, choked flow, under and over expanded nozzles, slip stream line.

One dimensional flow: Flow in constant area duct with friction and heat transfer, Fanno flow and Rayleigh flow, flow tables and charts for Fanno flow and Rayleigh flow.

UNIT-IV	APPLICATIONS OF COMPRESSIBLE FLOWS AND NUMERICAL TECHNIQUES	Classes: 08

Small perturbation equations for subsonic, transonic, supersonic and hypersonic flow; Experimental characteristics of airfoils in compressible flow, supercritical airfoils, area rule; Theory of characteristics, determination of the characteristic lines and compatibility equations, supersonic nozzle design using method of characteristics.

UNIT-V	EXPERIMENTAL METHODS IN COMPRESSIBLE FLOWS	Classes: 09
Experimental methods: Subsonic wind tunnels, supersonic wind tunnels, shock tunnels, free-piston shock tunnel, detonation-driven shock tunnels, and expansion tubes and characteristic features, their operation and performance, flow visualization techniques for compressible flows.		
Text Books :		
1. John D. Anderson, "Modern Compressible flow with historical perspective", McGraw-Hill Education, 3rd Edition, 2002. 2. John D. Anderson, "Fundamentals of Aerodynamics", McGraw-Hill Education, 6th Edition, 2016.		
Reference Books:		
1. Ascher H. Shapiro, "The Dynamics and Thermodynamics of Compressible Fluid Flow" John Wiley & Sons; Volume 1 ed. Edition, 1977. 2. Radhakrishnan Ethirajan, "Gas Dynamics", John Wiley & Sons, 2nd edition 2010. 3. H W Liepmann and A Roshko, "Elements of Gas Dynamics", John Wiley & Sons, 4th edition, 2003.		
Web References:		
1. https://nptel.ac.in/courses/101103004/pdf/mod8.pdf 2. https://www.uvm.edu/~dhitt/me346/?Page=exams.html		
E-Text Books:		
1. https://www3.nd.edu/~powers/ame.30332/notes.pdf 2. https://www.e-booksdirectory.com/details.php?ebook=11098 3. https://www.e-booksdirectory.com/details.php?ebook=4519		
Course Home Page:		

FINITE ELEMENT METHODS

V Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE009	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the theoretical basics of governing equations and convergence criteria of finite element method.

II. Use the commercial Finite Element packages to build Finite Element models and solve a selected range of engineering problems.

III. Discuss the accurate Finite Element Solutions for the various field problems.

UNIT-I	INTRODUCTION	Classes: 10

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain - displacement relations. Stress-strain relations for 2-D and3-D elastic problems. One Dimensional Problems: Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations – Treatment of boundary conditions, Quadratic shape functions.

UNIT-II	ANALYSIS OF TRUSSES AND BEAMS	Classes: 10

Analysis of Trusses: Stiffness matrix for plane Truss Elements, stress calculations and problems. Analysis of beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element and simple problems.

UNIT-III	CONTINUUM ELEMENTS	Classes: 09

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load vector and stresses.

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements Two dimensional four noded isoparametric elements and problems.

UNIT-IV	STEADY STATE HEAT TRANSFER ANALYSIS	Classes: 09

Steady state Heat Transfer Analysis: one dimensional analysis of slab, fin and two dimensional analysis of thin plate. Analysis of a uniform shaft subjected to torsion.

UNIT-V	DYNAMIC ANALYSIS	Classes: 07

Dynamic Analysis: Formulation of finite element model, element –Mass matrices, evaluation of Eigen values and Eigen Vectors for a stepped bar, truss. Finite element-formulation to 3D problems in stress analysis, convergence requirements, mesh eneration, techniques such as semi automatic and fully automatic use of software such as ANSYS, NISA, NASTRAN etc.

Text Books:

1. Tirupathi. R. Chandrapatla, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Printice Hall India, 3rd Edition, 2003.
2. Rao. S.S., "Finite Element Methods in Engineering," Butterworth and Heinemann, 2001.
3. Reddy J.N., "An Introduction to Finite Element Method", McGraw Hill, 2000.

Reference Books:

1. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000.
2. K. J. Bathe, E. L. Wilson, "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
3. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4th edition, John Wiley and Sons, Inc., 2003.
4. Larry J Segerlind, "Applied Finite Element Analysis", 2nd Edition, John Wiley and Sons, Inc. 1984.

Web References:

1. www.home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
2. www.nptel.ac.in/courses/112104116/
3. www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

E-Text Books:

1. www.civilenggforall.com/2015/09/finite-element-analysis-by-ss-bhavikatti-free-download-pdf-civilenggforall.com.html
2. www.books.google.co.in/books/about/Finite_Element_Analysis_For_Engineering.html

Course Home Page:

AIRCRAFT SYSTEMS AND CONTROL

V Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE010	Core	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Explain the concept and meaning of system and classify the various systems required for aircraft and their contribution in order to fulfill the aircraft tasks.
II. Describe the various types of Electrical power generations and distribution in aircraft.
III. Impart the knowledge of pneumatic, hydraulic and environmental control system.
IV. Demonstrate different actuators, flight control system and advanced flight actuation system.

UNIT-I	INTRODUCTION TO AIRCRAFT SYSTEMS	Classes: 10

System concepts, everyday examples of systems, sub-systems; Generic system definition, inputs, outputs, feedback, external influence. Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems; Specification of requirements, mission requirements, performance requirements; Operating environment conditions.

UNIT-II	ELECTRICAL SYSTEMS AND AIR CONDITIONING, PRESSURIZING SYSTEMS	Classes: 10

Electrical loads in aircraft. Electrical power generation and control- DC, AC- types. Power distribution- primary, secondary. Power conversion and energy storage; Load protection; Electrical load management systems, variable speed constant frequency (VSCS) cycloconverter, 270 V DC systems; Basic air cycle systems; Vapour cycle systems, boost-strap air cycle system; Evaporative vapour cycle systems; Evaporative air cycle systems; Oxygen systems; Fire protection systems, deicing and anti icing systems.

UNIT-III	HYDRAULIC SYSTEMS AND PNEUMATIC SYSTEMS	Classes: 09

Hydraulic systems: Study of typical workable system, function, merits, application, system loads, design requirements; Principal components; Hydraulic fluid: required properties, operating fluid pressures, temperatures, and flow rates; Hydraulic piping, pumps, reservoir, accumulator; Landing gear and brake management systems.

Pneumatic systems ; Advantages;- Working principles ; Typical air pressure system ; Brake system; Typical pneumatic power system ; Components, landing gear systems ; Classification.

UNIT-IV	ENGINE CONTROL AND FUEL SYSTEMS	Classes: 08

Principle of operation of aircraft gas turbine engines; Engine - airframe interfaces; Control of fuel flow, air flow, exhaust gas flow- need, means, system parameters, basic inputs and outputs; Limited authority control systems, full authority control systems- examples; Engine monitoring- sensors, indicators; Power off takes- need, types, effect on engine performance; Fuel systems- characteristics, components, operating modes; Fuel tank safety- fuel inserting system.

UNIT-V	AIRPLANE CONTROL SYSTEMS	Classes: 08

Flight control systems- primary and secondary flight control conventional systems; Power assisted and fully powered flight controls ; Power actuated systems; Engine control systems; Push pull rod system, flexible push full rod system; Components; Modern control systems; Digital fly by wire systems , control laws, implementation; Auto pilot system active control technology, communication and navigation systems instrument landing systems; Control linkages, actuation- types, description and redundancy.

Text Books:

1. Moir, I. and Sea bridge, A, “Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration”, John Wiley, 3rd Edition 2008.
2. Moir, I. and Sea bridge, A, “Design and Development of Aircraft Systems- An Introduction”, AIAA Education Series”, AIAA, 2004.

Reference Books:

1. Pallett, E.H.J., “Aircraft Instruments and Integrated Systems”, Longman Scientific &Technical 10th edition, 1992.
2. Harris, D, “Flight Instruments and Automatic Flight Control Systems”, 6th edition, 2004.
3. Bolton, W., “Pneumatic and Hydraulic Systems”, Butterworth-Heinemann.

Web References:

1. https://www.aircraftsystemscomjet.com/
2. https://www.srmuniv.ac.in/sites/default/files/downloads/Aircraft_ctrl_Systems.pdf
3. https://hydraulicspneumatics.com/other-technologies/chapter-5-pneumatic-and-hydraulic-systems
4. https://www.stahl.de/fileadmin/Dateien/download_publikationen/web havc_and_pressurization.pdf

E-Text Books:

1. https://www.amazon.in/Aircraft-Systems-Mechanical-ElectricalIntegration/dp/0470059966
2. https://www.scribd.com/book/142412367/Aircraft-Systems-Mechanical-Electrical-and Avionics-Subsystems-Integration
3. https://www.scribd.com/document/231235694/n-0447376

Course Home Page:

AIRCRAFT PERFORMANCE

V Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE011	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Learn the different Regimes of aircraft and performance requirements at different atmospheric conditions.
II. Understand the different type of velocities and gives differences between stall velocity and maximum and minimum velocities.
III. Estimate the time to climb and descent and gives the relation between rate of climb and descent and time to climb and descent at different altitudes.
IV. Illustrate the velocity and radius required for different type of maneuvers like pull-up, pull down and steady turn.

UNIT-I	INTRODUCTION TO AIRCRAFT PERFORMANCE	Classes: 10

The role and design mission of an aircraft; Performance requirements and mission profile; Aircraft design performance, the standard atmosphere; Off-standard and design atmosphere; Measurement of air data; Air data computers; Equations of motion for performance - the aircraft force system; Total airplane drag-estimation, drag reduction methods; The propulsive forces, the thrust production engines, power producing engines, variation of thrust, propulsive power and specific fuel consumption with altitude and flight speed; The minimum drag speed, minimum power speed; Aerodynamic relationships for a parabolic drag polar.

UNIT-II	CRUISE PERFORMANCE	Classes:08

Maximum and minimum speeds in level flight; Range and endurance with thrust production, and power producing engines; Cruise techniques: constant angle of attack, constant mach number; constant altitude, methods- comparison of performance. The effect of weight, altitude and temperature on cruise performance; Cruise performance with mixed power-Plants.

UNIT-III	CLIMB AND DECENT PERFORMANCE	Classes: 10

Importance of Climb and descent performance, Climb and descent technique generalized performance analysis for thrust producing, power producing and mixed power plants, maximum climb gradient, and climb rate.

Energy height and specific excess power, energy methods for optimal climbs - minimum time, minimum fuel climbs. Measurement of best climb performance. Descent performance in Aircraft operations. Effect of wind on climb and decent performance.

UNIT-IV	AIRCRAFT MANOEUVRE PERFORMANCE	Classes: 09

Lateral maneuvers- turn performance- turn rates, turn radius- limiting factors for turning performance. Instantaneous turn and sustained turns, specific excess power, energy turns. Longitudinal aircraft maneuvers, the pull-up, maneuvers. The maneuver envelope, Significance. Maneuver boundaries, Maneuver performance of military Aircraft, transport Aircraft.

UNIT-V	SAFETY REQUIREMENTS -TAKEOFF AND LANDING PERFORMANCE AND FLIGHT PLANNING	Classes:08
Estimation of takeoff distances. The effect on the takeoff distance of weight wind, runway conditions, ground effect. Takeoff performance safety factors. Estimation of landing distances. The discontinued landing, Baulk landing, air safety procedures and requirements on performance. Fuel planning fuel requirement, trip fuel, Environment effects, reserve, and tankering**.**		
Text Books:		
1. Anderson, J.D. Jr., "Aircraft Performance and Design", International edition McGraw Hill, 1st Edition, 1999, ISBN: 0-07-001971-1. 2. Eshelby, M.E., "Aircraft Performance theory and Practice", AIAA Education Series, AIAA, 2nd Edition, 2000, ISBN: 1-56347-398-4.		
Reference Books:		
1. McCormick, B.W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, 2nd Edition, 1995, ISBN: 0-471-57506-2. 2. Yechout, T.R. et al., "Introduction to Aircraft Flight Mechanics", AIAA Education Series, AIAA, 1st Edition, 2003, ISBN: 1-56347-577-4. 3. Shevel, R.S., "Fundamentals of Flight", Pearson Education, 2nd Edition, 1989, ISBN: 81-297-0514-1.		
Web References:		
1. www.myopencourses.com/subject/flight-dynamics-i-airplane-performance 2. www.scribd.com/doc/185026212/Introduction-to-Flight-Third-Edition-by-John-D-Anderson-Jr 3. www.scribd.com/book/282507871/Performance-and-Stability-of-Aircraft 4. www.scribd.com/doc/203462287/Aircraft-Performance-NPTEL 5. www.nptel.ac.in/courses/101106041/		
E-Text Books:		
1. www.scribd.com/doc/97544751/Anderson-Aircraft-Performance-and-Design		
Course Home Page:		

RESEARCH AND CONTENT DEVELOPMENT

V Semester: AE / CSE / IT / ECE / EEE / MECH								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHS106	**Skill**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	2	1	30	70	100

OBJECTIVES:

The course should enable the students to:

I. Gain a practical understanding of the various methodological tools used for social scientific research.
II. Learn the ethical, political, and pragmatic issues involved in the research process.
III. Improve their ability to develop technical writing.
IV. Identify the overall process of designing a research study from its inception to its report.

Week - l, 2, 3	**LATEX FOR DOCUMENTATION**

Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check and Track Changes using LaTeX; Mathematical expressions, Subscripts and superscripts, brackets and parentheses, fractions and binomials, aligning equations, operators, spacing in math mode, integrals, sums and limits, display style in math mode, list of Greek letters and math symbols, mathematical fonts; Prepare class timetable and student marks list using LaTex;

Week - 4	**RESEARCH FORMULATION AND DESIGN**

1. Topic/Title Selection for Research and Problem Statement
2. Title Selection and / or Methodology Formulation
3. Finalization of tentative Methodology

Week - 5	**DATA COLLECTION**

Data Preparation: Data Generation (simulated data) or Collection of Real Data – Part: I

Week - 6	**DATA COLLECTION AND SAMPLING DESIGN**

Data Preparation: Data Generation (simulated data) or Collection of Real Data – Part: II

Week – 7	**IMPLEMENTATION**

Implementation of Methodology on the Data and discussion of results - Part: I

Week – 8	**IMPLEMENTATION**

Implementation of Methodology on the Data and discussion of results - Part: II

Week – 9	**IMPLEMENTATION OF METHODOLOGY**

1. Block diagram / flowchart of Methodology or Algorithm
2. Testing of Methodology / algorithm, discussion of Results

Week – 10	**RESULTS**

Evaluation of Methodology / Algorithm, Discussion or Results and conclusion

Week – 11	PLAGIARISM ANALYSIS
Documentation / Paper formatting of Review / Research Article – Part: I (Plagiarism analysis)	
Week – 12	**DOCUMENTATION**
Documentation / Paper formatting of Review / Research Article – Part: II (Paper ready for submission)	

Text Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, "An Introduction to Research Methodology", RBSA Publishers. U.K., 2002.
2. Kothari, C.R, "Research Methodology: Methods and Techniques". New Age International. 418p, 1990.
3. Stefan Kottwitz , " LATEX Beginner's Guide", Packt Publishing Limited, 2011.

Reference Book:

1. Meenakshi Raman, Sangeeta Sharma, "Technical Communication", Oxford Publishers, 1st Edition, 2004.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.

Web References:

1. https://www.techwhirl.com/what-is-technical-writing/
2. https://www.mit.edu/me-ugoffice/communication/technical-writing
3. https://www.vocabulary.com/dictionary/technical

E-Text Books:

1. www.ebooksgo.org/
2. www.e-booksdirectory.com

COMPUTER AIDED AIRCRAFT ENGINEERING DRAWING

V Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE106	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

1. Understand the concepts and various tools used in design module
2. Understand the design of typical structural components.
3. Understand the design of typical aircraft components.
4. Understand the design of three view diagram of a typical aircraft.

LIST OF EXPERIMENTS

Week-l SKETCHER

Interface, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools , Constrain tool bar, Transformation Tool bar, User Selection Filter, Standards, Visualizations.

Week-2 PART DESIGN

Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations.

Week-3 SHEET METAL DESIGN

Walls, Cutting and Stamping, Bending, Rolled Walls,

Week-4 SURFACE DESIGN

Surfacer, Operations, Wireframe, Replication.

Week-5 ASSEMBLY

Product Structure Tools, Constrains.

Week-6 GD&T

Introduction to Geometric Dimensioning and Tolerance, Weld Symbols, GD&T Symbols, Types of Tolerances, Types of views, Roughness Symbols.

Week-7 DRAFTING

Views, Annotations, Sheet Background.

Week-8 DESIGN OF AIRCRAFT WING

Design of any two types of Aircraft structures

Week-9 DESIGN OF FUSELAGE

Design of fuselage with internal components

Week-10 DESIGN OF NOSE CONE

Design of Nose cone structures

Week-11 DESIGN OF LANDING GEAR

Design of Main landing gear and nose landing gear

Week-12 REVISION

Revision

Reference Books:

1. http://www.ehu.eus/asignaturasKO/DibujoInd/Manuales/R12_manual_catia_v5.pdf
2. http://www.engr.psu.edu/xinli/edsgn497k/TeaPotAssignment.pdf
3. http://file1.engineering.com/pdf/PartDesign.pdf

4. https://www.3ds.com/fileadmin/general/Terms/Licensed-Program Specifications /CATIA /CATIA_ V5R18.pdf

Web Reference:

1. http://www.iare.ac.in

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: CATIA V5

HARDWARE: 30 numbers of Desktop Computers with 4 GB RAM

FLIGHT CONTROLS LABORATORY

V Semester: AE									
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE107	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand the basics simulation of unaccelerated and accelerated level flight for climb and descend
II. Analyze the takeoff and landing performance and ground roll for different modes of aircraft.
III. Identify the basic controls and maneuver of in complex flight Path

LIST OF EXPERIMENTS

Week-1 SIMULATION OF UNACCELERATED AND ACCELERATED LEVEL FLIGHT

Implement the following tasks
1. Simulation of steady flight
2. Simulation of accelerated level flight at various altitudes

Week-2 SIMULATION OF UNACCELERATED AND ACCELERATED CLIMB

Implement the following tasks
1. Simulation of steady climb
2. Simulation of accelerated climb at various climb rates

Week-3 SIMULATION OF UNACCELERATED AND ACCELERATED DESCENT

Implement the following tasks
1. Simulation of steady descent
2. Simulation of accelerated descent at various descent rates

Week-4 SIMULATION OF TAKE-OFF PERFORMANCE

Implement the following tasks
1 Estimation of takeoff velocity for Cessna flight.

Week-5 SIMULATION OF LANDING PERFORMANCE

Implement the following tasks
1. Estimation of ground roll distance for Cessna flight
2. Estimation of total landing distance for Cessna flight

Week-6 SIMULATION OF CONVENTIONAL FLIGHT PATH

Implement the following tasks
1. Perform the given mission profiles

Week-7 STABILIZATION OF LONGITUDINAL PERTURBED AIRCRAFT

Implement the following tasks
1. Perform the operation from disturbed flight to trim flight
2. Perform long period and short period modes.

Week-8	STABILIZATION OF LATERAL PERTURBED AIRCRAFT
Implement the following tasks 1. Perform the operation from disturbed flight to trim flight 2. Simulate lateral directional modes.	
Week-9	**SIMULATION OF SPIN RECOVRY**
Implement the following tasks 1. Perform the operation of spin recovery	
Week-10	**SIMUILATION OF COORDINATED LEVEL TURN**
Implement the following tasks 1. Perform the level turn at given turn rate. 2. Perform the level turn at given turn radius.	
Week-11	**SIMUILATION OF BARREL ROLL MANEUVER**
Implement the following tasks 1. Perform the barrel roll maneuver	
Week-12	**SIMULATION OF A COMPLEX FLIGHT PATH**
Implement the following tasks 1. Perform flight simulation for given mission profiles	

Reference Books:

1. Peter John Davison. "A summary of studies conducted on the effect of motion in flight simulator pilot training".
2. Beard, Steven; et al. "Space Shuttle Landing and Rollout Training at the Vertical Motion Simulator" (PDF). AIAA. Retrieved 5 February 2014.

Web References:

1. www.helijah.free.fr/dev/Principles-of-Flight-Simulation.pdf/
2. www.faa.gov/news/safety_briefing/2012/media/SepOct2012ATD.pdf
3. www.aerosociety.com/Assets/Docs/Publications/DiscussionPapers/The_impact_of_flight_simulation_in_aerospace.pdf

Course Home Page:

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: MAT Lab
HARDWARE: 30 numbers of Desktop Computers with 4 GB RAM

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S.No	Details of Equipment	Quantity Required
1	Flight simulator	1
2	Live shares	18

SPACE PROPULSION

VI Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE012	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Evaluate various space missions, parameters to be considered for designing trajectories and rocket mission profiles

II. Understand the fundamentals of chemical rocket propulsion, types of igniters and performance considerations of rockets.

III. Discuss the working principle of solid and liquid propellant rockets and gain basic knowledge of hybrid rocket propulsion.

IV. Illustrate electric propulsion techniques, ion and nuclear rocket and the performances of different advanced propulsion systems.

UNIT-I	**PRINCIPLES OF ROCKET PROPULSION**	**Classes: 09**

History of rockets, Newtons third law, orbits and space flight, types of orbits, basic orbital equations, elliptical transfer orbits, launch trajectories, the velocity increment needed for launch, the thermal rocket engine, concepts of vertical takeoff and landing, SSTO and TSTO, launch assists.

UNIT-II	**FUNDAMENTALS OF ROCKET PROPULSION**	**Classes: 09**

Operating principle, Rocket equation, Specific impulse of a rocket, internal ballistics, Rocket nozzle classification, Rocket performance considerations of rockets, types of igniters, preliminary concepts in nozzle less propulsion, air augmented rockets, pulse rocket motors, static testing of rockets and instrumentation, safety considerations.

UNIT-III	**SOLID ROCKET PROPULSION**	**Classes: 09**

Salient features of solid propellant rockets, selection criteria of solid propellants, estimation of solid propellant adiabatic flame temperature, propellant grain design considerations.

Erosive burning in solid propellant rockets, combustion instability, strand burner and T-burner, applications and advantages of solid propellant rockets.

UNIT-IV	**LIQUID AND HYBRID ROCKET PROPULSION**	**Classes: 09**

Salient features of liquid propellant rockets, selection of liquid propellants, various feed systems and injectors for liquid propellant rockets, thrust control cooling in liquid propellant rockets and the associated heat transfer problems, combustion instability in liquid propellant rockets, peculiar problems associated with operation of cryogenic engines, introduction to hybrid rocket propulsion, standard and reverse hybrid systems, combustion mechanism in hybrid propellant rockets, applications and limitations.

UNIT-V	**ADVANCED PROPULSION TECHNIQUES**	**Classes: 09**

Electric rocket propulsion, types of electric propulsion techniques, Ion propulsion, Nuclear rocket, comparison of performance of these propulsion systems with chemical rocket propulsion systems, future applications of electric propulsion systems, Solar sail.

Text Books:

1. Hill, P.G. and Peterson, C.R., "Mechanics and Thermodynamics of Propulsion", 2nd Edition, Addison Wesley, 1992.
2. Turner, M.J.L., "Rocket and Spacecraft Propulsion", 2nd Edition, MIT Press, 1922.
3. Hieter and Pratt, "Hypersonic Air breathing propulsion" 5th Edition, 1993.

Reference Books:

1. Sutton, G.P., "Rocket Propulison Elements" John Wiley & Sons Inc., New York, 5th Edition, 1993.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.
3. Tajmar, M., Advanced Space Propulsion Systems, Springer 2003.

Web References:

1. https://nptel.ac.in/courses/101106033/
2. https://nptel.ac.in/courses/112106073/
3. https://www.coursera.org/specializations/propulsion

E-Text Books:

1. https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems
2. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118806778.html
3. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118307984.html
4. https://as.wiley.com/WileyCDA/WileyTitle/productCd-0470824972.html

Course Home Page:

COMPUTATIONAL AERODYNAMICS

<table>
<tr><td colspan="9">VI Semester: AE</td></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">AAE013</td><td rowspan="2">Core</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 45</td><td>Tutorial Classes: 15</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 60</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Discuss the fundamental aspects of numerical discretization and the major theories, approaches and methodologies used in computational aerodynamics.

II. Analyze to build up the skills in the actual implementation of computational aerodynamics methods boundary conditions, turbulence modeling etc by using commercial CFD codes.

III. Demonstrate the applications of CFD for classic fluid dynamics problems and basic thoughts and philosophy associated with CFD.

IV. Understand the various grids used in practice, including some recommendations related to grid quality and choose appropriate data structure to solve problems in real world.

UNIT-I	INTRODUCTION TO COMPUTATIONAL AERODYNAMICS	Classes: 09

Need of computational fluid dynamics, philosophy of CFD, CFD as a research tool as a design tool, applications in various branches of engineering, models of fluid flow finite control volume, infinitesimal fluid element, substantial derivative physical meaning of divergence of velocity, derivation of continuity, momentum and energy equations, physical boundary conditions significance of conservation and non-conservation forms and their implication on CFD applications strong and weak conservation forms shock capturing and shock fitting approaches.

UNIT-II	MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS AND THEIR IMPACT ON COMPUTATIONAL AERODYNAMICS	Classes: 09

Classification of quasi-linear partial differential equations by Cramer's rule and Eigen value method, general behavior of different classes of partial differential equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations: domain of dependence and range of influence for hyperbolic equations, well-posed problems.

UNIT-III	BASIC ASPECTS OF DISCRETIZATION	Classes: 09

Introduction to finite difference: finite difference approximation for first order, second order and mixed derivatives, explicit and implicit approaches, truncation and round-off errors, consistency, stability, accuracy, convergence, efficiency of numerical solutions. Von Neumann stability analysis, physical significance of CFL stability condition.

Need for grid generation, structured grids artesian grids, stretched (compressed) grids, body fitted structured grids, H-mesh, C-mesh, O-mesh, I-mesh, multi-block grids, C-H mesh, H-O-H mesh, overset grids, adaptive grids, unstructured grids: triangular, tetrahedral cells, hybrid grids, quadrilateral, hexahedral cells.

UNIT-IV	CFD TECHNIQUES	Classes: 09
Lax-Wendroff technique, MacCormack's technique, Crank Nicholson technique, Relaxation technique, aspects of numerical dissipation and dispersion. Alternating-Direction-Implicit (ADI) Technique, pressure correction technique: application to incompressible viscous flow, need for staggered grid. Philosophy of pressure correction method, pressure correction formula. Numerical procedures: SIMPLE, SIMPLER, SIMPLEC and PISO algorithms, boundary conditions for the pressure correction method.		
UNIT-V	**FINITE VOLUME METHODS**	**Classes: 09**
Basis of finite volume method, conditions on the finite volume selections, cell-centered and cell vertex approaches. Definition of finite volume discretization, general formulation of a numerical scheme, two dimensional finite volume method with example.		

Text Books:

1. J. D. Anderson, Jr., "Computational Fluid Dynamics- The Basics with Applications", McGraw-Hill Inc, 2012.
2. D. A.Anderson, J.C.Tannehill, R.H. Pletcher, "Computational Fluid Mechanics and Heat Transfer", 1st Edition, 1997.

Reference Books:

1. Hirsch, C., "Numerical Computation of Internal and External Flows: The Fundamentals of Computational Fluid Dynamics", Vol. I, Butter worth-Heinemann, 2nd Edition, 2007.
2. Hoffmann, K. A. and Chiang, S. T., "Computational Fluid Dynamics for Engineers", Engineering Education Systems, 4th Edition, 2000.
3. Patankar, S.V., "Numerical Heat Transfer and Fluid Flow", Hemisphere Pub. Corporation, 1st Edition, 1980.

Web References:

1. https://www.mathematik.uni-dortmund.de/~kuzmin/cfdintro/lecture1.pdf
2. https://bookboon.com/en/computational-fluid-dynamics-ebook
3. https://www.sciencedirect.com/science/book/9780080445069
4. https://cg.informatik.uni-freiburg.de/course_notes/cfd.pdf

E-Text Books:

1. https://www.leka.lt/sites/default/files/dokumentai/computational-fluid-dynamics.pdf
2. https://www.topajka-shaw.co.nz/UCFD.htm
3. https://www.grc.nasa.gov/WWW/wind/valid/tutorial/tutorial.html
4. https://www.scribd.com/doc/311680146/eBook-PDF-Cfd-Fluent

Course Home Page:

AIRCRAFT STABILITY AND CONTROL

VI Semester: AERO								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE014	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Illustrate concept of stability and application to dynamic systems like Aircraft, and the role of primary controls and secondary controls in longitudinal stability.
II. Understand the concept of slide slip angle, roll angle and yaw angle their concepts related to lateral-directional stability.
III. Learn about the mathematical modeling of an aircraft in longitudinal, lateral and directional cases.
IV. Estimate the longitudinal and directional parameters with the help of the linearzed equations of aircraft motion.
V. Analyze the different type of modes in longitudinal, lateral and directional motion of aircraft, and recovery from those modes.

UNIT-I	INTRODUCTION AND LONGITUDINAL STABILITY-I	Classes: 10

Aircraft axes system, Definition: Equilibrium, stability, controllability, & maneuverability. Examples from simple mechanical systems for stability. Longitudinal static stability and dynamic stability for un accelerated flight. Criteria for longitudinal static stability and trim condition. Contribution of Principle components. Equations of equilibrium- stick fixed neutral point, elevator angle required to trim. Definition-static margin. Equations of motion in steady, symmetric pull-up maneuver, elevator effectiveness, elevator hinge moment, neutral point, maneuver point, static margin for stick fixed and stick free conditions, control force and control gradient. Trim tabs and types of trim tabs, Aerodynamic and mass balancing of control surfaces, forward and aft most limits of CG.

UNIT-II	LATERAL-DIRECTIONAL STATIC STABILITY	Classes: 09

Introduction to lateral-direction stability- aerodynamic forces and moments, aircraft side force due to side slip, aircraft rolling moment due to side slip, and aircraft yawing moment due to side slip. Aircraft component contribution, directional static stability, Aircraft component contribution for lateral-directional stability, rudder requirements.

UNIT-III	AIRCRAFT EQUATION OF MOTION	Classes: 10

Description of motion of Flight vehicle - systems of reference frames - earth, body, wind, stability axes - relative merits. Euler angles, angles of attack and sideslip– definitions- earth to body axis transformation, stability axis to body axis transformation. Rotating axis system- expressions for linear and angular moment of rigid body, time derivatives-inertia tensor, components of linear and angular velocities, accelerations.

Components of aerodynamic, gravity forces, moments applied on flight vehicle. Equations of motion- longitudinal and lateral-directional. Relation between angular velocity components and Euler angle rates. Determination of velocities of airplane in earth axis system.

UNIT-IV	LINEARIZATION OF EQUATIONS OF MOTION AND AERODYNAMIC FORCES AND MOMENTS DERIVATIVES	Classes: 09
Description of state of motion of vehicle, forces and moments as perturbations over prescribed reference flight condition. Equation of motion in perturbation variables. Assumption of small perturbations, first order approximations-linearization equations of motion. Linearised of force and moment equation, of motion Linearised longitudinal and lateral-directional equations of perturbed motion. Significance of aerodynamic derivatives. Derivatives of axial, normal force components and pitching moment with respect to the velocity, angle of attack, angle of attack rate, pitch rate, elevator angle.		
UNIT-V	**AIRCRAFT DYNAMIC STABILITY**	**Classes: 07**
Principle modes of motion characteristics, mode shapes and significance, time constant, undamped natural frequency and damping ratio- mode shapes- significance. One degree of freedom, two degree of freedom approximations- constant speed (short period), constant angle of attack (long period) approximations- solutions. Determination of longitudinal and lateral stability from coefficients of characteristic equation- stability and lateral stability from coefficients of characteristics equation- stability criteria, Aircraft spin- entry, balance of forces in steady spin, recovery, pilot techniques.		

Text Books:

1. Yechout, T.R.etal., "Introduction to Aircraft Flight Mechanics", AIAA Education Series, 2003, ISBN 1-56347-577-4.
2. Nelson, R.C., "Flight Stability and Automatic Control", Tata McGraw Hill, 2nd Edition 2007, ISBN 0-07-066110-3
3. Etkin, B and Reid, L.D., "Dynamics of Flight", John Wiley, 3rd Edition 1998, ISBN0-47103418-5.

Reference Books:

1. Schmidt, L.V., "Introduction to Aircraft Flight Dynamics", AIAA Education Series, 1st Edition, 1998, ISBN A-56347-226-0.
2. McCormick, B.W., "Aerodynamics, Aeronautics, and Flight Mechanics", Wiley India, 2nd Edition, 1995, ISBN 97.

Web References:

1. www.scribd.com/book/282507871/Performance-and-Stability-of-Aircraft
2. www.nptel.ac.in/courses/101106043/
3. www.nptel.ac.in/courses/101106042/
4. www.scribd.com/document/174035182/Flight-mechanics

E-Text Books:

1. www.csobeech.com/files/AirplanePerformanceStabilityandControl.pdf
2. www.books.google.co.in/books?isbn=1600860788

Course Home Page:

IDEATION AND PRODUCT DEVELOPMENT

VI Semester: Common for all branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE201	Skill	L	T	P	C	CIA	SEE	Total
		0	0	2	1	30	70	100
Contact Classes:	Tutorial Classes:	Practical Classes: 28				Total Classes: 28		

OBJECTIVES:

The course should enable the students:

- **I.** To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- **II.** To understand about the future needs of industries.
- **III.** To transform innovative ideas into successful businesses.
- **IV.** To use a range of creative thinking tools to develop Out of the Box Ideas.
- **V.** To develop Breakthrough Innovators and Dynamic Thinkers.

Syllabus

- Successful team formation and management
- Introduction to user-centred design
- Ideation and use of personas and POVs
- Need finding
- Embedded Microcontrollers for consumer products
- Human factors in engineering design
- Critical Experience and Critical Function Prototyping
- Dark Horse and 'Funky' prototyping
- Rapid prototyping and manufacturing
- Design for manufacture
- User testing
- Use of video/electronic media for communication
- Start-ups and entrepreneurship
- Intellectual Property

Text Books:

1. Product Design: Techniques in Reverse engineering & New Product development. K Otto & K Wood. Prentice Hall, 2001. ISBN 0-13-0212271-7 TCD Shelf Mark. HL-236-568.
2. Invention by design: how engineers get from thought to thing, Petroski H. Cambridge, Mass., London, Harvard University Press, 1996. ISBN 0674463676. TCD Shelf Mark. HL-201-280.
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Tim Brown, Harper Business, 2009, ISBN 978-0061766084.
4. Creative Confidence: Unleashing the Creative Potential Within Us All, Tom & David Kelley, Crown Business, 2013, ISBN 978-0385349369.

AEROSPACE PROPULSION LABORATORY

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE108	Core	-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

1. Understand the basics of propulsion, working principles of reciprocating engines, performance estimation based on rotation angles, and components of engine and their functions
2. Knowledge about the operation of valves, ports and their functioning in four stroke and two stroke engines.
3. Calculation of percentage of carbon residue and flash and fire point temperatures of a Lubricating Oil.
4. Understand the basic characteristics and range of performance of axial flow gas turbine. Perform parametric jet engine performance analysis and turbo machinery and basic combustion calculations.

LIST OF EXPERIMENTS

Week-1 ENGINE DISASSEMBLY AND ASSEMBLY

a) To understand the working mechanism and identifying various components to build an IC engine.
b) Brief description about Components of engine and their functions.

Week-2 FLASH POINT AND FIRE POINT TEST

Determination of flash point and fire point for a sample using pen sky martin's test.

Week-3 DETERMINATION OF DYNAMIC VISCOSITY OF A GIVEN SAMPLE USING REDWOOD VISCOMETER

a) Determine kinematic viscosity and dynamic viscosity of given sample using a viscometer.
b) Order fluctuating temperature is measured in terms of viscosity

Week-4 MECHANICAL EFFICIENCY OF AXIAL COMPRESSOR

Calculation of the Mechanical efficiency of axial compressor- power required, power Available, Compression Ratio.

c)

Week-5 GAS TURBINE PARAMETERS CALCULATION

Calculation of work, power and Thrust requirement in gas turbine- combustion power input, work heat relationship.

Week-6 GAS TURBINE EFFICIENCY AND PERFORMANCE DIAGRAMS

Elucidate T-S, H-S diagrams for the gas turbine and compare efficiencies of non-ideal engine components.

Week-7 GAS TURBINE EFFICIENCY CALCULATIONS

Calculation of thermal, propulsive and overall efficiency of turbo jet cycle.

Week-8	**WORK OUTPUT OF AXIAL TURBINE**
Calculation of total work output of axial turbine- out put work necessary, Available output.	
Week-9	**NOZZEL PERFORMECE**
Calculation of various nozzle performance with airflow	
Week-10	**CALORIFIC VALUE OF DIFFERENT FUELS**
Calculation of calorific value of different fuels and materials using digital bomb calorimeter and optimizing astute fuels	
Week-11	**FREE AND FORCED CONVECTION**
Estimation of convection coefficient of air using forced jet or free convection apparatus	
Week-12	**PROPELLER TEST RIG**
Calculation of propeller efficiency and thrust availability using propeller test rig at various blade pitch angles.	

Reference Books:

1. https://www.cast-safety.org/pdf/3_engine_fundamentals.pdf
2. https://en.wikipedia.org/wiki/Reciprocating_engine

Web References:

1. https://www.cast-safety.org/pdf/3_engine_fundamentals.pdf
2. https://en.wikipedia.org/wiki/Reciprocating_engine
3. https://en.wikipedia.org/wiki/Flash_point
4. https://en.wikipedia.org/wiki/Fire_point
5. https://smallengineinformation.com/?page_id=459
6. https://www.youtube.com/watch?v=fApV3AXcAEA
7. https://www.youtube.com/watch?v=ZwxrMtThuBo

Course Home Page:

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S.No	Details of Equipment	Quantity Required
1	Tandem Aircraft Engine	1
2	Flash Point And Fire Point	1
3	Redwood Viscometer	1
4	Bomb colorimeter	1
5	Gas turbine test rig	1
6	Free and forced convection	1
7	Propeller test rig	1
8	Nozzle test rig	1

COMPUTATIONAL AERODYNAMICS LABORATORY

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE109	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Experience in computing aerodynamic problems and understanding flow physics over the objects.
II. Knowledge in estimating flow analysis for different mach numbers.
III. Determining the aerodynamic forces like mainly lift and drag.
IV. Analyze the errors and cause of errors in computational analysis.

LIST OF EXPERIMENTS

Week-1 INTRODUCTION

Introduction to computational aerodynamics, the major theories, approaches and methodologies used in computational aerodynamics. Applications of computational aerodynamics for classical aerodynamic's problems.

Week-2 INTRODUCTION TO GAMBIT

Introduction to gambit, geometry creation, suitable meshing types and boundary conditions.

Week-3 INTRODUCTION TO FLUENT

Introduction to fluent, boundary conditions, solver conditions and post processing results.

Week-4 FLOW OVER A FLAT PLATE

Flow over a flat plate at low Reynolds numbers, observe the boundary layer phenomena, no slip condition and velocity profile inside the boundary layer.

Week-5 FLOW THROUGH PIPE

Flow through pipe at different Reynolds numbers; observe the velocity changes for laminar and turbulent flows.

Week-6 FLOW OVER A CIRCULAR CYLINDER

Flow over a circular cylinder at different Reynolds numbers, observe the properties at separation region and wake region.

Week-7 FLOW OVER A CAMBERED AEROFOIL

Flow over a cambered aerofoil at different velocities, observe flow properties and compare the computation results with experimental results (consider the model from aerodynamics laboratory).

Week-8 FLOW OVER A SYMMETRIC AEROFOIL

Flow over a symmetric aerofoil at different velocities, observe flow properties and compare the computation results with experimental results (consider the model from aerodynamics laboratory).

Week-9	FLOW OVER WEDGE
Flow over wedge body at supersonic mach number; observe the shock wave phenomena and change of properties across the shock wave.	
Week-10	**FLOW OVER A CONE**
Flow over a cone at supersonic mach number; observe the shock waves and 3D relieving effect.	
Week-11	**CODE DEVELOPEMENT**
Solution for the following equations using finite difference method I. One dimensional wave equation using explicit method of lax. II. One dimensional heat conduction equation using explicit method.	
Week-12	**CODE DEVELOPEMENT**
Generation of the following grids I. Algebraic grids. II. Elliptic grids.	

Reference Books:

1. Anderson, J.D., Jr., Computational Fluid Dynamics The Basics with Applications, McGraw-Hill Inc, 1st Edition 1998.
2. Hoffmann, K. A. and Chiang, S. T., "Computational Fluid Dynamics for Engineers", 4th Edition, Engineering Education Systems (2000).
3. Hirsch, C., "Numerical Computation of Internal and External Flows: The Fundamentals of Computational Fluid Dynamics", Vol. I, 2nd Edition., Butterworth-Heinemann (2007).
4. JAF. Thompson, Bharat K. Soni, Nigel P. Weatherill "Grid generation", 1st Edition 2000.

Web References:

1. https://www.scribd.com/doc/311680146/eBook-PDF-Cfd-Fluent.
2. https://cfd.ninja/tutorials/ansys-fluent
3. https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules

Course Home Page:

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:

SOFTWARE: ANSYS 16

HARDWARE: Desktop Computers with 4 GB RAM 36 nos

COMPUTER AIDED MANUFACTURING LABORATORY

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE110	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Gain knowledge about software equipment, tools and machines associated with computer aided manufacturing.
II. Execute simple operations using computer numerical control codes.
III. Identify parameters and tools suitable for manufacturing a component on computer numerical control machines
IV. Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system

LIST OF EXPERIMENTS

Week	Experiment
Week-1	SIMULATION OF SIMPLE STEP TURNING AND FACING USING CNC MACHINE
To write the manual part program as per given dimensions for step turning and facing operations and simulate	
Week-2	MACHINING OF SIMPLE STEP TURNING AND FACING USING CNC MACHINE
To execute step turning and facing operations using the codes on CNC lathe	
Week-3	SIMULATION OF TAPPER TURNING AND CHAMFERING USING CNC MACHINE
To write the manual part program as per given dimensions for taper turning and chamfering operations and simulate	
Week-4	MACHINING OF TAPPER TURNING AND CHAMFERING USING CNC MACHINE
To execute taper turning and chamfering operations using the codes on CNC lathe	
Week-5	SIMULATION OF SIMPLE TURNING, CHAMFERING AND FILLET USING CNC MACHINE
To write the manual part program to the given dimensions for simple turning, chamfering and fillet operations and simulate	
Week-6	MACHINING OF SIMPLE TURNING, CHAMFERING AND FILLET USING CNC MACHINE
To execute simple turning, chamfering and fillet operations using the codes on CNC lathe	
Week-7	SIMULATION OF SIMPLE TURNING AND THREADING CYCLE USING CNC MACHINE
To write the manual part program to the given dimensions for simple turning and threading operations and simulate	
Week-8	MACHINING OF SIMPLE TURNING AND THREADING CYCLE USING CNC MACHINE
To execute simple turning and threading operations using the codes on CNC lathe	

Week-9	SIMULATION OF CONTOUR MILLING USING VMC MACHINE
To write the manual part program to the given dimensions for contour milling operations and simulate	
Week-10	**MACHINING OF CONTOUR MILLING USING VMC MACHINE**
To execute contour milling operations using the codes on CNC lathe	
Week-11	**SIMULATION OF DRILLING AND REAMING USING CNC MACHINE**
To write the manual part program to the given dimensions and execute contour milling operations in CNC	
Week-12	**MACHINING OF DRILLING AND REAMING USING CNC MACHINE**
To execute drilling and reaming operations using the codes on CNC	

Reference Books:

1. Computer Aided Manufacturing by T.K.Kundra., Tata McGraw-Hill Education, 13th Softcover Reprint 2008.
2. Lalit Narayan, "Computer Aided Design and Manufacturing ", Prentice-HallIndia Learning Private Limited (2008).

Web References:

1. https://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf
2. https://www.engr.uvic.ca/~mech410/CAM_references/CNC_Computer_Numerical_Control_Programmig_Basics.pdf
3. https://www.cnccookbook.com/CCCNCGCodeCourse.htm

Course Home Page:

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 36 STUDENTS:

S.No	Details of Equipment	Quantity Required
1	CNC Lathe Machine	1
2	CNC Vertical Machining centre	1

AEROSPACE STRUCTURAL DYNAMICS

VII SEMESTER: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE015	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Demonstrate the knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
II. Understand to identify, formulate and solve engineering problems. This will be accomplished by having students model, analyze and modify a vibratory structure order to achieve specified requirements.
III. Introduce to structural vibrations which may affect safety and reliability of engineering systems.
IV. Describe structural dynamic and steady and unsteady aerodynamics aspects of airframe and its components of space structures.

UNIT-I	SINGLE-DEGREE-OF-FREEDOM LINEAR SYSTEMS	Classes: 10

Introduction to theory of vibration, equation of motion, free vibration, response to harmonic excitation, response to an impulsive excitation, response to a step excitation, response to periodic excitation (Fourier series), response to a periodic excitation (Fourier transform), Laplace transform (Transfer Function).

UNIT-II	MULTI-DEGREE-OF-FREEDOM LINEAR SYSTEMS	Classes: 10

Equations of motion, free vibration, the Eigen value problem, response to an external applied load, damping effect; Modeling of continuous systems as multi-degree-of-freedom systems, using Newtons second law to derive equations of motion, influence coefficients - stiffness influence coefficients, flexibility influence coefficients, inertia influence coefficients; potential and kinetic energy expressions in matrix form, generalized coordinates and generalized forces, Lagrange's equations to derive equations of motion, equations of motion of undamped systems in matrix form, eigenvalue problem, solution of the Eigen value problem, expansion theorem, unrestrained systems, free vibration of undamped systems; forced vibration of undamped systems using modal analysis, forced vibration of viscously damped systems.

UNIT-III	NONLINEAR AND RANDOM VIBRATION	Classes: 08

Introduction to nonlinear vibrations, simple examples of nonlinear systems, physical properties of nonlinear systems, solutions of the equation of motion of a single-degree-of-freedom nonlinear system, multi-degree-of-freedom nonlinear systems.

Introduction to random vibrations; classification of random processes, probability distribution and density functions, description of the mean values in terms of the probability density function, properties of the autocorrelation function, power spectral density function, properties of the power spectral density function, white noise and narrow and large bandwidth, single-degree-of-freedom response, response to a white noise.

UNIT-IV	DYNAMICS OF CONTINUOUS ELASTIC BODIES	Classes: 09
Introduction, transverse vibration of a string or cable, longitudinal vibration of a bar or rod, torsional vibration of shaft or rod, lateral vibration of beams, the Rayleigh-Ritz method.		
UNIT-V	**INTRODUCTION TO AEROELASTICITY**	**Classes: 08**
Collar's aeroelastic triangle, static aeroelasticity phenomena, dynamic aeroelasticity phenomena, aeroelastic problems at transonic speeds, aeroelastic tailoring, active flutter suppression. Effect of aeroelasticity in flight vehicle design.		

Text Books:

1. Bismarck-Nasr, M.N., "Structural Dynamics in Aeronautical Engineering", AIAA Education Series, 2nd Edition, 1999.
2. Rao, S.S., "Mechanical Vibrations", Prentice-Hall, 5th Edition, 2011.
3. Thomson, W.T., "Theory of vibrations with applications", CBS Publishers, , Delhi, 3rd Edition, 2002.

Reference Books:

1. R.L. Bisplinghoff, H.Ashley, and R.L. Halfmann, "Aeroelasticity", Addison Wesley Publishing Co., Inc., 2nd Edition, 1996.
2. Leissa, A.W., Vibration of continuous system, The McGraw-Hill Company, 2nd Edition, 2011.
3. Inman, D.J., Vibration Engineering, Prentice Hall Int., Inc., 3rd Edition, 2001.

Web References:

1. http://ase.sbu.ac.ir/FA/Staff/abbasrahi/Lists/Dars/Attachments/11/Vibrations%20of%20Continuous%20Systems.pdf
2. http://arc-test.aiaa.org/doi/book/10.2514/4.862458
3. http://arc-test.aiaa.org/doi/abs/10.2514/5.9781600862373.0719.0728

E-Text Books:

1. http://www.gregorypaulblog.com/structural-dynamics-in-aeronautical-engineering-aiaa-education-series.pdf
2. https://aerocastle.files.wordpress.com/2012/10/mechanical_vibrations_5th-edition_s-s-rao.pdf

Course Home Page:

SPACE MECHANICS

VII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE016	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in two-body, restricted three-body and n-body problem, Hamiltonian dynamics, canonical transformations, Poincare surface sections.
II. Analyze the basic Newtonian dynamics and spacecraft altitude dynamics.
III. Provide necessary knowledge to study the satellite and interplanetary trajectories and Formal approaches for handling coordinate transformations.
IV. Solve the orbital problems related to Earth satellite orbits using Hamilton's and generate interplanetary orbits in the frame work of restricted three-body problem.

UNIT-I	**INTRODUCTION TO SPACE MECHANICS**	**Classes: 10**

Basic concepts: The solar system, Reference frames and coordinate systems, The celestial sphere, The ecliptic, Motion of vernal equinox, Sidereal time, Solar Time, Standard Time, The earth's atmosphere. The many body problem, Lagrange-Jacobi identity. The circular restricted three body problem, Libration points, Relative Motion in the N-body problem.

UNIT-II	**THE TWO BODY PROBLEM**	**Classes: 09**

Equations of motion-General characteristics of motion for different orbits-Relations between position and time for different orbits, Expansions in elliptic motion, Orbital Elements. Relation between orbital elements and position and velocity: Launch vehicle ascent trajectories, General aspects of satellite injection. Dependence of orbital parameters on in-plane injection parameters, Launch vehicle performances, Orbit deviations due to injection errors.

UNIT-III	**PERTURBED SATELLITE ORBIT**	**Classes: 09**

Special and general perturbations- Cowell's Method, Encke's method. Method of variations of orbital elements, General perturbations approach.

Two-dimensional interplanetary trajectories, Fast interplanetary trajectories, Three dimensional interplanetary trajectories. Launch of interplanetary spacecraft. Trajectory about the target planet.

UNIT-IV	**BALLISTIC MISSILE TRAJECTORIES**	**Classes: 09**

The boost phase, the ballistic phase, Trajectory geometry, optimal flights. Time of flight, Re-entry phase. The position of the impact point, Influence coefficients.

UNIT-V	LOW-THRUST TRAJECTORIES	Classes: 08

Equations of Motion. Constant radial thrust acceleration, Constant tangential thrust (Characteristics of the motion), Linearization of the equations of motion, Performance analysis.

Text Books:

1. J. W. Cornelisse, "Rocket Propulsion and Spaceflight Dynamics", Pitman Publishing, London, 1979.
2. William E. Wiesel, "Spaceflight Dynamics", McGraw-Hill, 3rd Edition, New Delhi, 2010.

Reference Books:

1. Vladimir A. Chobotov, "Orbital Mechanics", AIAA Education Series, USA, 3rd Edition, 2002.
2. Kaplan, Marshall H., "Modern Spacecraft Dynamics and Control", John Wiley & Sons, New York, 1976.
3. Wiesel, William E., "Spaceflight Dynamics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition 2007.
4. David A. Vellado, "Fundamentals of Astrodynamics and Applications", Springer, Germany, 3rd Edition, 2007.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

FLIGHT VEHICLE DESIGN

VII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE017	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic skills involved in weight estimation for aircraft conceptual design process.

II. Illustrate relevant theoretical knowledge, applicable for initial sizing and configuration layout of aircraft.

III. Evaluate basic techniques in literature retrieval and query, also creative and have systematic scientific research methods and working abilities

UNIT-I	**OVERVIEW OF THE DESIGN PROCESS**	**Classes: 10**

Phases of aircraft design, aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, integrated product development and aircraft design.

initial conceptual sketches, takeoff gross weight estimation, airfoil selection, airfoil design, airfoil design considerations, wing geometry and wing vertical location, wing tip shapes, tail geometry and arrangements, thrust to weight ratio, thrust matching, wing loading performance, constraint analysis.

UNIT-II	**INITIAL SIZING AND CONFIGURATION LAYOUT**	**Classes: 09**

Sizing with fixed engine and with rubber engine. geometry sizing of fuselage, wing, tail, control surfaces, development of configuration lay out from conceptual sketch. the inboard profile drawing, lofting-definition, significance and methods, flat wrap lofting, special consideration in configuration lay out, Isobar tailoring, Sears-Haack volume distribution, structural load paths, radar, IR, visual detectability, aural signature, considerations of vulnerability, crashworthiness, producibility, maintainability, fuselage design, crew station, passengers and payload

UNIT-III	**PROPULSION, FUEL SYSTEM INTEGRATION, LANDING GEAR AND BASELINE DESIGN ANALYSIS - I**	**Classes: 10**

Propulsion selection, jet engine integration, propeller engine integration, engine design considerations, engine size estimation, fuel system design and integration, landing gear and sub systems arrangements, guidelines and significance of design layout, report of initial specifications.

Estimation of lift curve slope, maximum lift coefficient, complete drag build up, installed performance of an engine, installed thrust methodology, net propulsive force, part power operation, aircraft structures and loads categories, air load distribution on lifting surfaces, review of methods of structural analysis, material selection, weights and moments statistical group estimation method, centre of gravity excursion control.

UNIT-IV	**BASELINE DESIGN ANALYSIS - II**	**Classes: 09**

Estimation of static pitch stability, velocity stability and trim, estimation of stability and control derivatives, static lateral, directional stability and trim. estimation of aircraft dynamical characteristics, handling qualities, Cooper – Harper scale, relation to aircraft dynamic characteristics, performance analysis and constraint analysis– steady level flight, minimum thrust required for level flight, range and loiter endurance, steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb, level turning flight, gliding flight, energy maneuverability methods of optimal climb trajectories and turns, the aircraft operating envelope, take off analysis, balanced field length, landing analysis, fighter performance measures of merit, effects of wind on aircraft performance, initial technical report of baseline design analysis and evaluation, refined baseline design and report of specifications.

UNIT-V	COST ESTIMATION, PARAMETRIC ANALYSIS, OPTIMISATION, REFINED SIZING AND TRADE STUDIES	Classes: 07

Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, cost measures of merit, aircraft and airline economics, DOC and IOC, airline revenue, breakeven analysis, investment cost analysis, parametric analysis and optimization, improved conceptual sizing methods, sizing matrix plot and carpet plot, trade studies, design trades, requirement trades, growth sensitivities, multivariable design optimization methods, measures of merit, determination of final baseline design configuration, preparation of type specification report.

Case studies on design of DC-3 and Boeing B-707&747; General dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber

Text Books:

1. Daniel P. Raymer, "Aircraft Design: A Conceptual Approach", AIAA Educational Series, USA, 4th Edition, 2006.
2. J. F. Marchman, L. R. Jenkinson, "Aircraft Design Projects for Engineering students", AIAA Publishers, USA, 2003.
3. Ajoy Kumar Kunda , "Aircraft Design", Cambridge University Press, UK, 2010.

Reference Books:

1. E. Torenbeek, "Synthesis of Subsonic Airplane Design", Delft University Press, New York, 1986.
2. E. H Bruhn, "Analysis and Design of Flight Vehicles Structures", Jacobs Publishing House, USA, New Edition, 1973.
3. E. E Scheler, L.G Dunn, "Airplane Structural Analysis and Design", John Wiley & Sons, USA, 1963.
4. D. Howe, "Aircraft conceptual Design Synthesis", John Wiley and Sons Publishers, USA, 2005.

Web References:

1. http://www.arabiceng.com/?page=articles_file_download&id=80
2. http://a.moirier.free.fr/Conception/Bouquins/Torenbeek%20~%20Synthesis%20Of%20Subsonic%20Airplane%20Design.pdf

E-Text Books:

1. http://jntuaerobooks.blogspot.in/p/aero-3-2-books.html
2. https://uta-ir.tdl.org/uta-ir/bitstream/handle/.../WALKER_uta_2502M_12539.pdf
3. https://www.scribd.com/doc/220947115/Analysis-and-Design-of-Flight-Vehicle-Structures-by-E-F-Bruhn-pdf

Course Home Page:

COMPUTATIONAL STRUCTURAL ANALYSIS LABORATORY

VII Semester: AE									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
AAE111	**Core**	-	-	3	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

OBJECTIVES:

The course should enable the students to:

I. Make the student familiar with latest computational techniques and software used for structural analysis.
II. Enable the student get a feeling of how real-life structures behavior for static and dynamics loads.
III. Become familiar with professional and contemporary issues in the design and fabrication.

LIST OF EXPERIMENTS

Week-l	**INTRODUCTION AND BASIC FUCTIONS**
a. Starting up of ANSYS/Nastran b. Description of user interface	
Week-2	**STATIC ANALYSIS: TRUSS AND FRAME STRUCTURES**
a. 2-D truss structures b. 3-D truss structures	
Week-3	**STATIC ANALYSIS: BEAMS**
a. Straight beams b. Tapered beams	
Week-4	**STATIC ANALYSIS: TWO DIMENSIONAL PROBLEMS**
a. 2-D structure with various loadings b. 2-D structures with different materials c. Plate with hole	
Week-5	**DYNAMIC ANALYSIS: MODAL AND TRANSIENT ANALYSES**
a. Modal analysis b. Transient Response (spring-mass system)	
Week-6	**THERMAL ANALYSIS**
a. Bars and beams b. 2D structures	
Week-7	**NON LINEAR ANALYSIS**
a. Nonlinear behavior (Large deflections) b. Nonlinear behavior (Materials)	
Week-8	**HARMONIC RESPONSE ANALYSIS**
a. Random Vibration Analysis of a Deep Simply-Supported Beam b. Harmonic Response of a Spring-Mass System	
Week-9	**ANALYSIS OF AIRCARFT STRUCTURE: WING**

a. Static analysis of Aircraft wing structure b. Modal analysis of aircraft wing structure	
Week-10	**ANALYSIS OF AIRCARFT STRUCTURE:FUSELAGE**
a. Static analysis of Aircraft Semi monoque fuselage structure b. Modal analysis of aircraft Semi monoque fuselage structure	
Week-11	**ANALYSIS OF AIRCARFT STRUCTURE:LANDING GEAR**
a. Static analysis of main landing gear b. Modal analysis of main landing gear	
Week-12	**ANALYSIS OF COMPOSITE STRUCTURES**
a. Static analysis of composite bar and beam b. Static analysis of composite plate	
Reference Books:	
1. Huei-Huang Lee, "Finite Element Simulations with ANSYS Workbench 16", SDC publications, 2nd Edition, 2016. 2. Anderson, William J "MSC/Nastran: Interactive Training Program" Wiley 1st Edition 2015.	
Web Reference:	
http://www.iare.ac.in	
Course Home Page:	
SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS: **SOFTWARE:** ANSYS 16 or MSC Nastran **HARDWARE:** Desktop Computers with 4 GB RAM 36 nos	

FLIGHT VEHICLE DESIGN LABORATORY

<table>
<tr><td colspan="9">VII Semester: AE</td></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">AAE112</td><td rowspan="2">Core</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>3</td><td>2</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: Nil</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: 36</td><td colspan="3">Total Classes: 36</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Draw conceptual sketch of aircrafts based on client requirements such as type, role, payload, mission, aerodynamic & performance requirements.

II. Estimate total takeoff gross weight, thrust-weight ratio, wing loading parameters using data sheets.

III. Develop initial layouts for major components such as fuselage, empennage, landing gears and wings.

LIST OF EXPERIMENTS

Week-1 | OBJECTIVES AND REQUIREMENTS OF THE VEHICLE

Data collection for conceptual sketch from existing aircraft includes :

a. Type, Role, Mission.
b. Payload
c. Aerodynamic & performance requirements.

Week-2 | CONCEPTUAL SKETCH AND WEIGHT ESTIMATION

a. Conceptual sketch of candidate aircraft (3-view).
b. First estimation of gross take-off weight with trade-off studies.

Week-3 | AIRFOIL DESIGN AND CONSTRAINT ANALYSIS

a. Airfoil and wing geometry selection

Week-4 | CONSTRAINT ANALYSIS

a. Determination of Thrust-to-Weight ratio and Wing Loading

Week-5 | INITIAL SIZING-I

a. Rubber engine & fixed engine sizing.

Week-6 | INITIAL SIZING-II

a. Configuration layout, crew station, passengers and payload

Week-7 | PERFORMANCE ESTIMATIONS

a. Performance constraint analysis

Week-8 | LOAD ESTIMATIONS-I

a. Landing gear loads

Week-9	LOAD ESTIMATIONS-II
a. Propulsion system load.	
Week-10	**COST ESTIMATION**
a. Cost estimation and parametric analysis b. Optimization and trade studies	
Week-11	**DESIGN CASE STUDY-I**
a. Design study of DC-3 b. Design study B-747	
Week-12	**DESIGN CASE STUDY-II**
I. Dynamics of F-16 II. Dynamics of SR-71	

REFERENCES:

1. Daniel P. Raymer "Aircraft design a conceptual approach", 5th Edition 1999.

Course Home Page:

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:

SOFTWARE: Microsoft office excel spread sheet, MATLAB, AutoCAD Tool.

HARDWARE: Desktop Computers with 4 GB RAM 36 nos

AEROSPACE STRUCTURAL DYNAMICS LABORATORY

VII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE113	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	3	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic principles of kinematics and the related terminology of machines.
II. Discriminate mobility; enumerate links and joints in the mechanisms.
III. Formulate the concept of analysis of different mechanisms

LIST OF EXPERIMENTS

Week-1	**GOVERNORS**
To study the function of a Governor.	
Week-2	**GYROSCOPE**
To determine the Gyroscope couple.	
Week-3	**STATIC FORCE ANALYSIS**
To draw free body diagram and determine forces under static condition.	
Week-4	**DYNAMIC FORCE ANALYSIS**
To draw free body diagram and determine forces under dynamic condition.	
Week-5	**BALANCING**
To determine balancing forces and reciprocating masses.	
Week-6	**BEARINGS**
To determine the bearing life.	
Week-7	**LONGITUDINAL AND LATERAL VIBRATIONS**
To determine the longitudinal and transfer vibration.	
Week-8	**VIBRATION ANALYSIS OF SHAFT**
To determine critical speed of a shaft.	
Week-9	**MECHANISMS**
To design various mechanism and their inversions.	
Week-10	**DIFFERENTIAL GEAR BOX**
To study automobile differential gear box.	
Week-11	**FREE AND FORCED VIBRATION OF CANTIEVER BEAM**
To study Vibrations in beam Structures	

Week-12	EXAMINATIONS

Reference Books:

1. Joseph E. Shigley, “Theory of Machines and Mechanisms”, Oxford University Press, 4th Edition, 2010.
2. Thomas Bevan, “Theory of Machines”, Pearson, 3rd Edition, 2009.

Web References:

1. nptel.ac.in/courses/112104168/L13.pdf
2. www.compositesworld.com/blog/post/fabrication-methods
3. www.ae.iitkgp.ernet.in/ebooks/chapter3.html
4. www.auif.utcluj.ro/images/VOLUME12_3/10_Chandramohan_Murali_67_71
5. www.kennametal.com/content/dam/kennametal/kennametal/common/Resources/Catalogs-Literature/Industry%20Solutions/Composite_material_machining_guide_Aerospace.pdf
6. home.iitk.ac.in/~mohite/Composite_introduction.pdf

Course Home Page:

LIST OF EQUIPMENTS REQUIRED FOR BATCH OF 36 STUDENTS:

S. No	Equipment Name	Quantity
1	Gyroscope	1
2	Governors	1
3	Differential gear box	1
4	Balancing test rig	1
5	Vibration analysis test rig	1
6	Dividing head	1
7	Demonstration of different models of mechanism	1

FLIGHT CONTROL THEORY

VII Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE018	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Apply stability criteria to determine the stability of an aircraft, and specify the aircraft time-domain and frequency-domain response specifications.
II. Understand Classical control theory in the frequency domain and modern control theory in the state-space are effectively mixed to provide the student with a modern view of systems theory.
III. Design control techniques for aircraft control systems, and study some feedback control applications.
IV. Study the controllability and observability of aerospace systems, and apply the modern control techniques to design enhanced flight control systems.

UNIT-I	INTRODUCTION TO CONTROL SYSTEMS	Classes: 10

Dynamical systems-principal constituents-input, output-process (plant)-block diagram representation. Inputs- control input, noise. Function of controls regulation (hold), tracking (command)-examples. Measure of effectiveness. Sensitivity of output to control input, noise and system parameters- robustness. Deterministic and stochastic control. Control in everyday life. The pervasiveness of control in nature, engineering and societal systems. The importance of study of control system. Need for stable, effective (responsive), robust control system. Modeling of dynamical systems by differential equations-system parameters. Examples from diverse fields. First and second order systems, higher order systems, single input single output systems, and multiple-input multiple-output.

UNIT-II	MATHEMATICAL MODELLING OF DYNAMIC SYSTEMS	Classes: 10

Control system performance- time domain description- output response to control inputs-- impulse and indicial response- characteristic parameters- significance- relation to system parameters- examples- first and second order linear systems, higher order systems. Synthesis of response to arbitrary input functions from impulse and indicial response. Review of Fourier transforms and Laplace transforms- inverse transforms- significance, applications to differential equations. 's' (Laplace) domain description of input-output relations- transfer function representation- system parameters- gain, poles and zeroes. Characteristic equation- significance- examples. Frequency and damping ratio of dominant poles. Relation of transfer functions to impulse response. Partial fraction decomposition of transfer functions-significance.

UNIT-III	STADY STATE RESPONSE ANALYSIS	Classes: 10

System type, steady state error, error constants- overall system stability. Application of feedback in stability augmentation, control augmentation, automatic control-examples. Composition, reduction of block diagrams of complex systems-rules and conventions. Control system components - sensors, transducers, servomotors, actuators, filters-modeling, transfer functions. Single-input single-output systems. Multiple input-multiple output systems, matrix transfer functions-examples. Types of control problems- the problem of analysis, control synthesis, system synthesis- examples- static control of aircraft. Extension to dynamic control. System identification from input output measurements importance. Experimental determination of system transfer functions by frequency response measurements. Example.

Frequency domain description- frequency response- gain and phase shift- significance- representation asymptotic (Bode) plots, polar (Nyquist) plots, frequency transfer functions. Characteristic parameters corner frequencies, resonant frequencies, peak gain, and bandwidth- significance. First and second order systems- extension to higher order systems.		
UNIT-IV	**AIRCRAFT RESPONSE TO CONTROLS**	**Classes: 07**
Approximations to aircraft transfer functions, control surface actuators-review. Response of aircraft to elevator input, Response of aircraft to rudder input and Response of aircraft to aileron input to atmosphere. Need for automatic control. Auto pilots Stability augmentation systems-pitch damper and yaw damper.		
UNIT-V	**FLYING QUALITIES OF AIRCRAFT**	**Classes: 08**
Reversible and irreversible flight control systems. Flying qualities of aircraft-relation to airframe transfer function. Pilot's opinion ratings. Flying quality requirements- pole-zero, frequency response and time-response specifications. Displacement and rate feedback determination of gains conflict with pilot input s resolution-control augmentation systems- Full authority fly-by-wire. Auto Pilot-Normal acceleration, Turn rate, Pitch rate Commands-Applications.		

Text Books:

1. Kuo, B.C., “Automatic Control Systems”, Prentice Hall India, 1992.
2. Stevens, B.L. and Lewis, F.L., “Aircraft Control and Simulation”, John Wiley, 1992.

Reference Books:

1. Mc Lean, D., “Automatic Flight Control Systems”, Prentice Hall, 1990.
2. Bryson, A.E., “Control of Aircraft and Spacecraft”, Princeton University Press, 1994.
3. E H J Pallett, Shawn Coyle “Automatic Flight Control” 4th Edition, 2002.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://www.worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

AVIATION MANAGEMENT

VIII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE019	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand about the history of aviation, major players airline industry, current trends and challenges.
II. Impart the knowledge on airport planning, airport operation and various authorities involved in airport management.
III. Understand and gain the knowledge on the meteorological services, environmental regulation and airport fee, rates and charges.
IV. Gain the indepth knowledge on safety regulation, economic regulation and aviation security.
V. Understand about the air traffic control, air space and navigational aid.

UNIT-I	**INTRODUCTION**	**Classes: 10**

History of Aviation- organization, global , social & ethical environment-history of aviation in India-Major players in Airline industry-Swot Analysis of different Airline companies in India- market potential of Airline industry in India- new airport development plans-current challenges in airline industry- competition in Airline industry- Domestic & International from an Indian perspective

UNIT-II	**AIRPORT INFRASTRUCTURE AND MANAGEMENT**	**Classes: 10**

Airport planning – Terminal planning design & operation -Airport operations – Airport functions-organization structure in an Airline – Airport Authority of India- comparison of global & Indian Airport management- Role of AAI -Airline privatization – Full privatization- Gradual privatization- partial privatization

UNIT-III	**AIR TRANSPORT SERVICES**	**Classes: 09**

Various Airport services- international air transport services – Indian Scenario- An overview of Airport in Delhi, Mumbai, Hyderabad & Bangalore.

The role of private operators- Airport development fees, Rates & Tariffs.

UNIT-IV	**INSTITUTIONAL FRAMEWWORK**	**Classes: 08**

Role of DGCA-Slot allocation -Methodology followed by ATC & DGCA – management of bi-laterals – economic Regulations.

UNIT-V	**CONTROLLING**	**Classes: 08**

Role of air traffic control- airspace & navigational aids- control process – case study in airline industry-Mumbai-Delhi airport privatization-Navi Mumbai airport tendering process- six cases in the airline industry.

Text Books:

1. Graham. a "Managing airports - an International Perspective" butterworth-heinemann, oxford 2001.
2. Wells. a. "Airport Planning and Management, Mcgraw-Hill, London, 4^{th} Edition, 2000.

Reference Books:

1. Alexander t. wells, seth young, "Principles of Airport management", Mcgraw-hill 2003.
2. Richard de neufille, "Airport systems : Planning, Design & Management", Mcgraw-hill London 2007.

Web References:

1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

E-Text Books:

1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition
2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html

Course Home Page:

ADVANCED SOLID MECHANICS

GROUP- I								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE501	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the theory of elasticity including stress strain/displacement and Hooke's law relationships.

II. Analyze solid mechanics problems using classical methods and energy methods.

III. Solve for stresses and deflections of beams under unsymmetrical loading and axisymmetric loading.

IV. Locate the shear center of thin wall beams and obtain stresses and deflections of beams on elastic foundations.

UNIT-I	TRACTION AND STRESSES	Classes: 08

Concept of traction, Cauchy's stress theorem, postulate of Cauchy stress tensor, traction on arbitrary planes, extreme normal and shear traction, octahedral shear stress, and other stress measure – engineering stress.

UNIT-II	AXISYMMETRIC ANALYSIS	Classes: 10

Introduction, thick walled cylinder subjected to internal and external pressures – lame's problem. Stress in composite tubes- shrink fits, sphere with purely radial displacements, stresses due to gravitation, rotating disks of uniform thickness, disks of variable thickness, rotating shafts and cylinders.

UNIT-III	BENDING OF CURVED BEAMS	Classes: 10

Winkler- Bach formula, elasticity solution for: pure bending of curved beams, curved cantilever under end loading.

Beams on elastic foundation, Derivation of the basic governing equation, solution to beam on an elastic foundation subjected to a point load at the center moment at the center, Udl over some length asymmetrically about the center

UNIT-IV	FRACTURE MECHANICS	Classes: 09

Brittle fracture, stress intensity factor, fracture toughness, fracture conditions, fracture modes, plane stress and plane strain, plastic collapse at a notch, experimental determination of K_{IC}, strain-energy release rate, elasto-plastic fracture mechanics, Green's theorem.

UNIT-V	THEORIES OF FAILURE	Classes: 08

Introduction, theories of failure, significance of the theories of failure, use of factor of safety in design, a note on the use of factor of safety, Mohr's theory of failure.

Text Books:

1. L.S. Srinath, “Advanced Mechanics of Solids”, Tata McGraw-hill, New Delhi, 2009.
2. P. Raymond, “Solid Mechanics in Engineering”, Willey, 2001.

Reference Books:

1. M.H. Sadd, “Elasticity: Theory, Applications, and Numerics”, Academic Press, 2nd Edition, 2009.
2. R.G. Budynas, “Advanced Strength and Applied Stress Analysis”, McGraw Hill, 3rd Edition, 1999.
3. A.P. Boresi, R.J. Schmidt, “Advanced Mechanics of Materials”, John Willey & Sons, 6th Edition, 2003.

Web References:

1. nptel.ac.in/courses/105106049/#
2. www.scribd.com/document/328427870/Advanced-Solid-Mechanics-Web-course-pdf
3. www.myopencourses.com/subject/advanced-solid-mechanics-2

E-Text Books:

1. esag.harvard.edu/rice/e0_Solid_Mechanics_94_10.pdf
2. www.brown.edu/Departments/Engineering/Courses/En175/notes.htm
3. web.mit.edu/abeyaratne/Volumes/RCA_Vol_II.pdf

Course Home Page:

EXPERIMENTAL STRESS ANALYSIS

GROUP - I								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE502	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Bring awareness on experimental method of finding the response of the structure to different types of load.

II. Understand the relation between the mechanics theory, experimental stress analysis, and the mechanical, optical, pneumatic and electrical strain gauges for strain measurement.

III. Establish the fundamental concepts and newly experimental techniques and able to use the experimental techniques on the practical problems.

IV. Evaluate and make a fine presentation related to the experimental paper.

UNIT-I	MEASUREMENTS & EXTENSOMETER	Classes: 08

Principles of measurements, accuracy, sensitivity and range of measurements; Mechanical, optical acoustical and electrical extensometers and their uses, advantages and disadvantages.

UNIT-II	ELECTRICAL RESISTANCE STRAIN GAGES	Classes:09

Strain sensitivity in metallic alloys, gage construction, adhesives and mounting techniques, gage sensitivity and gage factor, performance characteristics, environmental effects, strain gage circuits; Potentiometer, wheat stone's bridges, constant current circuits.

UNIT-III	TWO AND THREE DIMENSIONAL PHOTO-ELASTICITY	Classes: 10

Two dimensional photoelasticity; Concepts of light-photo-elastic effects, stress optic law-interpretation of fringe pattern-compensation and separation techniques; Photoelastic materials; Introduction to three dimensional photoelasticity.

Photoelastic (Birefringent) coatings, effects of coating thickness, brittle coatings, types of brittle coatings, advantages and brittle coating applications, crack detection methods and Moire methods: Applications and advantages**.**

UNIT-IV	PHOTO-ELASTICITY	Classes: 10

Nature of light, wave theory of light, optical interference, stress optic law, effect of stressed model in plane and circular polariscopes, isoclinics and isochromatics, fringe order determination fringe multiplication techniques, calibration photoelastic model materials.

UNIT-V	STRAIN ANALYSIS METHODS	Classes: 08
Two element, three element rectangular and delta rosettes, correction for transverse strain effects, stress gauge, plane shear gauge, and stress intensity factor gauge.		

Text Books:

1. Dally and Riley, "Experimental Stress Analysis", McGraw-Hill, New York, 1978.
2. Sadhu Singh, "Experimental Stress Analysis", Khanna Publisher, 4th Edition, 2009.
3. Srinath L.S tata , "Experimental stress Analysis", McGraw-Hill, 3rd Edition, 2012.

Reference Books:

1. M.M.Frocht, John Wiley & sons, "Photoelasticity Vol I and Vol II", McGraw Hill, 2nd Edition, 1969.
2. Perry and Lissner , "Strain Gauge Primer", McGraw Hill, 2nd Edition, 1969.

Web References:

1. www.nptel.ac.in/syllabus/syllabus.php?subjectId=112106068
2. www.textofvideo.nptel.iitm.ac.in/112106068/lec1.pdf

E-Text Books:

1. www.scribd.com/doc/241582542/Experimental-Stress-Analysis-by-Dally-and-Riley-P-1554n
2. www.apm.iitm.ac.in/smlab/kramesh/book_5.htm
3. www.myopencourses.com/subject/experimental-stress-analysis-1
4. https://www.amazon.com/Data-Structures-C-Noel-Kalicharan/dp/1438253273

Course Home Page:

FATIGUE AND FRACTURE MECHANICS

GROUP - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE503	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand S-N curves, notches, stress concentration and factors, fatigue cycles, cumulative damage and Miner's theory.

II. Explain the crack initiation, growth, fracture, stress & strength of cracked bodies, different theories on fracture mechanics.

III. Illustrate safe life & fail safe design applicable aerospace structure.

UNIT-I	FATIGUE OF STRUCTURES	Classes: 10

S.N. curves, endurance limit, effect of mean stress; Goodman, Gerber and Soderberg relations and diagrams; Notches and stress concentrations; Neuber's stress concentration factors; Plastic stress concentration factors, Notched S-N curves.

UNIT-II	STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR	Classes: 10

Low cycle and high cycle fatigue, Coffin-Manson's relation, transition life, Cyclic Strain hardening and softening, analysis of load histories; Cycle counting techniques, cumulative damage, miner's theory and other theories.

UNIT-III	PHYSICAL ASPECTS OF FATIGUE AND FRACTURE MECHANICS	Classes:08

Phase in fatigue life, crack initiation, crack growth. Final fracture, dislocations theories, fatigue fracture surfaces.

Strength of cracked bodies, potential energy and surface energy; Griffith's theory, Irwin and Orwin extension of Griffith's theory to ductile materials

UNIT-IV	FRACTURE MECHANICS	Classes: 08

Stress analysis of cracked bodies; Effect of thickness on fracture toughness; Stress intensity factors for typical geometries.

UNIT-V	FATIGUE DESIGN AND TESTING	Classes: 09

Safe life and fail safe design philosophies; Importance of Fracture Mechanics in aerospace structure; Application to composite materials and structures.

Text Books:

1. W Barrois and L Ripley, "Fatigue of Aircraft Structures", Pergamon Press, Oxford, 1983.
2. D Brock, "Elementary Engineering Fracture Mechanics", Noordhoff International Publishing Co., London, 1994.

Reference Books:

1. C.G.Sih, “Mechanics of Fracture”, Vol.1 Sijthoff and Noordhoff International Publishing Co., Netherland, 1989.
2. J.F.Knott, “Fundamentals of Fracture Mechanics”, Butterworth & Co., (Publishers) Ltd., London, 1983.

Web References:

1. https://www.accessengineeringlibrary.com/browse/elements-of-fracture-mechanics.
2. https://www.eng.ox.ac.uk/solidmech/research/fatigue-fracture-mechanics.
3. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1860583121.html.

E-Text Books:

1. https://en.wikipedia.org/wiki/Fatigue (material).
2. https://ocw.mit.edu/courses/materials-science-and...fracture...fatigue.../lecture-notes.
3. https://www.am.chalmers.se/~anek/teaching/fatfract/kursprogram.pdf

Course Home Page:

DESIGN AND ANALYSIS OF COMPOSITE STRUCTURES

GROUP - I								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE504	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes:	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the fabrication, analysis and design of composite materials & structures.

II. Explain basic composites technology, including materials and processes, manufacturing, structural design, maintenance, proof of structures and other considerations.

III. Identify the static testing procedure and repairing methodology of composite structural members and joints.

IV. Enrich to develop structural designs using composite materials.

UNIT-I	STRESS STRAIN RELATION	Classes: 08

Introduction- Advantages and application of composite materials, reinforcements and matrices; Generalized Hooke's Law; Elastic constants for anisotropic, orthotropic and isotropic materials.

UNIT-II	METHODS OF ANALYSIS	Classes:08

Micro mechanics: Mechanics of materials approach, elasticity approach to determine material properties; Macro Mechanics; Stress-strain relations with respect to natural axis, arbitrary axis; Determination of material properties; Experimental characterization of lamina.

UNIT-III	LAMINATED PLATES, SANDWICH CONSTRUCTIONS AND FABRICATION PROCESS	Classes: 10

Governing differential equation for a general laminate, angle ply and cross ply laminates; Failure criteria for composites.

Basic design concepts of sandwich construction ; Materials used for sandwich construction ; Failure modes of sandwich panels; Various open and closed mould processes; Manufacture of fibers; Types of resins and properties and applications; Netting analysis.

UNIT-IV	DAMAGE TOLERANCE IN COMPOSITES	Classes: 09

Introduction, sources of damage, types of damage, FAR requirements and advisory circulars, building block approach; Impact damages: Damage growth under fatigue loads; residual strength: Tests and analytical methods; Detailed design: Basics of projections, drawing standards and conventions, introduction to CADD, design of composite parts and assembly design; Optimization: Fundamentals of optimization, mathematical concepts in optimization, Optimization of composite plates.

UNIT-V	TESTING OF COMPOSITE STRUCTURES	Classes: 10

Factors influencing testing, test environment, test methods and standards, introduction to static testing of composite structures and examples; Repair of composite aircraft structures: Introduction to repair, repair philosophy, repair sequence, repair criteria, damage assessment, classification of repair, selection of repair joints, repair procedures, certification of repair.

Text Books:
1. Gibson, R.F, “Principles of Composite Material Mechanics”, CRC Press, 2nd Edition, 2007. 2. Jones, R.M, Taylor & Francis, “Mechanics of Composite Materials”, 2nd Edition, 2010 (Indian Print). 3. Reddy, J.N., “Mechanics of Laminated Composite Plates and Shells – Theory and Analysis”, CRC Press, 2nd Edition, 2004.
Reference Books:
1. Agarwal, B.D., and Broutman, L.J., “Analysis and Performance of Fibre Composites”, John Wiley and sons. Inc., New York, 1995. 2. Lubin, G., “Handbook on Advanced Plastics and Fibre Glass”, Von Nostrand Reinhold Co., New York, 1989. 3. Autar K.Kaw “Mechanics of Composite Materials”, 2nd Edition, CRC Press, 2005.
Web References:
1. www.nptel.ac.in/courses/101104010/ 2. www.freevideolectures.com/Course/94/Prestressed-Concrete-Structures/35 3. www.adturtle.biz/LP_TA/index.cfm?T=436857.
E-Text Books:
1. www.samples.sainsburysebooks.co.uk/9781118536957_sample_413689.pdf 2. www.samples.sainsburysebooks.co.uk/9780470972717_sample_386378.pdf 3. www.safaribooksonline.com/library/view/design-and-analysis/9781118536940/ 4. https://www.amazon.com/Data-Structures-C-Noel-Kalicharan/dp/1438253273**.**
Course Home Page:

AEROELASTICITY

<table>
<tr><td colspan="9">GROUP - I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">AAE505</td><td rowspan="2">Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 45</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 45</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Outline importance of aeroelasticity in flight vehicle design and classify static and dynamic aeroelastic problems.
II. Describe structural dynamic and steady and unsteady aerodynamics aspects of airframe and its components and their role in aeroelasticity.
III. Construct theoretical basis for the solution of static aeroelastic problems an estimate loads and other critical speeds.
IV. Construct theoretical basis for the solution of flutter problems and estimate of flutter speeds.

UNIT-I	AEROELASTIC PHENOMENA	Classes: 08

Stability versus response problems; The aeroelastic triangle of forces; Aero elasticity in aircraft design; Prevention of aero elastic instabilities; Influence and stiffness coefficients; Coupled oscillations.

UNIT-II	DIVERGENCE OF A LIFTING SURFACE	Classes: 10

Simple two dimensional idealizations; Strip theory, integral equation of the second kind exact solutions for simple rectangular wings, ‘Semi rigid’ assumption and approximate solutions; Generalized coordinates, successive approximations, numerical approximations using matrix equations.

UNIT-III	STEADY STATE AEROLASTIC PROBLEMS	Classes: 08

Loss and reversal of aileron control, critical aileron reversal speed, aileron efficiency, semi rigid theory and successive approximations.

Lift distribution, rigid and elastic wings; Tail efficiency, effect of elastic deformation on static longitudinal stability.

UNIT-IV	FLUTTER PHENOMENON	Classes: 10

Non-dimensional parameters, stiffness criteria, dynamic mass balancing, dimensional similarity; Flutter analysis, two dimensional thin airfoils in steady incompressible flow, quasi steady aerodynamic derivatives; Galerkin method for critical flutter speed, stability of disturbed motion, solution of the flutter determinant, methods of determining the critical flutter speeds, flutter prevention and control.

UNIT-V	EXAMPLES OF AEROELASTIC PROBLEMS	Classes: 09

Galloping of transmission lines and Flow induced vibrations of transmission lines, tall slender structures and suspension bridges.

Text Books:

1. Y.C. Fung, “An Introduction to the Theory of Aeroelasticity”, John Wiley & Sons Inc., New York, 2008.
2. E.G. Broadbent, “Elementary Theory of Aeroelasticity”, Bun Hill Publications Ltd., 1986.

Reference Books:

1. R.L. Bisplinghoff, H.Ashley, and R.L. Halfmann, “Aeroelasticity”, Addison Wesley Publishing Co., Inc., 2nd Edition, 1996.
2. R.H. Scanlan and R. Rosenbaum, “Introduction to the study of Aircraft Vibration and Flutter”, Macmillan Co., New York, 1981.

Web References:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://mathworld.wolfram.com/

E-Text Books:

1. https://www.e-booksdirectory.com/details.php?ebook=10166
2. https://www.e-booksdirectory.com/details.php?ebook=7400re

Course Home Page:

UNMANNED AIR VEHICLES

GROUP - I								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE506	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Introduce to the student about the basic ideas of Unmanned Air Vehicles.
II. Familiarize the students about the aerodynamics and airframe configurations.
III. Accustom the student to the wide variety of unmanned air vehicles.
IV. Acquaint the student about the various communication and navigation systems of unmanned air vehicles.

UNIT-I	INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS	Classes: 10

The systemic basis of UAS-system composition; Conceptual phase; Preliminary design; Selection of the system; Some applications of UAS.

UNIT-II	AERODYNAMICS AND AIRFRAME CONFIGURATIONS	Classes: 10

Lift-induced Drag; Parasitic Drag; Rotary-wing aerodynamics; Response to air turbulence; Airframe configurations scale effects; Packaging density ; Aerodynamics; Structures and mechanisms; Selection of power-plants; Modular construction; Ancillary equipment.

UNIT-III	CHARACTERISTICS OF AIRCRAFT TYPES	Classes: 09

Long-endurance, long-range role aircraft; Medium-range, tactical aircraft; Close-range / battlefield aircraft; MUAV types; MAV and NAV types; UCAV; Novel hybrid aircraft configurations; Research UAV.

UNIT-IV	COMMUNICATIONS NAVIGATION	Classes: 08

Communication media; Radio communication; Mid-air collision (MAC) avoidance; communications data rate and bandwidth usage; Antenna Types NAVSTAR Global Positioning System (GPS) - TACAN - LORAN C - Inertial Navigation - Radio Tracking - Way-point Navigation.

UNIT-V	CONTROL AND STABILITY	Classes: 08

HTOL Aircraft - Helicopters - OTE/OTE/SPH - Convertible Rotor Aircraft - Payload Control -Sensors – culmon filter- Autonomy.

Text Books:

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

Reference Books:

1. Milman & Halkias, “Integrated Electronics”, McGraw Hill, 1999.
2. Malvino & Leach, “Digital Principles & Applications”, McGraw Hill, 1986.
3. Collinson R.P.G, “Introduction to Avionics”, Chapman and Hall, India, 1996.

4. Bernad Etikin, "Dynamic of flight stability and control", John Wiley, 1972.
Web References:
1. www.tc.gc.ca/eng/civilaviation/publications/page-6557.html 2. www.dhl.com/en/about_us/logistics_insights/dhl_trend_research/ 3. www.books.google.co.in/books?id=guGVDQAAQBAJ&pg=PT3&lpg=PT3&dq
E-Text Books:
www.ebookstrust.com/9048197066/Ebooks%20Textbooks%20Handbook%20Of%20Unmanned.
Course Home Page:

GROUND VEHICLE AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE507	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the basics of vehicle aerodynamics, history of developments and apply the concepts of fluid mechanics to automobiles.
II. Estimate the drag on ground vehicles and analyze the effects of various configurations of cars on drag.
III. Analyze the stability and handling qualities based of ground vehicles due to side wind loads and dirt accumulation.
IV. Apply the above concepts to race car design and understand various experimental techniques applied in automotive aerodynamics.

UNIT-I	OVERVIEW AND INTRODUCTION	Classes: 10

Historical developments and trends, fundamentals of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, mechanics of air flow around a vehicle, pressure distribution, aerodynamic forces, vehicle drag and types, side and lift forces, performance potential of vehicle aerodynamics.

UNIT-II	AERODYNAMIC DRAG AND SHAPE OPTMIZATION OF CARS	Classes: 10

Cars as a bluff body, flow field around a car, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effect of rear configuration, effect of fasteners

UNIT-III	VEHICLE HANDLING AND STABILITY	Classes: 09

Origin, characteristics and effects of forces and moments on a vehicle, lateral stability problems.

Vehicle dynamics under side winds, dirt accumulation on the vehicle, wind noise: Mechanisms and generation design features, measurement and techniques.

UNIT-IV	RACE CAR AERODYNAMICS	Classes: 08

Basic vehicle body concepts, aerodynamics of the complete vehicle, flow over wheels, sliding seal and skirts, under body channels, simple add on: spoilers, strakes and wickers, internal flow, race car wings, most current examples in detail design.

UNIT-V	MEASUREMENT AND TEST TECHNIQUES	Classes: 08

Wind tunnel scope, fundamental techniques, simulation limitations, prototype tests,
wind tunnel types and testing methods, test techniques: scope, measuring equipment and transducers, road testing methods.

Text Books:
1. Wolf- Heinrich Hucho, "Aerodynamics of Road vehicles", SAE International 1998. 2. Joseph Katz, "Race Car Aerodynamics Designing for Speed", Bentley Publishers, 2nd Edition, 1996.
Reference Books:
1. Alan Pope, "Wind Tunnel Testing", John Wiley & Sons, 2nd Edition, 1974.
Web References:
1. https://www.buildyourownracecar.com/race-car-aerodynamics-basics-and-design/ 2. https://www.ara.bme.hu/oktatas/letolt/Vehicleaerodyn/Vehicleaerodyn.pdf 3. https://auto.howstuffworks.com/fuel-efficiency/fuel-economy/aerodynamics.html 4. https://www.slideshare.net/friendsrtg/vehicle-body-engineering-aerodynamics
E-Text Books:
1. https://dlx.bookzz.org/genesis/1111000/58a5c1c372f8f523a0c58e26c3c531eb/_as/[Wolf-Heinrich_Hucho_(Eds.)]_Aerodynamics_of_Road_(BookZZ.org).pdf 2. https://dlx.bookzz.org/genesis/555000/2c09a10c7a7c0f3deaeeb9ddc4251c26/_as/[Joseph_Katz]_Race_Car_Aerodynamics_Designing_for(BookZZ.org).pdf
Course Home Page:

ADVANCED COMPUTATIONAL AERODYNAMICS

GROUP - II								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE508	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Explain the concept of panel methods, analyze various boundary conditions applied and demonstrate several searching and sorting algorithms.

II. Describe the initial methods applied in the process of CFD tools development their advantages and disadvantages over modern developed methods.

III. Demonstrate different methods evolved in analyzing numerical stability of solutions and evaluate the parameters over which the stability depends and their range of values.

IV. Understand advanced techniques and methods in time marching steps and identify different boundary conditions for different cases in CFD techniques.

UNIT-I	NUMERICAL SOLUTIONS	Classes: 10

Euler equations: Flux approach, Lax-Wendroff method, basic principles of upwind schemes, flux vector splitting, Steger Warming flux vector splitting, Van Leer flux vector splitting, Upwind reconstruction, evolution, Godunov's first order upwind method, Roe's first order upwind method.

UNIT-II	TIME DEPENDENT METHODS	Classes: 10

Stability of solution, explicit methods, FTFS, FTCS, FTBS, Leapfrog method, Lax method. Implicit methods: Euler's FTCS, Crank Nicolson method, description of Lax- Wendroff scheme, McCormack two step predictor-corrector method, description of time split methods, approximate factorization schemes.

UNIT-III	BOUNDARY CONDITIONS	Classes: 09

Boundary Layer Equations: Setting up the boundary layer equations, flat plate boundary layer solution, boundary layer transformations, explicit and implicit discretization, solution of the implicit difference equations, integration of the continuity equation, boundary layer edge and wall shear stress, Keller-box scheme.

Concept of dummy cells, solid wall inviscid flow, viscous flow, farfield concept of characteristic variables, modifications for lifting bodies inlet outlet boundary, injection boundary, symmetry plane, coordinate cut, periodic boundaries, interface between grid blocks, flow gradients at boundaries of unstructured grids.

UNIT-IV	METHOD OF CHARACTERISTICS	Classes: 08

Philosophy of method of characteristics, determination of characteristic lines, two dimensional irrotational flow, determination of compatibility equations, unit processes, supersonic nozzle design by the method of characteristics, supersonic wind tunnel nozzle, minimum length nozzles, domain of dependence and range of influence.

UNIT-V	PANEL METHODS	Classes: 08

Basic formulation, boundary conditions, physical considerations, reduction of a problem to a set of linear algebraic equations, aerodynamic loads, preliminary considerations prior to establishing numerical solution, steps toward constructing a numerical solution, solution of thin airfoil with lumped vortex filament, accounting for effects of compressibility and viscosity.

Text Books:

1. Tannehill John C, Anderson Dale A, Pletcher Richard H, "Computational Fluid Mechanics and Heat Transfer", Taylor & Francis, 2^{nd} Edition, 1997.
2. Chung T G, "Computational Fluid Dynamics", Cambridge University Press, 2^{nd} Edition, 2010.
3. Katz Joseph and Plotkin Allen, "Low-Speed Aerodynamics", Cambridge University Press, 2^{nd} Edition, 2006.

Reference Books:

1. Anderson J D, "Modern Compressible Fluid Flow", McGraw Hill, 2^{nd} Edition, 1990.
2. Anderson J D, "Fundamentals of Aerodynamics", Tata McGraw Hill, 5^{th} Edition, 2010.
3. Anderson J D, "Computational Fluid Dynamics", McGraw Hill, 1995.

Web References:

1. https://s6.aeromech.usyd.edu.au/aerodynamics/index.php/sample-page/subsonic-aerofoil-and-wing-theory/2d-panel-methods/
2. www.wind.civil.aau.dk/lecture/8sem_CFD/Lecture1/Lecture1.pdf
3. personalpages.manchester.ac.uk/staff/david.d.apsley/lectures/comphydr/timedep.pdf

E-Text Books:

1. https://books.google.co.in/books/about/Advanced_Computational_Fluid_and_Aerodyn.html?id=dWS4jgEACAAJ&redir_esc=y.
2. https://www.scribd.com/doc/159468983/Low-Speed-Aerodynamics-Joseph-Katz-Alen-Plotkin
3. https://www.crcpress.com/Computational-Fluid-Mechanics-and-Heat-Transfer-Third-edition/Pletcher-Tannehill-Anderson/p/book/9781591690375.
4. https://www.faadooengineers.com/threads/8482-Computational-Fluid-Dynamics-Ebook-Ppt-Pdf-Download.

Course Home Page:

EXPERIMENTAL AERODYNAMICS

GROUP - II								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE509	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Describe basic fundamentals of Aerodynamics experiments, their need in comparison with numerical computation and theoretical studies.
II. Develop concepts of flow similarity and evaluate the loss coefficients of wind tunnel components.
III. Analyze the concept of force and moment measurements using wind tunnel balance and extrapolate it to new balance development.
IV. Summarize various techniques for pressure, velocity, temperature measurement and flow visualization.

UNIT-I	FUNDAMENTALS OF EXPERIMENTS IN AERODYNAMICS	Classes: 08

Forms of aerodynamic experiments, observations, measurement objectives. History: Wright Brother's wind tunnel, model testing, wind tunnel principles, scaling laws, scale parameters, geometric similarity, kinematic similarity& dynamic similarity. Wind tunnels: low speed tunnel, high speed tunnels, transonic, supersonic and hypersonic tunnels, shock tubes. Special tunnels: low turbulence tunnels, high Reynolds number tunnels, environmental tunnels, automobile tunnels, distinctive features, application.

UNIT-II	WIND TUNNEL EXPERIMENTATION CONSIDERATIONS	Classes: 10

Low speed wind tunnels, principal components. Function, description, design requirements, constraints and loss coefficients. Wind tunnel performance flow quality, power losses, wind tunnel corrections, sources of inaccuracies: buoyancy, solid blockage, wake blockage, streamline curvature causes, estimation and correction.

UNIT-III	WIND TUNNEL BALANCE	Classes: 08

Load measurement: low speed wind tunnel balances, mechanical & Strain gauge types, null displacement methods & strain method, sensitivity, weigh beams, steel yard type and current balance type, balance linkages, levers and pivots.

Model support three point wire support, three point strut support, platform balance, yoke balance, strain gauge, 3-component strain gauge balance, description, application.

UNIT-IV	PRESSURE, VELOCITY & TEMPERATURE MEASUREMETNS	Classes: 11

Pressure: static pressure, surface pressure orifice, static probes, pitot probe for total pressure, static pressure and flow angularity, pressure sensitive paints, steady and unsteady pressure measurement and various types of pressure probes and transducers, errors in pressure measurement. Temperature: measurement of temperature using thermocouples, resistance thermometers, temperature sensitive paints and liquid crystals. Velocity: measurement of airspeed, Mach number from pressure measurements, flow direction, boundary layer profile using pitot static probe, 5 hole probe yaw meter, total head rake, hot wire anemometry, laser doppler anemometry, particle image velocimetry, working principle description of equipment, settings, calibration, measurement, data processing, applications.

UNIT-V	FLOW VISUALIZATION TECHNIQUES	Classes: 08
Flow visualization: necessity, streamlines, streak lines, path lines, time lines, tufts, china clay, oil film, smoke, hydrogen bubble. Optical methods: density and refractive index, schlieren system, convex lenses, concave mirrors, shadowgraph, interferometry, working principle, description, setting up, operation, observation, recording, interpretation of imagery, relative merits and applications.		

Text Books:

1. Jewel B Barlow, William H Rae Jr. & Alan Pope, "Low Speed Wind Tunnel Testing", John Wiley& Sons Inc, Re-Print, 1999.
2. Alan Pope, Kennith L Goin, "High Speed Wind Tunnel Testing", John Wiley & Sons, Reprint, 1965.

Reference Books:

1. Gorlin S M & Slezinger I I, "Wind tunnels & Their Instrumentations", NASA publications, Translated version, 1966.
2. Jorge C Lerner & Ulfilas Boldes, "Wind Tunnels and Experimental Fluid Dynamics Research", InTech, 1st Edition, 2011.
3. Liepmann H W and Roshko A, "Elements of Gas Dynamics", John Wiley & Sons, 4th Edition, 2003.

Web References:

1. https://nptel.ac.in/courses/101106040/
2. https://ocw.metu.edu.tr/course/view.php?id=66
3. https://www.mace.manchester.ac.uk/our-research/research-themes/aerospaceengineering/specialisms/aerodynamics/
4. https://www.ara.co.uk/services/experimental-aerodynamics/
5. https://soliton.ae.gatech.edu/labs/windtunl/

E-Text Books:

1. https://www.scribd.com/doc/221788571/Wind-Tunnel-Testing-Barlow-Rae-Pope
2. https://www.scribd.com/document/84868596/Wind-Tunnelsibooksonline.com/library/view/data-structures-using/9789332524248/

Course Home Page:

HYPERSONIC AERODYNAMICS

GROUP - II								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE510	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**			**Total Classes: 45**			

OBJECTIVES:

The course should enable the students to:

I. Apply the basics of aerodynamics to know the boundary layer and variation of properties at different velocities.

II. Compute aerodynamic forces and moments on different aerodynamic bodies at different conditions.

III. Understand aerodynamic heating for bodies travelling at hypersonic speeds and importance of high entropy layer.

IV. Analyze and appreciate the complementary role of experiments and numerical computations in handling hypersonic flows.

UNIT-I	GENERAL CHARACTERIZATION OF HYPERSONIC FLOWS	Classes: 09

Defining hypersonic flow, characterizing hypersonic flow using fluid dynamic phenomena, basic equations of motion, equilibrium and non-equilibrium flows, equilibrium conditions, dependent variables, transport properties, continuity, momentum and energy equations, general form of the equations of motion in conservation form.

UNIT-II	DEFINING THE AEROTHERMODYNAMIC ENVIRONMENT, EXPERIMENTAL MEASUREMENTS OF HYPERSONIC FLOWS	Classes: 10

Empirical correlations complemented by analytical techniques, general comments about computational fluid dynamics, computations based on a two layer flow model, techniques treating entire shock layer in a unified fashion, calibration and validation of the computational fluid dynamics codes, experimental measurements of hypersonic flows: ground-based simulation of hypersonic flows, ground-based hypersonic facilities, experimental data and model design considerations, flight tests, importance of interrelating computational fluid dynamics, ground test data and flight test data.

UNIT-III	STAGNATION-REGION FLOW FIELD AND PRESSURE DISTRIBUTION	Classes:08

Stagnating streamline, stagnation-point convective heat transfer, radiative heat flux; pressure distribution, Newtonian flow models, departure from the Newtonian flow field.

Shock wave boundary layer (viscous) interaction for two dimensional compression ramps, tangent cone and tangent wedge approximations, need for more sophisticated models, pressure distributions for a reacting gas, pressures in separated regions.

UNIT-IV	BOUNDARY LAYER AND CONVECTIVE HEAT TRANSFER, VISCOUS INTERACTIONS	Classes: 09

Boundary conditions, metricor equivalent cross section radius, convective heat transfer and skin friction, effects of surface catalycity, base heat transfer in separated flow; viscous interactions: compression ramp flows, shock interactions, flow field perturbations around swept fins, corner flows, examples of viscous interactions for hypersonic vehicles: X-15, space shuttle orbiter, hypersonic air-breathing aircraft.

UNIT-V	AERODYNAMIC FORCES AND MOMENTS, AEROTHERMODYNAMICS AND DESIGN CONSIDERATIONS OF HYPERSONIC VEHICLES	Classes: 09

Newtonian aerodynamic coefficients, re entry capsule aerodynamics, shuttle orbiter aerodynamics, X-15 aerodynamics, hypersonic aerodynamics of research plane, dynamic stability considerations. Design considerations: re-entry vehicles, design philosophy, design considerations for rocket-launched glide reentry vehicles, air breathing vehicles, combined rocket and air breathing powered vehicles, design of a new vehicle.

Text Books:

1. John J Bertin, "Hypersonic Aerothermodynamics, , AIAA Education Series, 1st Edition, 1994.
2. Mikhailov G K & Parton V Z, "Super and Hypersonic Aerodynamics and Heat Transfer", CRC publishers, 1st Edition, 1992.

Reference Books:

1. John D Anderson, " Hypersonic and High Temperature Gas Dynamics", AIAA Education Series, 2nd Edition, 2006.
2. Ernst H Hirshchel, "Basics of Aerothermodynamics", Springer-Verlag, 1st Edition, 2005.

Web References:

1. https://nptel.ac.in/courses/101103003/
2. https://www.grc.nasa.gov/www/BGH/

E-Text Books:

1. https://bookzz.org/book/678872/21935f
2. https://bookzz.org/book/1201615/e314e1
3. https://bookzz.org/book/592471/7e27f3

Course Home Page:

HIGH ANGLE OF ATTACK AERODYNAMCS

GROUP - II								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE511	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the flows over various configurations of aircrafts at high angle of attack and phenomena like separation and vortex breakdown.

II. Analyze the topological approach of solving attached and separated flows by determining characteristics of skin friction lines and singular points

III. Implement the flow concepts in linear aerodynamics over wings and bodies using various linear panel methods of various orders.

IV. Analyze the intricacies in the rolled up vortex sheet and understand the deviation in nonlinear aerodynamics and methods to solve the flow problem.

UNIT-I	**INTRODUCTION TO FLOWS AT HIGH ANGLE OF ATTACK**	**Classes: 10**

Medium and high aspect ratio finite lifting wing at low subsonic speeds, low aspect ratio rectangular wings, slender delta type wings, elongated slender bodies, aircraft type configuration, vortex breakdown, unsteady aerodynamics at high angle of attack on slender configurations, effect of separation at high angle of attack in hypersonic flows.

UNIT-II	**TOPOLOGY OF SEPARATING AND REATTACHING VORTICAL FLOW**	**Classes: 10**

Equations of vortical flows, vorticity and transport equation, Biot Savart law, topological concepts for the analysis of vortical flows.

UNIT-III	**LINEAR AERODYNAMICS OF WINGS AND BODIES**	**Classes: 10**

Equation for potential subsonic flows, equations for the lifting wing at low speeds, linear panel methods for the wings and bodies at subsonic speeds.

Low and high order linear panel methods for subsonic and supersonic flows, comparison of various panel methods.

UNIT-IV	**VORTEX FLOWS AND THE ROLLED UP VORTEX**	**Classes: 05**

Vortex core of the rolled up wake, rolled up tip vortices, rolling up the vortex wake behind wings, rolling up of vortex lines of zero thickness vortex sheet, rolling up of finite thickness vortex sheet, the bursting of the rolled up vortices.

UNIT-V	**NON-LINEAR AERODYNAMICS OF WINGS AND BODIES**	**Classes: 10**

Analytical and semi empirical methods for calculations of the non-linear aerodynamic characteristics, introduction to non-linear panel methods for aircraft and missile configuration at high angle of attack, introduction to solutions of Euler equations for flows over configurations at high angle of attack, introduction to solutions of Navier Stokes equations for flows over configurations at high angle of attack.

Text Books:

1. Josef Rom, "High Angle of Attack Aerodynamics: Subsonic, Supersonic and Transonic Flows", Springer Verlag, 1st Edition, 1992.
2. Jack N Nielsen, "Missile Aerodynamics", McGraw Hill Company Inc, 1st Edition, 1960.

Reference Books:

1. Yahya S M, "Fundamentals of Compressible flow with Aircraft and Rocket Propulsion", New Age International, 3rd Edition, 2003.
2. John D Anderson, "Modern Compressible flow with historical perspective", McGraw-Hill Education, 3rd Edition, 2002.

Web References:

1. https://www.dept.aoe.vt.edu/~mason/Mason_f/ConfigAeroHiAlphaNotes.pdf
2. https://www.dept.aoe.vt.edu/~mason/Mason_f/HiAlphaBasicsPres.pdf

E-Text Books:

1. https://dlx.bookzz.org/genesis/958000/d80cf472f4537894a8039e06ea5110fb/_as/[Josef_Rom_(auth)]_ High_Angle_of_Attack_Aerodyna(BookZZ.org).pdf
2. https://www.amazon.in/High-Angle-Attack-Aerodynamics-Supersonic/dp/3540976728.

Course Home Page:

HELICOPTER AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE512	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the elements of helicopter aerodynamics and ground effect machines, their components and methods of control.
II. Formulate the mathematical model using simple blade element theory, analyze its figure of merit and evaluate power estimations.
III. Evaluate performance and its effect on altitude and understand the preliminary stability aspects of helicopters.
IV. Apply the aerodynamics, propulsion and control concepts for various VTOL and STOL aircraft and ground effect machines.

UNIT-I ELEMENTS OF HELICOPTER AERODYNAMICS Classes: 10

Configurations based on torque reaction, jet rotors and compound helicopters, methods of control, collective and cyclic pitch changes, lead and lag, flapping hinges.

UNIT-II IDEAL ROTOR THEORY Classes: 10

Hovering performance, momentum and simple blade element theories, figure of merit, profile and induced power estimation, constant chord and ideal twist rotors.

UNIT-III POWER ESTIMATES Classes: 09

Induced, profile and parasite power requirements in forward flight.

Performance curves with effects of altitude, preliminary ideas on helicopter stability.

UNIT-IV LIFT, PROPULSION AND CONTROL OF VSTOL AIRCRAFT Classes: 08

Various configurations: propeller, rotor, ducted fan and jet lift, tilt wing and vectored thrust, performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT-V GROUND EFFECT MACHINES Classes: 08

Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine, drag of hovercraft on land and water, applications of hovercraft.

Text Books:

1. Gessow A, and Myers G C, "Aerodynamics of Helicopter", Macmillan &Co., 1st Edition 1987.
2. McCormick B W, "Aerodynamics of V/STOL Flight", Academic Press, 1st Edition, 1987.

Reference Books:
1. Johnson W, "Helicopter Theory", Princeton University Press, 1st Edition, 1980. 2. McCormick BW, "Aerodynamics, Aeronautics and Flight Mechanics" John Wiley, 1st Edition, 1995. 3. Gupta L, "Helicopter Engineering", Himalayan Books, 1st Edition, 1996.
Web References:
1. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/media/hfh_ch02.pdf 2. https://www.mionome.com/Uni/Helicopter%20Aerodynamic.pdf 3. https://itlims.meil.pw.edu.pl/zsis/pomoce/WTLK/ENG/Sup/Aerodynamics_of_a_Helicopter_Rotor_in_Forward_Flight.pdf
E-Text Books:
1. https://books.google.co.in/books?id=PnV2JuLZi4C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false 2. https://aerostudents.com/files/rotorcraftMechanicsAndDesign/SeddonBasicHelicopterAerodynamics.pdf
Course Home Page:

THEORY OF COMBUSTION

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE513	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the concepts in combustion theory and illustrate students involved in combustion research with the required fundamental knowledge in combustion stoichiometry.

II. Familiarize in the area of combustion in various engines, generalise stability limits and flame stabilization in diffusion flame.

III. Calculate the combustion efficiency. Discuss fundamental combustion problems arising from gas turbine combustion or more generally from combustion in steady flowing premixed systems.

IV. Determine the supersonic combustion. Combustion in rocket engines and emission. Different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, afterburners.

UNIT-I BASICS OF COMBUSTION THEORY — Classes: 08

Combustion stoichiometry and thermo chemical calculation, chemical kinetics and equilibrium, transport phenomena, theory of viscosity, conductivity and diffusivity.

UNIT-II PRE-MIXED FLAMES — Classes: 10

Description of premixed flames, burning velocity and parametric dependences, experimental methods of measuring burning velocity, simple one-dimensional thermal theory of flame, concepts of minimum ignition energy, quenching distance, stability limits and flame stabilization.

UNIT-III DIFFUSION FLAME — Classes: 10

Jet flame physical description, theoretical analysis-Burke-Schumann's analysis, mechanism of soot formation, Defining of premixed, diffusion flames, liquid fuel combustion flames.

Liquid fuel combustion, difference between premixed and diffusion flames, liquid fuel combustion-conservation equations, calculation of mass burning rate, droplet burning.

UNIT-IV COMBUSTION IN RECIPROCATING AND GAS- TURBINE ENGINES — Classes: 09

Description of the combustion process in piston engines, Combustion efficiency and factors affecting it, Rankine - Hugoniot curves, deflagration and detonation in reciprocating engines and preventive methods; Description of different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, afterburners.

UNIT-V COMBUSTION IN ROCKET ENGINES AND EMISSION — Classes: 08

Types of rockets based on combustion, solid fuel combustion, combustion of carbon particle, simplified analysis, boundary layer combustion, combustion of carbon sphere with co burning gas phase; Chemical emission from combustion and its effects, exhaust gas analysis, emission control.

Text Books:

1. Stephen R Turns, "An Introduction to combustion Concepts and Application", TMH Publication, 3rd Edition, 2011.
2. Fawzy El-Mahallawy, Saad El-Din Habik, Elsevier "Fundamentals and Technology of combustion", 1st Edition, 2002.

Reference Books:

1. Charles E. Baukal, "Heat Transfer in Industrial Combustion", CRC Press, 1st Edition, 2000.
2. G. Singer, "Combustion, Fossil Power Systems" Ed Publications, 4th Edition, 1966.
3. S. P. Sharma, Chandra Mohan "Fuels and Combustion", Tata McGraw Hill Publishing Co., 1st Edition, 1987.

Web References:

1. https://www.personal.utulsa.edu/~kenneth-weston/chapter3.pdf
2. https://www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf

E-Text Books:

1. https://books.google.co.in/books?id=cVJkP4oEjZsC&printsec=frontcover&dq=Fuels+and+Combustion+latest+edition&hl=en&sa=X&ved=0ahUKEwjK2tWHzPfNAhVMto8KHRiMCBAQ6AEIHTAA#v=onepage&q=Fuels%20and%20Combustion%20latest%20edition&f=false
2. https://poisson.me.dal.ca/site2/courses/mech4840/04_Fuels%20&%20Combustion%20calculation09.pdf

Course Home Page:

TURBOMACHINERY

GROUP - III								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE514	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Learn basic concepts of turbo machinery, hydraulic pumps and effects of flow parameters on the performance of the machine.
II. Analyze geometrical conditions and description of the main components in Centrifugal pumps, Pelton, Francis, Kaplan and gas-turbines.
III. To understand energy transfer and losses in centrifugal compressors, axial fans and steam turbines
IV. Knowledge about Basic design of Wind turbines, Reversible Pumpturbines, multi-phase pumps and wet gas compressors. Main components in a Hydro Power Plant and Gas Power Plant. Analyze estimation of parameters required to design an efficient turbo machine.

UNIT-I	**INTRODUCTION TO TURBOMACHINERY**	**Classes: 10**

Classification of turbomachines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler's, Bernoulli's, equation and its applications, expansion and compression process, reheat factor, preheat factor

UNIT-II	**FUNDAMENTAL CONCEPTS OF AXIAL AND RADIAL MACHINES**	**Classes: 10**

Euler's equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT-III	**AXIAL COMPRESSOR AND FANS**	**Classes: 09**

Flow through axial flow fans, principle of axial fan and propeller, application of fan for circulation and ventilation, stage pressure rise and work done.

Slip stream and blade element theory for propellers, performance and characteristics of axial fans, effects of cascading, degree of reaction, blade loading coefficient and blade loss.

UNIT-IV	**CENTRIFUGAL COMPRESSORS**	**Classes: 08**

Flow through centrifugal compressors, stage velocity triangles, specific work, forward, radial and backward swept vanes, enthalpy entropy diagrams, degree of reaction, slip factor, efficiency, vaneless and vane diffuser system, volute as spiral casing, surge and stall in compressors.

UNIT-V	**AXIAL TURBINES**	**Classes: 08**

Stage velocity triangles, work, efficiency, blade loading, flow coefficient, single stage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, radial equilibrium and actuator disc approach for design of turbine blades, partial admission problems in turbines, losses in turbomachines

Text Books:

1. Yahya S.M, "Turbines, Compressor and Fans", Tata Mcgraw-Hill, 4th Edition, 2010.
2. Shepherd D.G., "Principles of Turbomachinery", 2nd Edition, Collier Macmillan, 1961.
3. Venkanna B.K., "Fundamentals of Turbomachinery", 3rd Edition, PHI, 2009.

Reference Books:

1. Peng W.W., "Fundamentals of Turbo machinery", 2nd Edition, Wiley, 2007.
2. Korpela S.A., "Principles of Turbo machinery", 2nd Edition, Wiley, 2011.
3. Turton R.K., "Principles of Turbo machinery", 3rd Edition, Springer, 1994.

Web References:

1. https://www.cfd-online.com/Wiki/Turbomachinery
2. https://www.leka.lt/sites/default/files/dokumentai/key-concepts-in-turbo-machinery_1.pdf
3. https://www.sciencedirect.com/science/book/9781856177931

E-Text Books:

1. https://elearning.vtu.ac.in/newvtuelc/courses/15/E-Notes/turbomachines/Unit-I%20&%20Unit-II_GRS.pdf
2. https://engineering-e-book.blogspot.com/2008/01/turbomachinery-books.html
3. https://myopencourses.com/subject/computational-fluid-dynamics-for-turbomachinery

Course Home Page:

HEAT TRANSFER

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE515	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand the basic modes of heat transfer like conduction, convection radiation with and without phase change in solid liquids and gases.

II. Design and analyze thermal fluidic components in engineering systems to energy mechanisms (in the form of heat transfer) for steady and unsteady state.

III. Conduct experiments in laboratories and analyze the results with theoretical ones to evolve research oriented projects in the field of heat transfer as well as propulsion.

IV. Apply the concepts of heat transfer with convective mode in internal and external flows involved in engineering components and work in real time problems in Industry.

UNIT-I	INTRODUCTION TO HEAT TRANSFER, CONDUCTION	Classes: 10

Modes and mechanisms of heat transfer, Basic laws of heat transfer. Conduction heat transfer: Fourier rate equation, Steady and unsteady and periodic heat transfer -Initial and boundary conditions, Overall heat transfer coefficient, Electrical analogy, Critical radius of insulation, Extended surfaces (Fins) Long, Short and insulated tips. Application to error measurement of temperature. Significance of Biot and Fourier numbers, Chart solutions of transient conduction systems –concept of Functional Body.

UNIT-II	CONVECTION, FORCED CONVECTION	Classes: 08

Buckingham Pi Theorem, application for developing semi-empirical non-dimensional correlation for convection heat transfer-significance of non-dimensional numbers-Concepts of Continuity, Momentum and Energy Equations. Concepts of hydrodynamic and thermal boundary layer -Flat plates and Cylinders. Concepts about Hydrodynamic and Thermal Entry Lengths-division of internal flows based on this- use of empirical correlations for Horizontal Pipe Flow and annulus flow.

UNIT-III	FREE CONVECTION, CONDENSATION	Classes: 10

Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes. Film boiling. Film wise and drop wise condensation, Nusselt's theory of condensation on a vertical plate.

Film condensation on vertical and horizontal cylinders using empirical correlations. Application in Aero engines, Gas turbine combustion chamber – Working principle, correlation with convection and condensation.

UNIT-IV	HEAT EXCHANGERS	Classes: 08

Classification of heat exchangers, overall heat transfer Coefficient and fouling factor, Concepts of LMTD and NTU methods, Problems using LMTD and NTU Methods, Application in Aero engines.

UNIT-V	RADIATION HEAT TRANSFER	Classes: 09
Emission characteristics, Laws of black-body radiation, Irradiation, Total and Monochromatic quantities, Laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, Heat exchange between two black bodies, concepts of shape factor, Emissivity, heat exchange between grey bodies, radiation shields, electrical analogy for radiation networks. Application in Space Engineering		
Text Books:		
1. Yunus A. Cengel, "Heat Transfer- A Practical Approach", Tata McGraw hill Education (P) Ltd, New Delhi, India. 4th Edition,2012. 2. R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age, New Delhi, India, 3rd Edition, 2012		
Reference Books:		
1. Holman, "Heat Transfer"Tata McGraw Hill education (P) Ltd, New Delhi, India. 10th Edition, 2012. 2. Ghoshdastidar, P. S. "Heat Transfer", Oxford University Press, New Delhi, India. 2nd Edition, 2012.		
Web References:		
1. https://nptel.ac.in/courses/112101097/ 2. https://hyperphysics.phy-astr.gsu.edu/hbase/thermo/heatra.html		
E-Text Books:		
1. https://bookzz.org/book/2556672/5ef6f5 2. https://bookzz.org/book/533930/66495a 3. https://bookzz.org/book/495953/61bfa5		
Course Home Page:		

CRYOGENICS

GROUP - III								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE516	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

V. Understand the behavior of fluids at cryogenic temperatures and utilize the feature for cryogenic application in aerospace propulsion.
I. Analyze the behavior of solids at cryogenic temperatures and develop systems used in hybrid rocket propulsion systems.
II. Estimate thermodynamically gas liquefaction systems and elucidate the application of liquefied gas in aerospace propulsion.
III. Create thermodynamically gas separation systems and experiment in a sustained environment for possible synthesis of rarefied gases for testing.

UNIT-I	INTRODUCTION TO CRYOGENICS	Classes: 10

Thermo physical and fluid dynamic properties of liquid and gas hydrogen, Thermo physical and fluid dynamic properties of liquid and gas helium, Liquefaction systems of hydrogen and helium gases, Liquefaction systems of hydrogen and helium gases, Refrigeration and liquefaction principals; Joule Thomson effect and inversion curve; Adiabatic and isenthalpic expansion with their comparison.

UNIT-II	PROPERTIES OF CRYOGENIC SUBSTANCE	Classes: 10

Cryogenic fluids, Solids at cryogenic temperatures; Superconductivity, Recuperative – Linde – Hampson, Claude, Cascade, Heylandt, Kapitza, Collins, Simon; Regenerative – Stirling cycle and refrigerator, Slovay refrigerator, Gifford-McMahon refrigerator, Vuilleumier refrigerator, Pulse Tube refrigerator; Liquefaction of natural gas.

UNIT-III	CRYOGENIC INSULATIONS	Classes: 08

Vacuum insulation, Evacuated porous insulation, Gas filled Powders and fibrous materials.

Solid foams, Multilayer insulation, Liquid and vapour Shields, Composite insulations.

UNIT-IV	STORAGE AND INSTRUMENTATION OF CRYOGENIC LIQUIDS	Classes: 08

Design considerations of storage vessel; Dewar vessels; Industrial storage vessels; Storage of cryogenic fluids in space; Transfer systems and Lines for cryogenic liquids; Cryogenic valves in transfer lines; Two phase flow in Transfer system; Cool-down of storage and transfer systems, Measurement of strain, pressure, flow, liquid level and Temperature in cryogenic environment; Cryostats.

UNIT-V	CRYOGENIC EQUIPMENTS	Classes: 09

Cryogenic heat exchangers – recuperative and regenerative; Variables affecting heat exchanger and system performance; Cryogenic compressors, Pumps, expanders; Turbo alternators; Effect of component inefficiencies; System Optimization, Magneto-caloric refrigerator; 3He-4He Dilution refrigerator; Cryopumping; Cryogenic Engineering applications in energy, aeronautics, space, industry, biology, preservation Application of Cryogenic Engineering in Transport.

Text Books:
1. Flynn, T.M., Dekker, Marcel "Cryogenic Engineering", Plenum Press, USA, 2009. 2. Timmerhaus, K.D, Flynn, T.M, "Cryogenic Process Engineering", Plenum Press, USA, 2009.
Reference Books:
1. Bose A. and Sengupta P."Cryogenics: Applications and Progress", Tata McGraw Hill, 2010. 2. Barron R., "Cryogenic Systems", Oxford University Press, 2012. 3. Haselden, G.G.,"Cryogenic Fundamentals", Academic Press, 2012.
Web References:
1. https://nptel.ac.in/courses/112101004/ 2. https://www.slac.stanford.edu/econf/C0605091/present/CERN.PDF
E-Text Books:
1. https://bookzz.org/book/690085/5d838f 2. https://bookzz.org/book/2121781/aff7cc 3. https://bookzz.org/book/939475/a6994a
Course Home Page:

AERO ENGINE DESIGN

GROUP - III								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE517	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Perform parametric and performance analysis of aircraft engines to achieve engine performance requirements identified in constraint and mission analysis.

II. Describe the fundamental thermodynamic and gas dynamic principles used in the parametric analysis and performance analysis of aero engines.

III. Explain the fundamental design tools used for analysis and preliminary design of main burner and afterburner, fundamental design tools used for analysis and preliminary design of inlet and nozzle.

IV. Demonstrate, Analyze and choose appropriate materials used in rockets& missiles, mission and weight requirements.

UNIT-I	FUNDAMENTALS OF ENGINE DESIGN	Classes: 10

Engine design roadmap, preliminary propulsion design sequence, basic definitions, unit conversions, standard atmosphere, compressible flow equations, mission profile, performance requirements and constraints, desired capabilities.

UNIT-II	CONSTRAINT ANALYSIS AND MISSION ANALYSIS	Classes: 10

Concept, design tools, preliminary estimates for constraint analysis, examples of constraint analysis, selection of preliminary design point, complete constraint boundary conditions, constant speed climb, horizontal acceleration, climb and acceleration, takeoff acceleration, constant altitude and speed cruise, constant altitude and speed turn, best subsonic cruise Mach number and altitude, liter, warm-up, takeoff rotation, constant energy height maneuver, general determination of takeoff weight, example and sample mission analysis.

UNIT-III	ENGINE SELECTION	Classes: 09

Parametric cycle analysis, station numbering, gas model, component efficiencies, engine performance analysis, computational inputs and outputs, finding plausible solutions.

Parametric and performance behaviors, examples, integrated results, design choices, performance cycle analysis, component performance analysis, iterative solution scheme, component behavior.

UNIT-IV	ENGINE SIZING	Classes: 08

Subsonic inlets, supersonic inlets, nozzles, drag, sizing, constraints, selecting number of engines, final reprise, engine system design, engine static structure, starting, overall operation.

UNIT-V	ENGINE COMPONENT OPERATION	Classes: 08

Operation lines, fan and compressor aerodynamics, turbine aerodynamics, engine life, high pressure and low pressure turbine design, combustion system components, combustion process, fuels, and ignition, afterburners, sample inlet and exhaust nozzle design.

Text Books:
1. Mattingly J.D., Heiser W.H., Pratt D.T., “Aircraft Engine Design”, AIAA ES, 2^{nd} Edition, 2002.
Reference Books:
1. Mathur, M., and Sharma, R.P., “Gas Turbines and Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1998. 2. Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W., Freeman & Co. Ltd., London, 1982. 3. Parker, E.R., “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co. Inc., 1982.
Web References:
1. https://www.tutorialspoint.com/aero_engine_design 2. https://www.geeksforgeeks.org/aero_engine-design/ 3. https://www.studytonight.com/aeroenginedesign. 4. https://www.coursera.org/specializations/aeroenginedesign
E-Text Books:
1. https://www.freeengineeringbooks.com/AeroSpace/AircraftDesignBooks.php 2. https://jntuaerobooks.blogspot.in/p/aero-3-1-books.html 3. https://www.amazon.in/Jet-Engines-Fundamentals-Theory-Operation/dp/1853108340
Course Home Page:

ROCKET AND MISSILES

GROUP - III								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE518	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn Fundamentals of rocket and missile systems, functions and disciplines and the full spectrum of rocket systems, uses and technologies.
II. Understand the Fundamentals and uses of solid, liquid and hybrid rocket systems and differences between systems built as weapons and those built for commerce.
III. Explain the use of low and high fidelity performance modeling, including performance loss factors, Staging theory, performance and practices for multi-stage rockets.
IV. Discuss the reliability issues in rocket systems, and strategies to improve reliability, including random and systematic failures, non-linier reliability curves.

UNIT-I	ROCKET DYNAMICS	Classes: 10

Classification of launch vehicles and missiles, rocket systems, airframe components, forces and moments acting on a rocket, propulsion, aerodynamics, gravity, inertial and non-inertial frames, coordinate transformation, equations of motion for three-dimensional motion through atmosphere and vacuum, earth's atmosphere, numerical problems.

UNIT-II	SOLID PROPULSION AND PYROTECHNICS	Classes: 10

Solid propellant rockets, classification, components and their design considerations, propellant grain design, grain mechanical properties, ballistics and burn rate design issues, igniter design, types of nozzles, thrust vector control, pyrotechnic devices and systems, classification, mechanisms and application of pyrotechnic devices in rockets and missiles; design problems in rocket systems.

UNIT-III	LIQUID PROPULSION AND CONTROL SYSTEMS	Classes: 09

Liquid propellant rockets, classification and components, thrust chamber, feed systems, propellant tanks, turbo-pumps, types of valves and applications, design considerations.

Different bipropellant systems like cryogenics and their characteristics, pogo and slooh engine gimbal systems and thrusters for control; Spacecraft propulsion and control systems design problems.

UNIT-IV	MULTI-STAGING OF ROCKET AND SEPERATION DYNAMICS	Classes: 08

Navigation and guidance systems in rockets and missiles, aerodynamic control systems of missiles, multi-staging of rockets, vehicle optimization techniques, stage separation system, dynamics, separation techniques, rocket flight dispersion, numerical problems.

UNIT-V	DESIGN, MATERIALS AND TESTING OF ROCKETS	Classes: 08

Design requirements and selection, performance evaluation and assessment, space environment on the selection of materials for rockets and spacecraft, material selection for specific requirements, advance materials, super alloys and composite materials, qualification of rocket and missile systems, types of testing and evaluation of design and function.

Text Books:

1. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 1993.
2. Martin J.L Turner , "Rocket & Space Craft Propulsion, Springers –oraxis publishing, 2001.

Reference Books:

1. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1998.
2. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
3. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

Web References:

1. https://www.tutorialspoint.com/materials for rockets & missiles.
2. https://www.geeksforgeeks.org/ rockets & missiles /
3. https://www.studytonight.com/ rockets & missiles/
4. https://www.coursera.org/specializations/ rockets & missiles –spacecraft.

E-Text Books:

1. https://www.scribd.com/doc/268924096/c-rockets&missiles-mathur-eBook
2. https://www.safaribooksonline.com/library/view/rockets&missiles-using/9789332524248/
3. https://www.amazon.com/rockets &missiles-C-sutton
4. https://www.scribd.com/doc/40147240/rockets and missiles-Using-c-by-parker-ER-946

Course Home Page:

PRECISION ENGINEERING

GROUP - III								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AAE519	**Elective**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**			**Total Classes: 45**			

OBJECTIVES:

The course should enable the students to:

I. Understand the BIS code fits and tolerances for geometrical dimensioning and tolerance (GD & T).
II. Understand the principal application of different measuring instruments.
III. Summarize the application of latest manufacturing techniques (nano).

UNIT-I	ACCURACY AND ALIGNMENT TESTS	Classes : 09

Accuracy and alignment tests: General concept of accuracy, spindle rotation accuracy, test methods, displacement accuracy, dimensional wear of cutting tools, accuracy of NC systems, clamping errors, setting errors, location of rectangular prism, cylinder, basic type of tests, measuring instruments used for testing machine tools, alignment tests, straightness, flatness, parallelism, squareness, circularity, cylindricity.

UNIT-II	INFLUENCE OF STATIC STIFFNESS,THERMAL EFFECTS	Classes : 09

Influence of static stiffness, thermal effects: Static stiffness, nature of deformation in a machine tool, overall stiffness of a lathe, compliance of work piece, errors due to the variation of the cutting force and total compliance, accuracies due to thermal effects, methods of decreasing thermal effects-Influence of vibration on accuracy.

UNIT-III	PRECISION MACHINING	Classes: 09

Top down and bottom up approach, development of nanotechnology, precision and micromachining, diamond turning of parts to nanometer accuracy.

Stereo microlithography, machining of micro-sized components, mirror grinding of ceramics, ultra precision block gauges.

UNIT-IV	NANO MEASURING SYSTEMS	Classes: 09

In-process measurement of position of processing point, post process and online measurement of dimensional features, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems.

UNIT-V	LITHOGRAPHY	Classes : 09

Nano Lithography, photolithography, nano lithography, photolithography, electron beam lithography, ion beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.

Text Books:

1. Murthy R.L, "Precision Engineering in Manufacturing", New Age International, New Delhi, 2005.
2. Norio Taniguchi, "Nanotechnology", Oxford university press, Cambridge, 1996.

Reference Books:

1. Lee TongHong, "Precision Motion Control, Design and Implementation", Springer Verlag, UK, 2001.
2. Liangchi Zhang, "Precision Machining of Advanced Materials", Trans Tech Publications Ltd., Switzerland, 2001.
3. Hiromu Nakazawa, "Principles of Precision Engineering", Oxford university press, 1994.

Web References:

1. https://nptel.ac.in/courses/112106138/
2. https://nptel.ac.in/courses/118102003/

E-Text Book:

1. https://accessengineeringlibrary.com/browse/precision-engineering
2. https://books.google.co.in/books/about/Precision_Engineering_in_Manufacturing.html?id=vueapsbGLc4C

Course Home Page:

NON DESTRUCTIVE TESTING

GROUP - IV								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE520	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understanding the basic principles of various non destructive testing methods, fundamentals, discontinuities in different product forms.
II. Differentiate various defect types and select the appropriate non destructive testing methods for better evaluation of the specimen.
III. Implement and document a written procedure paving the way for further training in specific techniques of non destructive inspection of the experimental subject.
IV. Recognize the principles and operational techniques of the radiographic testing followed by its interpretation and evaluation.

UNIT-I	OVERVIEW OF NON DESTRUCTIVE TESTING	Classes: 09

NDT versus mechanical testing, overview of the non destructive testing methods for the detection of manufacturing defects as well as material characterization; Relative merits and limitations, various physical characteristics of materials and their applications in NDT, visual inspection, v unaided and aided.

UNIT-II	SURFACE NON DESTRUCTIVE EXAMINATION METHODS	Classes: 09

Liquid Penetrant Testing: Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results; Magnetic particle testing; Theory of magnetism, inspection materials magnetisation methods, interpretation and evaluation of test indications, principles and methods of demagnetization, residual magnetism.

UNIT-III	THERMOGRAPHY AND EDDY CURRENT TESTING (ET)	Classes: 09

Thermography: Principles, contact and non contact inspection methods, techniques for applying liquid crystals.

Advantages and limitation, infrared radiation and infrared detectors, instrumentations and methods, applications; Eddy Current Testing; Generation of eddy currents, properties of eddy currents, Eddy current sensing elements, probes, instrumentation, types of arrangement, applications, advantages, limitations, interpretation/evaluation.

UNIT-IV	ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)	Classes: 09

Ultrasonic Testing: Principle, transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-scan, B-scan, C-scan; Phased array ultrasound, time of flight diffraction; Acoustic emission technique, V principle, AE parameters, applications.

UNIT-V	EXPERIMENTAL METHODS	Classes:09

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, inverse square, law, characteristics of films , graininess, density, speed, contrast, characteristic curves, pentameters, exposure charts, radiographic equivalence. Fluoroscopy; Xerox; Radiography, computed radiography, computed tomography.

Text Books :

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

Reference Books:

1. Paul E Mix, “Introduction to Non-destructive Testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.
2. Charles, J. Hellier, “Handbook of Non-destructive Evaluation”, McGraw Hill, New York 2001.

Web References:

1. https://nptel.ac.in/syllabus/syllabus_pdf/113106070.pdf
2. https://nptel.ac.in/courses/113106070/24

E-Text Books:

1. https://www.springer.com/la/book/9780412625008
2. https://eprints.nmlindia.org/1850/1/177-193.PDF
3. https://www.tower.com/non-destructive-test-evaluation-materials-prof-j-prasadpaperback/wapi/124712958

Course Home Page:

CAD / CIM

GROUP - IV								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE521	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Objectives:

The course should enable the students to:

I. Understand the basics of computer aided designing, computer aided manufacturing and computer integrated manufacturing.

II. To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP).

III. Gain knowledge about shop floor control and Flexible manufacturing systems (F.M.S).

IV. Emphasizes the integration of manufacturing enterprise using computer integrated manufacturing (CIM) technologies.

UNIT-I	INTRODUCTION	Classes: 08

Computers in industrial manufacturing , product cycle, CAD/CAM hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, and storage devices, computer graphics, raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, three dimensional transformations, mathematics of projections, clipping, hidden surface removal.

UNIT-II	GEOMETRIC MODELLING	Classes: 10

Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired, drafting and modeling systems, basic geometric commands, layers, display control commands, editing, dimensioning and solid modeling.

UNIT-III	GROUP TECHNOLGY COMPUTER AIDED PROCESS PLANNING	Classes: 10

History of group technology, role of G.T in CAD/CAM integration, part families, classification and coding, DCLASS and MCLASS and OPTIZ coding systems, facility design using G.T, benefits of G.T, cellular manufacturing.

Process planning, role of process planning in CAD/CAM integration, approaches to computer aided process planning, variant approach and generative approaches, CAPP and CMPP systems.

UNIT-IV	COMPUTER AIDED PLANNING AND CONTROL, SHOP FLOOR CONTROL AND INTRODUCTION TO FMS	Classes: 09

Production planning and control, cost planning and control, inventory management, material requirements planning (ERP), control, phases, factory data collection system, automatic identification methods, bar code technology, automated data collection system; FMS, components of FMS, types, FMS workstation, material handling and storage system, FMS layout, computer control systems, applications and benefits.

UNIT-V	COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING	Classes: 08

Production planning and control, cost planning and control, inventory management, material requirements planning (MRP), shop floor control, lean and agile manufacturing, types of production monitoring systems, structure model of manufacturing, process control and strategies, direct digital control.

Text Books :

1. A. Zimmers, P. Groover, “CAD/ CAM”, Prentice- Hall India, 2008.
2. Zeid, Ibrahim, “CAD / CAM Theory and Practice”, Tata McGraw-Hill, 1997.
3. Mikell. P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
4. Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd.,2005
5. Yorem Koren, “Computer Integrated Manufacturing”, McGraw Hill, 2005.

Reference Books:

1. P. Groover, Automation, “Production Systems & Computer Integrated Manufacturing”, Pearson Education.2nd Edition 1989.
2. Lalit Narayan, “Computer Aided Design and Manufacturing”, Prentice-Hall India.3rd Edition 2002.
3. Radhakrishnan, Subramanian, “CAD / CAM / CIM”, New Age.4th Edition 2016.
4. Jami J Shah, Martti Mantyla, “Parametric and Feature-Based CAD/CAM: Concepts, Techniques, and Applications”, John Wiley & Sons Inc, 1995.
5. Alavala, “CAD/ CAM: Concepts and Applications”, PHI Publications, 4th Edition, 2016.
6. W. S. Seames, “Computer Numerical Control Concepts and Programming”, 4th Edition 1999.

Web References:

1. https://en.wikipedia.org/wiki/CAD/CAM_dentistry
2. https://en.wikipedia.org/wiki/Computer-aided_manufacturing
3. https://en.wikipedia.org/wiki/Computer-integrated_manufacturing

E-Text Books:

1. https://books.google.co.in/books?id=8W0E9eK2raMC
2. https://books.google.co.in/books?id=mzm9WuuI4mQC
3. https://books.google.co.in/books?id=F5d6CwAAQBAJ

Course Home Page:

COMPOSITES FABRICATION AND MACHINING

GROUP - IV								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE522	**Elective**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Objectives:

The course should enable the students to:

I. Develop advance research and development projects on composite materials and its fabrication processes.

II. Classify the composites and composite materials based on matrix and fibres, fibers fabrication methodology.

III. To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.

IV. Understand the operation of conventional machining, Fabrication of Metal Matrix Composites, Basic Requirements in Selection of constituents, solidification.

UNIT-I	**OVERVIEW AND INTRODUCTION**	**Classes: 08**

Definition of composite material, classification based on matrix and topology, classification and characteristics of composites, conventional vs. composite materials, advantages and limitations, salient applications in various fields constituents of composites, interfaces and interphases, distribution of constituents, nano-composites; Classification of polymers properties of thermo plastics properties of thermosetting plastics, prepare layup and autoclave processing.

UNIT-II	**FIBERS AND MATRIX MATERIALS**	**Classes: 10**

fibers fabrication, structure, properties and applications glass fiber, boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers whiskers fabrication of matrix materials polymers, metals and ceramics and their properties interfaces wettability types of bonding at the interface tests for measuring interfacial strength physical and chemical properties.

UNIT-III	**PROCESSING OF POLYMER MATRIX COMPOSITES, METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES**	**Classes: 10**

Thermoset matrix composites: hand layup, spray, filament winding, pultrusion, resin transfer moulding, autoclave moulding bag moulding, compression moulding with bulk moulding compound and sheet Moulding Compound thermoplastic matrix composites film stacking, diaphragm forming, thermoplastic tape laying, injection moulding interfaces in PMCs structure, properties and application of PMCs recycling of PMCs.

Metallic matrices: aluminium, titanium, magnesium; Copper alloys processing of MMCs: Liquid state, solid state, in situ fabrication techniques diffusion bonding powder metallurgy techniques interfaces in MMCs; Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration; Lanxide process in situ chemical reaction techniques: Chemical vapour deposition, chemical vapours impregnation, SOLGEL interfaces in CMCs.

UNIT-IV	**FABRICATION OF COMPOSITES**	**Classes: 09**

Fabrication Composites: Fabrication of metal matrix composites: Commonly used matrices, basic requirements in selection of constituents, solidification processing of composites - XD process, spray processes; Osprey process, rapid solidification processing, dispersion processes; Stir-casting and

compocasting, screw extrusion, liquid metal impregnation technique; Squeeze casting, pressure infiltration, lanxide process), principle of molten alloy infiltration, rheological behavior of melt particle slurry, synthesis of in situ composites; Fabrication of polymer matrix composites; Commonly used matrices basic requirements in selection of constituents, moulding method, low pressure closed molding, pultrusion, filament winding, fabrication of ceramic matrix composites; Various techniques of vapour deposition, liquid phase method and hot pressing etc., fabrication of nano-composite.		
UNIT-V	**NONTRADITIONAL MACHINING OF FRPs AND HEALTH AND SAFETY ASPECTS IN MACHINING FRPS**	**Classes: 08**
Abrasive water jet machining, laser machining, electric discharge machining; Hazard sources and route exposure, dust generation in dry machining, aerosol emission in laser machining, work place control.		

Text Books :

1. Krishnan K Chawla, "Composite Materials: Science and Engineering", Springer, International Edition, 2012.
2. Jamal Y. Sheikh ahmad, "Machining of Polymer Composites", Springer, International Edition, 2009.
3. Autar. K. Kaw, "Mechanics of Composite Materials", Taylor & Francis Group, LLC, 2006.

Reference Books:

1. J.N Reddy, "Mechanics of laminated composite plates and shells theory and Analysis", CRC Press LLC, 2nd Edition, 2004.
2. P. K. Mallick, "Fiber Reinforced Composites: Materials, Manufacturing and Design", CRC press, 1st Edition, 2010.

Web References:

1. https://link.springer.com/book/10.1007%2F978-0-387-74365-3.
2. https://www.hydrojet.com/capabilities/composites/
3. https://www.me.iitb.ac.in/~ramesh/courses/ME338/comp.pdf

E-Text Books:

1. https://www.cantab.net/users/bryanharris/Engineering%20Composites.pdf
2. https://www.sciencedirect.com/science/article/pii/B9781856174152500034
3. https://www.sciencedirect.com/science/article/pii/B9781856174152500022

Course Home Page:

MECHANISM AND MACHINE DESIGN

Group- IV								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE523	**Elective**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Objectives:

The course should enable the students to:

I. Understand the basic mechanism involved in machine design and basic relative kinematics relations of two moving point.

II. Identify individual links and categorize the type of the connection of the links (joints) for the mechanism of machines.

III. Explain the fundamentals of specific link and joint combinations such as gyroscopic motion, followers, cam and gear systems.

IV. Define kinematic analysis and develop analytical equations describing the relative position, velocity and acceleration of all moving links.

UNIT-I	MECHANISMS & MACHINES	Classes: 08

Elements of links, classification, rigid link, flexible and fluid link, types of kinematic pairs, sliding, turning, rolling, screw and spherical pairs, lower and higher pairs, closed and open pairs, constrained motion, completely, partially or successfully constrained, and incompletely constrained, mechanism and machines, classification, kinematic chain, inversion of mechanism, inversion of quadratic cycle, chain, single and double slider crank chains; Exact and approximate straight line mechanisms: Paucellier, hart t, Chibichef, pantograph.

UNIT-II	KINEMATIC ANALYSIS OF MECHANISMS	Classes: 10

Velocity and acceleration, motion of link in machine, determination of velocity and acceleration diagrams, graphical method, application of relative velocity method for four bar chain, analysis of slider crank chain for displacement, velocity and acceleration of sliding, acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

UNIT-III	PLANE MOTION OF BODY & GYROSCOPIC MOTION PRECESSION	Classes: 10

Instantaneous centre of rotation, centroids and axodes, relative motion between two bodies, three centres in line theorem, graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

The gyroscope, free and restrained, working principle, the free gyro, rate gyro, integrating gyro as motion measuring instruments, effect of precession on the stability of vehicles, motorbikes, automobiles, airplanes and ships, static and dynamic forces generated due to in precession in rotating mechanisms.

UNIT-IV	CAMS AND FOLLOWERS, STEERING GEARS	Classes: 09

Cams and followers, definition uses, types, terminology, types of follower motion, uniform velocity, simple harmonic motion and uniform acceleration, maximum velocity and acceleration during outward and return strokes, roller follower, circular cam with straight, concave and convex flanks, condition for correct steering, Davis steering gear, Ackerman's steering gear, velocity ratio, hook's joint, single and double hooks joint, universal coupling, applications.

UNIT-V	GEARS AND GEAR TRAINS, DESIGN OF FOUR BAR MECHANISMS	Classes: 08
Introduction to gears: Types, law of gearing; Tooth profiles: Specifications, classification, helical, bevel and worm gears, simple and reverted gear train, epicyclic gear trains, velocity ratio or train value, four bar mechanism, Freudenstein equation, Precession point synthesis, Chebyshev's method, structural error.		

Text Books :

1. Amithab Ghosh, Asok Kumar Malik, "Theory of Mechanisms and Machines", East West Press Pvt Ltd, 2001.
2. J. S. Rao, R.V. Dukkipati "Mechanism and Machine Theory / New Age Publications", 1996.
3. Neil Sclater, P. Nicholas, Chironis "Mechanisms and Mechanical Devices Sourcebook", New York McGraw-Hill, publications, 3rd Edition.1963

Reference Books:

1. Dr Jagdish Lal, J. M. Shaw "Theory of Machines", 1st Edition, 1985.
2. Abdulla Sharif, Dhanpat Rai, "Theory of Machines", 5th Edition, 1987,
3. P. L. Ballaney, "Theory of Machines", Khanna Publishers, 3rd Edition, 2003,
4. J. E. Shigley, R. Charles, Mischke, "Mechanical engineering and design", TMH, 1st Edition, 2003.

Web References:

1. https://en, wikipedia.org/wiki/Mechanism_(engineering)
2. https://en, wikipedia.org/wiki/Machine_(mechanical)
3. https://en, wikipedia.org/wiki/Crank_(mechanism)

E-Text Books:

1. https://engineeringstudymaterial.net/ebook/mechanisms-and-mechanical-devices-sourcebook/
2. https://accessengineeringlibrary.com/browse/mechanisms-and-mechanical-devices-sourcebook-fifth-edition
3. https://www,amazon,com/Mechanisms-Mechanical-Devices-Sourcebook-Fourth-ebook/dp/B0062Y79H0#navbar

Course Home Page:

PRODUCT DESIGN AND DEVELOPMENT

Group- IV

<table>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th>CIE</th><th>SEE</th><th>Total</th></tr>
<tr><td>AAE524</td><td>Elective</td><td>3</td><td>-</td><td>-</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 45</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 45</td></tr>
</table>

Objectives:

The course should enable the students to:

I. Prioritize the growth of the organization and utilize the surplus capacity of the organization, such as physical facility, man power.

II. Develop the market share and to target new market segment and ensure complete product range in company's portfolio.

III. Apply contemporary theories of effective product design through the adaptive and/or original redesign of consumer products.

UNIT-I	INTRODUCTION	Classes: 08

Significance of product design, product design and development process, sequential engineering design method, the challenges of product development, product planning and project selection: Identifying opportunities, evaluate and prioritize projects, allocation of resources.

UNIT-II	IDENTIFYING CUSTOMER NEEDS, PRODUCT SPECIFICATIONS AND CONCEPT GENERATION	Classes: 10

Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs; Establish target specifications, setting final specifications; Activities of concept generation, clarifying problem, search both internally and externally, explore the output.

UNIT-III	INDUSTRIAL DESIGN AND CONCEPT SELECTION	Classes: 10

Assessing need for industrial design, industrial design process, management, assessing quality of industrial design.

Overview, concept screening and concept scoring, methods of selection.

UNIT-IV	THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ)	Classes: 09

Fundamentals, methods and techniques, general theory of innovation and TRIZ, value engineering applications in product development and design, model-based technology for generating innovative ideas.

UNIT-V	CONCEPT TESTING, INTELLECTUAL PROPERTY AND DESIGN FOR ENVIRONMENT	Classes: 08

Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response; Elements and outline, patenting procedures, claim procedure; Impact, regulations from government, ISO system.

Text Books:

1. K. T Ulrich, S. D. Eppinger, "Product Design and Development", Tata McGraw-Hill, 5th Edition, 2008.
2. K. Otto, K. Wood, "Product Design", Pearson, 1st Edition, 2001.

Reference Books:

1. Steven Eppinger, Karl Ulrich, "Product Design and Development", McGraw-Hill Education, 1st Edition, 2011.

2. Karl T. Ulrich, Steven D. Eppinger, "Product Design and Development", McGraw-Hill, 1st Edition, 2012.
3. Semyon D. Savransky, "Engineering of creativity: Introduction to TRIZ methodology of inventive Problem Solving", CRC Press, 1st Edition, 2000.

Web References:

1. https://nptel.ac.in/courses/105106049/#
2. https://www.rqriley.com/pro-dev.htm

E-Text Books:

1. https://faculty1.aucegypt.edu/farag/presentations/Chapter1.pdf
2. https://appinventor.mit.edu/explore/sites/all/files/teachingappcreation/unit1/DesignUnit1.pdf

Course Home Page:

AVIONICS AND INSTRUMENTATION

GROUP-V									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE525	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in various types of Avionics systems, its components & its applications in aerospace industries.
II. Offer a rigorous avionics technology, Review of the basic system integration and the different type of avionics architectures.
III. Provide necessary knowledge to study the aircraft instrumentation sensors, displays and different type of sensors.
IV. Give knowledge about military aircraft adaptation, avionics and mission system interface and gives the difference between civilian aircraft avionics and military aircraft avionics.

UNIT-I	AVIONICS TECHNOLOGY	Classes: 10

Evolution of electronics; The nature of microelectronic devices, processors, memory devices; Introduction to avionics, systems integration, need - data bus systems, MIL STD 1553 bus system, ARINC 429/ARINC 629 bus systems, optical data bus systems; Integrated modular avionics architectures , commercial off the shelf systems; Avionics packaging.

UNIT-II	AIRCRAFT INSTRUMENTATION - SENSORS AND DISPLAYS	Classes: 10

Air data sensors, magnetic sensing, inertial sensing, and radar shensors. The electromechanical instrumented flight deck, early flight deck instruments, attitude direction indicator, horizontal situation indicator, altimeter, airspeed indicator; Advanced flight deck display system architectures, display systems, display media, future flight deck displays.

UNIT-III	COMMUNICATION AND NAVIGATION AIDS	Classes: 09

Radio frequency spectrum, communication systems, HF, VHF, satellite communications; ATC transponder, traffic collision avoidance system; Navigational aids; Automatic direction finding, VHF Omni range, distance measuring equipment; TACAN, VORTAC; Satellite navigation systems, the GPS.

Basic navigation, radio, inertial navigations, satellite navigation; GPS, differential GPS, wide area augmentation systems, local area augmentation system, and GPS overlay program; Integrated navigation, sensor usage; Flight management system (FMS); FMS control and display unit; Lateral navigation.

UNIT-IV	MILITARY AIRCRAFT ADAPTATION	Classes: 08

Avionic and mission system interface, navigation and flight management; Navigation aids, flight deck displays, communications, aircraft systems; Applications, personnel, material and vehicle transport, air-to-air refueling, maritime patrol, airborne early warning, ground surveillance; Electronic warfare, the EW spectrum, electronic support measures, electronic countermeasures, electro-optics and the infra-red.

UNIT-V	AIRBORNE RADAR, ASTRIONICS - AVIONICS FOR SPACECRAFT	Classes: 08

Propagation of Radar waves, functional elements of radar, antenna- transmitter; Types of radar- pulse Doppler, civil aviation applications, military applications; Attitude determination and control of spacecraft, magnetometers, sun sensors, star trackers, earth and horizon sensors; Command and telemetry

Text Books:

1. Moir, I. and Seabridge, A., Civil Avionics Systems, AIAA Education Series, AIAA, 2002.
2. Collinson, R.P.G., Introduction to Avionics Systems, Springer, 2nd Edition, 2003.

Reference Books:

1. Helfrick, A., Principles of Avionics, Avionics Communications Inc. Leesburg, 2000.
2. Henderson, M. F., Aircraft Instruments & Avionics for A &P Technicians, Jeppesen Sanderson Training Products, 1993.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://www.worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

AIR TRANSPORTATION SYSTEMS

GROUP - V								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE526	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand complexity and transport operation systems.
II. Evaluate the nature of accidents and the role of the accident investigation process.
III. Describe how safety management systems (SMS) work to decrease airport and aircraft accidents.
IV. Understand many transport issues involved in handling passengers, freight of aircraft.

UNIT-I	AVIATION INDUSTRY	Classes: 08

Introduction, history of aviation, evolution, development, growth, challenges; Aerospace industry, air transportation industry- economic impact, types and causes; Airline industry, structure and economic characteristics; Airlines as oligopolists, other unique economic characteristics; Significance of airline passenger load factors.

UNIT-II	NATURAL ENVIRONMENT, REGULATORY ENVIRONMENT AND OPERATIONAL ENVIRONMENT	Classes: 10

The earth as a habitat, The Earth: physical issues affecting demand- surface, core, continents; Shape of demand; Demand forecasting- based on historical data, comparative analysis, theoretical demand models; Reliability of forecasts; The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA); Service properties: service volumes, international air service agreements, deregulation, privatization; Evolution: Communication, navigation and surveillance systems (CNSS); Radio communications: VHF, HF, ACARS, SSR, ADS; Navigation: NDB, VOR, DME, area-navigation systems(R-Nav), ILS, MLS, GPS, INS, laser-INS; Surveillance: SSR, ADS; Airborne elements: AFCS, PMS, electronic control and monitoring/engine instrumentation and central automated systems, EFIS, FMS, GPWS, TCAS- future trends.

UNIT-III	AIRCRAFT	Classes: 10

Costs- project cash-flow, aircraft price; Compatibility with the operational infrastructure; Direct and indirect operating costs; Balancing efficiency and effectiveness-payload-range, fuel efficiency.

Technical contribution to performance, operating speed and altitude, aircraft field length performance; Typical operating costs; Effectiveness- wake-vortices, cabin dimensions, flight deck.

UNIT-IV	AIRPORTS AND AIRLINES	Classes: 09

Setting up an airport: airport demand, airport sitting, runway characteristics, length, declared distances, aerodrome areas, obstacle safeguarding; Runway capacity, evaluating runway capacity, sustainable runway capacity; Setting up an airline, modern airline objectives; Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements; Indirect operating costs; Aircraft- buy or lease; Revenue generation, computerized reservation systems, yield management; Integrating service quality into the revenue-generation process; Marketing the seats; Airline scheduling; Evaluating success, financial viability, regulatory compliance, efficient use of resources, effective service.

UNIT-V	AIRSPACE	Classes: 08

Categories of airspace, separation minima, airspace sectors, capacity, demand and delay; Evolution of air traffic control system, procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems; Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS); Air-navigation service providers as businesses.

Text Books:

1. Hirst, M., "The Air Transport System", Woodhead Publishing Ltd, Cambridge, England, 2008.

Reference Books:

1. Wensven, J.G., "Air Transportation: A Management Perspective", Ashgate, 2nd Edition 2007.
2. Belobaba, P., Odoni, A. and Barnhart, C., Global Airline Industry, 2nd Edition Wiley, 2009.
3. M. Bazargan, M., "Airline Operations and Scheduling", Ashgate, 1st Edition 2004.

Web References:

1. https://pdfs.semanticscholar.org/7f85/e5cffcdd85e25bd495b5762e1ca4facda739.pdf2.pdf.pdfhttp://andromeda.rutgers.edu/~jy380/research/air-schedule/chapter50.pdf

E-Text Books:

1. https://link.springer.com/book/10.1007%2F978-3-7091-1880-

Course Home Page:

AIRPORT PLANNING AND MANAGEMENT

GROUP - V								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE527	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand design and planning of airport operation systems.

II. Understand many operational issues involved in design of airports.

UNIT-I	AIRPORTS AND AIRPORT SYSTEMS	Classes: 08

Introduction: Airport management on an international level; The national plan of integrated airport systems; The nation's airport system plan; The rules that govern airport management; Organizations that influence airport regulatory policie; A historical and legislative perspective: Introduction the formative period of aviation and airports, Airport growth: World War II and the postwar period airport modernization: The early jet age.

UNIT-II	COMPONENTS OF THE AIRPORT	Classes: 10

The components of an airport. The airfield. Navigational aids (NAVAIDS) located on airfields; Air traffic control and surveillance facilities located on the airfield; Weather reporting facilities located on airfields; Security infrastructure on airfields; Airspace and air traffic control: Brief history of air traffic control; The basics of air traffic control; Current and future enhancements to air traffic control; Airport terminals and ground access: The historical development of airport terminals; Components of the airport terminal; Airport ground access.

UNIT-III	AIRPORT OPERATIONS AND FINANCIAL MANAGEMENT	Classes: 10

Airport operations management: Introduction, pavement management, aircraft rescue and fire fighting (ARFF); Snow and ice control, safety inspection programs.

Bird and wildlife hazard management; Airport security: Security at commercial service airports, security at general aviation airports; The future of airport security.

UNIT-IV	AIRPORT FINANCIAL MANAGEMENT	Classes: 09

Airport financial accounting, revenue strategies at commercial airports, pricing of airport facilities and services, variation in the sources of operating revenues, rise in airport financial burdens, airport funding, grant programs, airport financing, private investment sale of the airport.

UNIT-V	AIRPORT CAPACITY AND DELAY	Classes: 08

Defining capacity, factors affecting capacity and delay, estimating capacity, analytical estimates of delay: The queueing diagram; The future of airport management: Introduction, restructuring of commercial air carriers, new large aircraft, small aircraft transportation systems.

Text Books:
1. Alexander T Wells, Ed. D Seth Young, "Airport planning and Management", 6nd Edition, 2011.
Reference Books:
1. Norman J. Ashford, H. P. Martin Stanton, Clifton A. Moore, Pierre Coutu, "Airport Operations", McGraw Hill, 3rd Edition, 2013.
Web References:
1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf 2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks
E-Text Books:
1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition 2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html
Course Home Page:

AIRWORTHINESS AND CERTIFICATIONS

GROUP-V								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE528	**Elective**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

Objectives:

The course should enable the students to:

I. Collaborate effective implementation of the safety related airworthiness rules, regulations and requirements contained in the various national documents and standards and recommended practices.

II. Evaluate the weaknesses in the engineering activities of the operators, maintenance and other related organizations so that necessary corrective measures can be taken in time before they become a potential safety hazard.

III. Apply and implement the standards and recommended practices laid down in the ICAO Annexes 1, 6 and 8.

UNIT-I	BASIC CONCEPTS	Classes: 08

Introduction to aircraft rules as far as they relate to airworthiness and safety of aircraft; airworthiness requirements for civil and military aircraft CAA, FAA, JAR and ICAO regulations; defense standards; military standards and specifications.

UNIT-II	RESPONSIBILITIES OF AME LICENSES	Classes: 10

Privileges and responsibilities of various categories of AME license and approved persons; knowledge of mandatory documents like certificate of registration, certificate of airworthiness, conditions of issue and validity; export certificate of airworthiness; knowledge of log book, journey log book, technical log book, etc.

UNIT-III	CERTIFICATION	Classes: 10

Procedure for development and test flights and certification; certificate of flight release, certificate of maintenance, approved certificates.

Technical publications, aircraft manual, flight manual, aircraft schedules.

UNIT-IV	REGULATION PROCEDURES	Classes: 09

Registration procedure, certification, identification and marking of aircraft; modification, concessions, airworthiness directives, service bulletins; crew training and their licenses, approved inspection, approved materials, identification of approved materials; bonded and quarantine stores; storage of various aeronautical products like rubber goods, various fluids.

UNIT-V	CASE STUDIES AND INVESTIGATIONS	Classes: 08

Accident investigation procedures; circumstances under which C of A is suspended; ICAO and IATA regulations, Chicago and Warsaw conventions; familiarization of recent issues of advisory circulars; civil aviation requirements section 2-airworthiness.

Text Books:

1. DGCA, "Aircraft Manual (India): The Aircraft Act 1934 Along With the Aircraft Rules, 1937", Sterling Book House, 2009.
2. "Civil Aviation Contingency Operations Manual of Planning, Training and Operations", Transport Canada publication, 1999.
3. "Civil Aircraft Airworthiness Information and Procedures (CAP 562)", safety and airspace regulation group, Version 4.1, 2016.

Reference Books:

1. Richard S. Leavenworth, Eugene Lodewick Grant, "Statistical quality control", McGraw-Hill Education, 2000.
2. Parker E.R., "British Civil Airworthiness Requirements", Civil Aviation Authority, revised edition, 2001.
3. Great Britain, Board of Trade, "Aeronautical Information Circulars", H.M. Stationery Office, 1967.

Web References:

1. https://dgca.nic.in/aic/aic-ind.htm
2. https://dgca.nic.in/rules/car-ind.htm
3. https://www.dgca.nic.in/rules/adv-ind.htm
4. https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=92

E-Text Books:

1. https://books.google.co.in/books?id=VC9k9KD4t3UC&printsec=frontcover&dq=gran+el+statistical+quality+control&hl=en&sa=X&ved=0ahUKEwjWgZujkd_QAhXHRo8KHaq1BcQQ6AEIJjAA#v=onepage&q&f=false
2. https://dgca.nic.in/circular/aac01_2016.pdf

Course Home Page:

FLIGHT SCHEDULING AND OPERATIONS

GROUP - V								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE529	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand complexity and scheduling of airline operation systems.

II. Understand many operational issues involved in handling passengers, freight and aircraft at airports.

UNIT-I	NETWORK FLOWS AND INTEGER PROGRAMMING MODELS	Classes: 08

Complexity of airline planning, operations and dispatch, need for optimization, role of operations research and simulation; Networks: definitions, network flow models, shortest path problem, minimum cost flow problem, maximum flow problem, multi-commodity problem; Integer programming models, set covering/partitioning problems, travelling salesman problem, mathematical formulation, decision variables, objective function, constraints, methods of solution; Solution by simulation.

UNIT-II	FLIGHT SCHEDULING, FLEET ASSIGNMENT AND AIRCRAFT ROUTING	Classes: 10

Significance of flight scheduling; The route system of the airlines, point-to-point flights, hub and spoke flights; Schedule construction, operational feasibility, economic viability; Route development and flight scheduling process, load factor and frequency, case study; Purpose of fleet assignment; Fleet types, fleet diversity, fleet availability, performance measures, formulation of the fleet assignment problem, decision variables, objective function, constraints, solution; Goal of aircraft routing, maintenance requirements, other constraints; Routing cycles, route generators; Mathematical models of routing, decision variables, objective functions, alternatives, constraints- flight coverage and aircraft available; Example problems and solutions.

UNIT-III	CREW AND MANPOWER SCHEDULING	Classes: 10

Crew scheduling process, significance; Development of crew pairing, pairing generators, mathematical formulation of crew pairing problem, methods of solution.

Crew roistering, rostering practices; The crew rostering problem, formulation, solutions; Manpower scheduling, modeling, formulation of the problem, solutions.

UNIT-IV	GATE ASSIGNMENT AND AIRCRAFT BOARDING STRATEGY, AIRLINE IRREGULAR OPERATION, DISRUPTION OF SCHEDULE AND RECOVERY	Classes: 09

Gate assignment, significance, the problem, levels of handling-passenger flow, distance matrix-mathematical formulation, solution; Common strategies for aircraft boarding process, mathematical model, interferences, model description, aisle interferences; The problem statement, the time band approximation model- formulation of the problem, the scenarios - solution.

UNIT-V	COMPUTATIONAL COMPLEXITY, CASE STUDIES OF AIRLINE OPERATIONS AND SCHEDULING AND SIMULATION.	Classes: 08

Complexity theory, heuristic procedures; Case studies of airline operation and scheduling, study through simulation modeling, use of available software.

Text Books:

1. Bazargan, M., “Airline Operations and Scheduling”, Ashgate Publishing Ltd, 2nd Edition, 2010.

Reference Books:

1. Belobaba, P., Odoni, A., Barnhart, C. “The Global Airline Industry”, Wiley, 2nd Edition 2009.
2. Wu, Cheng-Lu0ng, “Airline Operations and Delay Management”, Ashgate Publishing Ltd, 2010.
3. Wensveen, J.G., “Air Transportation: A Management Perspective”, Ashgate Publishing Ltd 6th Edition., 2007.
4. Ahuja, R. et al, “Network Flows-Theory, Algorithms and Applications”, Prentice-Hall, 1993.

Web References:

1. https://51.254.215.131/files/airport-operations-book-pdf.pdf
2. https://andromeda.rutgers.edu/~jy380/research/air-schedule/chapter50.pdf

E-Text Books:

1. https://51.254.215.131/files/airport-operations-book-pdf.pdf
2. https://andromeda.rutgers.edu/~jy380/research/air-schedule/chapter50.pdf

Course Home Page:

AIRPORT OPERATIONS

GROUP-V									
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE530	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyze and understand the complexity and functioning of airport operation systems.
II. Understand many operational issues involved in handling passengers, freight and aircraft at airports.

UNIT-I	THE AIRPORT AS AN OPERATIONAL SYSTEM	Classes: 08

Private airports and public use airports, commercial service airports and primary commercial service airports, general aviation airports, reliever airports; Hub classification, large hubs, medium hubs, small hubs, non-hubs; Components of an airport, airside, landside; Airport as a system, function of the airport-complexity of airport operation; Airport planning: Airport system planning, airport master plan, airport layout plan- forecasting, facilities requirements, design alternatives. Financial plans, land use planning, environmental planning.

UNIT-II	GROUND HANDLING AND BAGGAGE HANDLING	Classes: 10

Ground handling: Passenger handling; Ramp handling; Aircraft ramp servicing; Ramp layout; Departure control; Division of ground handling responsibilities; Control of ground handling efficiency; Baggage handling: Context, history and trends; Baggage handling processes; Equipment, systems and technologies, process and system design drivers; Organization; Management and performance metrics.

UNIT-III	PASSENGER TERMINAL AND CARGO OPERATIONS	Classes: 10

Passenger terminal operations: Functions of the passenger terminal; Terminal functions; Philosophies of terminal management; Direct passenger services; Airline related passenger services; Airline related operational functions; Government requirements; Non-passenger related airport authority functions; processing very important persons; Passenger information systems; Space components and adjacencies.

Aids to circulation; Hubbing considerations; Cargo operations: The cargo market; Expediting the movement; Flow through the terminal; Unit load devices; Handling within the terminal; Cargo apron operation; Facilitation; Examples of modern cargo terminal design and operation; Cargo operations by the integrated carriers.

UNIT-IV	AIRPORT TECHNICAL SERVICES AND ACCESS	Classes: 09

Airport technical services: The scope of technical services; Safety management system; Air traffic control; Tele communications; Meteorology; Aeronautical information; Airport access: Access as part of the airport system; Access users and modal choice; Access interaction with passenger; Access modes; In town and other off; Airport terminals; Factors affecting access; Mode choice.

UNIT-V	OPERATIONAL ADMINISTRATION AND PERFORMANCE	Classes: 08

Operational administration and performance: Strategic context; Tactical approach to administration of airport operations; Managing operational performance; Key success factors for high; Performance;

Airport operations control centres: The concept of airport operations; airport operations control system; The airport operations consideration; Airport performance monitoring; Design and equipment considerations; Organizational and human resources considerations; Leading AOCCSs; Best practices in airport operations.

Text Books:

1. Norman J. Ashford, H. P. Martin Stanton, Clifton A. Moore, Pierre Coutu, "Airport Operations", McGraw Hill, 3rd Edition, 2013.
2. R. Horonjeff, F. X. McKelvey, W. J. Sproule, S. B. Young, "Planning and Design of Airports", McGraw Hill, 5th Edition, 2010.

Reference Books:

1. A. Kazda, R. E. Caves, "Airport Design and Operation", Elsevier, 2nd Edition, 2007.
2. A. T. Wells, S. B. Young, "Airport Planning and Management", McGraw Hill, 6th Edition, 2011.

Web References:

1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

E-Text Books:

1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition
2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html

Course Home Page:

SPACECRAFT ATTITUDE AND CONTROL

GROUP-VI								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE531	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the representative mission profile and attitude determination and control methods and define the coordinate systems.
II. Demonstrate different attitude kinematics and dynamics of spacecraft and modes of operation of sensors.
III. Discuss Global positioning system, gyroscopes and reaction wheels characteristics, disturbances and configurations.
IV. Illustrate attitude control of spacecraft, different attitude determination methods, problems and errors.

UNIT-I	INTRODUCTION	Classes:04

Representative mission profile, representative examples of attitude determination and control methods of attitude determination and control, time measurements, the spacecraft-centered celestial sphere, coordinate systems, elementary spherical geometry.

UNIT-II	ATTITUDE KINEMATICS AND DYNAMICS	Classes: 09

Attitude kinematics, attitude matrix, vector addition of angular velocity, vector kinematics, kinematics of attitude parameterizations, quaternion kinematics, rodrigues parameter kinematics, modified rodrigues parameter kinematics, rotation vector kinematics, Euler angle kinematics, attitude error kinematics, attitude dynamics.

UNIT-III	SENSORS AND ACTUATORS	Classes: 11

Redundancy, star trackers, modes of operation, field of view, resolution, update rate, proper motion, parallax, and aberration, sun sensors, horizon sensors, magnetometers.

Global positioning system, gyroscopes, reaction wheels, reaction wheel characteristics, disturbances, configurations, control moment gyros, magnetic torquers, thrusters, nutation dampers.

UNIT-IV	STATIC ATTITUDE DETERMINATION METHODS	Classes: 11

The TRIAD algorithm, Wahba’s problem, quaternion solutions of Wahba’s problem, matrix solutions of Wahba’s problem, error analysis of Wahba’s problem, MLE for attitude determination, induced attitude errors from orbit errors, TRMM attitude determination, GPS attitude determination.

UNIT-V	ATTITUDE CONTROL	Classes: 10

Introduction, attitude control, attitude thruster control, magnetic torque attitude control, effects of noise, SAMPEX control design, attitude determination, magnetic torque control law, science modes, reaction wheel control law, simulations.

Text Books:

1. F. Landis Markley. John L. Crassidis, "Fundamentals of Spacecraft Attitude Determination and Control", Springer, New York, 2nd Edition 2014.
2. James R. Wertz, "Spacecraft Attitude Determination and Control", Kluwer Academic Publishers, Dordrecht, 1978.

Reference Books:

1. Anton H. de Ruiter, Christopher Damaren, James R. Forbes, "Spacecraft Dynamics and Control: An Introduction", John Wiley and Sons, 2013.
2. Marcel J. Sidi, "Spacecraft Dynamics and Control: A Practical Engineering Approach", Cambridge University Press, 1997.

Web References:

1. link.springer.com/book/10.1007%2F978-94-009-9907-7
2. https://s3.amazonaws.com/suncam/npdocs/211.pdf

E-Text Books:

1. https://books.google.co.in/books?isbn=1493908022
2. https://books.google.co.in/books?isbn=9400999070

Course Home Page:

AUTOMATIC CONTROL OF AIRCRAFT

GROUP-VI								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE532	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the guidance and control of aircraft and explain different augmentation system and concepts.
II. Demonstrate different auto pilot systems, flight path stabilization and Automatic Flare Control.
III. Discuss fly by wire flight control systems and different flight control law design using back stepping algorithm.
IV. Illustrate operating principles and design of guidance laws, Launch Vehicle and Mission requirements.

UNIT-I	INTRODUCTION	Classes: 04

Introduction to Guidance and control: Definition, historical background.

UNIT-II	AUGMENTATION SYSTEMS	Classes: 07

Need for automatic flight control systems, stability augmentation systems, control augmentation systems, gain scheduling concepts.

UNIT-III	LONGITUDINAL AUTOPILOT	Classes: 12

Displacement Autopilot: Pitch orientation control system, acceleration control system, glide slope coupler and automatic flare control.

Flight path stabilization, longitudinal control law design using back stepping algorithm.

UNIT-IV	LATERAL AUTOPILOT	Classes: 10

Damping of the dutch roll, methods of obtaining coordination, yaw orientation control system, turn compensation, automatic lateral beam guidance.

UNIT-V	FLY BY WIRE FLIGHT CONTROL	Classes: 12

Introduction to Fly-by-wire flight control systems, fly-by-wire flight control features and advantages, control laws, redundancy and failure survival, digital implementation, fly-by-light flight control.

Text Books:

1. Blake Lock, J.H, “Automatic control of Aircraft and missiles”, John Wiley Sons, New York, 1990.
2. Stevens B.L & Lewis F.L, “Aircraft control & simulation”, John Wiley Sons, New York, 1992.
3. Collinson R.P.G, “Introduction to Avionics”, Chapman and Hall, 1st Edition India, 1996.

Reference Books:
1. Garnel.P. & East. D.J, “Guided Weapon control systems”, Pergamon Press, Oxford, 1st Edition 1977. 2. Bernad Etikin, “Dynamic of flight stability and control”, John Wiley, 1st Edition 1972. 3. Nelson R.C, “Flight stability & Automatic Control”, McGraw Hill, 1st Edition 1989.
Web References:
1. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16...aircraft.../lecture-16 2. www.fsd.mw.tum.de/research/flight-control/ 3. nptel.ac.in/courses/101108056/
E-Text Books:
1. https://books.google.co.in/books?isbn=1118870972 2. https://books.google.co.in/books?isbn=0387007261
Course Home Page:

FLIGHT SIMULATION

<table>
<tr><td colspan="11">GROUP-VI</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">AAE533</td><td rowspan="2">Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 45</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 45</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Illustrate the history of flight simulation, role of simulation, aerodynamic models with examples.
II. Understand the principle of modeling and simulation of flight control systems, different equations of aircraft system.
III. Describe the dynamics of aircraft and model validation, the atmospheric conditions and different axis systems of aircraft
IV. Define various model validation and visual systems, visual database management, projection systems, problems in visual systems.

UNIT-I	INTRODUCTION	Classes: 10

Historical Perspective, the first 40 years of flight 1905–1945,analogue computing, 1945–1965, digital computing 1965–1985, the microelectronics revolution, 1985 present, the case for simulation, safety, financial benefits, training transfer, engineering flight simulation, the changing role of simulation, the organization of a flight simulator, equations of motion, aerodynamic model, engine model, data acquisition, gear model, weather model, visual system, sound system, motion system, control loading, instrument displays, navigation systems, maintenance, the concept of real-time simulation, pilot cues, visual cueing, motion cueing, training versus simulation, examples of simulation, commercial flight training, military flight training, Ab initio flight training, land vehicle simulators, engineering flight simulators aptitude testing, computer-based training, maintenance training.

UNIT-II	PRINCIPLES OF MODELLING	Classes: 10

Modelling concepts, Newtonian mechanics, axes systems, differential equations, numerical integration, approximation methods, first order methods, higher order methods, real-time computing, data acquisition, data transmission, data acquisition, flight data, interpolation, distributed systems, a real-time protocol, and problems in modelling.

UNIT-III	AIRCRAFT DYNAMICS	Classes: 09

Principles of flight modelling, the atmosphere, forces, aerodynamic lift, aerodynamic side force, aerodynamic drag, propulsive forces, gravitational force, moments, static stability, aerodynamic moments, aerodynamic derivatives, axes systems, the body frame, stability axes, wind axes, inertial axes, transformation between axes.

Earth-centred earth-fixed frame, latitude and longitude, quaternions, equations of motion; Propulsion, piston engines, jet engines, the landing gear, the equations collected; The equations revisited: Long range navigation, coriolis acceleration.

UNIT-IV	SIMULATION OF FLIGHT CONTROL SYSTEMS	Classes: 08
The Laplace transform, simulation of transfer functions; Proportional–integral–derivative control systems, trimming, aircraft flight control systems, the turn coordinator and the yaw damper, the auto-throttle, vertical speed management, altitude hold, heading hold, localizer tracking, auto-land systems, flight management systems.		
UNIT-V	**MODEL VALIDATION AND VISUAL SYSTEMS**	**Classes: 08**
Simulator qualification and approval, model validation methods, cockpit geometry, open-loop tests, closed-loop tests, latency, performance analysis, longitudinal dynamics, lateral dynamics, model validation in perspective; Visual systems: Background, the visual system pipeline, graphics operations, real-time image generation, a rudimentary real time wire frame image generation system, an open GL real-time image generation system, an open GL real-time textured image generation system, an open scene graph image generation system, visual database management, projection systems, problems in visual systems.		

Text Books:

1. David Allerton, “Principles of Flight simulation” John Wiley & Sons, Ltd Publication, 1st Edition 1999.
2. M. J Rycroft, “Flight simulation”, Cambridge university press, 1st Edition, 1999.
3. J. M. Rolfe, K. J. Staples “Flight simulation”, Cambridge University press, 1st Edition, 1987.
4. Jeffrey Strickland, “Missile Flight Simulation”, Lulu press, Inc, 2nd Edition, 2012.
5. Jonathan M. Stern “Microsoft Flight Simulator Handbook” Brady Publishing, 1st Edition, 1995.

Reference Books:

1. Ranjan Vepa, “Flight Dynamics, Simulation, and Control: For Rigid and Flexible Aircraft”,
2. CRC press, 1st Edition, 2014.
3. Duane Mc Ruer, Irving Ashkenas, Dunstan Graham “Aircraft Dynamics and Automatic Control” Princeton University Press, 2nd Edition, 2014.
4. Brian L. Stevens, Frank L. Lewis, “Aircraft Control and Simulation”, John Wiley & Sons Ltd Publication, 2nd Edition, 2003.

Web References:

1. https://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol1/kwc2/article1.html
2. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.132.5428&rep=rep1&type=pdf
3. https://research.omicsgroup.org/index.php/Flight_simulator
4. https://as.wiley.com/WileyCDA/WileyTitle/productCd-0471371459.html

E-Text Books:

1. https://www.aeronautics.nasa.gov/pdf/principles_of_flight_in_action_9_12.pdf
2. https://helijah.free.fr/dev/Principles-of-Flight-Simulation.pdf
3. https://leseprobe.buch.de/images-adb/ee/49/ee495ffc-8dc1-4a07-ad7b-b18540b9fb60.pdf
4. https://samples.sainsburysebooks.co.uk/9780470682197_sample_388478.pdf

Course Home Page:

ORBITAL MECHANICS

<table>
<tr><td colspan="10">GROUP-VI</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">AAE534</td><td rowspan="2">Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: 45</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: 45</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in two-body, restricted three-body and n-body problem, Hamiltonian dynamics, canonical transformations, Poincare surface sections.
II. Offer a rigorous vector analysis of rotational kinematics, Review of the basic Newtonian dynamics and Analysis of spacecraft altitude dynamics.
III. Provide necessary knowledge to study the satellite and interplanetary trajectories and Formal approaches for handling coordinate transformations.
IV. Solve the orbital problems related to Earth satellite orbits using Hamilton's and generate interplanetary orbits in the frame work of restricted three-body problem.
V. Understand the rendezvous problems in orbitsal transfer problems, to provide the knowledge about link between two spacecrafts.

UNIT-I	INTRODUCTION TO ORBITAL MECHANICS	Classes: 10

Fundamental principles and definitions, problem of two bodies, Kepler's equation; Equation of motion in inertial frame, equations of relative motion, angular momentum and the orbit formulas; Central orbits, circular orbits, elliptical orbits.

UNIT-II	ORBITAL POSITION AND ORBITS IN THREE DIMENSIONS	Classes: 10

Time since periapsis, parabolic trajectories, hyperbolic trajectories, geocentric right ascension-declination frame, state vector and the geocentric equatorial frame, orbital elements and the state vector; Coordinate transformation, transformation between geocentric equatorial and perifocal frames; Effects of the Earth's oblateness.

UNIT-III	PRELIMAMINARY ORBIT DETERMINATION	Classes: 09

Gibbs method of orbit determination from three position Lambert's problem, sidereal time top centric coordinate system, top centric equatorial coordinate system, top centric horizon coordinate system.

Orbit determination from angle and range measurements angles only, preliminary orbit determination; Gauss method of preliminary orbit determination.

UNIT-IV	ORBITAL MANEUVERS	Classes: 08

Kepler's equation and Lambert's theorem, force model, fundamentals of perturbation theory, perturbation in the elements, Lagrange's and Hamilton's equations, the method of canonical transformations, the general integrals of the problem of n-bodies, the problem of three bodies, restricted three-body problem, periodic and quasi-periodic orbits, Poincare surface sections.

UNIT-V	RELATIVE MOTION AND RENDEZVOUS	Classes: 08
Approximations to Relative motion in orbit Linearization of the equations of relative motion in orbit Clohessy-Wiltshire equations two-impulse rendezvous maneuvers Relative motion in close-proximity circular orbits.		

Text Books:

1. Curtis, Howard D., "Orbital Mechanics for Engineering Students", Butterworth Heinemann, Elsevier series, 3rd Edition, 2010.
2. Bate, Roger R.; Mueller, Donald D.; White, Jerry E. "Fundamentals of Astrodynamics". Dover Publications, 1st Edition 1971.

Reference Books:

1. Sellers, Jerry J.; Astore, William J.; Giffen, Robert B.; Larson, Wiley J. Kirkpatrick, Douglas H., ed. "Understanding Space An Introduction to Astronautics", McGraw Hill, 2nd Edition,2004.
2. Bryson, A.E., "Control of Aircraft and Spacecraft." Princeton University Press, 1994.
3. Thomson, William T. "Introduction to Space Dynamics." New York: Wiley. 3rd Edition, 1963.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://projectehermes.upc.edu/Enginyeria_Aeroespacial/4A/Enginyeria%20espacial/Teoria/Extra/Orbital%20Mechanics%20for%20Engineering%20Students.pdf

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

SPACE DYNAMICS

GROUP-VI								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE535	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in two-body, restricted three-body and n-body problem, Hamiltonian dynamics, canonical transformations, poincare surface sections.

II. Illustrate the importance of vector analysis of rotational kinematics, review of the basic newtonian dynamics and analysis of spacecraft altitude dynamics.

III. Understand and gain the knowledge to study the satellite and interplanetary trajectories and formal approaches for handling coordinate transformations.

IV. Analyze and solve the space dynamic problems related to earth satellite orbits using Hamilton's and generate interplanetary orbits in the frame work of restricted three-body problem.

UNIT-I	INTRODUCTION TO SPACE DYNAMICS	Classes: 10

Basic concepts: Atmospheric and space flight basic definitions, vector operations; Coordinate systems and rotation matrix, Euler axis and principal angle, Euler angles, Euler symmetric parameters (Quaternion), Rodriguez parameters, attitude kinematics.

UNIT-II	FUNDAMENTALS OF SPACE FLIGHT	Classes: 10

Newton's law of gravitation, gravitational potential, escapes velocity, mechanics of circular orbits and circular velocity non circular orbits; The two body problem, derivation of Kepler's laws from Newton's law.

UNIT-III	SPACE FLIGHT ORBITS AND ATMOSPHERE ENTRY	Classes: 09

Orbit equation, space vehicle trajectories, transfer orbit changes.

Introduction to earth and planetary entry, equations of motion for atmosphere entry; Application to ballistic entry, case study.

UNIT-IV	ORBIT TRANSFER	Classes: 08

Coplanar transfer, Hohmann transfer and Bielliptic transfer; Orbital change due to impulsive thrust; Noncoplanar transfer; Interception and Rendezvous, continuous thrust transfer.

UNIT-V	ATTITUDE DYNAMICS	Classes: 08

Euler Equations of rotational motion, rotational kinetic energy; Principal body frame, torque free rotation of spacecraft, spacecraft with attitude thrusters, spacecraft with rotors, gravity gradient satellite, dual spin satellite.

Text Books:

1. Ashish Tewari, "Atmospheric and space flight dynamics" Birkhauser publications, 1st Edition, 2007
2. Vallado, David A., "Fundamentals of Astrodynamics and Applications", Kluwer Academic Publishers, London, 3rd Edition, 2007.

Reference Books:

1. Roy, Archie E., "The Foundation of Astrodynamics", The Macmillan Company, Collier Macmillan Limited, London, 3rd Edition, 2007.
2. Kaplan, Marshall H., "Modern Spacecraft Dynamics and Control", John Wiley & Sons, New York, 1st Edition, 1976.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

ATMOSPHERIC RE-ENTRY VEHICLE

GROUP-VI									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE536	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Discuss the fundamental aspects of Re-entry.
II. Understand the major theories, approaches and methodologies used in Re-entry.
III. Analyze to build up the skills in the actual implementation of Re-entry mechanism using MATLAB/C++ code.
IV. Demonstrate the applications of Re-entry for interplanetary missions.
V. Understand basic thoughts and philosophy associated with different types of Re-entry.

UNIT-I	INTRODUCTION TO RE-ENTRY AND ATMOSPHERIC MODEL	Classes: 10

What is Re-entry? Background, meteorites-nature's re-entry, artifacts-manmade re-entry, standard atmospheres, atmospheric description, physical foundations of an atmospheric model, derived atmospheric quantities, exponential atmosphere, planetary atmospheres.

UNIT-II	AXIS TRANSFORMATIONS, FORCE AND MOMENT EQUATIONS	Classes:09

Directional cosine matrix, updating the DCM, Euler angles, updating Euler angles, axis/angle Parameters, updating the axis/angle parameters, Euler four-parameter method (Quaternions), Newton's second law of motion, force and moment equations, calculation of the moments and products of inertia.

UNIT-III	FLOW FIELD DESCRIPTION, RE-ENTRY VEHICLE PARTICLE MECHANICS, DECOYS AND THE IDENTIFICATION OF RE-ENTRY VEHICLES	Classes: 10

Introduction, flow field determination, fluid flow governing equations, definition of fluid: Microscopic and macroscopic structure of gases, flow regimes, free molecular flow, continuum flow.

Hypersonic Flow, impact methods, transition flow re-entry physics, equations of planar motion, re-entry case studies, some non dimensional representations, heat transfer and dynamics, estimators, decoy effectiveness.

UNIT-IV	MANEUVERING RE-ENTRY VEHICLES: PARTICLE MOTION	Classes: 08

Introduction, drag polar, MARV state equations, dive line guidance, determining the projected interception point, interceptor guidance equations, interceptor state equations, other guidance laws.

UNIT-V	ANGULAR MOTION DURING RE-ENTRY	Classes: 08

Introduction, planar motion, static stability, phugoid and spiral motion, aerodynamic force and moments in a body frame, rolling moment, pitching moment equations in an exponential atmosphere.

Text Books:

1. Regan, Frank J. "Dynamics of Atmospheric Re-entry". AIAA, 1993.
2. Hankey, Wilbur L. "Re-entry Aerodynamics". AIAA, 1988.

Reference Books:

1. Vk Harrison, H. Ron. "Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink" TewariA. Birkhauser Verlag, Viaduktstrasse 42, CH-4051 Basel, Switzerland, 1st Edition, 2007.

Web References:

1. www.amazon.com/Re-Entry-Making-Transition-Missions/dp/0927545403
2. www.amazon.com/Reentry-Team-Caring-Returning-Missionaries/dp/1880185075/ref=pd_sim_14_3?_encoding=UTF8&psc=1&refRID=H4C5H050A6E0PYN3X4NQ

E-Text Books:

1. www.arc.aiaa.org/doi/abs/10.2514/8.9476?journalCode=jasps
2. www.arc.aiaa.org/doi/abs/10.2514/5.9781600862342.0081.0142
3. www.arc.aiaa.org/action/doSearch?AllField=re-entry+aerodynamics

Course Home Page:

ELEMENTS OF MECHANICAL ENGINEERING

VI Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AME551	Elective	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Familiarize with fundamentals of mechanical systems.
II. Understand and appreciate the significance of mechanical engineering in different fields of engineering.
III. Understanding of application and usage of various engineering materials.

UNIT-I	INTRODUCTION TO ENERGY SYSTEMS	Classes: 09

Introduction: Prime movers and its types, concept of force, pressure, energy, work, power, system, heat, temperature, specific heat capacity, change of state, path, process, cycle, internal energy, enthalpy, statement of zeroth law and first law; Energy: Introduction and application, of energy sources like fossil fuels, nuclear fuels, hydels, solar, wind, and bio-fuels, environment issues like global warming and ozone depletion; Properties of gases: Gas laws, Boyle's law, Charle's law, gas constant, relation between C_p and C_v, various non flow processes like constant volume processes, constant pressure process, isothermal process, adiabatic process, poly-tropic process.

UNIT-II	STEAM TURBINES, HYDRAULIC MACHINES	Classes: 09

Properties of steam: Steam formation, types of steam enthalpy, specific volume, internal volume, internal energy and dryness fraction of steam, use of steam tables, calorimeters; Heat engine: Heat engine cycle and heat engine, working substances, classification of heat engines, description and thermal efficiency of carnot, Rankine, otto cycle, diesel cycles; Steam boilers: Introduction, cochran, lancashire, babcock, and Wilcox boiler, functioning of different mountings and accessories.

UNIT-III	INTERNAL COMBSUTION ENGINES, REFRIGERATION AND AIR-CONDITIONING	Classes: 09

Internal combustion engines: Introduction, classification, engine details, four stroke, two stroke cycle, petrol engine, diesel engine, indicated power, brake power, efficiencies; Pumps: Types, operation of reciprocating. rotary, centrifugal pumps, priming.

Air compressors: Types, operation of reciprocating, rotary air compressors, significance of multi-staging; Refrigeration and air-conditioning: Refrigerant, vapor compression refrigeration system, vapor absorption refrigeration system, domestic refrigerator, window and split air conditioners.

UNIT-IV	MACHINE TOOLS AND AUTOMATION	Classes: 09

Machine tools and automation machine tools operation: Turning, facing , knurling, thread cutting, taper turning by swiveling the compound rest, drilling, boring, reaming, tapping, counter sinking, counter boring, plane milling, end milling, slot milling; Robotic and automation: Introduction, classification based on robot configuration, polar, cylindrical, cartesian, coordinate and spherical, application, advantages and advantages; Automation: Definition, types, fixed, programmable and flexible automation, NC/CNC machines, basic elements with simple block diagrams, advantages and disadvantages.

UNIT-V	ENGINEERING MATERIALS, JOINING PROCESS	Classes: 09
Engineering materials and joining processes: Types, applications of ferrous metals, non-ferrous metals, alloys; Composites: Introduction, definition, classification and application (Automobile and Air Craft).		
Text Books:		
1. V. K. Manglik, "Elements of Mechanical Engineering", Prentice Hall, 1st Edition, 2013. 2. Mikell P. Groover, "Automation, Production Systems and CIM", Prentice Hall, 4th Edition, 2015.		
Reference Books:		
1. S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", University Press, 4th Edition, 2006. 2. K. P. Roy, S. K. Hajra Choudary, Nirjhar Roy, " Element of Mechanical Engineering", Media Promoters & Publishers, 7th Edition, 2012. 3. Pravin Kumar, "Basic Mechanical Engineering", Pearson, 1st Edition, 2013.		
Web References:		
1. http://www.nptel.ac.in/courses/112107144/ 2. *http://www.*nptel.ac.in/courses/112101098/download/lecture-37.pdf		
E-Text Books:		
1. www.wiley-vch.de/vch/journals/2081/books/2081_rel_title_varadan.pdfM 2. www.ebooks.cawok.pro/Artech.House.Publishers.An.Introduction.to.Microelectrical.pdf		
Course Home Page:		

DISASTER MANAGEMENT

VI Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
ACE551	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Identify the major disaster types and develop an understanding of modern disaster management.
II. Recognize and develop awareness of the chronological phases of natural disaster response and refugee relief operations.
III. Understand the key concepts of disaster management related to development and the relationship of different disaster management activities.
IV. Categorize the organizations that are involved in natural disaster assistance and relief system.

UNIT-I	ENVIRONMENTAL HAZARDS AND DISASTERS	Classes: 09

Environmental hazards and disasters: meaning of environmental hazards, environmental disasters and environmental stress; concept of environmental hazards, environmental stress and environmental disasters, different approaches and relation with human ecology, landscape approach, ecosystem approach, perception approach, human ecology and its application in geographical researches.

UNIT-II	TYPES OF ENVIRONMENTAL HAZARDS AND DISASTERS	Classes: 09

Types of environmental hazards and disasters: Natural hazards and disasters, man induced hazards and disasters, natural hazards, planetary hazards/ disasters, extra planetary hazards/ disasters, planetary hazards, endogenous hazards, exogenous hazards.

UNIT-III	ENDOGENOUS HAZARDS	Classes: 09

Endogenous hazards, volcanic eruption, earthquakes, landslides, volcanic hazards/ disasters, causes and distribution of volcanoes, hazardous effects of volcanic eruptions, environmental impacts of volcanic eruptions.

Earthquake hazards/ disasters, causes of earthquakes, distribution of earthquakes, hazardous effects of, earthquakes, earthquake hazards in India, human adjustment, perception and mitigation of earthquake.

UNIT-IV	EXOGENOUS HAZARDS	Classes: 09

Exogenous hazards/ disasters, infrequent events, cumulative atmospheric hazards/ disasters; Infrequent events: Cyclones , lightning , hailstorms; Cyclones: Tropical cyclones and local storms, destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation); Cumulative atmospheric hazards/ disasters: Floods, droughts, cold waves, heat waves floods; Causes of floods, flood hazards India, flood control measures (human adjustment, perception and mitigation); Droughts: Impacts of droughts, drought hazards in India, drought control measures, extra planetary hazards/ disasters, man induced hazards /disasters, physical hazards/ disasters, soil erosion, Soil erosion: Mechanics and forms of soil erosion, factors and causes of soil erosion, conservation measures of soil erosion; Chemical hazards/ disasters: Release of toxic chemicals, nuclear explosion, sedimentation processes; Sedimentation processes: Global sedimentation problems regional sedimentation problems, sedimentation and environmental problems, corrective measures of erosion and sedimentation, biological hazards/ disasters, population explosion.

UNIT-V	EMERGING APPROACHES IN DISASTER MANAGEMENT	Classes: 09
Emerging approaches in Disaster Management, Three Stages 1. Pre, disaster stage (preparedness) 2. Emergency Stage 3. Post Disaster stage, Rehabilitation.		

Text Books:

1. Pardeep Sahni, "Disaster Mitigation: Experiences and Reflections", PHI Learning Pvt. Ltd., 1st Edition, 2001.
2. J. Glynn, Gary W. Hein Ke, "Environmental Science and Engineering", Prentice Hall Publishers, 2nd Edition, 1996.

Reference Books:

1. R.B.Singh (Ed), "Environmental Geography", 2nd Edition, 1990.
2. R.B. Singh (Ed), "Disaster Management", 2nd Edition, 2006.

Web References:

1. https://www.google.co.in/?gfe_rd=cr&ei=,iAwWLiDIazv8we8_5LADA#q=disater+mangement
2. http://ndma.gov.in/images/policyplan/dmplan/National%20Disaster%20Management%20Plan%20May%202016.pdf
3. http://www.eib.europa.eu/attachments/pipeline/20080021_eia_en.pdf
4. http://www.ndmindia.nic.in/

E-Text Books:

1. https://www.google.co.in/?gfe_rd=cr&ei=,iAwWLiDIazv8we8_5LADA#q=disaster+management+e+textbooks
2. http://cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf\
3. http://www.digitalbookindex.org/_search/search010emergencydisastera.asp
4. http://www.icbse.com/books/cbse,ebooks,download

Course Home Page:

GEOSPATIAL TECHNIQUES

VI SEMESTER: Common for all branches									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
ACE552	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Apply the technical skills to use geo-referenced data for the purpose of economic, educational, and social development.

II. Apply descriptive and analytical knowledge about map reading, statistics, and geospatial technologies.

III. Integrate the domains of geography and apply their knowledge to issues concerning people, places, and environments.

IV. Describe**,** analyze, and explain the patterns, processes, and interactions of human and physical phenomena on Earth's surface.

UNIT-I	**INTRODUCTION TO GEOSPATIAL DATA**	**Classes: 09**

Introduction geospatial data, why to study geospatial data, importance of geospatial technology, spatial data infrastructure, three important geospatial technologies, spatial elements, coordinates and coordinate systems, basic electromagnetic radiation.

UNIT-II	**PHOTOGRAMMETRY AND REMOTE SENSING**	**Classes: 09**

Definition and scope, history of photogrammetry and remote sensing, principle, remote sensing data acquisition, remote sensing data analysis methods, advantages and limitations, hardware and software required; Map vs mosaic, ground control points; Energy interactions with atmosphere and earth surface features.

UNIT-III	**MAPPING AND CARTOGRAPHY**	**Classes: 09**

What is map and its importance, map scale and types, elements of map and indexing, map coordinate systems, visual interpretation of satellite images, interpretation of terrain evaluation.

Introduction to digital data analysis, cartographic symbolization, classification of symbols, colours in cartography, scale and purpose of a map, cartographic design, thematic cartography, digital cartography.

UNIT-IV	**GEOGRAPHIC INFORMATION SYSTEM**	**Classes: 09**

Introduction to GIS, definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, a theoretical framework for GIS, GIS data structures, data collection and input overview, processing of spatial data, data input or output, vector data model, raster data model, geometric representation of spatial feature and data structure; Spatial data and modeling, tin, DTM, overlay, spatial measurement etc.

UNIT-V	**GEOSPATIAL TECHNOLOGIES APPLICATIONS**	**Classes: 09**

Visual image analysis for land use/land cover mapping, land use and land cover in water resources, surface water mapping and inventory, geological and soil mapping, agriculture applications for forestry

applications, water resources applications, urban and regional planning, environmental assessment, principles of land form identification and evaluation: sedimentary, igneous and metamorphic rock terrain.
Text Books:
1. John D. Bossler, Taylor, Francis, "Manual of Geospatial Science and Technology", CRC Press, 2010. 2. M. Anji Reddy, "Textbook of Remote Sensing and Geographical Information Systems", BS Publication, 2001.
Reference Books:
1. C. P. Lo Albert, K.W. Yonng, "Concepts and Techniques of GIS", 2nd Edition, 2007. 2. Otto Huisman and Rolf A. de "Principles of Geographic Information Systems", 4th Edition, 2009
Web References:
1. https://www.aaas.org/content/what-are-geospatial-technologies 2. http://www.istl.org/10-spring/internet2.htmls 3. https://geography.columbian.gwu.edu/applied-geospatial-techniques 4. http://kiran.nic.in/pdf/publications/Geospatial_Techniques.pdf
E-Text Books:
1. http://link.springer.com/book/10.1007%2F978-94-007-1858-6 2. http://www.springer.com/us/book/9789400718579 3. http://cbseacademic.in/web_material/doc/2014/7_Geospatial%20Technology%20Text%20Book%20(Class-XII).pdf 4. http://freegeographytools.com/2009/two-free-textbooks-on-geospatialgeostatistical-analysis.
Course Home Page:

PRINCIPLES OF OPERATING SYSTEMS

VI Semester: Common for all Braches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACS551	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the functionalities of main components in operating systems.
II. Analyze the algorithms used in memory and process management.
III. Understand the clock synchronization protocols.
IV. Interpret the concepts of input and output storage for file management.

UNIT-I	INTRODUCTION	Classes: 10

Operating systems objectives and functions: Computer system architecture, operating systems structure, operating systems operations; Evolution of operating systems: Simple batch, multi programmed, time shared, real time systems, operating system services; Systems calls: Types of systems calls.

UNIT-II	PROCESS AND CPU SCHEDULING, PROCESS COORDINATION	Classes: 10

Process concepts: The process, process state, process control block, threads; process scheduling: Scheduling queues, schedulers, context switch, preemptive scheduling, dispatcher, scheduling criteria, scheduling algorithms, Process synchronization, the critical section problem; semaphores and monitors.

UNIT-III	MEMORY MANAGEMENT AND VIRTUAL MEMORY	Classes: 08

Logical and physical address space: Swapping, contiguous memory allocation, paging, structure of page table.

Segmentation: Segmentation with paging, virtual memory, demand paging; Page replacement, page replacement algorithms, thrashing.

UNIT-IV	FILE SYSTEM INTERFACE	Classes: 09

The concept of a file, access methods, directory structure, file system mounting, file sharing, protection, file system structure, file system implementation, allocation methods, free space management, directory implementation.

UNIT-V	DEADLOCKS, PROTECTION	Classes: 08

System model: Deadlock characterization, methods of handling deadlocks, deadlock prevention, dead lock avoidance, dead lock detection, principles of protection, domain of protection, access matrix, implementation of access matrix.

Text Books:
1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Principles", Wiley Student Edition, 8th Edition, 2010. 2. William Stallings, "Operating System- Internals and Design Principles", Pearson Education, 6th Edition, 2002.
Reference Books:
1. Andrew S Tanenbaum, "Modern Operating Systems", PHI, 3rd Edition, 2007. 2. D. M. Dhamdhere, "Operating Systems a Concept based Approach", Tata McGraw Hill, 2nd Edition, 2006.
Web References:
1. https://www.smartzworld.com/notes/operatingsystems 2. https://www.scoopworld.in 3. https://www.sxecw.edu.in 4. https://www.technofest2u.blogspot.com
E-Text Books:
1. https://it325blog.files.wordpress.com/2012/09/operating-system-concepts-7-th-edition.pdf 2. http://mpathinveco.blog.com/2014/11/25/operating-systems-william-stalling-6th-edition/ 3. http://www.e-booksdirectory.com/details.php?ebook=10050 4. http://www.e-booksdirectory.com/details.php?ebook=9907 5. http://www.e-booksdirectory.com/details.php?ebook=9460
Course Home Page:

JAVA PROGRAMMING

VI Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
ACS552	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand fundamentals of object-oriented terminology and programming concepts in java.
II. Acquire basics of how to translate solution problem into object oriented form.
III. Develop programs in java for solving simple applications.
IV. Design and implement simple program that use exceptions and multithreads.

UNIT-I	OOP CONCEPTS AND JAVA PROGRAMMING	Classes: 08

OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, constructors, methods, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow statements, arrays, parameter passing.

UNIT-II	INHERITANCE	Classes: 10

Inheritance: Inheritance hierarchies, super and subclasses, member access rules, Polymorphism**:** Dynamic binding, method overriding, abstract classes and methods.

UNIT-III	EXCEPTION HANDLING AND MULTI THREADING	Classes: 08

Exception Handling: Benefits of exception handling, the classification of exceptions, usage of try, catch, throw, throws and finally.

Multithreading: Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads.

UNIT-IV	INTERFACES AND PACKAGES	Classes: 09

Interface: Interfaces vs Abstract classes, defining an interface, implement interfaces, Packages: Defining, creating and accessing a package, importing packages.

UNIT-V	FILES, AND CONNECTING TO DATABASE	Classes: 10

Files: streams – byte streams, character stream, text input/output, binary input/output, file management; Connecting to Database: Connecting to a database, querying a database and processing the results, updating data with JDBC.

Text Books:

1. Herbert Schildt, Dale Skrien, “Java Fundamentals – A Comprehensive Introduction”, McGraw-Hill, 1st Edition, 2013.
2. Herbert Schildt, “Java the Complete Reference”, McGraw Hill, Osborne, 8thEditon, 2011.
3. T. Budd, “Understanding Object-Oriented Programming with Java”, Pearson Education, Updated Edition (New Java 2 Coverage), 1999.

Reference Books:

1. P. J. Deitel, H. M. Deitel, “Java: How to Program”, Prentice Hall, 6th Edition, 2005.
2. P. Radha Krishna, “Object Oriented Programming through Java”, Universities Press, CRC Press, 2007.
3. Bruce Eckel, “Thinking in Java”, Prentice Hall, 4th Edition, 2006.
4. Sachin Malhotra, Saurabh Chaudhary, “Programming in Java”, Oxford University Press, 2nd Edition, 2014.

Web References:

1. http://www.javatpoint.com/java-tutorial
2. http://www.javatutorialpoint.com/introduction-to-java/

E-Text Books:

1.http://bookboon.com/en/java-programming-language-ebooks
2.https://en.wikibooks.org/wiki/Java_Programming

Course Home Page:

EMBEDDED SYSTEM DESIGN

VI SEMESTER: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AEC551	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 0**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Imbibe knowledge about the basic functions, structure, concepts and applications of Embedded Systems.
II. Understand Real time operating system concepts.
III. Analyze different tools for development of embedded software.
IV. Understand the architecture of advanced processors.

UNIT-I	**EMBEDDED COMPUTING**	**Classes: 09**

Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, complex systems and microprocessor, classification, major application areas, the embedded system design process, , formalisms for system design, design examples

UNIT-II	**THE 8051 ARCHITECTURE**	**Classes: 09**

Introduction, 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts. The Assembly Language Programming Process, Instructions of 8051 Programming Tools and Techniques, Simple Programs.

UNIT-III	**INTRODUCTION TO EMBEDDED C AND APPLICATIONS**	**Classes: 09**

Embedded systems programming in C, binding and running embedded C program in Keil IDE, dissecting the program, building the hardware;

Basic techniques for reading and writing from I/O port pins, LED interfacing, interfacing with keyboards, displays, D/A and A/D conversions, using embedded C interfacing

UNIT-IV	**INTRODUCTION TO REAL – TIME OPERATING SYSTEMS**	**Classes: 09**

Tasks and Task States, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Interrupt Routines in an RTOS Environment. Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine

UNIT-V	**INTRODUCTION TO ADVANCED ARCHITECTURES**	**Classes: 09**

ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus.

Text Books:

1. Wayne Wolf, “Principles of Embedded Computing System Design”, Elseveir., 2nd Edition 2014,
2. Kenneth J.Ayala, “The 8051 Microcontroller”, Thomson, 3rd Edition 2016,.
3. Dr. K V K K Prasad, “Embedded / Real-Time Systems : Concepts, Design And Programming”, Black Book , DreamTech Press, ISBN: 9788177224610

Reference Books:

1. Embedding system building blocks, Labrosse, via CMP publishers.
2. Embedded Systems, Raj Kamal, TMH.
3. Micro Controllers, Ajay V Deshmukhi, TMH.
4. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley
5. Microcontrollers, Raj kamal, Pearson Education.
6. An Embedded Software Primer, David E. Simon, Pearson Education.
7. 8051 Microcontroller and Embedded Systems, by Muhammad Ali Mazadi,Janice Mazidi,Janice Gillispie Mazdi

Web References:

1. https://www.smartzworld.com/notes/embedded-systems-es/
2. http://notes.specworld.in/embedded-systems-es/
3. http://education.uandistar.net/jntu-study-materials
4. http://www.nptelvideos.in/2012/11/embedded-systems.html

E-Text Books:

1. https://www.scribd.com/doc/233633895/Intro-to-Embedded-Systems-by-Shibu-Kv
2. http://www.ee.eng.cmu.ac.th/~demo/think/_DXJSq9r3TvL.pdf
3. https://www.scribd.com/doc/55232437/Embedded-Systems-Raj-Kamal
4. https://docs.google.com/file/d/0B6Cytl4eS_ahUS1LTkVXb1hxa00/edit
5. http://www.ecpe.nu.ac.th/ponpisut/22323006-Embedded-c-Tutorial-8051.pdf

INTRODUCTION TO AUTOMOBILE ENGINEERING

VI Semester: **Common for all Branches**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AME552	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes:45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the function of various parts of automobile, features of fuel supply systems for S.I and C.I engines.
II. Distinguish the features of various types of cooling, ignition and electrical systems.
III. Identify the merits and demerits of the various transmission and suspension systems.
IV. Recognize the working of various braking and steering systems.
V. Summarize the ways and means of reducing the emissions from automobiles.

UNIT-I INTRODUCTION — Classes: 09

Introduction to automobile engineering, chassis and automobile components, automobile engines, otto cycle, diesel cycle, dual cycle, engine lubrication, lubricating oil, lubrication oil filter, engine servicing; Fuel supply system; Fuel tank, strainer, feed pump, fuel filter, injection pump, injector, filters, electronic controlled fuel injection, common rail direct injection systems.

UNIT-II COOLING SYSTEM — Classes: 09

Cooling requirements, air cooling, liquid cooling, water forced circulation system, radiators, cooling fan, water pump, thermostat, pressure sealed cooling, antifreeze solutions, intelligent cooling; Ignition system: Function of an ignition system, battery ignition system, storage battery, condenser and spark plug, magneto coil ignition system, electronic ignition system, electronic ignition, spark advance mechanisms; Electrical system: Charging circuit, generator, current-voltage regulator, starting system, bendix drive mechanism solenoid switch, lighting systems, automatic high beam control, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator.

UNIT-III TRANSMISSION AND SUSPENSIONS SYSTEMS — Classes: 09

Transmission system: Clutches, principle, types, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel.

Gear boxes, types, constant mesh, synchro mesh gear boxes, epicyclic gear box, auto transmission, continuous variable transmission, propeller shaft, Hotch-Kiss drive, Torque tube drive, universal joint, differential, rear axles types, wheels and tyres; Suspension system: Objects of suspension systems, rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT-IV BRAKING AND STEERING SYSTEMS — Classes: 09

Braking system: Mechanical brake system, Hydraulic brakes system, Master cylinder, wheel cylinder, Requirements of brake fluid, pneumatic and vacuum brake, ABS; Steering system: Steering geometry, camber, castor, king pin, rake, combined angle toe-in, toe-out, types of steering mechanism, Ackerman steering mechanism, Davis steering mechanism, steering gears types, steering linkages.

UNIT-V	EMISSIONS FROM AUTOMOBILES	Classes: 09
Emissions from automobiles, pollution standards national and international, pollution control techniques, petrol injection, common rail diesel injection, variable valve timing; Energy alternatives, solar, photo-voltaic, hydrogen, biomass, alcohols, LPG, CNG, liquid fuels and gaseous fuels, hydrogen as a fuel for internal combustion engines, their merits and demerits.		

Text Books:

1. Willam H crouse, Donald L. Anglin, "Automobile Engineering", McGraw Hill, 10th Edition, 2006.
2. Manzoor, Nawazish Mehdi, Yosuf Ali, "A Text Book Automobile Engineering", Frontline Publications, 1st Edition, 2011.

Reference Books:

1. R. K. Rajput, "A Text Book of Automobile Engineering", Laxmi Publications, 1st Edition, 2015.
2. Joseph Heinter, "Automotive Mechanics", CBS, 2nd Edition, 2006.
3. K. Netwon, W. Steeds, T. K.Garrett, "Automotive Engineering", Butterworth-Heinamann, 13th Edition, 2016.
4. S. Srinivasan, "Automotive Engines", Tata McGraw-Hill, 2nd Edition, 2003.
5. Khalil. U. Siddiqui, "A Text Book of Automobile Engineering", New Age International, 1st Edition, 2012.

Web References:

1. http://www.nptel.kmeacollege.ac.in/syllabus/125106002/
2. http://www.nptel.ac.in/courses/125106002/

E-Text Books:

1. http:// www.engineeringstudymaterial.net/tag/automotive-engineering-books
2. https://www.studynama.com/.../299-Automobile-engineering-lecture-notes-ebook-pdf

Course Home Page:

INTRODUCTION TO ROBOTICS

VI Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AME553	Elective	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes:45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Familiarize with the automation and brief history of robot and applications.
II. Understand the kinematics of robots and knowledge about robot end effectors and their design.
III. Apply robot actuators and feedback components to automation.

UNIT-I	INTRODUCTION TO ROBOTICS	Classes: 09

Introduction: Automation and robotic, an over view of robotics, classification by coordinate system and control systems; Components of the industrial robotics: Degrees of freedom, end effectors: Mechanical gripper, magnetic, vacuum cup and other types of grippers, general consideration on gripper selection and design.

UNIT-II	MOTION ANALYSIS AND KINEMATICS	Classes: 09

Motion analysis: Basic rotation matrices, composite rotation matrices, Euler angles, equivalent angle and axis, homogeneous transformation, problems; Manipulator kinematics: D-H notations, joint coordinates and world coordinates, forward and inverse kinematics, problems.

UNIT-III	KINEMATICS AND DYNAMICS	Classes: 09

Differential kinematics: Differential kinematics of planar and spherical manipulators, Jacobians, problems.

Robot dynamics: Lagrange, Euler formulations, Newton-Euler formulations, problems on planar two link manipulators.

UNIT-IV	TRAJECTORY PLANNING AND ACTUATORS	Classes: 09

Trajectory planning: Joint space scheme, cubic polynomial fit, avoidance of obstacles, types of motion: Slew motion, joint interpolated motion, straight line motion, problems; Robot actuators and feedback components; Actuators: pneumatic and hydraulic actuators.

UNIT-V	ELECTRIC ACTUATORS AND ROBOTIC APPLICATIONS	Classes: 09

Electric actuators: DC servo motors, stepper motors, feedback components: position sensors, potentiometers, resolvers and encoders, velocity sensors, tactile sensors; Robot application in manufacturing: Material handling, assembly and inspection.

Text Books:

1. Groover M. P, “Industrial Robotics”, Tata McGraw-Hill, 1st Edition, 2013.
2. J. J Craig,” Introduction to Robotic Mechanics and Control”, Pearson, 3rd Edition, 2013.

Reference Books:
1. Richard D. Klafter, "Robotic Engineering", Prentice Hall, 1^{st} Edition, 2013. 2. Fu K S, "Robotics", McGraw-Hill, 1^{st} Edition, 2013.
Web References:
1. https://www.doc.ic.ac.uk/~ajd/Robotics/RoboticsResources/lecture1.pdf 2. http://opencourses.emu.edu.tr/course/view.php?id=32 3. https://www.researchgate.net/publication/277712686_Introduction_to_Robotics_class_notes_UG_level
E-Text Books:
1. http://*www.robot.bmstu.ru/* 2. http://www.robotee.com/index.php/download-free-robotic-e-books/
Course Home Page:

AEROSPACE PROPULSION AND COMBUSTION

VI Semester: **Common for all Branches**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE551	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Demonstrate with an overview of various aerospace propulsion systems and a sound foundation in the fundamentals of thermodynamics.
II. Distinguish the elementary principles of thermodynamic cycles as applied to propulsion analysis.
III. Prioritize an introduction to combustion& gas kinetic theory.
IV. Discover a working knowledge of and the tools to measure various flight propulsion systems such as turbojets, turbofans, ramjets, rockets, air turbo-rockets and nuclear/electric propulsion systems.

UNIT-I	ELEMENTS OF AIRCRAFT PROPULSION	Classes: 10

Classification of power plants, methods of aircraft propulsion, propulsive efficiency, specific fuel consumption, thrust and power, factors affecting thrust and power, illustration of working of gas turbine engine, characteristics of turboprop, turbofan and turbojet, ram jet, scram jet, methods of thrust augmentation, atmospheric properties, turbojet, turbofan, turboprop, turbo-shaft engine construction and nomenclature, theory and performance, introduction to compressors, turbines, combustors and after burners for aircraft engines.

UNIT-II	PROPELLER THEORY	Classes: 08

Momentum theory, Blade element theory, combined blade element and momentum theory, propeller power losses, propeller performance parameters, prediction of static thrust and in flight, negative thrust, prop fans, ducted propellers, propeller noise, propeller selection, propeller charts.

UNIT-III	INLETS, NOZZLES AND COMBUSTION CHAMBERS	Classes: 10

Subsonic and supersonic inlets, relation between minimum area ratio and external deceleration ratio, starting problem in supersonic inlets, modes of inlet operation, jet nozzle, efficiencies, over expanded, under and optimum expansion in nozzles, thrust reversal.

Classification of combustion chambers, combustion chamber performance flame tube cooling, flame stabilization.

UNIT-IV	THERMODYNAMICS OF REACTING SYSTEMS	Classes: 09

Chemical kinetics: equilibrium, analysis of simple reactions, steady, state and partial equilibrium approximations, explosion theories; Transport phenomena: Molecular and convective transports; Conservation equations of multicomponent, reacting systems.

UNIT-V	PREMIXED FLAMES	Classes: 08

Rankine hugoniot relations, theories of laminar premixed flame propagation, quenching and flammability limits; Diffusion flames: Burke-Schumann theory, laminar jet diffusion flame, droplet combustion, turbulent combustion, closure problem, premixed and non-premixed turbulent combustion, introduction to DNS and LES.

Text Books:

1. Stephen R. Turns, "An Introduction to Combustion", McGraw-Hill, 3rd Edition, 2012.
2. Thomas A. Ward, "Aerospace Propulsion Systems", John Wiley and Sons, 1st Edition, 2010.

Reference Books:

1. M. H. Sadd, "Elasticity: Theory, Applications, and Numerics", Academic Press, 2nd Edition, 2009.
2. R. G. Budynas, "Advanced Strength and Applied Stress Analysis", McGraw-Hill, 2nd Edition, 1999.
3. A. P. Boresi, R.J. Schmidt, "Advanced Mechanics of Materials", John Willey & Sons, 5th Edition, 2003.

Web References:

4. https://www.nptel.ac.in/courses/101101002/
5. https://www.en.wikipedia.org/wiki/Airbreathing_jet_engine
6. https://www.en.wikipedia.org/wiki/Combustor
7. https://www.aero.iisc.ernet.in/page/propulsion

E-Text Books:

4. https://www.as.wiley.com/WileyCDA/WileyTitle/productCd-1118307984.html
5. https://www.sciencedirect.com/science/book/9781856179126
6. https://www.books.google.co.in/books?id=iUuPAQAAQBAJ&source=gbs_similarbooks

Course Home Page:

FUNDAMENTALS OF IMAGE PROCESSING

VII SEMESTER: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AEC552	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 0**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the image fundamentals and the relationship between pixels.
II. Understand the image enhancement techniques in spatial domain and frequency domain.
III. Analyze the image restoration technique from degraded image using various filtering techniques.
IV. Design segmentation of the image for boundary detection.
V. Differentiate redundancy techniques and apply for image compression.

UNIT-I	INTRODUCTION	Classes: 09

Digital image fundamentals and image transforms digital image fundamentals, sampling and quantization, relationship between pixels.

UNIT-II	IMAGE ENHANCEMENT	Classes: 09

Introduction, image enhancement in spatial domain, enhancement through point processing, types of point processing, histogram manipulation, linear and non-linear gray level transformation, local or neighborhood operation, median filter processing; Spatial domain high pass filtering, filtering in frequency domain, obtaining frequency domain filters from spatial filters, generating filters directly in the frequency domain, low pass (smoothing) and high pass (sharpening) filters in frequency domain

UNIT-III	IMAGE RESTORATION	Classes: 9

Image restoration degradation model, algebraic approach to restoration, inverse filtering.

Least mean square filters, constrained least square restoration, interactive restoration.

UNIT-IV	IMAGE SEGMENTATION, MORPHOLOGICAL IMAGE PROCESSING	Classes: 9

Image segmentation detection of discontinuities, edge linking and boundary detection, threshold, region oriented segmentation. Morphological image processing dilation and erosion, structuring element decomposition, the Strel function, erosion; Combining dilation and erosion: Opening and closing the hit and miss transformation.

UNIT-V	IMAGE COMPRESSION	Classes: 09

Image compression: Redundancies and their removal methods, fidelity criteria, image compression models, source encoder and decoder, error free compression, lossy compression, JPEG 2000 standard.

Text Books:
1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing‖, Pearson”, 3rd Edition, 2008. 2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, “Digital Image Processing”, TMH, 3rd Edition, 2010.
Reference Books:
1. Rafael, C. Gonzalez, Richard E woods, Stens L Eddings, “Digital Image Processing using MATLAB”, Tata McGraw Hill, 2nd Edition, 2010. 2. A.K. Jain, “Fundamentals of Digital Image Processing”, PHI, 1st Edition, 1989. 3. Somka, Hlavac, Boyle, “Digital Image Processing and Computer Vision”, Cengage Learning, 1st Edition, 2008. 4. Adrain Low, “Introductory Computer vision Imaging Techniques and Solutions”, Tata McGraw-Hill, 2nd Edition, 2008. 5. John C. Russ, J. Christian Russ, “Introduction to Image Processing & Analysis”, CRC Press, 1st Edition, 2010.
Web References:
1. https://imagingbook.com/ 2. https://en.wikipedia.org/wiki/Digital_image_processing 3. http://www.tutorialspoint.com/dip/ 4. http://www.imageprocessingplace.com/ 5. http://web.stanford.edu/class/ee368/ 6. https://sisu.ut.ee/dev/imageprocessing/book/1 7. https://in.mathworks.com/discovery/digital-image- 8. https://processing.html?requestedDomain=www.mathworks.com
E-Text Books:
1. http://www.sci.utah.edu/~gerig/CS6640-F2010/dip3e_chapter_02.pdf 2. http://www.faadooengineers.com/threads/350-Digital-Image-Processing 3. http://newwayofengineering.blogspot.in/2013/08/anil-k-jain-fundamentals-of-digital.html 4. http://bookboon.com/en/digital-image-processing-part-one-ebook

FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS

VII Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACS553	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the role of database management system in an organization and learn the database concepts.
II. Design databases using data modeling and data normalization techniques.
III. Construct database queries using relational algebra and calculus.
IV. Understand the concept of a database transaction and related database facilities.
V. Learn how to evaluate set of queries in query processing.

UNIT-I	CONCEPTUAL MODELING	Classes: 10

Introduction to file and database systems: Database system structure, data models: entity relationship model, relational model.

UNIT-II	RELATIONAL APPROACH	Classes: 08

Relational algebra and calculus: Relational algebra, selection and projection, set operations, renaming, joins, division, examples of algebra queries, relational calculus, tuple relational calculus.

UNIT-III	BASIC SQL QUERY AND NORMALIZATION	Classes: 10

SQL data definition; Queries in SQL: updates, views, integrity and security, relational database design.

Normal Forms: 1NF, 2NF, 3NF and BCNF.

UNIT-IV	TRANSACTION MANAGEMENT	Classes: 09

Transaction processing: Introduction, need for concurrency control, desirable properties of transaction, schedule and recoverability, Serializability and schedules.

UNIT-V	CONCURRENCY CONTROL	Classes: 08

Concurrency control; Types of locks: Two phases locking, deadlock, timestamp based concurrency control, recovery techniques, concepts, immediate update, deferred update, shadow paging.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, 4thEdition, 2002.

Reference Books:
1. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 3rd Edition, 2003. 2. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill Publishing Company, 3rd Edition, 2003. 3. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000. 4. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.
Web References:
1. https://www.youtube.com/results?search_query=DBMS+onluine+classes 2. http://www.w3schools.in/dbms/ 3. http://beginnersbook.com/2015/04/dbms-tutorial/
E -Text Books:
1. http://www.e-booksdirectory.com/details.php?ebook=10166 2. http://www.e-booksdirectory.com/details.php?ebook=7400re
Course Home Page:

BASICS OF INFORMATION SECURITY AND CRYPTOGRAPHY

VII Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AIT551	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn the basic categories of threats to computers and networks.
II. Understand various cryptographic algorithms and be familiar with public-key cryptography.
III. Apply authentication functions for providing effective security.
IV. Analyze the application protocols to provide web security.
V. Discuss the place of ethics in the Information Security Area.

UNIT-I	ATTACKS ON COMPUTERS	Classes: 08

Attacks on computers and computer security: Introduction, the need for security, security approaches, types of security attacks and security services. \

UNIT-II	SYMMETRIC KEY CIPHERS	Classes: 10

Symmetric key ciphers: Block cipher principles and algorithms (DES, AES), differential and linear cryptanalysis, block cipher modes of operation, stream ciphers; Asymmetric key ciphers: Principles of public key cryptosystems, algorithms (RSA Diffie – Helman).

UNIT-III	MESSAGE AUTHENTICATION AND CRYPTOGRAPHY	Classes: 08

Message authentication algorithm and hash functions: Authentication requirements, functions, message, authentication codes, hash functions, secure hash algorithm, whirlpool, digital signatures.

Cryptography: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography.

UNIT-IV	E-MAIL SECURITY	Classes: 10

E-mail security: Pretty good privacy; S/MIMI IP Security: IP security overview, IP security architecture, authentication header, encapsulating security payload, combining security associations, key management.

UNIT-V	WEB SECURITY	Classes: 09

Web security: Web security considerations, secure electronic transaction intruders; Virus and firewalls: Intruders, intrusion detection password management, virus and related threats, firewall design principles; Types of firewalls.

Text Books:

1. William Stallings, "Cryptography and Network Security", Pearson Education, 4th Edition, 2005.
2. AtulKahate, "Cryptography and Network Security", McGraw-Hill, 2nd Edition, 2009.

Reference Books:

1. C K Shymala, N Harini, Dr. T R Padmanabhan, "Cryptography and Network Security", Wiley India, 1st Edition, 2016.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay , "Cryptography and Network Security", McGraw-Hill, 2nd Edition, 2010.

Web References:

1. http://bookboon.com/en/search?q=INFORMATION+SECURITY
2. https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0E7QC
3. https://books.google.co.in/books/about/Information_Security.html?id=Bh45pU0_E_4C

E-Text Books:

1. https://books.google.co.in/books/about/Information_Security.html
2. http://www.amazon.in/Cryptography-Network-Security-Behrouz-Forouzan/dp/007070208X

Course Home Page:

MODELING AND SIMULATION

VII Semester: Common to All Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHS551	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic system concept and definitions of system.
II. Study the techniques to model and to simulate various systems.
III. Analyze a system and to make use of the information to improve the performance.

UNIT-I	INTRODUCTION	Classes: 08

When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of simulation; Areas of application; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of models; Discrete event system simulation; Steps in a simulation study; The basics of spreadsheet simulation; Simulation example: Simulation of queuing systems in a spreadsheet.

UNIT-II	GENERAL PRINCIPLES SIMULATION SOFTWARE	Classes: 10

Concepts in discrete-event simulation: The event-scheduling / time-advance algorithm, world views, manual simulation using event scheduling; List processing, simulation in java; Simulation in GPSS review of terminology and concepts; Useful statistical models; Discrete distributions; Continuous distributions; Poisson process; Empirical distributions.

UNIT-III	QUEUING MODELS AND RANDOM NUMBERS	Classes: 08

Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues; Rough-cut modeling: An illustration.

Properties of random numbers: Generation of pseudo random numbers; Techniques for generating random numbers; Tests for random numbers random-variate generation: Inverse transforms technique; Acceptance-rejection technique; Special properties.

UNIT-IV	INPUT MODELING	Classes: 10

Data collection; Identifying the distribution with data; Parameter estimation; Goodness of fit tests; Fitting a non-stationary poisson process; Selecting input models without data; Multivariate and time-series input models.

UNIT-V	ESTIMATION OF ABSOLUTE PERFORMANCE	Classes: 09

Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations; Model building, verification and validation; Verification of simulation models; Calibration and validation of models, optimization via simulation.

Text Books:

Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, “Discrete-Event System Simulation”, Pearson Education, 5th Edition, 2010.

Reference Books:

1. Lawrence M. Leemis, Stephen K. Park, “Discrete – Event Simulation: A First Course”, Pearson Education, 1st Edition, 2006.
2. Averill M., “Law: Simulation Modeling and Analysis”, Tata McGraw-Hill, 4th Edition, 2007.

Web References:

1. https://storage.googleapis.com/northwestern14-edu/Vtu-Notes-For-System-Modeling-And Simulation.pd.
2. http://www.slideshare.net/qwerty626/system-simulation-modeling-notessjbit.

E-Text Books:

1. http://www.e-booksdirectory.com/listing.php?category=100
2. https://www.google.co.in/?gfe_rd=cr&ei=YGRCWOWMKuPx8AfQqaaoCg#q=simulation+and+modeling+e+books&start=30

Course Home Page:

RESEARCH METHODOLOGIES

VII Semester: Common for All Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS552	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Orient the student to make an informed choice from the large number of alternative methods and experimental designs available.
II. Empower the student with the knowledge and skills they need to undertake a research project, to present a conference paper and to write a scientific article.
III. Develop a thorough understanding of the fundamental theoretical ideas and logic of research.
IV. Identify various sources of information for literature review and data collection.

UNIT-I **INTRODUCION TO RESEARCH AND PHILOSOPHIES** **Classes: 07**

Introduction to research: The role of research, research process overview; Philosophies and the language of research theory building: Science and its functions, what is theory, the meaning of methodology.

UNIT-II **A RESEARCHER PROBLEMS AND HYPOTHESES** **Classes: 10**

Thinking like a researcher: Understanding concepts, constructs, variables, and definitions; Problems and hypotheses: Defining the research problem, formulation of the research hypotheses, the importance of problems and hypotheses.

UNIT-III **RESEARCH DESIGN AND DATA COLLECTION** **Classes: 09**

Research design: Experimental and no experimental research design, field research, and survey research.

Methods of data collection: Secondary data collection methods, qualitative methods of data collection, and survey methods of data collection.

UNIT-IV **ATTITUDE MEASUREMENT , SCALING AND SAMPLING TECHNIQUES** **Classes: 09**

Attitude measurement and scaling: Types of measurement scales; Questionnaire designing, reliability and validity; Sampling techniques: The nature of sampling, probability sampling design, non probability sampling design, and determination of sample size.

UNIT-V **PROCESSING AND ANALYSIS OF DATA,ETHICAL ISSUES** **Classes: 10**

Processing and analysis of data ; Ethical issues in conducting research; Report generation, report writing, and APA format; Title page, abstract, introduction, methodology, results, discussion, references, and appendices.

Text Books:

1. Bryman, Alan, Bell, Emma, “Business Research Methods”, Oxford University Press, 3rd Edition, 2011.
2. Kerlinger, F.N., Lee, H.B.,“Foundations of Behavioral Research”, Harcourt Inc., 4th Edition, 2000.
3. Rubin, Allen, Babbie, Earl, “Essential Research Methods for Social Work”, Cengage Learning Inc., USA, 2009.

Reference Books:

1. Anantasi A., Urbina S., "Psychological Testing", Pearson Education, 2004.
2. Chawla, Deepak, Sondhi, Neena, "Research Methodology: Concepts and Cases", Vikas Publishing House Pvt. Ltd. Delhi, 2011.
3. Pawar B. S., "Theory Building For Hypothesis Specification In Organizational Studies", Response Books, New Delhi, 2009.
4. NeumanW.L., "Social Research Methods: Qualitative and Quantitative Approaches", Pearson Education, 2008.

Web References:

1. https://en.wikipedia.org/wiki/Online_research_methods
2. https://www.prescott.edu/library/resources/research-bibliography.php

E-Text Books:

1. https://www.hcmuaf.edu.vn/.../Research%20Methodology%20-%20Methods%20and%20T...
2. https://www.federaljack.com/ebooks/My%20collection%20of%20medical%20books,%2020...

Course Home Page:

ENERGY FROM WASTE

VII Semester: Common for all Branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE551	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the principles associated with effective energy management and to apply these principles in the day to day life.
II. Develop insight into the collection, transfer and transport of municipal solid waste.
III. Explain the design and operation of a municipal solid waste landfill.
IV. Device key processes involved in recovering energy from wastes, systematically evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities.

UNIT - I	INTRODUCTION TO WASTE AND WASTE PROCESSING	Classes: 08

Solid waste sources solid waste sources, types, composition, properties, global warming; Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, segregation of waste, size reduction, managing waste, status of technologies for generation of energy from waste treatment and disposal aerobic composting, incineration, furnace type and design, medical waste / pharmaceutical waste treatment technologies, incineration, environmental impacts, measures to mitigate environmental effects due to incineration .

UNIT - II	WASTE TREATMENT AND DISPOSAL	Classes: 10

Land fill method of solid waste disposal land fill classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leach ate and gases, environmental monitoring system for land fill gases.

UNIT - III	BIO-CHEMICAL CONVERSION	Classes: 09

Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel.

Industrial waste, agro residues and anaerobic digestion.

UNIT - IV	THERMO-CHEMICAL CONVERSION	Classes: 10

Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion.

UNIT - V	E-WASTE MANAGEMENT	Classes: 08

E-waste: E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; Recycling e-waste: A thriving economy of the unorganized sector, global trade in hazardous waste, impact of hazardous e-waste in India; Management of e-waste: E-waste legislation, government regulations on e-waste management, international experience, need for stringent health safeguards and environmental protection laws of India.

Text Books:

1. Nicholas P Cheremisinoff, “Handbook of Solid Waste Management and Waste Minimization Technologies”, An Imprint of Elsevier, New Delhi, 2003.
2. P Aarne Vesilind, William A Worrell and Debra R Reinhart, “Solid Waste Engineering”, 2nd edition 2002.
3. M Dutta , B P Parida, B K Guha and T R Surkrishnan, “Industrial Solid Waste Management and Landfilling practice”, Reprint Edition New Delhi, 1999.
4. Rajya Sabha Secretariat, “E-waste in India: Research unit”, Reprint Edition, June, 2011.
5. Amalendu Bagchi Design, “Construction and Monitoring of Landfills”, John Wiley and Sons, New York, 1994.
6. M. L. Davis and D. A. Cornwell, “Introduction to environmental engineering”, International Edition, 2008.
7. C. S. Rao, “Environmental Pollution Control Engineering”, Wiley Eastern Ltd. New Delhi, 1995.
8. S. K. Agarwal, “Industrial Environment Assessment and Strategy”, APH Publishing Corporation, New Delhi, 1996.
9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), “Biomass Conversion Processes for Energy and Fuels”, New York, Plenum Press, 1981.
10. Hagerty, D.Joseph; Pavoni, Joseph L; Heer, John E., “Solid Waste Management”, New York, Van Nostrand, 1973.
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, “Integrated Solid Waste management: Engineering Principles and Management issues”, New York, McGraw Hill, 1993.

Reference Books:

1. C Parker and T Roberts (Ed), “Energy from Waste”, An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
2. KL Shah, “Basics of Solid and Hazardous Waste Management Technology”, Prentice Hall, Reprint Edition, 2000.
3. M Datta, “Waste Disposal in Engineered Landfills”, Narosa Publishing House, 1997.
4. G Rich et.al, Hazardous, “Waste Management Technology”, Podvan Publishers, 1987.
5. AD Bhide, BB Sundaresan, “Solid Waste Management in Developing Countries”, INSDOC, New Delhi, 1983.

Web References:

1. https://www.e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy Kahnat, Eric williams Tech. & Engg.-2013 (Publisher: Earthscan 2013
2. https://www.What is the impact of E-waste: Tamara Thompson
3. https://www. E-waste poses a Health Hazard: Sairudeen Pattazhy

E-Text Books:

1. https://www.unep.org
2. https://www.outledge.com
3. https://www.bookdepository.com
4. https://www.ecoactiv.com

Course Home Page:

FINITE ELEMENT ANALYSIS

VII Semester: Common for all branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE552	Elective	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

IV. Possess a good understanding of the theoretical basis of the weighted residual finite element method.
V. Use the commercial finite element package ANSYS to build finite element models and solve a selected range of engineering problems.
VI. Communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.

UNIT-I	INTRODUCTION	Classes: 10

Review of various approximate method, variational approach and weighted residual approach application to structural mechanics problems; Finite difference methods- governing equation and convergence criteria of finite element method.

UNIT-II	DISCRETE ELEMENTS	Classes: 10

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element, problems for various loadings and boundary conditions 2D and 3D Frame elements, longitudinal and lateral vibration; Use of local and natural coordinates.

UNIT-III	CONTINUUM ELEMENTS	Classes: 09

Plane stress, plane strain and axi-symmetric problem; Derivation of element matrices for constant.

Linear strain triangular elements and axi-symmetric element.

UNIT-IV	ISOPARAMETRIC ELEMENTS	Classes: 08

Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.

UNIT-V	FIELD PROBLEM AND METHODS OF SOLUTIONS	Classes: 08

Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. Bandwidth, elimination method and method of factorization for solving simultaneous algebraic equations, features of software packages, sources of error.

Text Books:

1. Tirupathi. R. Chandrapatha, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Printice Hall India, 3rd Edition, 2003.
2. Rao. S.S., "Finite Element Methods in Engineering", Butterworth and Heinemann, 5th Edition 2010.
3. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill, 3rd Edition, 2005.

Reference Books:

1. Krishnamoorthy C.S, "Finite Element Analysis", Tata McGraw Hill, 2nd Edition 2001.
2. K. J. Bathe, E. L. Wilson, "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
3. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, Inc., 4th Edition, 2003.
4. Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, Inc, 2nd Edition, 1984.

Web References:

1. http://home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
2. http://nptel.ac.in/courses/112104116/
3. http://www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

E-Text Books:

1. http://www.civilenggforall.com/2015/09/finite-element-analysis-by-ss-bhavikatti-free-download-pdf-civilenggforall.com.html
2. https://books.google.co.in/books/about/Finite_Element_Analysis_For_Engineering.html?id=3XJoK4x5fZwC

Course Home Page:

BASIC REFRIGERATION AND AIR-CONDITIONING

VI Semester: **Common for all Branches**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AME554	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyze and understand various concepts and laws of thermodynamics.
II. Understand the concepts of refrigeration and air refrigeration.
III. Understand vapour compression refrigeration system and also vapour absorption refrigeration system.
IV. Identify various psychometric properties and processes.

UNIT-I	RECAPITULATION OF THERMODYNAMICS	Classes : 09

Recapitulation of thermodynamics: Thermodynamic systems, laws of thermodynamics, phase, state, process, cycle, concepts of enthalpy, entropy, specific heat, sensible heat, latent heat, dryness fraction, correlations involving enthalpy, entropy and dryness fraction, types of various processes and their representation on T-s, P-V and P-h diagrams, carnot cycle, reversed carnot cycle.

UNIT-II	INTRODUCTION AND AIR REFRIGERATION	Classes : 09

Introduction to Refrigeration: Basic concepts, unit of refrigeration; C.O.P: Refrigerators, heat pump, Carnot refrigerators and applications of refrigerator; Air refrigeration cycle: Bell Coleman cycle, open and dense air system – ideal and actual refrigeration, applications, aircraft refrigeration cycles; Refrigerants: Desirable properties, nomenclature and selection of refrigerants, effects of refrigerants on ozone depletion and global warming, alternate refrigerants.

UNIT-III	VAPOUR COMPRESSION REFRIGERATION	Classes: 09

Vapor compression refrigeration, ideal cycle, effect of variation in evaporator pressure, condenser pressure, super heating of vapor, sub cooling of liquid.

Evaporator and condenser temperatures, deviations of practical (actual cycle) from ideal cycle, construction and use of p-h chart problems.

UNIT-IV	VAPOUR ABSORPTION REFRIGERATION	Classes: 09

Vapor absorption refrigeration: description, working of NH3-Water, Li Br–water system, calculation of HCOP, principle and operation of three fluid vapor absorption refrigeration systems, steam jet refrigeration system, working principle, basic operation, principle and operation of thermo electric and vortex tube or hilsch tube refrigeration systems.

UNIT-V	INTRODUCTION TO AIR CONDITIONING	Classes : 09

Psychometric properties and processes, sensible and latent heat loads, characterization, need for ventilation, consideration of infiltration, load concepts of RSHF, ASHF, ESHF and ADP; Concept of human comfort and effective temperature, comfort air conditioning, industrial air conditioning and requirements, air conditioning load calculations.

Text Books:
1. S. C. Arora, Domkundwar, "A Course in Refrigeration and Air-conditioning", Dhanpatrai Publications, 2nd Edition, 2014. 2. C. P. Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill, 17th Edition, 2006.
Reference Books:
1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 3rd Edition, 2015. 2. P. N Ananthanarayanan, "Basic Refrigeration and Air Conditioning", Tata McGraw-Hill, 2015.
Web References:
1. http://www.engineeringstudymaterial.net/tag/air-conditioning-and-refrigeration-books/ 2. https://www.en.wikipedia.org/wiki/Air_conditioning
E-Text Book:
1. http://www.mechanicalgeek.com/refrigeration-and-air-conditioning-by-rs-khurmi-pdf/ 2. http://www.engineeringstudymaterial.net/tag/air-conditioning-and-refrigeration-books/
Course Home Page:

LAUNCH VEHICLES AND CONTROLS

VII Semester: Common to all branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE553	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the various configurations of launch vehicles and application of controls.
II. Identify different tracking systems for launch vehicles.
III. Distinguish between different errors associated with navigation system and compensation errors.
IV. Compare the guidance systems for short medium and long range missile.

UNIT-I	INTRODUCTION	Classes: 10

Types of rockets and missiles, various configurations, components forces on the vehicle during atmospheric flight, nose cone design and drag estimation; Concepts of navigation ADF, VOR/DME, Doppler, LORAN and OMEGA, guidance and control; Introduction to basic principles; Air data information; Guidance trajectories; Radar systems; Principle of working of radar; Radar equations and applications; MTI and pulse Doppler radar; moving target detector; limitation of MTI performance.

UNIT-II	TRACKING WITH RADAR	Classes: 10

Mono pulse tracking: Conical scan and sequential lobbing; Automatic tracking with surveillance radar (ADT); CW radar; Applications; Other guidance systems; Gyros and stabilized platforms; Inertial guidance and laser based guidance; Components of inertial navigation system; imaging infrared guidance; Satellite navigation; GPS; Accelerometers.

UNIT-III	INERTIAL NAVIGATION SYSTEM	Classes: 09

INS transfer function and errors; Different coordinate system, compensation errors, schuler loops; Cross coupling; Missile control system; Guided missile concept; Augmented systems.

Control of aerodynamic missile; Missile parameters for dynamic analysis; Missile autopilot schematics; Longitudinal and Lateral autopilots.

UNIT-IV	MISSILE GUIDANCE	Classes: 08

Missile guidance laws, short and medium range missiles; Proportional navigation guidance; Command guidance; Comparison of guidance system performance; Bank to turn missile guidance; Terminal guidance; Weapon control missile guidance.

UNIT-V	INTEGRATED FLIGHT/FIRE CONTROL SYSTEM	Classes: 08

Director fire control system; Fire control modes; Tracking control laws; Longitudinal flight control system; Lateral flight control system; Rate of change of Euler angle, auto pilot; Integrated flight and fire control (IFFC) flight testing.

Text Books:

1. Merrilh I. Skolnik, “ Introduction to Radar Systems”, Tata McGraw-Hill, 3rd Edition, 2001.
2. John H Blakelock, “Automatic control of Aircraft and Missiles”, Wile –Inter Science Publication, 2nd Edition, May 1990.

Reference Books:

1. R.B. Underdown, Tony Palmer, “Navigation”, Black Well Publishing, 6th Edition, 2001.
2. R P G Collinson, “Introduction to Avionics Systems”, Kulwar Academic Publishers, 3rd Edition, 2003.

Web References:

1. http://home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
2. http://nptel.ac.in/courses/112104116/
3. http://www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

E-Text Books:

1. http://www.civilenggforall.com/2015/09/finite-element-analysis-by-ss-bhavikatti-free-download-pdf-civilenggforall.com.html
2. https://books.google.co.in/books/about/Finite_Element_Analysis_For_Engineering.html?id=3XJoK4x5fZwC

Course Home Page:

INTELLECTUAL PROPERTY RIGHTS

<table>
<tr><td colspan="11">IV Semester: Common for all Branches</td></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>C</th><th>CIA</th><th>SEE</th><th>Total</th></tr>
<tr><td rowspan="1">AHS601</td><td>Perspective</td><td>-</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: Nil</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: Nil</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Explore the knowledge in determination of trade secrets status.
II. Adequate knowledge in New Developments in trade law.
III. Understand the complexities involved in the process of attributing intellectual property rights to people.
IV. Learn the legalities of intellectual property to avoid plagiarism and other IPR relates crimes like copyright, infringements, etc.
V. Learn the fundamental principles and the application of those principles to factual, real-world disputes.

UNIT-I	INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT-II	TRADE MARKS

Purpose and function of trademarks, acquisition of trademarks rights, protectable matter, selecting and evaluating trademark, trademark registration processes.

UNIT-III	LAW OF COPYRIGHTS AND LAW OF PATENTS

Fundamentals of copyrights law, originality of material, rights to reproduction, rights to perform the work publicly, copyright ownership issues.

Copyright registration, notice of copyright, international copyright law, foundation of patent law, patent searching process, ownership rights and transfer.

UNIT-IV	TRADE SECRETS AND UNFAIR COMPETITION:

Trade secrets law, determination of trade secrets status, liability for misappropriations of trade secrets, protection for submission, trade secrets litigation, misappropriation of right of publicity and false advertising.

UNIT-V	NEW DEVELOPMENTS OF INTELLECTUAL PROPERTY

New developments in trade law, copyright law, patent law, intellectual property audits international overview of intellectual property, international-trademark law, copyright law, international patent law, international development in trade secrets law.

Text Books:
1. Deborah.E.Bouchoux, "Intellectual Property Right", Cengage Learning, 4th Edition, 2013. 2. Prabuddha Ganguli, "Intellectual Property Right: Unleashing the Knowledge Economy", Tata McGraw- Hill Publishing Company Ltd., 3rd Edition, 2005.
Reference Books:
1. Catherine J. Holland, "Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, CDR Edition, 2007. 2. Stephen Elias, "Patent, Copyright & Trademark: A Desk Reference to Intellectual Property Law", Lisa Goldoftas Publishers, Nolo Press, 1996.
Web References:
1. https://en.wikipedia.org/wiki/Intellectual_property 2. http://sokogskriv.no/en/sources-and-references/why-cite-sources/intellectual-property-rights/
E-Text Books:
1. http://www.e-booksdirectory.com/listing.php?category=269 2. http://www.lexisnexis.com/store/catalog/catalog.jsp?id=80
Course Home Page:

TOTAL QUALITY MANAGEMENT

IV Semester: Common for all Branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS602	Perspective	L	T	P	C	CIA	SEE	Total
		-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Understand the philosophy and core values of Total Quality Management (TQM).
II. Determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization.
III. Apply and evaluate best practices for the attainment of total quality.
IV. Utilize Statistical Process Control (SPC) techniques as a means to diagnose, reduce and eliminate causes of variation.
V. Describe and apply the development and nature of quality control charts.

UNIT-I PRINCIPLES AND PRACTICES-1

Introduction, gurus of TQM, historic review, benefits of TQM leadership, characteristics of quality leaders, the deming philosophy, quality councils, strategic planning, customer satisfaction, customer perception of quality service quality, customer retention, employee involvement, employee survey-empowerment, gain sharing, performance appraisal.

UNIT-II PRINCIPLES AND PRACTICES-2

Continuous process improvement, the juran trilogy, the PDCA cycle-kaizen, reengineering; Supplier partnership, partnering, sourcing, supplier selection, supplier rating, performance measures, basic concept, strategy quality cost bench marking, reasons for bench marking, process understanding current performance, pitfalls and criticism of benchmarking.

UNIT-III TOOLS AND TECHNIQUES-1

Information technology, computers and the quality functions, information quality issues, quality management system, benefits of ISO registration, ISO 9000 series standards, and internal audits.

Environmental management system, ISO 14000series, benefits of EMS, relation to healthy and safety quality function deployment, the voice of the customer, building a house of quality, QFD process.

UNIT-IV TOOLS AND TECHNIQUES-2

Quality by design benefits, communication model, failure mode and effective analysis, failure rate, FMEA documentation, the process of FMEA documentation, product liability, proof and expert witness; Total productive maintenance, promoting the philosophy and training-improvements and needs, autonomous work groups.

UNIT-V MANAGEMENT TOOLS

Management tools introduction-forced field analysis, tree diagram, process decision program chart statistical process control, cause and effect diagram-histogram, state of control, process capability, experimental design, hypothesis, orthogonal design two factors and full factors-quality strategy for Indian industries, quality management in India.

Text Books:
1. Joel E Ross, “Total Quality Management”, CRC Press, 3rd Edition,2015
Reference Books:
1. Dale H.Besterfeild, Carlon Besterfeild, “Total Quality Management”, Pearson Education, 1st Edition, 2015. 2. Sridhara Bhatt, “Total Quality Management Texts and Cases”, Himalaya, 1st Edition, 2015. 3. Poornima M Charantimath, “Total Quality Management”, Pearson Education, 1stEdition, 2015.
Web References;
http://managementhelp.org/quality/total-quality-management.htm 2. http://www.tandfonline.com/toc/ctqm20/current
E-Text Books:
1. https://www.scribd.com/doc/19378602/Quality-Management-eBook 2. http://bookboon.com/en/quality-management-ebook
Course Home Page:

PROFESSIONAL ETHICS AND HUMAN VALUES

IV Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHS603	**Perspective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: Nil**		

OBJECTIVES:

The course should enable the students to:

I. Understand the fundamental theoretical and historic graphical topics of professional ethics and human values.

II. Study independence and self-evaluation professional ethics and human values, so that they can grasp the core values as independent thinkers.

III. Develop their analytical and pragmatic abilities & situational reasoning aligned towards right and wrong.

UNIT-I	**INTRODUCTION TO PROFESSIONAL ETHICS**

Basics of profession: Engineering and professionalism, two models of professionalism, three types of ethics or morality, the negative face of engineering ethics, the positive face of engineering ethics, responsibility in engineering, engineering standards, the standard care, blame responsibility and causation.

UNIT-II	**PROFESSIONAL ETHICS IN ENGINEERING**

Engineering ethics , variety of moral issues, types of inquiry moral dilemmas, moral autonomy, the problems of many hands, Kohlburg's theory, Gilligan's theory impediments to responsible action, engineering as social experimentation, framing the problem, determining the facts, codes of ethics, clarifying concepts application issues, common ground, general principles, utilitarian thinking respect for persons.

UNIT-III	**ETHICS AND HUMAN VALUES**

Human values, morals, values, and ethics, integrity, work ethic, service learning, civic virtue, respect for others, living peacefully.

Caring, sharing, honesty, courage, valuing time, co-operation, commitment, empathy, self-confidence, spirituality, character.

UNIT-IV	**MORAL RESPONSIBILITIES & RIGHTS**

Ethics consensus, controversy, models of professional roles, theories about right action, self, interest, customs and religion, uses of ethical theories, responsibility for rights, respect for authority, conflicts of interest, occupational crime, professional rights and employee rights, communicating risk and public policy, collective bargaining.

UNIT-V	**GLOBAL ETHICS & VALUES**

Global issues, multinational corporations, environmental ethics, engineers as managers, advisors, and experts witnesses, moral leadership sample codes of ethics problem of bribery, extortion and grease payments, problem of nepotism, excessive gifts, paternalism, different business practices, negotiating tax, global trends.

Text Books:

1. PSR Murthy, “Indian Culture Values and Professional Ethics”, BS Publications, 1st Edition, 2013.
2. Mike Martin, Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, 3rd Edition, 2003.
3. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, 4th Edition, 2012.
4. George Reynolds, “Ethics in Information Technology”, Cengage Learning, 5th Edition, 2012.

Reference Books:

1. Mike Martin, Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, 4th Edition, 2004.
2. Charles E Harris, Micheal J Rabins, “Engineering Ethics”, Cengage Learning, 5th Edition, 2014.
3. Edmund G Seebauer, Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 1st Edition, 2000.

Web References:

1. http://www.imd.inder.cu/adjuntos/article/524/Professional%20Ethics%20and%20Human%20Values.pdfhttp://bit.ly/29SyL7i
2. https://books.google.com/books/about/Textbook_on_Professional_Ethics_and_Huma.html?id=-dPiHmlV_

E-Text Books:

1. https://www.amazon.com/Professional-Ethics-Human-Values-Govindarajan-ebook/dp/B00K6GSSUW
2. http://bookboon.com/en/business-ethics-ebook

Course Home Page:

LEGAL SCIENCES

IV Semester: Common for all Branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS604	Perspective	L	T	P	C	CIA	SEE	Total
		-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Acquaint the student with the scientific method of social science research.
II. Provide the knowledge of the technique of selection, collection and interpretation of primary and secondary data in socio legal research.
III. Emphasis would be laid on practical training in conducting research.

UNIT-I **CONCEPT OF LEGAL SCIENCE**

Fundamentals of legal science, law systems in India, comparative public law, law and justice in a globalizing world; Impact of the human rights instruments on domestic law.

UNIT-II **TECHNOLOGY & LEGAL SYSTEMS**

Principles of corporate law conjunction, temporal, subordinate clauses complex sentences, intellectual property rights, contract law, cyber law.

UNIT-III **CONSTITUTION AND ADMINISTRATIVE LAW**

Minorities law, human rights, international and national sphere, media law.

Health law, globalization vis-à-vis human rights, significance of human rights.

UNIT-IV **HUMAN RIGHTS INTERNATIONAL AND NATIONAL SPHERE**

Human rights with special reference to right to development, rights of disadvantaged and vulnerable groups, critical analysis, cultural relativism and human rights, human rights in the Indian sphere, an over view, constitution and the analysis of preamble, social action litigation and the role of Indian judiciary, critical examination of the human rights council and human rights commission, treaty mechanism with respect to covenants ICESCR and ICCPR, convention on the elimination of discrimination against women and child rights convention.

UNIT-V **SCIENTIFIC METHODOLOGY IN LEGAL SYSTEMS**

The science of research and scientific methodology ,analysis of law with scientific methods, scientific approach to socio legal problems, interrelation between speculation, fact and theory building fallacies of scientific methodology with reference to socio legal research ,inter-disciplinary research and legal research models, arm chair research vis-a-vis empirical research, legal research-common law and civil law legal systems.

Text Books:

1. Robert Watt, "Concise book on Legal Research", Abe Books publishers, 1st Edition, 2015.
2. Ram Ahuja, "Research Method", News Way Publishers, 1st Edition, 2012.
3. Goode and Hatt, "Research Methodology", Eastern Limited Publication, 1st Edition reprinted, 2006.

Reference Books:

1. B. Somekh & C. Lewin, "Research Methods", Vistaar Publications, 1st Edition, 2005.
2. Bhandarkar, "Research Methods, Research styles and Research Strategies", Wilkinson Publishers, 1st Edition, 2009.

Web References:

1. http://humansecurityconf.polsci.chula.ac.th/Documents/Presentations/Shanawez.pdf
2. http://www.lexisnexis.com/documents/pdf/20080806034945_large.pdf
3. http://www.theglobaljusticenetwork.org/journal
4. http://humansecurityconf.polsci.chula.ac.th/Documents/Presentations/Shanawez.pdf
5. http://as.nyu.edu/docs/IO/1172/globaljustice.pdf

E-Text Books:

www.bookboon.com/en/natural-sciences-eBooks

Course Home Page:

CLINICAL PSYCHOLOGY

IV Semester: **Common for all Branches**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS605	Perspective	L	T	P	C	CIA	SEE	Total
		-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Develop the knowledge pertinent to the organism, developmental, social and situational factors those are relevant to the initiation and maintenance of human behavior.
II. Understand the present and implement effective strategies to deal with these issues during work with patients.
III. Study the professional identity and practice as clinical psychologists through fundamental knowledge of psychology, commitment to professional ethics.
IV. Understand the multiculturalism, diversity and participation in life-long learning.

UNIT-I **BASIC PSYCHOLOGY**

Introduction: Psychology, definition, psychology as a science, early schools of psychology, modern perspectives, methods of psychology, experimental method, systematic observation, case study method, survey method, fields of psychology.

UNIT-II **BIOLOGY OF BEHAVIOR AND SENSORY PROCESS**

Neurons and synapses: Nervous system , peripheral and central nervous system: brain and sleep: importance of fore brain, association cortex, left and right hemisphere functions; Some general properties of senses, subliminal stimuli, the visual sense, auditory sense, the other senses; Consciousness, meaning, functions, divided consciousness, stages of sleep, dreams, meditation, hypnosis.

UNIT-III **ATTENTION AND PERCEPTION**

Selective attention; physiological correlates of attention, internal influences on perception, learning set, motivation and emotion, cognitive styles.

External influences on perception, figure ground, movement, illusions, perceptual organization, constancy, depth perception, binocular and monocular cues.

UNIT-IV **MOTIVATION AND EMOTION MOTIVES**

Definitions, motivation cycle, theories of motivation, biological motivation, social motives, frustration and conflicts of motives, defense mechanism, emotion, expression and judgment of emotion, the physiology of emotion, theories of emotion.

UNIT-V **CLINICAL PSYCHOLOGY & MENTAL HEALTH**

History of clinical psychology and its role in understanding and alleviation of mental illness, promotion of mental health and rehabilitation of the mentally ill, role and functions of clinical psychologists in DMHP, professional code of conduct and ethical issues

Text Books:

1. M. S. Bhatia, "Clinical Psychology", B J Publishers,1st Edition, 2008.
2. Paul Bennett, "Abnormal and Clinical Psychology: An Introductory Textbook", Pearson Publishers, 2nd Edition, 2006.

Reference Books:
1. Robert A. Baron, Girishwar Misra, "Psychology: Indian Subcontinent Edition", Pearson Education, 5^{th} Edition, 2009. 2. Hill Gard, E. R., C.A. Richard, L.A.Rita, "Introduction to Psychology", Oxford & IBH, New Delhi, 6^{th} Edition, 1976.
Web References:
1. https://www.amazon.com/Clinical-Psychology-Counseling-Books/b?ie=UTF8&node=11143 2. https://global.oup.com/academic/content/series/o/oxford-textbooks-in-clinical-psychology-otcp/?cc=in&lang=en&
E-Text Books:
1. https://www.amazon.com/Clinical-Psychology-Counseling-Books/b?ie=UTF8&node=11143 2. https://books.google.co.in/books/about/Clinical_Psychology.html?id=u4aDPdw0Fi4C&redir_esc=y
Course Home Page:

ENGLISH FOR SPECIAL PURPOSES

<table>
<tr><td colspan="10">IV Semester: Common for all Branches</td></tr>
<tr><td rowspan="3">Course Code
AHS606</td><td rowspan="3">Category
Perspective</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: Nil</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: Nil</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Learn the structure and style of effective sentences, paragraphs, and essays.
II. Focus on diction and spelling, punctuation and mechanics, and functional grammar in direct relation to students' own writing.
III. Understand and apply the basic conventions of syntax and mechanics; and proofread competently and prepare acceptable manuscripts.
IV. Emphasize the importance of language in academic and employability
V. Empower the communicative skills which enhance the employability skills with self-confidence.

UNIT-I **PRESENTATION SKILLS**

English presentation, effective presentation, live presentation, web access, language orientation, classifications, method of presentations, declarations ,impact, concepts of presentation, skill oriented presentations, analysis of presentation, types of presentations.

UNIT-II **NON-VERBAL COMMUNICATION**

Overview, this unit includes body language, posture, distance different levels of physical closeness appropriate to different types of relationship, right usage of gestures, open and closed postures, to be aware of facial expressions and their importance in non-verbal communication.

UNIT-III **INTERPERSONAL SKILLS**

To build rapport, handling the criticism, giving and receive the feedback, be assertive, influencing and negotiation skills.

Methods of interpersonal skills, problem solving, decision making, verbal communication, peer negotiation, effective participating.

UNIT-IV **LISTENING**

Listen effectively, how to make notes, the difference between active listening and passive listening to understand different dialects. Initiating the contact, the important context in communicating. the reluctant speaker, appendices, problems in listening.

UNIT-V **SPEAKING AND READING**

Actively participate in GDs and debates, deal with JAM topics, answer questions in interviews, vocabulary section, useful information, discussing, socializing the effectiveness; How to read critically, to understand the main idea and tone of the author to understand complex ideas.

Text Books:

1. Susan E. Boyer, “Word Building Activities for Beginners of English” Birrong Book Publishers, 1st Edition, 2009.
2. Clive Oxenden , Christina Latham-Koenig, Paul Seligson, “New English File Intermediate Workbook”, Oxford Publications, 1st Edition, 2006.
3. P Peter Bullions, “Practical Lessons in English Grammar and Composition”, ESL Publications, 1st Edition, 1849.

Reference Books:

1. Wren and Martin, “High school English Grammar and Composition”, S Chand Publications,1st Edition, 2013.
2. Ron Cowan, “The Teacher’s Grammar of English, Cambridge University Press, 1st Edition, 2008.

Web References:

1. http://www.cde.ca.gov/be/st/ss/documents/englangdevstnd.pdf
2. http://ell.stanford.edu/sites/default/files/ELP_task_force_report_rev.pdf

E-Text Books:

1. http://www.linguistik-online.org/40_09/dahmardeh.pdf
2. http://bookboon.com/en/english-language-ebooks

Course Home Page:

ENTREPRENEURSHIP

IV Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHS607	Perspective	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: Nil**		

OBJECTIVES:

The course should enable the students to:

I. Identify and apply the elements of entrepreneurship and to entrepreneurial processes;
II. Recognize the importance of entrepreneurship and identify the profile of entrepreneurs and their role in economic growth.
III. Analyze the business environment, opportunity recognition, and the business idea-generation process;
IV. Develop an idea on the legal framework and also understand strategic perspectives in entrepreneurship.

UNIT-I UNDERSTANDING ENTREPRENEURIAL MINDSET

The revolution impact of entrepreneurship-The evolution of entrepreneurship-Approaches to entrepreneurship-Process approach-Twenty first centaury trend s in entrepreneurship.

UNIT-II THE INDIVIDUAL ENTREPRENEURIAL MINDSET

The individual entrepreneurial mind set and personality, the entrepreneurial journey, stress and the entrepreneur, the entrepreneurial ego, entrepreneurial motivation, corporate entrepreneurial mindset the nature of corporate entrepreneur, conceptualization of corporate entrepreneurship strategy sustaining corporate entrepreneurship

UNIT-III LAUNCHING ENTREPRENEURIAL VENTURES

Opportunities identification, entrepreneurial imagination and creativity, the nature of the creativity process, innovation and entrepreneurship, methods to initiate ventures.

Creating new ventures acquiring an established entrepreneurial venture, franchising-hybrid disadvantage of franchising.

UNIT-IV LEGAL CHALLENGES OF ENTREPRENEURSHIP

Intellectual property protection, patents, copyrights trademarks and trade secrets-avoiding trademark pitfalls, formulation of the entrepreneurial plan, the challenges of new venture start-ups, poor financial understanding, and critical factors for new venture development-the evaluation process-feasibility criteria approach.

UNIT-V STRATEGIC PERSPECTIVES IN ENTREPRENEURSHIP

Strategic planning, strategic actions, strategic positioning business stabilization, building the adaptive firms-understanding the growth stage, unique managerial concern of growing ventures.

Text Books:

1. D F Kuratko,T V Rao, "Entrepreneurship: A South Asian Perspective", Cengage Learning, 1st Edition,2012.
2. Gordon, K .Natarajan, "Entrepreneurship Development", Himalaya, 4th Edition, 2008.
3. Coulter, "Entrepreneurship in Action", PHI, 2nd Edition, 2002.
4. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Ltd, 5th Edition, 2007.

Reference Books:

1. Vijay Sathe, "Corporate Entrepreneurship", Cambridge, 1st Edition, 2009.
2. Vasanth Desai, "Dynamics of Entrepreneurial Development and Management", HPH, Millenium Edition, 2007.
3. P. Narayana Reddy, "Entrepreneurship – Text and Cases", Cengage Learning", 1st Edition, 2010.
4. David H. Hott, "Entrepreneurship New Venture Creation", PHI, 1st Edition, 2004.

Web References:

1. http://www.tutorialspoint.com/entrepreneurship_development/entrepreneurship_development_tutorial.pdf
2. http://www.advalue-project.eu/content_files/EN/33/AdValue_Personal_Effectiveness_EN.pdf

E-Text Books:

1. http://www.freebookcentre.net/Business/Entrepreneurship-Books.html
2. http://www.e-booksdirectory.com/listing.php?category=390
3. http://www.bookboon.com/en/entrepreneurship-ebooks

Course Home Page:

GERMAN LANGUAGE

<table>
<tr><td colspan="10">IV Semester: Common for all Branches</td></tr>
<tr><th rowspan="1">Course Code</th><th>Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">AHS608</td><td rowspan="2">Perspective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td>Contact Classes: Nil</td><td>Tutorial Classes: Nil</td><td colspan="4">Practical Classes: Nil</td><td colspan="3">Total Classes: Nil</td></tr>
</table>

OBJECTIVES:

The course should enable the students to:

I. Complete reading, writing, speaking, and listening assignments with ever increasing proficiency and accuracy.
II. Increase grammatical accuracy on written assignments.
III. Implement the language skills in listening, speaking, reading and writing in German language.

UNIT-I **GERMAN SOUNDS**

Vowels, consonants, diphthongs, umlaut, the nouns, gender distinctions, cases, definite and indefinite articles, conjugation of verbs, verbs with separable and inseparable prefixes, modal verbs, personal pronouns, possessive pronouns, reflexive pronouns, cases nominative, accusative and dative; Structure of sentence and categories of sentences, subordinate clause, causative and conditional sentences; A very interesting slideshow presentation is held to enlighten the students about the culture, people, and lifestyle in Germany.

UNIT-II **SENTENCES FORMATION**

Infinite sentences, use of conjunctive and conjunctive ii (contd.) plusquam perfect, modal verb (contd.) conjunction, temporal, subordinate clauses complex sentences.

UNIT-III **GERMAN BASIC GRAMMAR**

Verbs: Different forms, past tense and present perfect tense, adjectives and their declension, degrees of comparison; Prepositions, genitive case, conjunctive.

Different conjunctions (co-coordinating and subordinating), simple, complex and compound sentences, active and passive voice, relative pronouns.

UNIT-IV **PURPOSE OF LANGUAGE STUDY**

Pictures and perceptions, conflicts and solutions, change and the future, the purpose of the study of the German language, listening, understanding, reacting, speaking, communicating, use of language, pronunciation and intonation ,reading, reading and understanding, writing, text writing, text forming, use of language, language reflection, building up the language, language comparison, culture reflection, other cultures and cultural identity.

UNIT-V **GERMAN ADVANCED COMMUNICATION LEVEL-1**

The significance of language study 1. Speaking and thinking 2. Self – discovery 3. Communication 4. Language Competence 5. Language and culture 6. Language changes 7. Connection with other areas of study 8. The mother—language 9. Other languages.

Text Books:

1. Korbinian, Lorenz Nieder Deutschals Fremds prache IA. Ausländer, "German Language", Perfect Paperback Publishers, 1st Edition, 1992.
2. Deutsch als Fremdsprache, IB, Ergänzungskurs,"German Language", Front Cover. Klett, Glossar Deutsch-Spanish Publishers, 1st Edition, 1981.

Reference Books:

1. Griesbach, "Moderner Gebrauch der deutschen Sprache", Schulz Publishers,10th Edition, 2011.
2. Anna Quick , Hermann Glaser U.A, "Intermediate German: A Grammar and workbook", Paperback, 1st Edition, 2006.

Web References:

1. http://www.prsformusicfoundation.com/docs/408/Schenke%20-%20Seago%20-%20Basic%20German.pdf
2. https://upload.wikimedia.org/wikipedia/commons/2/2d/German.pdf

E-Text Books:

1. http://www.staidenshomeschool.com/files/Learning_German_Ebook.pdf
2. http://weblearn.ox.ac.uk/access/content/group/modlang/general/handbooks/09-10/prelims/german_language_guide_0910.pdf

Course Home Page:

DESIGN HISTORY

IV Semester: Common for all Branches								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS609	Perspective	L	T	P	C	CIA	SEE	Total
		-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Understand the fundamental theoretical and historic graphical topics of design, from the fifties of the twentieth century to the present day.
II. Use methodological tools and develop their analytical and critical capacities, so that they can grasp the bonds that link works of design with their respective social, economic and cultural backdrop.
III. Identify the influences at work between the various different creative disciplines.
IV. Develop their analytical and critical abilities, focusing on their search for their own expressive design language.

UNIT-I INTRODUCTION TO DESIGN HISTORY

Materials and techniques of design, design in the machine age, design body, environmental design.

UNIT-II DESIGN PRODUCTS

Innovative ideas of design products, intellectual and creative research, commercial and critical perspectives on design products, social, ethical and economic impact of your design.

UNIT-III GLOBAL INNOVATION IN DESIGN

Styles of global innovation design, the service design basics.

Concepts of vehicle design, techniques of design engineering (IDE).

UNIT-IV THE DESIGN INTERACTIONS

Interaction design, digital media, fine art, products, graphic and furniture design, architecture, life sciences, biotech, social sciences, and computer science, human consequences of different technological design futures.

UNIT-V RESEARCH IN DESIGN HISTORY

Research in craftsmanship and artisanal cultures, design, trade and exchange, design exhibitions, curatorial practice, history and theory, design and national, global identities ,the design and material culture of the domestic interior, material history and the history of materiality, Asian design history.

Text Books:

1. R.S. Khurmi, “A Textbook of Machine Design”, Eurasia Publishing House (pvt.) Ltd., 14th Edition, 2005.
2. Nicolas, “Beyond”, Nova Publishers, 2nd Edition, 2014.
3. Mariana Amatullo, **“**Career Pathways in Design for Social Innovation; Design matters at Art Center College of Design”, LEAP Dialogues, 1st Edition, 2016.

Reference Books:
1. Max Bruinsma, “Design for the Good Society”, Paperback, 1st Edition, 2015. 2. Beppe Finessi, “How to Break the Rules of Brand Design”, Global Publishers, 1st Edition, 2009.
Web References:
1. https://en.wikipedia.org/wiki/Web_design 2. https://en.wikipedia.org/wiki/Responsive_web_design
E-Text Books:
1.http://www.creativebloq.com/design/free-ebooks-designers-7133700 2.https://www.amazon.com/Designing-History-East-Asian-Textbooks/dp/0415855586
Course Home Page:

GENDER SENSITIVITY

III Semester: **Common to All Branches**								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHS017	**Perspective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: Nil**		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic concepts relating to gender and to provide logical understanding of gender roles.
II. Analyze present various perspective of body and discourse on power relationship.
III. Develop cultural construction of masculinity and femininity.
IV. Study the evolution of gender studies from women's studies

UNIT-I **INTRODUCTION**

Sex and gender; types of gender, gender roles and gender division of labour, gender stereotyping and gender discrimination the other and objectification, male gaze and objectivity.

UNIT-II **GENDER PERSPECTIVES OF BODY**

Biological-phenomenological and socio-cultural perspectives of body, body as a site and articulation of power relations- cultural meaning of female body and women's lived experiences -gender and sexual culture.

UNIT-III **SOCIAL CONSTRUCTION OF FEMININITY**

Bio-social perspective of gender, gender as attributional fact, essentialism in the construction of femininity, challenging cultural notions of femininity.

Butler, Douglas, Faucault and Haraway, images of women in sports, arts, entertainment and fashion industry, media and feminine identities.

UNIT-IV **SOCIAL CONSTRUCTION OF MASCULINITY**

Definition and understanding of masculinities, sociology of masculinity, social organization of masculinity and privileged position of masculinity, politics of masculinity and power, media and masculine identities.

UNIT-V **WOMEN'S STUDIES AND GENDER STUDIES**

Evolution and scope of women's studies, from women‘s studies to gender studies: A paradigm shift, women's studies vs. gender studies, workshop, gender sensitization through gender related.

Text Books

1. Gender," How Gender Inequality Persists in the Modern World", Oxford University Press, Reprinted Edition, 2011.
2. William M Johnson "Recent reference books in religion", Duke University Publications, Reprinted Edition, 2014.

Reference Books
4. Alolajis. Mustapha, Sara Mils, "Gender representation in learning materials", Pearson Publications, 1st Edition, 2015.
Web References:
1. https://www.google.co.in/search?q=clinical++pscyology+ebooks&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&ei=xPmJV6OhFcuL8Qf3qam4Cw#q=gender+sensitivity+web+references 2. https://en.wikipedia.org/wiki/Gender_sensitization
E-Text Books:
1. http://ebooklibrary.org/articles/gender_sensitization 2. http://cbseacademic.in/publication_ebooks.html
Course Home Page:

MACHINE LEARNING APPLICATIONS

VI Semester: AE									
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE801	**SKILL**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes:	**Tutorial Classes: Nil**		**Practical Classes: Nil**			**Total Classes:**		

OBJECTIVES:

The course should enable the students to:

I. Apply knowledge of computing and mathematics appropriate to the discipline.
II. Illustrate the concepts of machine learning and related algorithms.
III. Understand the dimensionality problems using linear discriminants.
IV. Study various statistical models for analyzing the data.
V. Learn clustering algorithms for unlabeled data.

UNIT - I TYPES OF MACHINE LEARNING

Concept learning: Introduction, version spaces and the candidate elimination algorithm; Learning with trees: Constructing decision trees.

UNIT - II LINEAR DISCRIMINANTS

Perceptron (MLP): Going forwards, backwards, MLP in practices, deriving back; Propagation support vector Machines: Optimal separation, kernels.

UNIT - III BASIC STATISTICS

Averages, variance and covariance, the Gaussian; The bias-variance tradeoff Bayesian learning: Introduction, Bayes theorem, Bayes optimal classifier, naïve Bayes classifier. Graphical models: Bayesian networks, approximate inference, making Bayesian networks.

UNIT - IV EVOLUTIONARY LEARNING

Genetic Algorithms, genetic operators; Genetic programming; Ensemble learning: Boosting, bagging; Dimensionality reduction: Linear discriminate analysis.

UNIT - V CLUSTERING

Similarity and distance measures, outliers, hierarchical methods, partitional algorithms, clustering large databases, clustering with categorical attributes, comparison.

Text Books:

1. Tom M. Mitchell, "Machine Learning ", McGraw Hill, 1st Edition, 2013.
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 1st Edition, 2009.

Reference Books:

1. Margaret H Dunham, "Data Mining", Pearson Edition, 2nd Edition, 2006.
2. Galit Shmueli, Nitin R Patel, Peter C Bruce, "Data Mining for Business Intelligence", John Wiley and Sons, 2nd Edition, 2007.

3. Rajjal Shinghal, "Pattern Recognition and Machine Learning", Springer-Verlag, New York, 1st Edition, 2006.

Web References:

1. Httd://ww.udemy.com/MachineLearning/Online_Course
2. https://en.wikipedia.org/wiki/Machine_learning

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=1118
2. http://www.otexts.org/sfml

AIRCRAFT MODELING

VI Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE802	**SKILL**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes:	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes:		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic ideas Conservation of the Angular Momentum Equations.
II. Learn the Modeling of the Longitudinal Steady-State Aerodynamic Forces and Moment.
III. Understand the technology and basic components modelling.
IV. Discuss the Modeling of Lateral Directional Aerodynamic Forces and Moments.

UNIT - I **AIRCRAFT EQUATIONS OF MOTION**

Introduction, Reference Frames and Assumptions, Conservation of the Linear Momentum Equations (CLMEs), Conservation of the Angular Momentum Equations (CAMEs), Conservation of the Angular Momentum Equations (CAMEs) with Rotor Effects, Euler Angles, Flight Path Equations (FPEs), Kinematic Equations (KEs), Gravity Equations (GEs), Summary of the Aircraft Equations of Motion, Definition of Steady-State and Perturbation Conditions, Aircraft Equations of Motion at Steady-State Conditions, Aircraft Equations of Motion at Perturbed Conditions, Small Perturbation Equations from a Steady-State Level Flight.

UNIT - II **MODELING OF LONGITUDINAL AERODYNAMIC FORCES AND MOMENTS**

Introduction, Aircraft Stability Axes, Modeling of the Longitudinal Steady-State Aerodynamic Forces and Moment, Modeling of Fax, Modeling of FAz' 83, Modeling of MA, Aircraft Aerodynamic Center, Summary of the Longitudinal Steady-State Aerodynamic Forces and Moment, Modeling of the Longitudinal Small Perturbation Aerodynamic Forces and Moments, Modeling of (CD&, CL., Cm1), Modeling of (cD., cLu, em.), Modeling of (CD.;, CL (Cll\0) and (CDq, CLq, Cmq).

UNIT - III **MODELING OF LATERAL DIRECTIONAL AERODYNAMIC FORCES AND MOMENTS**

Introduction, Modeling of Fay, Conceptual Modeling of Cyp, Mathematical Modeling of cyp, Modeling of Cr6A, Modeling of ey6, Modeling of LA1, Conceptual Modeling of C/fJ, Mathematical Modeling of CIIJ, Modeling of C; A, Modeling of c16, Modeling of NA1, Conceptual Modeling of C11J, Mathematical Modeling of C11J, Modeling of c106A, Modeling of c116.

UNIT - IV **MODELING OF THE SMALL PERTURBATION LATERAL DIRECTIONAL AERODYNAMIC FORCE AND MOMENTS**

Modeling of Cyβ' qiβ' Cnβ, Modeling of cyP, Modeling of clp, Modeling of Cnp,. Modeling of Cyr, Modeling of Clr Modeling of Cnr.

UNIT - V **REVIEW OF BASIC AIRCRAFT PERFORMANCE AND MODELING OF THRUST FORCES AND MOMENTS**

Introduction, Review of Different Aircraft Propulsion Systems: Piston Engine (Propeller) Aircraft Engines, Turboprop Aircraft Engines, Turbojet Aircraft Engines, Turbofan Aircraft Engines, RamjetAircraft Engines. Power at Level Flight: Maximum Aerodynamic Efficiency, Minimum Aerodynamic Drag, Minimum Power Required. Determination of Power Required, Determination of Power Available,Modeling of the Thrust Forces and Moments: Modeling of the Steady-State Thrust

Forces and Moments, Modeling of the Small Perturbation Thrust Forces and Moments.
Text Books:
1. Marcello R. Napolitano "Aircraft Dynamics from Modeling to Simulation", John Wiley & Sons, 2011, ISBN, 0470626674, 9780470626672.
Reference Books:
1. Brett Green "Aircraft Modelling (Modeling Master class)" Bloomsbury USA, 2010, ISBN 1846039320, 9781846039324. 2. Ranjan Vepa "Flight Dynamics Simulation and Control For Rigid and Flexible Aircraft" CRC Press , 18, 1st Edition, 2014 , ISBN 9781466573352 - CAT# K16647.
Web References:
1. https://books.google.co.in/books 2. https://www.amazon.co.uk/Aircraft-Modelling-Masterclass-Brett-Green/dp/1846039320
E-Text Books:
1. https://books.google.co.in/books?id=jmG6dXpa7A0C&printsec=frontcover&dq=aircraft+modeling&hl=en&sa=X&ved=0ahUKEwixqrzXmNvgAhXJro8KHRgtBYwQ6AEIOjAE#v=onepage&q=aircraft%20modeling&f=false 2. https://books.google.co.in/books?id=VMij4rR-zoC&dq=Marcello+R.+Napolitano+-+Aircraft+Dynamics++From+Modeling+to+Simulation-Wiley+(2011)&hl= en&sa= X&ved=0ahUKEwj5vNrkptvgAhULuI8KHQoWBrkQ6AEIKDAA

AIRCRAFT INTERIOR DESIGN

VI Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE803	**SKILL**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	-	-	-	-	-
Contact Classes:	**Tutorial Classes: Nil**		**Practical Classes: Nil**			**Total Classes:**		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic ideas about comfort requirements for the passengers.
II. Learn the Interior design parameters.
III. Understand the required technology to design Interior of aircraft.
IV. Discuss the various types of New Demands for Aircraft seats and other interior components.

UNIT - I AIRCRAFT INTERIOR COMFORT

Comfort Stories, Role of Comfort in Sales, The Difficulty of Making People Feel Comfortable, The Good News: It Is Possible to Make People, Feel More Comfortable, Comfort Theory, Comfort Manifestations, Inputs Leading to (Dis)comfort, History, State of Mind, Visual Input, Smell, Noise, Temperature and Humidity, Pressure and Touch, Posture and Movements, Persons Influencing theInput.

UNIT - II AIRCRAFT INTERIOR COMFORT STUDIES

Lack of Many Substantial Studies on Aircraft Comfort -A Classic Study, German Study on Aircraft Interior Comfort, Experience Preceding the Flight, Experience during the Flight Experience after the Flight, A Study Regarding Service, Perceived Value, and Satisfaction in Taiwan, A German Study of Noise, A Dutch Study Regarding Aircraft Interior Comfort ,A U.S. Study Regarding Passenger Experience.

UNIT - III THE VOICES OF CUSTOMERS

Technology Versus Passenger, Innovations Have Their Effects, Study Methodology, Factors Correlating with Comfort, Leg Room, Hygiene, Crew, Luggage Room, Neighbor, Seat Flying Time, In-Flight Entertainment, Delay, Lost Luggage, Aircraft Type, Direct versus No Direct Flight.

UNIT - IV NEW DEMANDS FOR AIRCRAFT SEATS

Using Research for Seat Design, Seat Design and Health, Aircraft Seats Should Fit, Pitch Watchers, Designing an Aircraft Seat Is Difficult, Ideal Pressure Distribution, Seating and Shear Forces, Comfort and Seating, Specific Dynamic Seat Characteristics, Comfort and "Wow", Feet off the Ground, Backrest Angle, Seating and Electronics, Other Features: Headrests and Massage, Opportunity for Designers.

UNIT - V THE ULTRA COMFORTABLE FLIGHT EXPERIENCE AND ANALYSIS ON AIRCRAFT INTERIOR COMFORT AND DESIGN

Introduction, The Flight Experience: At Home, Forty-Eight Hours before the Flight, To the Airport, At the Airport, The Lounge, Airport Plus, At the Gate, The Plane Entrance, The Long Haul Flight, Business Class, Inexpensive Flight, In-Flight Entertainment (IFE), Cleanliness, Crew, Arrival.

Introduction, Leg Room, Service, Hygiene, Luggage Room, Neighbor, Seat, IFE, Delay/Waiting.

Text Books:

1. Peter Vink and Klaus Brauer "Aircraft Interior Comfort And Design" CRC Press Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300.

Reference Books:
1. B. Spicer "Introduction to Aircraft Interiors: Volume 1" Create space Independent Pub, 10th June 2009,ISBN-10: 1448601894 2. B. Spicer "Introduction to Aircraft Interiors: Volume 2" Create space Independent Pub, 10th June 2009, ISBN-13: 978-1448601899
Web References:
1. https://www.priestmangoode.com/project/latam 2. http://www.jetaviation.com/basel/completions/designstudio
E-Text Books:
1. https://books.google.co.in/books/about/Aircraft_Interior_Comfort_and_Design.html?id=WaWNp0fK8G0C&printsec=frontcover&source=kp_read_button&redir_esc=y#v=onepage&q&f=false 2. https://www.amazon.in/Introduction-Aircraft-Interiors-B-Spicer/dp/1448601894

AIRCRAFT NAVIGATION SYSTEMS

VII Semester: AERO								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE805	SKILL	L	T	P	C	CIA	SEE	Total
		-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:			

OBJECTIVES:

The course should enable the students to:

I. Describe the aircraft navigation systems and system used.
II. Explain the external navigation system and its techniques.
III. Understand the navigation tracking and safety system.
IV. Distinguish among missile, UAV and satellite Navigation system.

UNIT-I	NAVIGATION SYSTEMS & SENSORS

Introduction to aircraft navigation systems– Introduction to Inertial Sensors – Mechanical – Ring Laser gyro – Accelerometers, Fiber optic gyro – MEMS system, Multi-sensors navigation.

UNIT-II	INERTIAL NAVIGATION SYSTEMS

INS components: transfer function and errors- Earth in inertial space – coriolis effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors.

UNIT-III	NAVIGATION, TRACKING AND SAFETY SYSTEMS

Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations-LORAN, DECCA and Omega – TACAN, ILS, MLS, GLS - Ground controlled approach system – surveillance Systems-radio altimeter, TCAS, ATC transponder, Regional Navigation Systems- Distress and Safety-Cospas- Sarsat- Inmarsat Distress System- Location-Based service, Emergency locator transmitters.

UNIT-IV	MISSILE AND UAV NAVIGATION

Tactical Guidance Intercept Techniques, Proportional Navigation, Augmented and 3D Proportional Navigation, Optimal Control of Linear Feedback system, Way-point Navigation, UAV Control Stations, Path Planning, Collision Avoidance and Mid-air Collision (MAC) Avoidance.

UNIT-V	SATELLITE NAVIGATION & HYBRID NAVIGATION

Introduction to Global Navigation Satellite Systems, Concepts of GPS, DGPS, Introduction to Kalman Filtering - Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

Text Books:

1. Mike Tooley, David Wyatt "Aircraft Communications and Navigation Systems", 2nd Edition 1998.
2. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 2nd Edition, 1997.
3. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone. "Global Navigation Satellite Systems", Inertial Navigation, and Integration, 3rd Edition 1998.
4. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd Edition, 1975.

Reference Books:

1. Reg Austin, “Unmanned Aircraft Systems: UAVS Design, Development and Deployment”, Wiley, 2010.
2. George M. Siouris, Missile Guidance and Control Systems, Springer New York, 2010.
3. Antonios Tsourdos, Brian A White, Madhavan Shanmugavel, “Cooperative Path Planning of Unmanned Aerial Vehicles”, Wiley, 2010.
4. George M Siouris, “Aerospace Avionics System; A Modern Synthesis”, Academic Press Inc., 1993.

Web References:

4. http://nptel.ac.in/courses/101108056/

E-Text Books:

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_airframe_handbook/media/ama_Ch11.pdf

HIGH TEMPERATURE MATERIALS

VII Semester: AERO									
Course Code	Category	Hours / Week			Credits	Maximum Marks			
AAE806	SKILL	L	T	P	C	CIA	SEE	Total	
		-	-	-	-	-	-	-	
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:				

OBJECTIVES:

The course should enable the students to:

I. Explain the creep behaviour, mechanisms and effect of different parameters like stress, temporary, strain rate on creep.
II. Learn laws that would be beneficial in determining the rupture life of a component.
III. Identify the various types of fracture and its occurrence.
IV. Understand the Oxidation and Corrosion, behaviour of super alloys and other high temperature materials.

UNIT-I CREEP

Creep – Creep Strength, Creep Limit, Creep Curve - Stages of Creep, Creep Fracture, Factors influencing creep property of a material, Factors Affecting Creep – Temperature, Stress, Time, Grain Size, Mechanism of Creep – Diffusion Creep & Dislocation Creep, Metallurgical Factors Influencing Creep at High Temperature, Creep Test, Creep resistant materials.

UNIT-II LAWS TO DETERMINE CREEP

Laws of Creep- Andrade's law, Logarithmic Law, Hyperbolic Law of Transient creep, Secondary creep law, Laws to determine rupture life of component – Larson –Miller Parameter, Monkman Grant Relationship, Creep Mechanism Maps.

UNIT-III HIGH TEMPERATURE FRACTURE

Fracture – Types of Fracture –Ductile fracture, Brittle fracture, Shearing Fracture, Factors Affecting Fracture, Fracture toughness, Griffith Theory of Brittle Fracture, Blue Brittleness, Orange Peel Effect, Cleavage Fracture, Micro void Coalescence and Dominant Void Growth Modes, Ductile to Brittle Transition (DBT), Bauchinger's effect.

UNIT-IV OXIDATION & CORROSION

Oxidation –Nature of Oxides formed on Metal Surface, Types of Corrosion, Kinetic laws of Oxidation – Parabolic rate law, Linear rate law and Logarithmic rate law, Pilling- Bedworth ratio, Corrosion – Types of Corrosion, Factors Influencing Corrosion, Fluxing Mechanisms – Acidic and Basic Fluxing, Effect of Alloying Element on Hot Corrosion, Corrosion Control - Methods to Combat Hot Corrosion.

UNIT-V HIGH TEMPERATURE RESISTANT MATERIALS

Super Alloys – Cobalt Base, Nickel base, Iron Base. Ultra High Temperature Ceramics, Intermetallics, Thermal Barrier Coatings, Hydrogen Embrittlement, Refractory Metals, Structural Heat Resistant Composites.

Text Books:

1. Norman E Dowling, "Mechanical Behaviour of Materials" Pearson Publisher, 4th Edition, 2012.
2. Jun-Shan Zhang, "High Temperature Deformation and Fracture of Materials", Publishing 1st Edition, Woodhead, 2010.

Reference Books:

1. J. Betten, “Creep Mechanics” Springer, 3rd Edition 2008.

Web References:

1. https://books.google.co.in/books?id=e-51AgAAQBAJ&printsec=frontcover#v=onepage&q&f= false
2. https://www.crcpress.com/High-Temperature-Materials-and-Mechanisms/Bar-Cohen/p/book/9781138071544

E-Text Books:

1. https://www.coursera.org/learn/materials-science/lecture/Fpo4U/mechanisms-for-creepdeformation
2. https://www.doitpoms.ac.uk/tlplib/creep/index.php

AEROSPACE STRUCTURAL HEALTH MONITORING SYSTEM

VII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE807	SKILL	L	T	P	C	CIA	SEE	Total
		-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes:		

OBJECTIVES:

The course should enable the students to:

I. Understand the concept of new type of smart sensor for health monitoring system.
II. Evaluation of the damage detection using different technique.
III. Discuss the development of sensor using smart materials for aerospace application.
IV. Demonstrate the difference between theoretical developments and engineering applications.

UNIT-I **AIRCRAFT STRUCTURAL HEALTH AND USAGE MONITORING**

Introduction - aircraft structural damage - ageing aircraft problem - lifecycle cost of aerospace structures - aircraft structural design - damage monitoring systems in aircraft - non-destructive testing - structural health monitoring - emerging monitoring techniques and sensor technologies.

UNIT-II **OPERATIONAL LOAD MONITORING USING OPTICAL FIBRE SENSORS**

Introduction - Fibre Optics - Sensor Target Specifications - Reliability of Fibre Bragg Grating Sensors - Fibre Coating Technology - Example of Surface Mounted Operational Load Monitoring Sensor System - Optical Fibre Strain Rosette - Example of Embedded Optical Impact Detection System.

UNIT-III **DAMAGE DETECTION USING STRESS AND ULTRASONIC WAVES**

Acoustic Emission – Ultrasonics - Acousto-ultrasonics - Guided Wave Ultrasonics - Piezoelectric Transducers - Passive Damage Detection Examples - Active Damage Detection Examples.

UNIT-IV **SIGNAL PROCESSING FOR DAMAGE DETECTION**

Introduction - Data Pre-processing - Signal Features for Damage Identification - Time–Domain Analysis - Spectral Analysis - Instantaneous Phase and Frequency - Time–Frequency Analysis - Wavelet Analysis - Dimensionality Reduction Using Linear and Nonlinear Transformation - Data Compression Using Wavelets.

UNIT-V **STRUCTURAL HEALTH MONITORING EVALUATION TESTS**

Introduction - Large-scale Metallic Evaluator - Large-scale Composite Evaluator - Flight Tests - Summary.

Text Books:

1. Staszewski, W., Boller, C., & Tomlinson, G. R. “Health Monitoring of Aerospace Structures: Smart Sensor Technologies and Signal Processing. John Wiley & Sons, (Eds.). (2004).

Reference Books:

1. Andrei Zagrai (Editor), Brandon Arritt (Editor), Derek Doyle (Editor), “Structural Health Monitoring for Space Systems (Aerospace Series)”, Wiley-Blackwell ISBN-10: 1118729641.

Web References:

1. https://play.google.com/store/books/details?id=nzSPVBZ_Yg0C&rdid=booknzSPVBZ_Yg0C&rdot=1&source=gbs_vpt_read&pcampaignid=books_booksearch_viewport

2.	https://play.google.com/store/books/details/Victor_Giurgiutiu_Structural_Health_Monitorig_wit?id=AG5h8Hu-MdUC

E-Text Books:	
1.	https://onlinecourses.nptel.ac.in/noc18_oe05/preview
2.	http://www.cism.it/courses/A1102/
3.	http://courses.ce.metu.edu.tr/ce5802/2015/02/11/hello-world/

AIRBORNE RADAR SYSTEM

VII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE808	SKILL	L	T	P	C	CIA	SEE	Total
		-	-	-	-	-	-	-
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: Nil**			**Total Classes:**			

OBJECTIVES:

The course should enable the students to:

I. Understand the concepts of Phased array antennas and detection of moving targets.
II. Analyse the Radars requirements and waveforms.
III. Identify the Advantages and constraints of tracking radars.
IV. Learn the concepts of radar systems for aircraft in landing and other aids.

UNIT-I **INTRODUCTION TO RADAR**

Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies – Applications of Radar- Receiver noise and signal to noise ratio- Radar cross section (RCS) – Radar system –system losses- Radar Antennas types.

UNIT-II **TYPES OF RADARS**

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

UNIT-III **RADAR SIGNAL PROCESSING**

Radar requirements –Matched filters- Radar ambiguity function – Optimum waveforms for detection in clutter – Classes of waveforms – Digital representation of signals -Pulse compression.

UNIT-IV **TRACKING RADAR**

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

UNIT-V **FLIGHT RADAR SYSTEM**

History of flight radar-Role of radar in military and civil aircraft-Airborne Radars-Aircraft Doppler Stabilization and Navigation- Applications of Doppler Weather Radar-Air Traffic Control radar beacon system- Applications of microwave radar.

Text Books:

1. Merrill I. Skolnik , "Introduction to Radar Systems", Tata Mc Graw-Hill, 3rd Edition, 2003.
2. N.S.Nagaraja, "Elements of Electronic Navigation Systems", Tata Mc Graw-Hill 2nd Edition, 2000.

Reference Books:

1. Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004.
2. J.C Toomay, "Principles of Radar", PHI, 2nd Edition 2004.

VISION AND MISSION OF THE INSTITUTE

VISION

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

B.TECH - PROGRAM OUTCOMES (POS)

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**).

PO-2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).**

PO-3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).**

PO-4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).**

PO-5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations **(Modern Tool Usage).**

PO-6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).**

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).**

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).**

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).**

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).**

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(Life-long learning).**

OBJECTIVES OF THE DEPARTMENT

DEPARTMENT OF AERONAUTICAL ENGINEERING

Programme Educational Objectives (PEO's)

The current Aeronautical Engineering program educational objectives were developed as part of the program's ongoing efforts to maintain through innovation in undergraduate program that meets the needs of our constituents. The current educational objectives of the Aeronautical Engineering program are:

PEO – I: To prepare and provide student with an academic environment for students to excel in postgraduate programs or to succeed in industry / technical profession and the life-long learning needed for a successful professional career in Aeronautical Engineering and related fields (Preparation & Learning Environment).

PEO – II: To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies (Core Competence).

PEO – III: To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems (Breadth).

PEO – IV: To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context (Professionalism).

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO – I: **Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products

PSO – II: **Problem solving skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles

PSO – III: **Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies

PSO – IV: **Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats.

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University

In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its own powers to grant autonomy directly to Govt. and Govt. aided Colleges.

2 Shall IARE award its own Degrees?

No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3 What is the difference between a Deemed University and an Autonomy College?

A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4 How will the Foreign Universities or other stake – holders know that we are an Autonomous College?

Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5 What is the change of Status for Students and Teachers if we become Autonomous?

An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6 Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?

There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Programme Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7 Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?

No. IARE has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8 Can IARE have its own Convocation?

No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9 Can IARE give a provisional degree certificate?

Since the examinations are conducted by IARE and the results are also declared by IARE, the college sends a list of successful candidates with their final Grades and Grade Point Averages including CGPA to the University. Therefore with the prior permission of the University the college will be entitled to give the provisional certificate.

10 Will Academic Autonomy make a positive impact on the Placements or Employability?

Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11 What is the proportion of Internal and External Assessment as an Autonomous College?

Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12 Is it possible to have complete Internal Assessment for Theory or Practicals?

Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13 Why Credit based Grade System?

The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14 What exactly is a Credit based Grade System?

The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15 What are the norms for the number of Credits per Semester and total number of Credits for UG/PG programme?

These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16 What is a Semester Grade Point Average (SGPA)?

The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n}(C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and i represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17 What is a Cumulative Grade Point Average (CGPA)?

An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{m} \left(C_j S_j\right) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester. CGPA is rounded to two decimal places.

18 Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19 Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20 Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21 How fast Syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22 Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23 What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in every body is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24 Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Boared of Studies level are to be ratified at the Academic Council and Governing Body.

25 What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations spot valuations, tabulations preparation of Grade Cards etc fall within the duties of the Examination Committee.

26 Is there any mechanism for Grievance Redressal?

The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27 How many attempts are permitted for obtaining a Degree?

All such matters are defined in Rules & Regulation

28 Who declares the result?

The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29 Who will keep the Student Academic Records, University or IARE?

It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30 What is our relationship with the JNT University?

We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31 Shall we require University approval if we want to start any New Courses?

Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32 Shall we get autonomy for PG and Doctoral Programmes also?

Yes, presently our PG programmes also enjoying autonomous status.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculator, cell phone, pager, palm computer or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Controller of Examinations.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the COE or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the COE or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the Institute premises or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already

		appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

UNDERTAKING BY STUDENT / PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr./Ms. -- joining I Semester / III Semester for the academic year 2016-2017 / 2017-2018 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/practical/drawing) and secure attendance of not less than 75% in every course as stipulated by Institute. I am fully aware that an attendance of less than 65% in more than three theory courses will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus/Hostel/Residence and attend all the tests to secure more than the minimum prescribed Class/Sessional Marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the HOD concerned/ Principal.
11. I hereby acknowledge that I have received a copy of IARE - R16 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number