ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

21

AERONAUTICAL ENGINEERING

For

B.TECH. FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2013-14)

(I - IV Years Syllabus)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
KUKATPALLY, HYDERABAD - 500 085.

ACADEMIC REGULATIONS R13 FOR B. TECH. (REGULAR)

Applicable for the students of B. Tech. (Regular) from the Academic Year 2013-14 and onwards

1. **Award of B. Tech. Degree**

A student will be declared eligible for the award of B. Tech. Degree if he fulfils the following academic regulations:

1.1 The candidate shall pursue a course of study for not less than four academic years and not more than eight academic years.

1.2 After eight academic years of course of study, the candidate is permitted to write the examinations for two more years.

1.3 The candidate shall register for 224 credits and secure 216 credits with compulsory subjects as listed in Table-1.

Table 1: Compulsory Subjects

Serial Number	Subject Particulars
1	All practical subjects
2	Industry oriented mini project
3	Comprehensive Viva-Voce
4	Seminar
5	Project work

2 The students, who fail to fulfill all the academic requirements for the award of the degree within ten academic years from the year of their admission, shall forfeit their seats in B. Tech. course.

3 Courses of study

The following courses of study are offered at present as specializations for the B. Tech. Course:

Branch Code	Branch
01	Civil Engineering
02	Electrical and Electronics Engineering
03	Mechanical Engineering
04	Electronics and Communication Engineering
05	Computer Science and Engineering
08	Chemical Engineering
10	Electronics and Instrumentation Engineering

11	Bio-Medical Engineering
12	Information Technology
14	Mechanical Engineering (Mechatronics)
17	Electronics and Telematics Engineering
18	Metallurgy and Material Technology
19	Electronics and Computer Engineering
20	Mechanical Engineering (Production)
21	Aeronautical Engineering
22	Instrumentation and Control Engineering
23	Biotechnology
24	Automobile Engineering
25	Mining Engineering
26	Mining Machinery
27	Petroleum Engineering
28	Civil and Environmental Engineering
29	Mechanical Engineering (Nano Technology)
30	Agricultural Engineering
31	Computer Science & Technology

4 Credits

	I Year		Semester	
	Periods / Week	**Credits**	**Periods / Week**	**Credits**
Theory	03+1/03	06	04	04
	02	04	—	—
Practical	03	04	03	02
Drawing	02+03	06	03 06	02 04
Mini Project	—	—	—	02
Comprehensive Viva Voce	—	—	—	02
Seminar	—	—	6	02
Project	—	--	15	10

5 Distribution and Weightage of Marks

5.1 The performance of a student in each semester or I year shall be evaluated subject-wise for a maximum of 100 marks for a theory and 75 marks for a practical subject. In addition, industry-oriented mini-project, seminar and project work shall be evaluated for 50, 50 and 200 marks, respectively.

5.2 For theory subjects the distribution shall be 25 marks for Internal Evaluation and 75 marks for the End-Examination.

5.3 For theory subjects, during a semester there shall be 2 mid-term examinations. Each mid- term examination consists of one objective paper, one essay paper and one assignment. The objective paper and the essay paper shall be for 10 marks each with a total duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for essay paper). The Objective paper is set with 20 bits of multiple choice, fill-in the blanks and matching type of questions for a total of 10 marks. The essay paper shall contain 4 full questions (one from each unit) out of which, the student has to answer 2 questions, each carrying 5 marks. While the first mid-term examination shall be conducted on 1 to 2.5 units of the syllabus, the second mid-term examination shall be conducted on 2.5 to 5 units. Five (5) marks are allocated for Assignments (as specified by the subject teacher concerned). The first Assignment should be submitted before the conduct of the first mid-examination, and the second Assignment should be submitted before the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate. However, in the I year, there shall be 3 mid term examinations, each for 25 marks, along with 3 assignments in a similar pattern as above (1st mid shall be from Unit-I, 2nd mid shall be 2 &3 Units and 3rd mid shall be 4 & 5 Units) and the average marks of the examinations secured (each evaluated for a total of 25 marks) in each subject shall be considered to be final marks for the internals/sessionals. If any candidate is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the University.

The details of the Question Paper pattern without deviating from the R13 regulations as notified in the website is as follows:

- ***The End semesters Examination will be conducted for 75 marks which consists of two parts viz. i). Part-A for 25 marks, ii). Part –B for 50 marks.***
- ***Part-A is compulsory question which consists of ten sub-questions. The first five sub-questions are from each unit and carries 2 marks each. The next five sub-questions***

are one from each unit and carries 3 marks each.

- ***Part-B consists of five Questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice (that means there will be two questions from each unit and the student should answer any one question)***

5.4 For practical subjects there shall be a continuous evaluation during a semester for 25 sessional marks and 50 end semester examination marks. Out of the 25 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 15 marks and internal practical examination shall be evaluated for 10 marks conducted by the laboratory teacher concerned. The end semester examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the clusters of colleges which are decided by the examination branch of the University.

5.5 For the subject having design and/or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and Estimation, the distribution shall be 25 marks for internal evaluation (15 marks for day-to-day work and 10 marks for internal tests) and 75 marks for end semester examination. There shall be two internal tests in a Semester and the average of the two shall be considered for the award of marks for internal tests. However, in the I year class, there shall be three tests and the average will be taken into consideration.

5.6 There shall be an industry-oriented Mini-Project, in collaboration with an industry of their specialization, to be taken up during the vacation after III year II Semester examination. However, the mini-project and its report shall be evaluated along with the project work in IV year II Semester. The industry oriented mini-project shall be submitted in a report form and presented before the committee. It shall be evaluated for 50 marks. The committee consists of an external examiner, head of the department, the supervisor of the mini-project and a senior faculty member of the department. There shall be no internal marks for industry-oriented mini-project.

5.7 There shall be a seminar presentation in IV year II Semester. For the seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his understanding of the topic, and submit it to the department. It shall be evaluated by the departmental committee consisting of head of the department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for the seminar.

5.8 There shall be a Comprehensive Viva-Voce in IV year II semester.

The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is intended to assess the student's understanding of the subjects he studied during the B. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce.

5.9 Out of a total of 200 marks for the project work, 50 marks shall be allotted for Internal Evaluation and 150 marks for the End Semester Examination (Viva Voce). The End Semester Examination of the project work shall be conducted by the same committee as appointed for the industry-oriented mini-project. In addition, the project supervisor shall also be included in the committee. The topics for industry oriented mini project, seminar and project work shall be different from one another. The evaluation of project work shall be made at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project.

5.10 The Laboratory marks and the sessional marks awarded by the College are subject to scrutiny and scaling by the University wherever necessary. In such cases, the sessional and laboratory marks awarded by the College will be referred to a Committee. The Committee will arrive at a scaling factor and the marks will be scaled accordingly. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective institutions as per the University rules and produced before the Committees of the University as and when asked for.

6 Attendance Requirements

6.1 A student is eligible to write the University examinations only if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

6.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or I year may be granted by the College Academic Committee

6.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

6.4 A student who is short of attendance in semester / I year may seek re-admission into that semester/I year when offered within 4 weeks from the date of the commencement of class work.

6.5 Students whose shortage of attendance is not condoned in any semester/I year are not eligible to write their end semester examination of that class and their registration stands cancelled.

6.6 A stipulated fee shall be payable towards condonation of shortage of attendance.

6.7 A student will be promoted to the next semester if he satisfies the attendance requirement of the present semester/I year, as applicable, including the days of attendance in sports, games, NCC and NSS activities.

6.8 If any candidate fulfills the attendance requirement in the present semester or I year, he shall not be eligible for readmission into the same class.

7 Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6.

7.1 A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/ practical design/drawing subject/project and secures not less than 35% of marks in the end semester exam, and minimum 40% of marks in the sum total of the mid-term and end semester exams.

7.2 A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement.

7.3 A student will not be promoted from II year to III year unless he fulfils the academic requirement of 34 credits up to II year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

7.4 A student shall be promoted from III year to IV year only if he fulfils the academic requirements of 56 credits up to III year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

7.5 A student shall register and put up minimum attendance in all 224 credits and earn 216 credits. Marks obtained in the best 216 credits shall be considered for the calculation of percentage of marks.

7.6 Students who fail to earn 216 credits as indicated in the course structure within ten academic years (8 years of study + 2 years additionally for appearing for exams only) from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled.

8 Course pattern

8.1 The entire course of study is for four academic years. I year shall be on yearly pattern and II, III and IV years on semester pattern.

8.2 A student, eligible to appear for the end examination in a subject, but absent from it or has failed in the end semester examination, may

write the exam in that subject during the period of supplementary exams.

8.3 When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the next semester/year. However, the academic regulations under which he was first admitted, shall continues to be applicable to him.

9 Award of Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	**From the aggregate marks secured from 216 Credits.**
First Class	Below 70 but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

The marks obtained in internal evaluation and end semester / I year examination shall be shown separately in the memorandum of marks.

10 Minimum Instruction Days

The minimum instruction days for each semester/I year shall be 90/ 180 days.

11 There shall be no branch transfers after the completion of the admission process.

12 There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Hyderabad.

13 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

14. **TRANSITORY REGULATIONS**

14.1 Discontinued, detained, or failed candidates are eligible for readmission as and when next offered.

14.2 After the revision of the regulations, the students of the previous batches will be given two chances for passing in their failed subjects, one supplementary and the other regular. If the students cannot

clear the subjects in the given two chances, they shall be given equivalent subjects as per the revised regulations which they have to pass in order to obtain the required number of credits.

14.3 In case of transferred students from other Universities, the credits shall be transferred to JNTUH as per the academic regulations and course structure of the JNTUH.

15. General

15.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

15.2 The academic regulation should be read as a whole for the purpose of any interpretation.

15.3 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

15.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

15.5 The students seeking transfer to colleges affiliated to JNTUH from various other Universities/Institutions, have to pass the failed subjects which are equivalent to the subjects of JNTUH, and also pass the subjects of JNTUH which the candidates have not studied at the earlier Institution on their own without the right to sessional marks. Further, though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of JNTUH, the candidates have to study those subjects in JNTUH in spite of the fact that those subjects are repeated.

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Academic Regulations R13 For B.Tech. (Lateral Entry Scheme)

Applicable for the students admitted into II year B. Tech. (LES) from the Academic Year 2013-14 and onwards

1 **Eligibility for award of B. Tech. Degree (LES)**

I. The LES candidates shall pursue a course of study for not less than three academic years and not more than six academic years.

II. They shall be permitted to write the examinations for two more years after six academic years of course work.

2. The candidate shall register for 168 credits and secure 160 credits from II to IV year B.Tech. Program (LES) for the award of B.Tech. degree with compulsory subjects as listed in Table-1.

Table 1: Compulsory Subjects

Serial Number	Subject Particulars
1	All practical subjects
2	Industry oriented mini project
3	Comprehensive Viva-Voce
4	Seminar
5	Project work

3. The students, who fail to fulfil the requirement for the award of the degree in 8 consecutive academic years (6 years of study + 2 years additionally for appearing exams only) from the year of admission, shall forfeit their seats.

4. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

5. **Promotion Rule**

A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

A student shall be promoted from III year to IV year only if he fulfils the academic requirements of 34 credits up to III year I semester from all the examinations, whether or not the candidate takes the examinations.

6. **Award of Class**

After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	**From the aggregate marks secured from 216 Credits.**
First Class	Below 70 but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

The marks obtained in the internal evaluation and the end semester examination shall be shown separately in the marks memorandum.

7. All the other regulations as applicable to **B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)**.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/ Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers 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 University.
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 University 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 University 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 Chief Superintendent/Assistant – Superintendent / 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 officer-in charge 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 officer-in-charge, or	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

	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 College campus 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.	registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of 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 University 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

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.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   - (i) A show cause notice shall be issued to the college.
   - (ii) Impose a suitable fine on the college.
   - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

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B. TECH. AERONAUTICAL ENGINEERING

I YEAR

Code	Subject	L	T/P/D	C
A10001	English	2	-	4
A10002	Mathematics – I	3	1	6
A10302	Engineering Mechanics	3	-	6
A10004	Engineering Physics	3	-	6
A10005	Engineering Chemistry	3	-	6
A10501	Computer Programming	3	-	6
A10301	Engineering Drawing	2	3	6
A10581	Computer Programming Lab.	-	3	4
A10081	Engineering Physics & Engineering Chemistry Lab.	-	3	4
A10083	English Language Communication Skills Lab.	-	3	4
A10082	IT Workshop / Engineering Workshop	-	3	4
	Total	**19**	**16**	**56**

II YEAR I SEMESTER

Code	Subject	L	T/P/D	C
A30006	Mathematics – II	4	-	4
A30306	Thermodynamics	4	-	4
A30104	Mechanics of Solids	4	-	4
A30103	Mechanics of Fluids	4	-	4
A32101	Introduction of Aerospace Engg	4	-	4
A30009	Environmental Studies	4	-	4
A32181	Aircraft Engineering Drawing Lab with CAD	-	3	2
A30182	Mechanics of Solids and Mechanics of Fluids Lab	-	3	2
	Total	**24**	**6**	**28**

II YEAR II SEMESTER

Code	Subject	L	T/P/D	C
A42102	Aerodynamics-I	4	-	4
A42104	Aircraft Production Technology	4	-	4
A40203	Electrical and Electronics Engineering	4	-	4
A42103	Aerospace Vehicle Structures -I	4	-	4
A42106	Introduction to Space Technology	4	-	4
A42105	Flight Mechanics –I	4	-	4
A42182	Aircraft Production Technology Lab	-	3	2
A40281	Electrical and Electronics Engineering Lab	-	3	2
	Total	**24**	**6**	**28**

III YEAR I SEMESTER

Code	Subject	L	T/P/D	C
A50014	Management Science	4	-	4
A52111	Flight Mechanics- II	4	-	4
A52107	Aerodynamics– II	4	-	4
A52109	Aerospace Vehicle Structures– II	4	-	4
A52108	Aerospace Propulsion- I	4	-	4
A52110	Air Transportation Systems	4	-	4
A52184	Aerospace Structures Lab	-	3	2
A52183	Aerodynamics and Propulsion Lab	-	3	2
	Total	**24**	**6**	**28**

III YEAR II SEMESTER

Code	Subject	L	T/P/D	C
A62114	Computational Aerodynamics	4	-	4
A62115	Conceptual Design of Flight Vehicles	4	-	4
A62112	Aerospace Propulsion- II	4	-	4
A62113	Aircraft Systems	4	-	4
A60330	Finite Element Methods	4	-	4
	Open Elective			
A60117	Disaster Management			
A60017	Intellectual Property Rights			
A60018	Human Values and Professional Ethics	4	-	4
A60086	Advanced Communication Skills Lab	-	3	2
A62185	Flight Vehicle Design & Instrumentation Lab	-	3	2
	Total	**24**	**6**	**28**

IV YEAR I SEMESTER

Code	Subject	L	T/P/D	C
A72118	Airframe Structural Design	4	-	4
A72122	Mechanical Vibrations and Structural Dynamics	4	-	4
A70328	CAD/CAM	4	-	4
A72119	Control Theory – Application to Flight Control Systems	4	-	4
	Elective – I	4	-	4
A72116	Advanced Computational Aerodynamics			
A72121	Flight Scheduling and Operations			
A72123	Mechanisms and Mechanical Design			
A72125	Theory of Elasticity			
A70008	Probability and Statistics			
	Elective - II	4	-	4
A72124	Space Mechanics			
A72120	Experimental Aerodynamics			
A70352	Operations Research			
A72117	Aircraft Maintenance Engineering			
A72187	Computational Structures Lab	-	3	2
A72186	Computational Aerodynamics Lab	-	3	2
	Total	**24**	**6**	**28**

IV YEAR II SEMESTER

Code	Subject	L	T/P/D	C
A82129	Avionics & Instrument Systems	4	-	4
	Elective –III	4	-	4
A82127	Airport Planning and Operations			
A82128	Analysis of Composite Structures			
A82130	Helicopter Engineering			
A82131	Hypersonic Aerodynamics			
	Elective – IV	4	-	4
A80331	Heat Transfer			
A82132	Launch Vehicle and Missile Technology			
A82133	Wind Engineering and Industrial Aerodynamics			
A82126	Aero elasticity			
A80087	Industry Oriented Mini Project	-	-	2
A80089	Seminar	-	6	2
A80088	Project Work	-	15	10
A80090	Comprehensive Viva	-	-	2
	Total	**12**	**21**	**28**

Note: All End Examinations (Theory and Practical) are of three hours duration.
T-Tutorial L – Theory P – Practical D-Drawing C – Credits

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I Year B.Tech. AE	**L**	**T/P/D**	**C**
	2	**-/-/-**	**4**

(A10001) ENGLISH

Introduction:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competencies of Engineering students. The prescribed books and the exercises are meant to serve broadly as students' handbooks.

In the English classes, the focus should be on the skills of reading, writing, listening and speaking and for this the teachers should use the text prescribed for detailed study. For example, the students should be encouraged to read the texts/selected paragraphs silently. The teachers can ask comprehension questions to stimulate discussion and based on the discussions students can be made to write short paragraphs/essays etc.

The text for non-detailed study is for extensive reading/reading for pleasure. Hence, it is suggested that they read it on their own the topics selected for discussion in the class. The time should be utilized for working out the exercises given after each section, as also for supplementing the exercises with authentic materials of a similar kind for example, from newspaper articles, advertisements, promotional material etc.. However, the stress in this syllabus is on skill development, fostering ideas and practice of language skills.

Objectives:

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To equip the students to study academic subjects more effectively using the theoretical and practical components of the English syllabus.
- To develop the study skills and communication skills in formal and informal situations.

SYLLABUS:

Listening Skills:

Objectives

1. To enable students to develop their listening skill so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation.
2. To equip students with necessary training in listening so that they

can comprehend the speech of people of different backgrounds and regions.

Students should be given practice in listening to the sounds of the language to be able to recognise them, to distinguish between them to mark stress and recognise and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills:

Objectives

1. To make students aware of the role of speaking in English and its contribution to their success.
2. To enable students to express themselves fluently and appropriately in social and professional contexts.

- Oral practice
- Describing objects/situations/people
- Role play – Individual/Group activities (Using exercises from the five units of the prescribed text: **Skills Annexe -Functional English for Success)**
- Just A Minute(JAM) Sessions.

Reading Skills:

Objectives

1. To develop an awareness in the students about the significance of silent reading and comprehension.
2. To develop the ability of students to guess the meanings of words from context and grasp the overall message of the text, draw inferences etc.

- Skimming the text
- Understanding the gist of an argument
- Identifying the topic sentence
- Inferring lexical and contextual meaning
- Understanding discourse features
- Scanning
- Recognizing coherence/sequencing of sentences

NOTE : The students will be trained in reading skills using the prescribed text for detailed study.

They will be examined in reading and answering questions using 'unseen' passages which may be taken from authentic texts, such as magazines/ newspaper articles.

Writing Skills :

Objectives

1. To develop an awareness in the students about writing as an exact and formal skill.
2. To equip them with the components of different forms of writing, beginning with the lower order ones.

- Writing sentences
- Use of appropriate vocabulary
- Paragraph writing
- Coherence and cohesiveness
- Narration / description
- Note Making
- Formal and informal letter writing
- Describing graphs using expressions of comparison

TEXTBOOKS PRESCRIBED:

In order to improve the proficiency of the student in the acquisition of the four skills mentioned above, the following texts and course content, divided into Five Units, are prescribed:

For Detailed study: First Textbook: "Skills Annexe -Functional English for Success", Published by Orient Black Swan, Hyderabad.

For Non-detailed study

1. **Second text book "Epitome of Wisdom",** Published by Maruthi Publications, Guntur
   - The course content and study material is divided into Five Units.

Unit –I:

1. Chapter entitled **'Wit and Humour**' from **'Skills Annexe'** -Functional English for Success, Published by Orient Black Swan, Hyderabad
2. Chapter entitled **'Mokshagundam Visvesvaraya'** from **"Epitome of Wisdom**", Published by Maruthi Publications, Hyderabad.

L- Listening For Sounds, Stress and Intonation

S- Greeting and Taking Leave, Introducing Oneself and Others (Formal and Informal Situations)

R- Reading for Subject/ Theme

W- Writing Paragraphs

G- Types of Nouns and Pronouns

V- Homonyms, homophones synonyms, antonyms

Unit –II

1. Chapter entitled **"Cyber Age"** from **"Skills Annexe -Functional English for Success"** Published by Orient Black Swan, Hyderabad.
2. Chapter entitled **'Three Days To See'** from **"Epitome of Wisdom"**, Published by Maruthi Publications, Hyderabad.

L – Listening for themes and facts

S – Apologizing, interrupting, requesting and making polite conversation

R- for theme and gist

W- Describing people, places, objects, events

G- Verb forms

V- noun, verb, adjective and adverb

Unit –III

1. Chapter entitled **'Risk Management'** from **"Skills Annexe - Functional English for Success"** Published by Orient Black Swan, Hyderabad
2. Chapter entitled **'Leela's Friend'** by R.K. Narayan from **"Epitome of Wisdom"**, Published by Maruthi Publications, Hyderabad

L – for main points and sub-points for note taking

S – giving instructions and directions; Speaking of hypothetical situations

R – reading for details

W – note-making, information transfer, punctuation

G – present tense

V – synonyms and antonyms

Unit –IV

1. Chapter entitled **'Human Values and Professional Ethics'** from **"Skills Annexe -Functional English for Success"** Published by Orient Black Swan, Hyderabad
2. Chapter entitled **'The Last Leaf'** from **"Epitome of Wisdom"**, Published by Maruthi Publications, Hyderabad

L - Listening for specific details and information

S- narrating, expressing opinions and telephone interactions

R - Reading for specific details and information

W- Writing formal letters and CVs

G- Past and future tenses

V- Vocabulary - idioms and Phrasal verbs

Unit –V

1. Chapter entitled **'Sports and Health'** from **"Skills Annexe - Functional English for Success"** Published by Orient Black Swan, Hyderabad
2. Chapter entitled **'The Convocation Speech'** by N.R. Narayanmurthy' from **"Epitome of Wisdom"**, Published by Maruthi Publications, Hyderabad

L- Critical Listening and Listening for speaker's tone/ attitude

S- Group discussion and Making presentations

R- Critical reading, reading for reference

W- Project proposals; Technical reports, Project Reports and Research Papers

G- Adjectives, prepositions and concord

V- Collocations and Technical vocabulary

Using words appropriately

* Exercises from the texts not prescribed shall also be used for classroom tasks.

REFERENCES :

1. Contemporary English Grammar Structures and Composition by David Green, MacMillan Publishers, New Delhi. 2010.
2. Innovate with English: A Course in English for Engineering Students, edited by T Samson, Foundation Books.
3. English Grammar Practice, Raj N Bakshi, Orient Longman.
4. Technical Communication by Daniel Riordan. 2011. Cengage Publications. New Delhi.
5. Effective English, edited by E Suresh Kumar, A RamaKrishna Rao, P Sreehari, Published by Pearson
6. Handbook of English Grammar& Usage, Mark Lester and Larry Beason, Tata Mc Graw –Hill.
7. Spoken English, R.K. Bansal & JB Harrison, Orient Longman.
8. Technical Communication, Meenakshi Raman, Oxford University Press
9. Objective English Edgar Thorpe & Showick Thorpe, Pearson Education
10. Grammar Games, Renuvolcuri Mario, Cambridge University Press.

11. Murphy's English Grammar with CD, Murphy, Cambridge University Press.
12. Everyday Dialogues in English, Robert J. Dixson, Prentice Hall India Pvt Ltd.,
13. ABC of Common Errors Nigel D Turton, Mac Millan Publishers.
14. Basic Vocabulary Edgar Thorpe & Showick Thorpe, Pearson Education
15. Effective Technical Communication, M Ashraf Rizvi, Tata Mc Graw – Hill.
16. An Interactive Grammar of Modern English, Shivendra K. Verma and Hemlatha Nagarajan , Frank Bros & CO
17. A Communicative Grammar of English, Geoffrey Leech, Jan Svartvik, Pearson Education
18. Enrich your English, Thakur K B P Sinha, Vijay Nicole Imprints Pvt Ltd.,
19. A Grammar Book for You And I, C. Edward Good, MacMillan Publishers

Outcomes:

- Usage of English Language, written and spoken.
- Enrichment of comprehension and fluency
- Gaining confidence in using language in verbal situations.

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(A10002) MATHEMATICS -I

Objectives: To learn

- The types of Matrices and their properties
- Concept of rank of a matrix and applying the concept of rank to know the consistency of linear equations and to find all possible solutions, if exist.
- The concept of eigenvalues and eigenvectors of a matrix is to reduce a quadratic form into a canonical form through a linear transformation.
- The mean value theorems and to understand the concepts geometrically.
- The functions of several variables and optimization of these functions.
- The evaluation of improper integrals, Beta and Gamma functions.
- Multiple integration and its applications.
- Methods of solving the differential equations of 1st and higher order.
- The applications of the differential equations to Newton's law of cooling, Natural growth and decay, Bending of beams etc
- The definition of integral transforms and Laplace Transform.
- Properties of Laplace transform.
- Inverse Laplace Transform.
- Convolution theorem.
- Solution of Differential equations using Laplace transform.

UNIT-I

Theory of Matrices: Real matrices – Symmetric, skew – symmetric, orthogonal. Complex matrices: Hermitian, Skew-Hermitian and Unitary Matrices. Idempotent matrix.

Elementary row and column transformations- Elementary matrix, Finding rank of a matrix by reducing to Echelon and normal forms. Finding the inverse of a non-singular square matrix using row/ column transformations (Gauss-Jordan method). Consistency of system of linear equations (homogeneous and non- homogeneous) using the rank of a matrix. Solving m x n and n x n linear system of equations by Gauss elimination.

Cayley-Hamilton Theorem (without proof) – Verification. Finding inverse of a matrix and powers of a matrix by Cayley-Hamilton theorem, Linear dependence and Independence of Vectors. Linear Transformation –

Orthogonal Transformation. Eigen values and eigen vectors of a matrix. Properties of eigen values and eigen vectors of real and complex matrices. Finding linearly independent eigen vectors of a matrix when the eigen values of the matrix are repeated.

Diagonalization of matrix – Quadratic forms up to three variables. Rank – Positive definite, negative definite, semi definite, index, signature of quadratic forms. Reduction of a quadratic form to canonical form.

UNIT – II

Differential calculus methods : Rolle's Mean value Theorem – Lagrange's Mean Value Theorem – Cauchy's mean value Theorem – (all theorems without proof but with geometrical interpretations), verification of the Theorems and testing the applicability of these theorem to the given function.

Functions of several variables: Functional dependence- Jacobian- Maxima and Minima of functions of two variables without constraints and with constraints-Method of Lagrange multipliers.

UNIT – III

Improper integration, Multiple integration & applications: Gamma and Beta Functions –Relation between them, their properties – evaluation of improper integrals using Gamma / Beta functions

Multiple integrals – double and triple integrals – change of order of integration-change of variables (polar, cylindrical and spherical) Finding the area of a region using double integration and volume of a region using triple integration.

UNIT – IV

Differential equations and applications : Overview of differential equations-exact, linear and Bernoulli (NOT TO BE EXAMINED). Applications of first order differential equations – Newton's Law of cooling, Law of natural growth and decay, orthogonal trajectories.

Linear differential equations of second and higher order with constant coefficients, Non-homogeneous term of the type type f(X) = e^{ax}, Sin ax, Cos ax, and x^n, $e^{ax}V(x)$, $x^n V(x)$, method of variation of parameters. Applications to bending of beams, Electrical circuits and simple harmonic motion.

UNIT – V

Laplace transform and its applications to Ordinary differential equations Definition of Integral transform, Domain of the function and Kernel for the Laplace transforms. Existence of Laplace transform. Laplace transform of standard functions, first shifting Theorem, Laplace transform of functions when they are multiplied or divided by “t”. Laplace transforms of derivatives and integrals of functions. – Unit step function – second shifting theorem –

Dirac's delta function, Periodic function – Inverse Laplace transform by Partial fractions(Heaviside method) Inverse Laplace transforms of functions when they are multiplied or divided by "s", Inverse Laplace Transforms of derivatives and integrals of functions, Convolution theorem –- Solving ordinary differential equations by Laplace transforms.

TEXT BOOKS:

1. Advanced engineering Mathematics by Kreyszig, John Wiley & Sons Publishers.
2. Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers.

REFERENCES:

1. Advanced Engineering Mathematics by R.K. Jain & S.R.K. Iyengar, 3rd edition, Narosa Publishing House, Delhi.
2. Engineering Mathematics – I by T.K. V. Iyengar, B. Krishna Gandhi & Others, S. Chand.
3. Engineering Mathematics – I by D. S. Chandrasekhar, Prison Books Pvt. Ltd.
4. Engineering Mathematics – I by G. Shanker Rao & Others I.K. International Publications.
5. Advanced Engineering Mathematics with MATLAB, Dean G. Duffy, 3rd Edi, CRC Press Taylor & Francis Group.
6. Mathematics for Engineers and Scientists, Alan Jeffrey, 6th Edi, 2013, Chapman & Hall/ CRC
7. Advanced Engineering Mathematics, Michael Greenberg, Second Edition. Pearson Education.

Outcome:

- After learning the contents of this Unit the student is able to write the matrix representation of a set of linear equations and to analyze solutions of system of equations.
- The student will be able to understand the methods of differential calculus to optimize single and multivariable functions.
- The student is able to evaluate the multiple integrals and can apply the concepts to find the Areas, Volumes, Moment of Inertia etc., of regions on a plane or in space.
- The student is able to identify the type of differential equation and uses the right method to solve the differential equation. Also able to apply the theory of differential equations to the real world problems.
- The student is able to solve certain differential equations using Laplace Transform. Also able to transform functions on time domain to frequency domain using Laplace transforms.

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(A10302) ENGINEERING MECHANICS

UNIT – I

Introduction to Engineering Mechanics – Basic Concepts. **Resultants of Force System:** Parallelogram law **–**Forces and components- Resultant of coplanar Concurrent Forces – Components of forces in Space – Moment of Force - principle of moments – Coplanar Applications – Couples - Resultant of any Force System.

Equilibrium of Force Systems : Free Body Diagrams, Equations of Equilibrium - Equilibrium of planar Systems - Equilibrium of Spatial Systems.

UNIT – II

Friction: Introduction **–** Theory of Friction – Angle of friction - Laws of Friction – Static and Dynamic Frictions – Motion of Bodies: Wedge, Screw, Screw-jack, and Differential Screw-jack.

Transmission of Power: Flat Belt Drives - Types of Flat Belt Drives – Length of Belt, tensions, Tight side, Slack Side, Initial and Centrifugal – Power Transmitted and Condition for Max. Power.

UNIT – III

Centroids and Centers of Gravity: Introduction – Centroids and Centre of gravity of simple figures (from basic principles) – Centroids of Composite Figures - Theorem of Pappus – Center of gravity of bodies and centroids of volumes.

Moments of Inertia : Definition – Polar Moment of Inertia –Radius of gyration - Transfer formula for moment of inertia - Moments of Inertia for Composite areas - Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia : Moment of Inertia of Masses- Transfer Formula for Mass Moments of Inertia - mass moment of inertia of composite bodies.

UNIT – IV

Kinematics of a Particle: 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

Kinetics of particles: Translation -Analysis as a Particle and Analysis as a Rigid Body in Translation – Equations of plane motion - Angular motion - Fixed Axis Rotation – Rolling Bodies.

UNIT – V

Work – Energy Method: Work energy Equations for Translation - Work-Energy Applications to Particle Motion – Work energy applied to Connected Systems - Work energy applied to Fixed Axis Rotation and Plane Motion. Impulse and momentum.

Mechanical Vibrations : Definitions and Concepts – Simple Harmonic

Motion – Free vibrations, simple and Compound Pendulums – Torsion Pendulum – Free vibrations without damping: General cases.

TEXT BOOKS:

1. Engineering Mechanics - Statics and Dynamics by Ferdinand.L. Singer / Harper International Edition.
2. Engineering Mechanics/ S. Timoshenko and D.H. Young, Mc Graw Hill Book Compan.

REFERENCES:

1. Engineering Mechanics / Irving Shames / Prentice Hall
2. A text of Engineering Mechanics /YVD Rao/ K. Govinda Rajulu/ M. Manzoor Hussain, Academic Publishing Company
3. Engg. Mechanics / M.V. Seshagiri Rao & D Rama Durgaiah/ Universities Press
4. Engineering Mechanics, Umesh Regl / Tayal.
5. Engg. Mechanics / KL Kumar / Tata McGraw Hill.
6. Engg. Mechanics / S.S. Bhavikati & K.G. Rajasekharappa

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(A10004) ENGINEERING PHYSICS

Objectives:

It gives

- to the students basic understanding of bonding in solids, crystal structures and techniques to characterize crystals.
- to understand the behavior of electron in a solid and thereby one can determine the conductivity and specific heat values of the solids.
- to study applications in Engineering like memory devices, transformer core and Electromagnetic machinery.
- to help the student to design powerful light sources for various Engineering Applications and also enable them to develop communication systems using Fiber Technology.
- to understand the working of Electronic devices, how to design acoustic proof halls and understand the behavior of the materials at Nano scale.

UNIT-I

Crystallography: Ionic Bond, Covalent Bond, Metallic Bond, Hydrogen Bond, Vander-Waal's Bond, Calculation of Cohesive Energy of diatomic molecule-Space Lattice**,** Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC, Miller Indices, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems, Structure of Diamond and NaCl.

X-ray Diffraction & Defects in Crystals: Bragg's Law, X-Ray diffractions method: Laue Method, Powder Method**:** Point Defects: Vacancies, Substitutional, Interstitial, Frenkel and Schottky Defects, line defects (Qualitative) & Burger's Vector.

UNIT-II

Principles of Quantum Mechanics: Waves and Particles, de Broglie Hypothesis , Matter Waves, Davisson and Germer' Experiment, Heisenberg's Uncertainty Principle, Schrödinger's Time Independent Wave Equation - Physical Significance of the Wave Function – Infinite square well potential, extension to three dimensions

Elements of Statistical Mechanics & Electron theory of Solids: Phase space, Ensembles, Micro Canonical , Canonical and Grand Canonical Ensembles **-** Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics (Qualitative Treatment), Concept of Electron Gas, , Density of States, Fermi

Energy- Electron in a periodic Potential, Bloch Theorem, Kronig-Penny Model (Qualitative Treatment), E-K curve, Origin of Energy Band Formation in Solids, Concept of Effective Mass of an Electron, Classification of Materials into Conductors, Semi Conductors & Insulators.

UNIT-III

Dielectric Properties: Electric Dipole, Dipole Moment, Dielectric Constant, Polarizability, Electric Susceptibility, Displacement Vector, Electronic, Ionic and Orientation Polarizations and Calculation of Polarizabilities: Ionic and Electronic - Internal Fields in Solids, Clausius - Mossotti Equation, Piezo - electricity and Ferro- electricity.

Magnetic Properties & Superconducting Properties: Permeability, Field Intensity, Magnetic Field Induction, Magnetization, Magnetic Susceptibility, 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, Soft and Hard Magnetic Materials, Properties of Anti-Ferro and Ferri Magnetic Materials and their Applications, Superconductivity, Meissner Effect, Effect of Magnetic field, Type-I & Type-II Superconductors, Applications of Superconductors

UNIT-IV

Optics: Interference-Interference in thin films(Reflected light), Newton rings experiment- Fraunhofer diffraction due to single slit, N-slits, Diffraction grating experiment , Double refraction-construction and working of Nicol's Prism

Lasers & Fiber Optics: Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Einstein's Coefficients and Relation between them, Population Inversion, Lasing Action, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers- Principle of Optical Fiber, Construction of fiber, Acceptance Angle and Acceptance Cone, Numerical Aperture, Types of Optical Fibers: Step Index and Graded Index Fibers, Attenuation in Optical Fibers, Application of Optical Fiber in communication systems.

UNIT-V:

Semiconductor Physics: Fermi Level in Intrinsic and Extrinsic Semiconductors, Calculation of carrier concentration in Intrinsic &, Extrinsic Semiconductors, Direct and Indirect Band gap semiconductors, Hall Effect-Formation of PN Junction, Open Circuit PN Junction, Energy Diagram of PN Diode, Diode Equation, I-V Characteristics of PN Junction diode, Solar cell, LED & Photo Diodes. Acoustics of Buildings & Acoustic Quieting: Reverberation and Time of Reverberation, Sabine's Formula for Reverberation Time, Measurement of Absorption Coefficient of a Material, factors affecting the Architectural Acoustics and their Remedies.

Nanotechnology: Origin of Nanotechnology, Nano Scale, Surface to Volume

Ratio, Quantum Confinement, Bottom-up Fabrication: Sol-gel, Top-down Fabrication: Chemical Vapour Deposition, Characterization by TEM.

TEXT BOOKS:

1. Engineering Physics,K. Malik, A. K. Singh, Tata Mc Graw Hill Book Publishers.
2. Engineering Physics, V. Rajendran, Tata Mc Graw Hill Book Publishers.

REFERENCES:

1. Fundamentals of Physics, David Halliday, Robert Resnick, Jearl Walker by John Wiley & Sons.
2. Sears and Zemansky's University Physics (10th Edition) by Hugh D. Young Roger A. Freedman, T. R. Sandin, A. Lewis FordAddison-Wesley Publishers.
3. Applied Physics for Engineers – P. Madhusudana Rao (Academic Publishing company, 2013).
4. Solid State Physics – M. Armugam (Anuradha Publications).
5. Modern Physics – R. Murugeshan & K. Siva Prasath – S. Chand & Co. (for Statistical Mechanics).
6. A Text Book of Engg Physics – M. N. Avadhanulu & P. G. Khsirsagar– S. Chand & Co. (for acoustics).
7. Modern Physics by K. Vijaya Kumar, S. Chandralingam: S. Chand & Co.Ltd.
8. Nanotechnology – M.Ratner & D. Ratner (Pearson Ed.).
9. Introduction to Solid State Physics – C. Kittel (Wiley Eastern).
10. Solid State Physics – A.J. Dekker (Macmillan).
11. Applied Physics – Mani Naidu Pearson Education.

Outcomes:

- The student would be able to learn the fundamental concepts on behavior of crystalline solids.
- The knowledge on Fundamentals of Quantum Mechanics, Statistical Mechanics enables the student to apply to various systems like Communications Solar Cells, Photo Cells and so on.
- Design, Characterization and study of properties of materials help the student to prepare new materials for various Engineering applications.
- This course also helps the student exposed to non- destructive testing methods.
- Finally, Engineering Physics Course helps the student to develop problem solving skills and analytical skills.

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(A10005) ENGINEERING CHEMISTRY

Objective:

An engineer is as someone who uses scientific, natural and physical principles to design something of use for people or other living creatures. Much of what any engineer does involves chemistry because everything in our environment has a molecular make up. Engineering requires the concepts of applied chemistry and the more chemistry an engineer understands, the more beneficial it is. In the future, global problems and issues will require an in-depth understanding of chemistry to have a global solution. This syllabus aims at bridging the concepts and theory of chemistry with examples from fields of practical application, thus reinforcing the connection between science and engineering. It deals with the basic principles of various branches of chemistry which are fundamental tools necessary for an accomplished engineer.

UNIT I:

Electrochemistry & Corrosion: Electro Chemistry – Conductance - Specific, Equivalent and Molar conductance and their Units; Applications of Conductance (Conductometric titrations). **EMF:** Galvanic Cells, types of Electrodes – (Calomel, Quinhydrone and glass electrodes); Nernst equation and its applications ; concept of concentration cells, electro chemical series, Potentiometric titrations, determination of P^H using glass electrode-Numerical problems.

Batteries: Primary cells (dry cells) and secondary cells (lead-Acid cell, Ni-Cd cell, Lithium cells). Applications of batteries. **Fuel cells** – Hydrogen – Oxygen fuel cell; methanol – oxygen fuel cell ; Advantages and Applications.

Corrosion and its control: Causes and effects of corrosion; Theories of corrosion – Chemical & Electrochemical corrosion; Types of corrosion (Galvanic, Water line, Pitting and Intergranular); Factors affecting rate of corrosion – Nature of metal and Nature of Environment – Corrosion control methods – Cathodic protection (sacrificial anodic and impressed current). Surface coatings: Metallic coatings & methods of application of metallic coatings - hot dipping (galvanization & tinning), Cementation, cladding, electroplating (copper plating) Electroless plating (Ni plating) - Organic coatings – Paints - constituents and their functions.

UNIT II:

Engineering Materials: Polymers: Types of Polymerization (Chain & Step growth).**Plastics:** Thermoplastic & Thermo setting resins; Compounding &

fabrication of plastics (Compression and injection moulding).Preparation, properties, engineering applications of PVC, Teflon and Bakelite.

Fibers- Charcterstics of fibers – preparation, properties and uses of Nylon – 6,6 and Dacron – Fiber Reinforced Plastics (FRP) – applications. **Rubbers** – Natural rubber and its vulcanization. Elastomers – Buna-s, Butyl rubber and Thiokol rubber.

Conducting polymers: Polyacetylene, Polyaniline, Mechanism of Conduction, doping; applications of Conducting polymers. **Bio-degradable Polymers**- preparation and Applications of Poly vinyl acetate and Poly lactic acid - **Cement:** composition of Portland cement, setting & hardening of cement (reactions), **Lubricants:** Classification with examples- Characterstics of a good lubricant & mechanism of lubrication (thick film , thin film and extreme pressure) – properties of lubricants: viscosity , Cloud point, flash and fire points. **Refractories:** Classification, characteristics of a good refractory and applications.

Nanomaterials: Introduction, preparation by sol-gel & chemical vapour deposition methods. Applications of nanomaterials.

UNIT III:

Water and its Treatment: Hardness of Water: Causes of hardness, expression of hardness – units – types of hardness, estimation of temporary & permanent hardness of water by EDTA method - numerical problems. Boiler troubles – Scale & sludges, Priming and foaming, caustic enbrittlement and boiler corrosion; Treatment of boiler feed water – Internal treatment (Phosphate, Colloidal and calgon conditioning) – External treatment – Lime Soda process, Zeolite process and ion exchange process. Numerical Problems. **Potable Water**- Its Specifications – Steps involved in treatment of potable water – Disinfection of water by chlorination and ozonisation. Reverse osmosis & its significance.

Unit – IV :

Fuels & Combustion: Fuels – Classification – soild fuels : coal – analysis of coal - proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining – cracking – types – fixed bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol, Bergius and Fischer-Tropsch's process: Gaseous fuels - constituents, characteristics and applications of natural gas, LPG and CNG. Analysis of flue gas by Orsat's apparatus – Numerical Problems.

Combustion – Definition, Calorific value of fuel – HCV , LCV; Determination of calorific value by Junker's gas calorimeter – theoretical calculation of Calorific value by Dulong's formula – Numerical problems on combustion.

UNIT V:

Phase Rule & Surface Chemistry : **Phase Rule:** Definition of terms: Phase,

component, degree of freedom, phase rule equation. Phase diagrams – one component system- water system. Two component system Lead- Silver, cooling curves, heat treatment based on iron-carbon phase diagram - hardening, annealing and normalization.

Surface Chemistry: **Adsorption –** Types of Adsorption, Isotherms – Freundlich and Langmuir adsorption isotherm, applications of adsorption; **Colloids**: Classification of Colloids; Electrical & optical properties, micelles, applications of colloids in industry.

TEXT BOOKS:

1. Engineering Chemistry by R.P. Mani,K.N. Mishra, B. Rama Devi / CENGAGE learning.
2. Engineering Chemistry by P.C Jain & Monica Jain, Dhanpatrai Publishing Company (2008).

REFERENCE BOOKS

1. Engineering Chemistry by B. Siva Shankar Mc.Graw Hill Publishing Company Limited, New Delhi (2006).
2. Engineering Chemistry J.C. Kuriacase & J. Rajaram, Tata McGraw Hills Publishing Company Limited, New Delhi (2004).
3. Text Book of Engineering Chemistry by S.S. Dara & Mukkati S. Chand & Co Publishers, New Delhi (2006).
4. Chemistry of Engineering Materials by CV Agarwal, C.P Murthy, A.Naidu, BS Publications.

Outcome:

- Students will demonstrate a depth of knowledge and apply the methods of inquiry in a discipline of their choosing, and they will demonstrate a breadth of knowledge across their choice of varied disciplines.
- Students will demonstrate the ability to access and interpret information, respond and adapt to changing situations, make complex decisions, solve problems, and evaluate actions.
- Students will demonstrate awareness and understanding of the skills necessary to live and work in a diverse engineering world.

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(A10501) COMPUTER PROGRAMMING

Objectives:

- To understand the various steps in Program development.
- To understand the basic concepts in C Programming Language.
- To learn how to write modular and readable C Programs.
- To learn to write programs (using structured programming approach) in C to solve problems.
- To introduce the students to basic data structures such as lists, stacks and queues.
- To make the student understand simple sorting and searching methods.

UNIT - I

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Program Development.

Introduction to the C Language – Background, C Programs, Identifiers, Types, Variables, Constants, Input / Output, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associativity, Expression Evaluation, Type conversions, Statements- Selection Statements (making decisions) – if and switch statements, Repetition statements (loops)-while, for, do-while statements, Loop examples, other statements related to looping – break, continue, goto, Simple C Program examples.

UNIT - II

Functions-Designing Structured Programs, Functions, user defined functions, inter function communication, Standard functions, Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Limitations of recursion, example C programs, Preprocessor commands.

Arrays – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays, C program examples.

UNIT - III

Pointers – Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, Pointer Applications-Arrays and Pointers, Pointer Arithmetic and arrays, Passing an array to a function,

memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions.

Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

UNIT - IV

Enumerated, Structure, and Union Types– The Type Definition (typedef), Enumerated types, Structures –Declaration, initialization, accessing structures, operations on structures, Complex structures, structures and functions, Passing structures through pointers, self referential structures, unions, bit fields, C programming examples, command –line arguments.

Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling),Positioning functions, C program examples.

UNIT – V

Searching and Sorting – Sorting- selection sort, bubble sort, Searching-linear and binary search methods.

Lists- Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Push and Pop Operations, Queues- Enqueue and Dequeue operations.

TEXT BOOKS:

1. Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Programming in C. P. Dey and M Ghosh , Oxford University Press.

REFERENCE BOOKS:

1. C& Data structures – P. Padmanabham, Third Edition, B.S. Publications.
2. C for All, S. Thamarai Selvi, R.Murugesan, Anuradha Publications.
3. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, 7th Edition, Pearson education.
4. Programming in C, Ajay Mittal, Pearson.
5. Programming with C, B.Gottfried, 3rd edition, Schaum's outlines, TMH.
6. Problem solving with C, M.T.Somasekhara, PHI.
7. Programming with C, R.S.Bickar, Universities Press.
8. Computer Programming & Data Structures, E.Balagurusamy, 4th edition, TMH.

9. Programming in C – Stephen G. Kochan, III Edition, Pearson Education.
10. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI.
11. C Programming with problem solving, J.A. Jones & K. Harrow,Dreamtech Press.

Outcomes:

- Demonstrate the basic knowledge of computer hardware and software.
- Ability to apply solving and logical skills to programming in C language and also in other languages.

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I Year B.Tech. AE	**L**	**T/P/D**	**C**
	2	**-/-/3**	**6**

(A10301) ENGINEERING DRAWING

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Drawing/ Graphics – Various Drawing Instruments – Conventions in Drawing – **Lettering practice** – BIS Conventions.

Curves: Constructions of Curves used in Engineering Practice:

a) Conic Sections including the Rectangular Hyperbola – General method only.

b) Cycloid, Epicycloid and Hypocycloid

c) Involute.

Scales: Construction of different types of Scales, Plain, Diagonal, Vernier scale.

UNIT – II

Orthographic Projections in First Angle

Projection: Principles of Orthographic Projections – Conventions – First and Third Angle projections.

Projections of Points: including Points in all four quadrants.

Projections of Lines: Parallel, perpendicular, inclined to one plane and inclined to both planes. True length and true angle of a line. Traces of a line.

Projections of Planes: Plane parallel, perpendicular and inclined to one reference plane. Plane inclined to both the reference planes.

UNIT – III

Projections of Solids: Projections of regular solids, cube, prisms, pyramids, tetrahedran, cylinder and cone, axis inclined to both planes.

Sections and Sectional Views: Right Regular Solids – Prism, Cylinder, Pyramid, Cone – use of Auxiliary views.

UNIT – IV

Development of Surfaces: Development of Surfaces of Right, Regular Solids – Prisms, Cylinder, Pyramids, Cone and their parts. frustum of solids.

Intersection of Solids:- Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone.

UNIT – V

Isometric Projections : Principles of Isometric Projection – Isometric Scale – Isometric Views– Conventions – Plane Figures, Simple and Compound

Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of parts with Spherical surface.

Transformation of Projections : Conversion of Isometric Views to Orthographic Views. Conversion of orthographic views to isometric views – simple objects.

Perspective Projections : Perspective View : Points, Lines and Plane Figures, Vanishing Point Methods (General Method only).

TEXT BOOKS

1. Engineering Drawing – Basant, Agrawal, TMH
2. Engineering Drawing, N.D. Bhatt

REFERENCES :

1. Engineering Graphics. P I Varghese Tata McGraw Hill Education Pvt. Ltd.
2. Engineering drawing – P.J. Shah .S.Chand Publishers.
3. Engineering Drawing- Johle/Tata Macgraw Hill Book Publishers.
4. Engineering Drawing – M.B. Shah and B.C. Rana, Pearson.
5 . Engineering Drawing by K.Venu Gopal & V.Prabu Raja New Age Publications.
6. Engineering Drawing by John. PHI Learning Publisher.

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(A10581) COMPUTER PROGRAMMING LAB

Objectives:

- To write programs in C to solve the problems.
- To implement linear data structures such as lists, stacks, queues.
- To implement simple searching and sorting methods.

Recommended Systems/Software Requirements:

- Intel based desktop PC
- ANSI C Compiler with Supporting Editors

Week I

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.

Week 2

a) Write a C program to calculate the following Sum:

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

b) Write a C program to find the roots of a quadratic equation.

Week 3

a) The total distance travelled by vehicle in 't' seconds is given by distance s = $ut+1/2at^2$ where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec^2). Write C program to find the distance travelled at regular intervals of time given the values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.

b) 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)

Week 4

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 GCD (greatest common divisor) of two given integers.

Week 5

a) Write a C program to find the largest integer in a list of integers.

b) Write a C program that uses functions to perform the following:

i) Addition of Two Matrices

ii) Multiplication of Two Matrices

Week 6

a) Write a C program that uses functions to perform the following operations:

i) To insert a sub-string in to 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

Week 7

a) 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.

b) Write a C program to count the lines, words and characters in a given text.

Week 8

a) Write a C program to generate Pascal's triangle.

b) Write a C program to construct a pyramid of numbers.

Week 9

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.

Week 10

a) 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.

b) Write a C program to convert a Roman numeral to its decimal equivalent.

Week 11

Write a C program that uses functions to perform the following operations:

i) Reading a complex number

ii) Writing a complex number

iii) Addition of two complex numbers

iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.)

Week 12

a) Write a C program which copies one file to another.

b) Write a C program to reverse the first n characters in a file.

(Note: The file name and n are specified on the command line.)

Week 13

a) Write a C program to display the contents of a file.

b) Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)

Week 14

a) Write a C program that uses non recursive function to search for a Key value in a given list of integers using Linear search.

b) Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers using Binary search.

Week 15

a) Write a C program that implements the Selection sort method to sort a given array of integers in ascending order.

b) Write a C program that implements the Bubble sort method to sort a given list of names in ascending order.

Week 16

Write a C program that uses functions to perform the following operations:

i) Create a singly linked list of integer elements.

ii) Traverse the above list and display the elements.

Week 17

Write a C program that implements stack (its operations) using a singly linked list to display a given list of integers in reverse order. Ex. input: 10 23 4 6 output: 6 4 23 10

Week 18

Write a C program that implements Queue (its operations) using a singly

linked list to display a given list of integers in the same order. Ex. input: 10 23 4 6 output: 10 23 4 6

Week 19

Write a C program to implement the linear regression algorithm.

Week 20

Write a C program to implement the polynomial regression algorithm.

Week 21

Write a C program to implement the Lagrange interpolation.

Week 22

Write C program to implement the Newton- Gregory forward interpolation.

Week 23

Write a C program to implement Trapezoidal method.

Week 24

Write a C program to implement Simpson method.

TEXT BOOKS:

1. C programming and Data Structures, P. Padmanabham, Third Edition, BS Publications
2. Computer Programming in C, V. Rajaraman, PHI Publishers.
3. C Programming, E.Balagurusamy, 3rd edition, TMH Publishers.
4. C Programming, M.V.S.S.N.Prasad, ACME Learning Pvt. Ltd.
5. C and Data Structures, N.B.Venkateswarlu and E.V.Prasad,S.Chand Publishers
6. Mastering C, K.R. Venugopal and S.R. Prasad, TMH Publishers.

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(A10081) ENGINEERING PHYSICS / ENGINEERING CHEMISTRY LAB

ENGINEERING PHYSICS LAB

(Any TEN experiments compulsory)

Objectives

This course on Physics lab is designed with 13 experiments in an academic year. It is common to all branches of Engineering in B.Tech Ist year.

The objective of the course is that the student will have exposure to various experimental skills which is very essential for an Engineering student.

The experiments are selected from various areas of Physics like Physical Optics, Lasers, Fiber Optics, Sound, Mechanics, Electricity & Magnetism and Basic Electronics.

Also the student is exposed to various tools like Screw gauge, Vernier Callipers, Physics Balance , Spectrometer and Microscope.

1. Dispersive power of the material of a prism – Spectrometer
2. Determination of wavelength of a source – Diffraction Grating.
3. Newton's Rings - Radius of curvature of plano convex lens.
4. Melde's experiment – Transverse and longitudinal modes.
5. Time constant of an R-C circuit.
6. L-C-R circuit.
7. Magnetic field along the axis of current carrying coil – Stewart and Gees method.
8. Study the characteristics of LED and LASER sources.
9. Bending losses of fibres & Evaluation of numerical aperture of a given fibre.
10. Energy gap of a material of p-n junction.
11. Torsional pendulum.
12. Wavelength of light –diffraction grating - using laser.
13. Characteristics of a solar cell

LABORATORY MANUAL:

1. Laboratory Manual of Engineering Physics by Dr.Y.Aparna & Dr.K.Venkateswara Rao (V.G.S Publishers)

Outcomes

The student is expected to learn from this laboratory course the concept of error and its analysis. It also allows the student to develop experimental skills to design new experiments in Engineering.

With the exposure to these experiments the student can compare the theory and correlate with experiment.

ENGINEERING CHEMISTRY LAB

List of Experiments (Any 12 of the following)

Titrimetry:

1. Estimation of ferrous iron by dichrometry.
2. Estimation of hardness of water by EDTA method.

Mineral analysis:

3. Determination of percentage of copper in brass.
4. Estimation of manganese dioxide in pyrolusite.

Instrumental Methods:

Colorimetry:

5. Determination of ferrous iron in cement by colorimetric method
6. Estimation of copper by colorimetric method.

Conductometry:

7. Conductometric titration of strong acid vs strong base.
8. Conductometric titration of mixture of acids vs strong base.

Potentiometry:

9. Titration of strong acid vs strong base by potentiometry.
10. Titration of weak acid vs strong base by potentiometry.

Physical properties:

11. Determination of viscosity of sample oil by redwood / oswald's viscometer.
12. Determination of Surface tension of lubricants.

Preparations:

13. Preparation of Aspirin
14. Preparation of Thiokol rubber

Adsorption:

15. Adsorption of acetic acid on charcoal.

TEXT BOOKS:

1. Practical Engineering Chemistry by K. Mukkanti, etal, B.S. Publications, Hyderabad.
2. Inorganic quantitative analysis, Vogel.

REFERENCE BOOKS:

1. Text Book of engineering chemistry by R. N. Goyal and Harrmendra Goel, Ane Books Private Ltd.,
2. A text book on experiments and calculation Engg. S.S. Dara.
3. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications.

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(A10083) ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

The **Language Lab** focuses on the production and practice of sounds of language and familiarises the students with the use of English in everyday situations and contexts.

Objectives

- To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
- To sensitise the students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency in spoken English and neutralize mother tongue influence
- To train students to use language appropriately for interviews, group discussion and public speaking

Syllabus: English Language Communication Skills Lab shall have two parts:

a. Computer Assisted Language Learning (CALL) Lab

b. Interactive Communication Skills (ICS) Lab

The following course content is prescribed for the **English Language Communication Skills Lab**

Exercise – I

CALL Lab: Introduction to Phonetics – Speech Sounds – Vowels and Consonants

ICS Lab: Ice-Breaking activity and JAM session

Articles, Prepositions, Word formation- Prefixes & Suffixes, Synonyms & Antonyms

Exercise – II

CALL Lab: Structure of Syllables - Past Tense Marker and Plural Marker – Weak Forms and Strong Forms - Consonant Clusters.

ICS Lab: Situational Dialogues – Role-Play- Expressions in Various Situations

– Self-introduction and Introducing Others – Greetings – Apologies – Requests – Social and Professional Etiquette - Telephone Etiquette.

Concord (Subject in agreement with verb) and Words often misspelt-confused/misused

Exercise - III

CALL Lab: Minimal Pairs- Word accent and Stress Shifts- Listening Comprehension.

ICS Lab: Descriptions- Narrations- Giving Directions and guidelines.

Sequence of Tenses, Question Tags and One word substitutes.

Exercise – IV

CALL Lab: Intonation and Common errors in Pronunciation.

ICS Lab: Extempore- Public Speaking

Active and Passive Voice, –Common Errors in English, Idioms and Phrases

Exercise – V

CALL Lab: Neutralization of Mother Tongue Influence and Conversation Practice

ICS Lab: Information Transfer- Oral Presentation Skills

Reading Comprehension and Job Application with Resume preparation.

Minimum Requirement of infra structural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer aided Language Lab for 40 students with 40 systems, one master console, LAN facility and English language software for self- study by learners.

System Requirement (Hardware component):

Computer network with Lan with minimum 60 multimedia systems with the following specifications:

i) P – IV Processor

a) Speed – 2.8 GHZ

b) RAM – 512 MB Minimum

c) Hard Disk – 80 GB

ii) Headphones of High quality

2. Interactive Communication Skills (ICS) Lab :

The Interactive Communication Skills Lab: A Spacious room with

movable chairs and audio-visual aids with a Public Address System, a T. V., a digital stereo –audio & video system and camcorder etc.

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

1. Suresh Kumar, E. & Sreehari, P. 2009. *A Handbook for English Language Laboratories.* New Delhi: Foundation.
2. *Speaking English Effectively* 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
3. Sasi Kumar, V & Dhamija, P.V. *How to Prepare for Group Discussion and Interviews.* Tata McGraw Hill.
4. Hancock, M. 2009. *English Pronunciation in Use. Intermediate.* Cambridge: CUP.
5. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad.
6. Hewings, M. 2009. *English Pronunciation in Use. Advanced.* Cambridge: CUP.
7. Marks, J. 2009. *English Pronunciation in Use. Elementary.* Cambridge: CUP.
8. Nambiar, K.C. 2011. *Speaking Accurately. A Course in International Communication.* New Delhi : Foundation.
9. Soundararaj, Francis. 2012. *Basics of Communication in English. New Delhi: Macmillan*
10. **Spoken English** (CIEFL) in 3 volumes with 6 cassettes, OUP.
11. **English Pronouncing Dictionary** Daniel Jones Current Edition with CD.
12. **A textbook of English Phonetics for Indian Students** by T. Balasubramanian (Macmillan)
13. **Prescribed Lab Manual:** A Manual entitled "***English Language Communication Skills (ELCS) Lab Manual- cum- Work Book***", published by Cengage Learning India Pvt. Ltd, New Delhi. 2013

DISTRIBUTION AND WEIGHTAGE OF MARKS

English Language Laboratory Practical Examination:

1. The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.

2. For the Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 year-end Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The year- end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

Outcomes:

- Better Understanding of nuances of language through audio- visual experience and group activities.
- Neutralization of accent for intelligibility.
- Speaking with clarity and confidence thereby enhancing employability skills of the students.

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(A10082) IT WORKSHOP / ENGINEERING WORKSHOP

Objectives:

The IT Workshop for engineers is a training lab course spread over 54 hours. The modules include training on PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel and Power Point.

PC Hardware introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers. In addition hardware and software level troubleshooting process, tips and tricks would be covered. **The students should work on working PC to disassemble and assemble to working condition and install Windows and Linux on the same PC. Students are suggested to work similar tasks in the Laptop scenario wherever possible.**

Internet & World Wide Web module introduces the different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet. Usage of web browsers, email, newsgroups and discussion forums would be covered. In addition, awareness of cyber hygiene, i.e., protecting the personal computer from getting infected with the viruses, worms and other cyber attacks would be introduced.

Productivity tools module would enable the students in crafting professional word documents, excel spread sheets and power point presentations using the Microsoft suite of office tools and LaTeX. (**Recommended to use Microsoft office 2007 in place of MS Office 2003)**

PC Hardware

Week 1 – Task 1 : Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Week 2 – Task 2 : Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Week 3 – Task 3 : Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Week 4 – Task 4 : Every student should install Linux on the computer. This

computer should have windows installed. The system should be configured as dual boot with both windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Week 5 – Task 5: Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva

Week 6 – Task 6 : Software Troubleshooting : Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.

Internet & World Wide Web

Week 7 - Task 1 : **Orientation & Connectivity Boot Camp :** Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Week 8 - Task 2 : Web Browsers, Surfing the Web : Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Week 9 - Task 3 : **Search Engines & Netiquette :** Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Week 10 - Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to first install antivirus software, configure their personal firewall and windows update on their computer. Then they need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

Week 11- Task 5: Develop your home page using HTML Consisting of your photo, name, address and education details as a table and your skill set as a list.

Productivity tools

LaTeX and Word

Week 12 – Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office 2007/ equivalent (FOSS) tool word:

Importance of LaTeX and MS office 2007/ equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that would be covered in each, using LaTeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.

Task 1 : Using LaTeX and Word to create project certificate. Features to be covered:-Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.

Week 13 - Task 2: Creating project abstract Features to be covered:- Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Week 14 - Task 3 : Creating a Newsletter : Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

Excel

Week 15 - Excel Orientation: The mentor needs to tell the importance of MS office 2007/ equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the two tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered:- Gridlines, Format Cells, Summation, auto fill, Formatting Text

Week 16 - Task 2 : Calculating GPA - .Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting

LaTeX and MS/equivalent (FOSS) tool Power Point

Week 17 - Task1: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both LaTeX and Power point. Students will be given model power point presentation which needs to be replicated (exactly how it's asked).

Week 18- Task 2: Second week helps students in making their presentations interactive. Topic covered during this week includes: Hyperlinks, Inserting – Images, Clip Art, Audio, Video, Objects, Tables and Charts

Week 19 - Task 3: Concentrating on the in and out of Microsoft power point and presentations in LaTeX. Helps them learn best practices in designing

and preparing power point presentation. Topic covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides.

REFERENCE BOOKS:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2. LaTeX Companion – Leslie Lamport, PHI/Pearson.
3. Introduction to Computers, Peter Norton, 6/e Mc Graw Hill Publishers.
4. Upgrading and Repairing, PC's 18th e, Scott Muller QUE, Pearson Education
5. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech
6. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
7. PC Hardware and A+Handbook – Kate J. Chase PHI (Microsoft)

Outcomes:

- Apply knowledge for computer assembling and software installation.
- Ability how to solve the trouble shooting problems.
- Apply the tools for preparation of PPT, Documentation and budget sheet etc.

ENGINEERING WORKSHOP

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

1. Carpentry
2. Fitting
3. Tin-Smithy and Development of jobs carried out and soldering.
4. Black Smithy
5. House-wiring
6. Foundry
7. Welding
8. Power tools in construction, wood working, electrical engineering and mechanical Engineering.

2. TRADES FOR DEMONSTRATION & EXPOSURE:

1. Plumbing
2. Machine Shop
3. Metal Cutting (Water Plasma)

TEXT BOOK:

1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech Publishers.
2. Workshop Manual / Venkat Reddy/ BS Publications/Sixth Edition.

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(A30006) MATHEMATICS - II

Objectives:

- The objective is to find the relation between the variables x and y out of the given data (x,y).
- This unit also aims to find such relationships which exactly pass through data or approximately satisfy the data under the condition of least sum of squares of errors.
- The aim of numerical methods is to provide systematic methods for solving problems in a numerical form using the given initial data.
- This topic deals with methods to find roots of an equation and solving a differential equation.
- The numerical methods are important because finding an analytical procedure to solve an equation may not be always available.
- In the diverse fields like electrical circuits, electronic communication, mechanical vibration and structural engineering, periodic functions naturally occur and hence their properties are very much required.
- Indeed, any periodic and non-periodic function can be best analyzed in one way by Fourier series and transforms methods.
- The unit aims at forming a partial differential equation (PDE) for a function with many variables and their solution methods. Two important methods for first order PDE's are learnt. While separation of variables technique is learnt for typical second order PDE's such as Wave, Heat and Laplace equations.
- In many Engineering fields the physical quantities involved are vector-valued functions.
- Hence the unit aims at the basic properties of vector-valued functions and their applications to line integrals, surface integrals and volume integrals.

UNIT – I

Vector Calculus: Vector Calculus: Scalar point function and vector point function, Gradient- Divergence- Curl and their related properties. Solenoidal and irrotational vectors – finding the Potential function. Laplacian operator. Line integral – work done – Surface integrals -Volume integral. Green's

Theorem, Stoke's theorem and Gauss's Divergence Theorems (Statement & their Verification).

UNIT – II:

Fourier series and Fourier Transforms: Definition of periodic function. Fourier expansion of periodic functions in a given interval of length 2π . Determination of Fourier coefficients – Fourier series of even and odd functions – Fourier series in an arbitrary interval – even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

Fourier integral theorem - Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

UNIT – III:

Interpolation and Curve fitting

Interpolation: Introduction- Errors in Polynomial Interpolation – Finite differences- Forward Differences- Backward differences –Central differences – Symbolic relations of symbols. Difference expressions – Differences of a polynomial-Newton's formulae for interpolation - Gauss Central Difference Formulae –Interpolation with unevenly spaced points-Lagrange's Interpolation formula.

Curve fitting: Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares.

UNIT – IV : Numerical techniques

Solution of Algebraic and Transcendental Equations and Linear system of equations: Introduction – Graphical interpretation of solution of equations .The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method .

Solving system of non-homogeneous equations by L-U Decomposition method (Crout's Method). Jacobi's and Gauss-Seidel iteration methods.

UNIT – V

Numerical Integration and Numerical solutions of differential equations:

Numerical integration - Trapezoidal rule, Simpson's $1/3^{rd}$ and 3/8 Rule , Gauss-Legendre one point, two point and three point formulas.

Numerical solution of Ordinary Differential equations: Picard's Method of successive approximations. Solution by Taylor's series method – Single step methods-Euler's Method-Euler's modified method, Runge-Kutta (second and classical fourth order) Methods.

Boundary values & Eigen value problems: Shooting method, Finite difference method and solving eigen values problems, power method.

TEXT BOOKS:

1. Advanced Engineering Mathematics by Kreyszig, John Wiley & Sons.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers.

REFERENCES:

1. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi & Others, S. Chand.
2. Introductory Methods by Numerical Analysis by S.S. Sastry, PHI Learning Pvt. Ltd.
3. Mathematical Methods by G.Shankar Rao, I.K. International Publications, N.Delhi
4. Advanced Engineering Mathematics with MATLAB, Dean G. Duffy, 3rd Edi, 2013, CRC Press Taylor & Francis Group.
5. Mathematics for Engineers and Scientists, Alan Jeffrey, 6th Edi, 2013, Chapman & Hall/ CRC
6. Advanced Engineering Mathematics, Michael Greenberg, Second Edition, Person Education
7 Mathematics For Engineers by K.B.Datta And M.A S.Srinivas, Cengage Publications

Outcomes: From a given discrete data, one will be able to predict the value of the data at an intermediate point and by curve fitting, can find the most appropriate formula for a guessed relation of the data variables. This method of analysis data helps engineers to understand the system for better interpretation and decision making.

- After studying this unit one will be able to find a root of a given equation and will be able to find a numerical solution for a given differential equation.
- Helps in describing the system by an ODE, if possible. Also, suggests to find the solution as a first approximation.
- One will be able to find the expansion of a given function by Fourier series and Fourier Transform of the function.
- Helps in phase transformation, Phase change and attenuation of coefficients in acoustics.
- After studying this unit, one will be able to find a corresponding Partial

Differential Equation for an unknown function with many independent variables and to find their solution.

- Most of the problems in physical and engineering applications, problems are highly non-linear and hence expressing them as PDEs'. Hence understanding the nature of the equation and finding a suitable solution is very much essential.
- After studying this unit, one will be able to evaluate multiple integrals (line, surface, volume integrals) and convert line integrals to area integrals and surface integrals to volume integrals.
- It is an essential requirement for an engineer to understand the behavior of the physical system.

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A30306) THERMODYNAMICS

UNIT – I

Introduction: Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale- 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

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 – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT – III

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes. Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables- Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

UNIT IV

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air -

Psychrometric 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 – Psychrometric chart.

UNIT - V

Thermodynamic Cycles : Power cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Refrigeration Cycles: Bell-Coleman cycle- Vapour compression cycle-performance Evaluation.

TEXT BOOKS :

1. Engineering Thermodynamics / PK Nag /TMH, 5th Edition
2. Engineering Thermodynamics/E Rathakrishnan/PHI/Second Edition/ 2013.

REFERENCE BOOKS:

1. Engineering Thermodynamics/DP Mishra/ Cengage Learning/Second impression 2012.
2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH.
3. Thermodynamics – J.P.Holman / McGrawHill.
4. Engineering Thermodynamics – Jones & Dugan.
5. Engineering Thermodynamics/P.Chattopadhyay/Oxford Higher Education/Revised First Edition.
6. Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A30104) MECHANICS OF SOLIDS

UNIT – I

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

UNIT – II

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

UNIT – III

Flexural Stresses : Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T,Angle and Channel sections – Design of simple beam sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV

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

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

UNIT – V

Torsion of Circular Shafts : Theory of pure torsion – Derivation of Torsion equations : $T/J = q/r = N\theta/L$– Assumptions made in the theory of pure torsion

– Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

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

TEXT BOOKS :

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov.
3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
4. Strength of Materials – W.A. Nash, TMH.

REFERENCES :

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

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A30103) MECHANICS OF FLUIDS

Aim & Objectives:

The student will gain insight into a number of potentially useful phenomena involving movement of fluids. He/she will learn to do elementary calculations for engineering application of fluid motion. This course also prepares the student for more advanced courses such as Aerodynamics- I & -II.

UNIT I

Fluid Properties: Density, specific weight , specific gravity, surface tension & capillarity, Newton's law of viscosity, incompressible & 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 on vertical, inclined and curved surfaces.

Manometers- simple and differential manometers, inverted manometers, micro manometers, Pressure gauges and numerical problems. **Buoyancy**- Archimedes's Principle, Metacenter, meta centric height calculations.

UNIT II

Fluid Kinematics: 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. Vorticity, irrotational flow, Velocity potential function.

UNIT III

Fluid Dynamics: Surface & body forces, substantive derivative, local derivative and convective derivative, momentum equation, Euler equation, Bernoulli's equation, .Phenomenological basis of Navier-Stokes equation, Introduction to vortex flows.

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, flow measurements : pressure, velocity and mass flow rate, viscosity , Pitot-static tube, venturi meter and orifice meter, viscometers.

UNIT IV

Boundary Layer: Introductory concepts of boundary layer, Large Reynolds number flows and Prandtl's boundary layer hypothesis, Qualitative description of Boundary layer thickness and velocity profile on a flat plate and flow around submerged objects. Pressure drag and skin friction drag.

UNIT V

Pipe flow: Reynolds experiment, Darcy's equation, major and minor losses in pipes and numerical problems.

Exact solutions of Navier stokes equations, flow between parallel plates, flow through long tubes, Fully developed flow, turbulent flow, variation of friction factor with Reynolds number, Moody's chart.

TEXT BOOKS:

1. Engineering Fluid mechanics – K.L . Kumar, S.Chand & Co.
2. Introduction to Fluid Mechanics and Fluid machines – S.K. Som and G. Biswas.

REFERENCES:

1. Fluid Mechanics – Frank M and White, Mc-Grawhill.
2. Fluid Mechanics- Fox and Mc Donald.
3. Fluid Mechanics – E. Rathakrishnan.

Outcome:

It makes the student ready to understand advance Aero dynamics.

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A32101) INTRODUCTION TO AEROSPACE ENGINEERING

Objective: To introduce to the student, the field of Aerospace Engineering.

UNIT – I

History of Flight- the Aerospace Environment: Balloons and dirigibles, heavier than air aircraft, commercial air transport, introduction of jet aircraft, helicopters, missiles, conquest of space, commercial use of space, exploring solar system and beyond. Earth's atmosphere, standard atmosphere, the temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity. The near earth radiative environment. The magnetosphere. Environmental impact on spacecraft. Meteoroids and micrometeoroids, space debris. Planetary environments.

UNIT – II

Aerodynamics and Flight Vehicle Propulsion: Anatomy of the airplane, helicopter, launch vehicles and missiles, space vehicles. Static forces and moments on the vehicle. Understanding engineering models. Aerodynamics of wings and bodies. Generation of lift. Sources of drag. Force and moment coefficients, centre of pressure. Thrust for flight, the propeller, the jet engine, rocket engines- description, principles of operation. Governing equations.

UNIT- III

Flight Vehicle Performance and Stability: Performance parameters. Performance in steady flight, cruise, climb, range, endurance; accelerated flight- symmetric manoeuvres, turns, sideslips, take off and landing. Flight vehicle stability- longitudinal and lateral- static, dynamic; trim, control. Handling qualities of airplanes.

UNIT- IV

Satellite Systems Engineering- Human Space Exploration: Satellite missions, an operational satellite system, elements of satellite, satellite subsystems. Satellite structures, mechanisms and materials. Power systems. Communication and telemetry. Thermal control. Attitude determination and control. Propulsion and station keeping. Space missions. Mission objectives. Case studies. Human space flight missions- goals, 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. Life support systems.

UNIT – V

Introduction to Engineering Design, Air Transportation: Design as a

critical component of engineering education- as a skill- the process, design thinking, design drawing. Design for mission, performance and safety requirements. Concurrent engineering. Computer aided engineering, design project. Example: the lighter-than –air vehicle student design project at MIT. Air Transportation Systems- civil, military- objectives- principal constituents- the vehicle, the ground facilities, the organisation- role. Regulation- national and international. Flight safety and security. Indian effort- civil and military- in the field of Aerospace Engineering.

TEXT BOOKS

1. Newman, D., *Interactive Aerospace Engineering and Design*, (with software and reference material on CD), McGraw-Hill, 2002, ISBN 0-07-112254-0.
2. Anderson, J.D., *Introduction to Flight,* fifth edition, Tata McGraw-Hill, 2007, ISBN: 0-07-006082-4.
3. The Wikipedia (on the web): Transportation Systems, Air Transportation, Aviation, Space Transportation.

REFERENCES:

1. Numerous references cited in Newman's book.
2. Barnard, R. H. and Philpot, D.R., *Aircraft Flight,* 3rd edition,Pearson, 2004,ISBN: 81-297-0783-7.
3. Hirst, M., The Air Transport System, Woodhead Publishing Ltd,Cambridge, England, 2008.
4. Swatton, P.J., *Flight Planning,* Blackwell Publisher.
5. NASA Education Home Page, http://www.ne.nasa.gov/education.

Outcome: The student would have sufficient acquaintance with Aerospace Engineering to take up study of the field in detail through subsequent courses.

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A30009) ENVIRONMENTAL STUDIES

Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understanding the environmental policies and regulations.

UNIT-I :

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT-II:

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest 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: 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. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT-IV:

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and

characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol.

UNIT-V:

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

SUGGESTED TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.

2 Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T.Wright. 2008 PHL Learning Private Ltd. New Delhi.

2. Environmental Engineering and science by Gilbert M.Masters and Wendell P. Ela .2008 PHI Learning Pvt. Ltd.

3. Environmental Science by Daniel B.Botkin & Edward A.Keller, Wiley INDIA edition.

4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which inturn helps in sustainable development.

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A32181) AIRCRAFT ENGINEERING DRAWING LAB with CAD

Aim:

Learn to draw the machine components and to give the better exposure of air craft components drawing.

UNIT :I

Machine Drawing conventions. Need for Drawings conventions – Introduction to ISI- Conventions.

a) Conventional representation of materials , common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

b) Types of sections – Selection of sectional planes and drawing of sections. Parts not usually sectioned.

c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and Tapered features.

UNIT : II

Drawing of Machine Elements and simple parts .Section of views , additional views for the following machine elements and parts with every drawing proportions.

a) Popular forms of screw threads, bolts, set screws and bolted joints.

b) Various types of Riveted joints.

c) Shaft couplings, spigot and socket joint.

d) Journal, pivot, collar and foot step bearing.

e) Welded joints and welding symbols.

UNIT : III

Following simple Aircraft assembly drawings only.

a) Different types of trusses used in wings fuselage including ribs, striengers, skin, brakets.

b) Different elements of fuselage structures ,bulk head , rings (frame) long irons.

c) Different types of fuselage.

d) landing gear basic elements, structural brackets ,wheel, shock absorber and Hydraulic cylinder

e) connecting rod for aero piston engine.

TEXT BOOKS:

1. Daniel P. Raymer Aircraft Design a Conceptual Approach Third Addition.
2. Machine drawing by N.D. Baht / V.M. Panchal / Charotar Publication House – 2000 Ed.
3. Megson THG, "Aircraft Structures for Engineering Students ", Edward Arnold Publication.

REFERENCES:

1. Machine Drawing by K.L.Narayana, P.Kannaiah and K.Venkata Reddy / New Age Publishers.
2. Air Craft structures by Bruhn.E.H
3. Machine Drawing by P.S.Gill.
4. Machine Drawing by Luzzader.
5. Machine Drawing by Rajput.

***Note**: 40% Course Work Should be Done on Drawing Board & 60% Course Work Should Be Done By Computer aided drafting (CAD).*

Equipment Needed

1. Hardware assembly models relevant to above are needed for demonstration
2. Drawing Boards with Mini drafting machines, 60 required for strength of 60 capacity .

Outcome:

Students are familiarized with the drawings of the air craft components.

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II Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A30182) MECHANICS OF SOLIDS AND MECHANICS OF FLUIDS LAB

(A) MECHANICS OF SOLIDS LAB :

1. Direct tension test
2. Torsion test
3. Hardness test
   a) Brinells hardness test
   b) Rockwell hardness test
4. Test on springs
5. Compression test on cube
6. Impact test
7. Punch shear test

(B) MECHANICS OF FLUIDS LAB

1. Calibration of Venturimeter
2. Determination of co-efficient of discharge for a small orifice by a constant head method.
3. Calibration of Triangular notch
4. Verification of Bernoulli's apparatus.
5. Pipe friction.
6. Calibration of orifice meter
7. Determination of co-efficient of discharge for an external mouth piece by variable head method.
8. Determination of co-efficient of loss of head in a sudden retraction.

Note: A minimum of ten experiments should be taking at least four experiments from each lab.

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A42102) AERODYNAMICS – I

Objective:

The student will learn basic principles on how determinate pressure, force and moments acting on airfoils and wings in low speed flights.

UNIT – I:

Review of Fluid Mechanics : Importance of Aerodynamics, Fundamental aerodynamics variables and dimensional analysis (statement of buckinghan – π theorem) leading to force & moment coefficient and dimensionless similarity parameters such as Reynolds number, Mach number, incompressible flow, compressible flow and Mach number- Continuity & momentum equations in differential form. Euler equation, viscosity, Navier – Stokes equation, Reynolds number as an order- of-magnitude measure of ratio of Inertia forces to viscous forces.

UNIT – II:

Inviscid Incompressible Flows: Large Reynolds number flows, Prandtl's Boundary Layer Hypothesis, viscous boundary layer flow and inviscid external flow. Justification of inviscid flow analysis. Angular Velocity, Vorticity and circulation, Kelvin Theorem and irrotational flow velocity potential, Stream function, Laplace equitation, boundary condition at infinity and wall, Elementary flows and their combinations, flow past circular cylinder – non lifting case, lifting case & Magnus effect, the spinning tennis ball, D'Alembert's Paradox, Kutta – Joukowsky theorem – circular cyclinder with vortex, airfoil as an arbitrary cylinder with a sharp trailing edge, Kutta condition. Kelvin's circulation theorem & starting vortex, concept of small perturbation & thin airfoil theory – linearization of the boundary condition, resolution of thin airfoil problem into lifting & nonlifting cases, their solutions by method of singularity distribution, the aerodynamic center, the center of pressure, load representation.

UNIT – III:

Viscous Flow and Boundary Layer: Role of viscosity in fluid flow. boundary layer growth along a flat plate and nearly flat surface, displacement thickness and patching of inviscid external flow to viscous boundary layer flow, laminar boundary layer, transition and turbulent boundary layer, skin friction drag by integration of tangential stress & pressure dragby integration of normal stress, factors influencing boundary layer separation – adverse pressure gradient and sharp bending / turning of surface. Real (Viscous) flow and variation of drag coefficient with Reynolds number for circular cylinder.

Real (viscous) flow and importance of skin friction drag for airfoils. Effect of transition and surface roughness on airfoils, N – S equation, Boundary layer approximation, Blasius solution for the flat plate problem. Definition of momentum thickness & derivation of Von Karman's momentum equation.

UNIT – IV:

Invicid Flow over Wings & Panel Methods: Vortex filament statement of Helmholtz's vortex theorems, Biot – Savart Law, starting, bound & trailing vortices of wings, Lanchester's experiment, Prandtl's Lifting line theory – downwash and induced drag, Elliptic loading & wings of elliptic platforms, expression for induced drag, minimum induced drag for Elliptic platform. Source and vortex panel methods for airfoils. Replacement of an air foil by a concentrated vortex at quarter – chord point, importance of three – quarter chord point for discretization, use of quarter chord and three- quarter chord points in vortex panel method for wings.

UNIT – V:

Applied Aerodynamics & Introduction to Propellers: Critical March number & Drag Divergence, drag reduction & lift augmentation – Sweep, winglets, Flaps, slats and vortex generators. Propellers : Concept of slip stream with only axial velocity, Actuator disk theory due to Rankine & Froude ; power& thrust coefficients, why the propeller is twisted by blade element analysis , blade angle, advance ratio and Torque coefficient , efficiency , how to read propeller chart.

TEXT BOOKS

1. Aerodynamics for Engineers, fourth edition, Bertin, J.J., Pearson Education, 2002, ISBN: 81-297-0486-2.
2. Fundamentals of Aerodynamics, Anderson, Jr., J.D., International edition, McGraw-Hill, 2001, ISBN: 0-07-118146-6.
3. Kuethe, A.M., and Chow, C., Foundations of Aerodynamics, 5th Edn., Wiley, 1998,ISBN: 0-471-12919-4.
4. Karamcheti, Krishnamurthy, Ideal fluid Aerodynamics.

REFERENCES

1. Kuchemann, D., The Aerodynamic Design of Aircraft, Pergamon, 1978.
2. Shevell, R.S., Fundamentals of Flight, Indian reprint, Pearson Education, 2004, ISBN: 81-297-0514-1.
3. McCormick, B.W., Aerodynamics, Aeronautics & Flight Mechanics, second edition John Wiley, 1995, ISBN: 0-471-57506-2.

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A42104) AIRCRAFT PRODUCTION TECHNOLOGY

Aim:

To make the student aware of various production technologies generally involved in air craft manufacturing.

UNIT – I

Casting & Welding: General principles of various Casting Processes - Sand casting, die-casting, centrifugal casting, investment casting and shell molding types.

Principles and equipment used in arc welding, gas welding, resistance welding, Laser welding , Electron Beam welding, Soldering and brazing techniques.

UNIT - II

Machining and Forming: General Principles (with schematic diagram only) of working and types-lathe, shaper, milling machines, grinding, drilling m/c, CNC machining.

Sheet metal operations-shearing, punching, super plastic forming and diffusion bonding. Bending, Automation in bend forming and different operations in bending like stretch forming, spinning, drawing etc.

UNIT- III

Unconventional Machining: Principles of working and applications of abrasive jet machining, ultrasonic machining, electric discharge machining, electro chemical machining, laser beam, electron beam and plasma arc machining.

UNIT-IV

Heat Treatment and Surface Finishing: Heat treatment of Aluminum alloys, titanium alloys, steels, case hardening, Initial stresses and the stress alleviation procedures. Corrosion prevention, protective treatment for aluminum alloys, steels, anodizing of titanium alloys, organic coating, and thermal spray coatings.

UNIT – V

Jigs & Fixtures: Jigs, fixtures, stages of assembly, types and equipment for riveted joints, bolted joints (only). Aircraft Tooling Concepts.

NDT and Other Inspection Techniques: Dye Penetrant Test, X - ray, magnetic particle and ultrasonic testing. Accoustic holography.

TEXTBOOKS:

1. "Manufacturing Engineering and Technology" by Kalpajikau – Addison Wesley.

REFERENCES:

1. "Air craft production techniques" Keshu S.C, Ganapathy K.K., Interline Publishing House, Banglore-1993.
2. "Production technology"- R.K. Jain – Khanna Publishers – 2002.
3. "Production technology"-O.P.Khanna and lal. M.Dhanpat rai publications-New Delhi-1997.

Outcome:

The student shall be abrest with traditional and manufacturing methods.

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A40203) ELECTRICAL AND ELECTRONICS ENGINEERING

Objective:

This course introduces the concepts of electrical DC and AC circuits, basic law's of electricity, instruments to measure the electrical quantities, different methods to solve the electrical networks, construction operational features of energy conversion devices i.e. DC and AC machines, transformers. It also emphasis on basics of electronics, semiconductor devices and their characteristics and operational features.

UNIT-I:

Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations.

Instruments: Basic Principle of indicating instruments – permanent magnet moving coil and moving iron instruments.

UNIT-II:

DC Machines: Principle of operation of DC Generator – EMF equation - types – DC motor types –torque equation – applications – three point starter.

UNIT-III:

Transformers: Principle of operation of single phase transformers –EMF equation – losses – efficiency and regulation.

AC Machines: Principle of operation of alternators – regulation by synchronous impedance method –Principle of operation of induction motor – slip – torque characteristics – applications.

UNIT–IV:

Diodes: P-n junction diode, symbol, V-I Characteristics, Diode Applications, and Rectifiers – Half wave, Full wave and Bridge rectifiers (simple Problems).

Transistors: PNP and NPN Junction transistor, Transistor as an amplifier, SCR characteristics and applications.

UNIT-V:

Cathode Ray Oscillos Scope: Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity, Electrostatic and Magnetic deflection, Applications of CRO - Voltage, Current and frequency measurements.

Outcome:

After going through this course the student gets a thorough knowledge on

basic electrical circuits, parameters, and operation of the transformers in the energy conversion process, electromechanical energy conversion, construction operation characteristics of DC and AC machines and the constructional features and operation of measuring instruments like voltmeter, ammeter, wattmeter etc...and different semiconductor devices, their voltage-current characteristics, operation of diodes, transistors, realization of various electronic circuits with the various semiconductor devices, and cathode ray oscilloscope, With which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

EEE: TEXT BOOKS:

1. Basic concepts of Electrical Engineering, PS Subramanyam, BS Publications.
2. Basic Electrical Engineering, S.N. Singh, PHI.

EEE: REFERENCE BOOKS:

1. Basic Electrical Engineering, Abhijit Chakrabarthi, Sudipta nath, Chandrakumar Chanda, Tata-McGraw-Hill.
2. Principles of Electrical Engineering, V.K Mehta, Rohit Mehta, S.Chand Publications.
3. Basic Electrical Engineering, T.K.Nagasarkar and M.S. Sukhija, Oxford University Press.
4. Fundamentals of Electrical Engineering, RajendraPrasad, PHI.
5. Basic Electrical Engineering by D.P.Kothari , I.J. Nagrath, McGraw-Hill.

ECE: TEXT BOOKS:

1. Electronic Devices and Circuits, S.Salivahanan, N.Suresh Kumar, A.Vallavaraj,Tata McGraw-Hill companies..
2. Electronic Devices and Circuits, K. Lal Kishore, BS Publications.

ECE: REFERENCE BOOKS:

1. Millman's Electronic Devices and Circuits,J. Millman, C.C.Halkias, and Satyabrata Jit, Tata McGraw-Hill companies.
2. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, PEI/PHI.
3. Introduction to Electronic Devices and Circuits, Rober T. Paynter,PE.
4. Integrated Electronics, J. Millman and Christos C. Halkias, Tata McGraw-Hill companies.
5. Electronic Devices and Circuits, Anil K. Maini, Varsha Agarwal,Wiley India Pvt. Ltd.

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A42103) AEROSPACE VEHICLE STRUCTURES – I

Aim & Objectives:

To impart basic understanding aircraft structure

UNIT I

Introduction to Theory of Elasticity : Equilibrium and Compatibility conditions for elastic solids, 2D elasticity equations for plane stress, plane strain and generalized plane strain cases Airy's stress function. Simple problems in plane stress / plane strain Stresses and Strains on arbitrary planes and transformations. Concept of principal planes, stress and Strains, Construction of Mohr's circle.

UNIT II

Redundant Structures : Indeterminate structures and order of redundancy, Introduction to redundant analysis, Statically determinate models - Area movement method, Clayprons method - Use of free body diagrams to explain compatibility and redundant analysis principles. Singularity method for uniform beams with various boundary and support conditions (props, hinges and fixities) subjected to distributed / discrete loads (including moments).

UNIT III

Beams with elastic supports and initial curvature: Direct solution of beams on elastic foundation, Deflection of beams with discrete elastic supports using singularity methods and modeling concepts. Equation of equilibrium for curved beam stress and deflections of a typical curved beam (Bulk Head segments on fuselages).

UNIT IV

Stability: Stability of Structural systems, Modes of instability of columns. Euler's formula for critical loads of column. Slenderness ratio, Effect of boundary conditions on mode shapes and critical loads. Column with initial curvature, effect of eccentricity. Long, medium and short column ranges. Rankine and Jhonson's formulae. Eigen values and Eigen modes. Effect of intermediate supports. Concept of beam column.

UNIT - V

Energy principles and shear flow in closed sections: Introduction to energy principles and methods. Principles of Virtual Displacement and Principle of Virtual Force Castigliano's theorems, Maxwell's reciprocal theorem and Unit load method. The displacement method (Rayleigh Ritz method).

Direct application of energy principles to beams and trusses.

Bredt-Batho formula. Single and multi-cell closed box structures. Semi monocoque and moncoque structures. Shear flow in single and multicell monocoque and semi monocoque box beams subject to torsion.

TEXTBOOKS:

1. Megson THG, “Aircraft Structures for Engineering students”, Edward Arnold Publication.

REFRENCES

1. Shames I. H. and Dym C. L, Energy and finite element methods structural analysis McGraw Hill
2. B.C.Punmia, “Theory of Structures”, Laxmi Publication.
3 Timoshenko S. P. and J.N. Goodier, “Theory of Elasticity McGraw Hill Book Co.
4. David J. Peery” Aircraft Structures” McGRAW-HILL Book Company.
5. S.Ramamrutham, R.Narayanan, “Theory of Structures” – Dhanpat Rai Publishing Co, 2003.
6. Argyris J. H. and Kelsey S. Energy theorems and structural analysis, Butterworths Scientific Publications.1960.
7. Donaldson, B. K. Analysis of Aircraft Structues-An introduction “McGraw Hill.
8. David H. Allen, and Walter E. Haiseler Introduction to Aeronautical Stuructre Analysis, John Wiley & Son,1985.

Outcome:

The student will be able to analysis basic aircraft structure.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A42106) INTRODUCTION TO SPACE TECHNOLOGY

Objectives:

To impact fundamental knowledge of space technology.

UNIT-I

Fundamentals of Rocket Propulsion : Space Mission-Types-Space Environment-Launch Vehicle Selection. Introduction to rocket propulsion-fundamentals of solid propellant rockets- Fundamentals of liquid propellant rockets-Rocket equation.

Two-dimensional trajectories of rockets and missiles-Multi-stage rockets-Vehicle sizing-Two stage Multi-stage Rockets-Trade-off Ratios-Single Stage to Orbit- Sounding Rocket-Aerospace Plane-Gravity Turn Trajectories-Impact point calculation-Injection conditions-Flight dispersions.

UNIT-II

Atmospheric Reentry: Introduction-Steep Ballistic Reentry-Ballistic Orbital Reentry-Skip Reentry-"Double- Dip" Reentry - Aero-braking - Lifting Body Reentry.

UNIT-III

Fundamentals of Orbital Mechanics, Orbital Maneuvers: Two-body motion-Circular, elliptic, hyperbolic, and parabolic orbits-Basic Orbital Elements-Ground Trace In-Plane Orbit changes-Hohmann Transfer-Bielliptical Transfer-Plane Changes- Combined Maneuvers-Propulsion for Maneuvers.

UNIT -IV

Satellite Attitude Dynamics: Torque free Axi-symmetric rigid body-Attitude Control for Spinning Spacecraft - Attitude Control for Non-spinning Spacecraft - The Yo-Yo Mechanism – Gravity – Gradient Satellite-Dual Spin Spacecraft-Attitude Determination.

UNIT-V

Space Mission Operations: Supporting Ground System Architecture and Team Interfaces - Mission phases and Core operations- Team Responsibilities – Mission Diversity – Standard Operations Practices.

TEXT BOOKS

1. "Spaceflight Dynamics", W.E. Wiesel, McGraw-Hill, 1997.

REFERENCES

1. "Rocket Propulsion and Space flight dynamics", Cornelisse, Schoyer

HFR, and Wakker KF, Pitman, 1984.

2. Vincet L. Pisacane, " Fundamentals of Space Systems" , Oxford University Press, 2005.
3. "Understanding Space: An Introduction to Astronautics", J.Sellers, McGraw- Hill, 2000.
4. "Introduction to Space Flight", Francis J Hale, Prentice-Hall, 1994.
5. "Spacecraft Mission Design", Charles D.Brown, AIAA Education Series, 1998.
6. "Spacecraft Mission Design", Charles D.Brown, AIAA Education Series, 1998.
7. "Elements of Space Technology for Aerospace Engineers", Meyer Rudolph X, Academic Press, 1999.

Outcome: The students shall be a quant himself with space technology.

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A42105) FLIGHT MECHANICS – I

Objectives:

To acquaint the student with the methods of aircraft performance analysis.

UNIT – I

Introduction to Aircraft Performance- the Force System of The Aircraft: The role and design mission of an aircraft. Specification of the performance requirements and mission profile. Importance of performance analysis, estimation, measurement, operational safety and economy. Scheduled performance and operational performance of aircraft. The Standard Atmosphere. Off-standard and design atmosphere. Measurement of air data. Air data computers.

Equations of motion for performance - the aircraft force system. Lift, drag, side force. Total airplane drag - estimation, drag reduction methods. The propulsive forces - the thrust producing 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: Maximum and minimum speeds in level flight. Range and endurance with thrust producing, and power producing engines. Cruise techniques- constant angle of attack, constant Mach number; constant altitude, methods- comparison of performance. The effect of alternative fuel flow laws, weight, altitude and temperature on cruise performance. Cruise performance with mixed power-plants.

UNIT – III

Climb, Descent and Manoeuvre Performance: Climb and descent-techniques, safety considerations, performance analysis- maximum climb gradient, climb rate. Energy height and specific excess power, optimal climbs – minimum time, minimum fuel climbs. Measurement of climb performance. Descent performance in aircraft operations. Effect of wind on climb and descent performance.

Accelerated motion of aircraft- equations of motion- the manoeuvre envelope. Longitudinal manoeuvres- the pull-up, push over manoeuvres. Lateral manoeuvres- turn performance- turn rates, turn radius- limiting factors. Instantaneous and sustained turns, specific excess power, energy turns.

Manoeuvre boundaries. Manoeuvre performance of military aircraft, transport aircraft.

UNIT – IV

Take-off And Landing- Safety Requirements – Flight Planning : Estimation of take-off distances. The effect on the take-off distance, of weight, wind, runway conditions, ground effect. Take-off performance safety factors. Estimation of landing distances - the discontinued landing, baulked landing. Air safety procedures and requirements on landing performance.

Flight safety criteria. Performance classification of civil aircraft. Flight planning - performance planning and fuel planning- fuel requirements, trip fuel, environmental effects, reserves, tankering.

UNIT- V

Aircraft Performance Measurement and Data Handling- Application of Performance Data: Purpose of performance measurement in flight. Flight testing- principal performance variables – weight, altitude and ambient temperature (WAT). Parametric performance data analysis. Dimensional analysis. Measurement of cruise, climb, take-off and landing performance-data reduction- equivalent weight method. Corrections for weight and temperature.

Operational performance data for flight planning– take-off field performance, runway correction, aircraft datum performance (WAT) charts, determination of the maximum take-off weight. Performance summary for fleet selection - the block performance, payload–range diagram. Route analysis and optimisation. Operational analysis procedure.

TEXT BOOKS

1. Eshelby, M.E., Aircraft Performance: Theory and Practice, AIAA Education Series, AIAA, 2000, ISBN: 1-56347-398-4.
2. Brandt, S.A. et. al., Introduction to Aeronautics: A Design Perspective, Second Edition, AIAA Education Series, AIAA, 2004, ISBN: 1-56347-701-7
3. Anderson, J.D. Jr., Aircraft Performance and Design, International edition, McGraw-Hill, 1999, ISBN: 0-07-001971-1.

REFERENCES

1. Dole, C.E., Flight Theory and Aerodynamics: a Practical Guide for Operational Safety, Wiley Interscience, 1981, ISBN: 0-471-09152-9.
2. McCormick, B.W, Aerodynamics, Aeronautics and Flight Mechanics, second edition, John Wiley, 1995, ISBN: 0-471-57506-2.
3. Shevel, R.S., Fundamentals of Flight, second edition, Pearson

Education, 1989, ISBN: 81-297-0514-1.

4. Raymer, D.P., Aircraft Design: A Conceptual Approach, third edition, AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0

5. Yechout, T.R. et al., Introduction to Aircraft Flight Mechanics, AIAA Education Series, AIAA, 2003, ISBN: 1-56347-577-4.

Outcome*: The student should be able to estimate the performance of given aircraft and apply the performance data to flight planning.*

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A42182) AIRCRAFT PRODUCTION TECHNOLOGY LAB

The student is expected to conduct 10 exercises.

Aim and Objectives:

Basic Exercises in Lathe, Shaper, Milling, Slotting, CNC and Grinding machines welding equipment and metallurgy equipment comprising Microscopes polishing disc grinders as under.

PRODUCTION LAB

1. Plain Turning, Facing, Knurling.
2. Taper turning, Thread Cutting.
3. Drilling, boring, counter boring, counter sinking
4. Simple exercises on shaping
5. Simple exercises Planing
6. Plain Milling
7. Gear Milling
8. Sheet metal joining by Soldering.
9. Simple exercises on CNC machines and Programme generation.
10. Simple exercises in Gas
11. Simple exercises in Arc Welding.
12. Aircraft wood gluing practice
13. Study of properties of sandwich structures

Reference:

1. “Air craft production techniques” Keshu S.C, Ganapathy K.K., Interline Publishing House, Banglore-1993
2. “Manufacturing Engineering and Technology” by Kalpakajam – Addison Wesley.

Outcome:

Student will have hands on experience on various production techniques.

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II Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A40281) ELECTRICAL AND ELECTRONICS ENGINEERING LAB

SECTION A: ELECTRICAL ENGINEERING:

1. Verification of KCL and KVL.
2. Magnetization characteristics of D.C. Shunt generator.
3. Speed control of DC motor.
4. Swinburne's Test on DC shunt machine.
5. Brake test on DC shunt motor.
6. OC and SC tests on Single-phase transformer.
7. Brake test on 3-phase Induction motor.
8. Regulation by an alternator by synchronous impedance method.

SECTION B: ELECTRONICS ENGINEERING:

1. PN Junction Diode Characteristics (Forward bias, Reverse bias)
2. Transistor CE Characteristics (Input and Output)
3. Study of CRO.
4. Class A Power Amplifier
5. Zener Diode Characteristics
6. Transistor CE Characteristics
7. Rectifier without Filters (Full wave & Half wave)
8. Rectifier with Filters (Full wave & half wave).

Note: Total 12 experiments are to be conducted.

(Six experiments from PART-A, Six experiments from PART-B)

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III Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A50014) MANAGEMENT SCIENCE

Objectives:

This course is intended to familiarise the students with the framework for the managers and leaders available for understanding and making decisions relating to issues related organisational structure, production operations, marketing, Human resource Management, product management and strategy.

UNIT -I:

Introduction to Management and Organisation: Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory – Fayal's Principles of Management – Maslow's theory of Hierarchy of Human Needs – Douglas McGregor's Theory X and Theory Y – Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organisational Structures: Basic concepts related to Organisation - Departmentation and Decentralisation, Types and Evaluation of mechanistic and organic structures of organisation and suitability.

UNIT -II:

Operations and Marketing Management: Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering (BPR) - Statistical Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records – JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on Product Life Cycle, Channels of distribution.

UNIT -III:

Human Resources Management (HRM): Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels – Performance Management System.

UNIT -IV:

Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT -V:

Strategic Management and Contemporary Strategic Issues: Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Card as Contemporary Business Strategies.

TEXT BOOKS:

1. Stoner, Freeman, Gilbert, *Management*, 6th Ed, Pearson Education, New Delhi, 2004.
2. P. Vijaya Kumar, N. Appa Rao and Ashnab, Chnalill, Cengage Learning India, 2012.

REFERENCE BOOKS:

1. Kotler Philip and Keller Kevin Lane: Marketing Management, Pearson, 2012.
2. Koontz and Weihrich: Essentials of Management, McGraw Hill, 2012.
3. Thomas N.Duening and John M.Ivancevich Management—Principles and Guidelines, Biztantra, 2012.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2012.
5. Samuel C.Certo: Modern Management, 2012.
6. Schermerhorn, Capling, Poole and Wiesner: Management, Wiley, 2012.
7. Parnell: Strategic Management, Cengage,2012.
8. Lawrence R Jauch, R.Gupta andWilliam F.Glueck: Business Policy and Strategic Management, Frank Bros.2012.
9. Aryasri: Management Science, McGraw Hill, 2012.

Outcomes:

By the end of the course, the student will be in a position to

- Plan an organisational structure for a given context in the organisation
- carry out production operations through Work study.
- understand the markets, customers and competition better and price the given products appropriately.
- ensure quality for a given product or service.
- plan and control the HR function better.
- plan, schedule and control projects through PERT and CPM.
- evolve a strategy for a business or service organisation.

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(A52111) FLIGHT MECHANICS – II

Objective:

To familiarize the student with the statics, dynamics, trim and control of aircraft.

UNIT- I

Aircraft in Equilibrium Flight- Elevator Angle to Trim- Longitudinal Static and Maneuver Stability: Need for controlled flight. Equilibrium, stability, trim, control- definitions- examples. Longitudinal forces and moments on aircraft in unaccelerated flight- contribution of principal components. Equations of equilibrium- thrust, angle of attack, elevator angle required to trim. Control gradient, total airplane lift curve slope and pitch stiffness. Tailless aircraft and aircraft with foreplanes. Longitudinal static stability- definition, relation to control gradient, pitch stiffness. Stick fixed neutral point- static margin. Effect of flaps and flight speed on force and moment coefficients, aerodynamic derivatives, stability, trim.

Steady, symmetric pull-up maneuvers- equations of motion- pitch rate, pitch damping. Control to trim, trim curves- elevator per g- maneuver point, maneuver margin- relation to static margin. Statutory limits on position of centre of gravity. Determination of neutral and maneuver points by flight testing.

UNIT- II

Estimation of Aerodynamic Force and Moment Derivatives of Aircraft : Significance of aerodynamic derivatives. Derivatives of axial, normal force components and pitching moment with respect to the flight speed, angle of attack, angle of attack rate, pitch rate, elevator angle- dependence on vehicle geometry, flight configuration- effects of flaps, power, compressibility and aeroelasticity.

Lateral directional motion- coupling- derivatives of side force, rolling and yawing moments with respect to the sideslip, rate of sideslip, roll rate, yaw rate, aileron, rudder deflections- dependence on vehicle geometry, flight configuration. Estimation- the strip theory method. Relation between dimension-less and dimensional aerodynamic derivatives.

UNIT- III

Stick Free Longitudinal Stability- Control Forces to Trim, Lateral-Directional Static Stability and Trim : Elevator hinge moments- relation to control stick forces. Hinge moment derivatives. Stick force to trim in symmetric unaccelerated flight, maneuvering flight. Stick force gradients- effect of trim speed- role of trim tab. Effect of freeing elevator on tail effectiveness, static

and maneuver stability. Elevator-free factor. Stick-free neutral and maneuver points, stability margins- relation with stick force gradients. Aerodynamic and mass balancing of control surfaces. Control tabs- types, function, construction.

Lateral-directional static stability, definition, requirements. Equilibrium of forces and moments. Aileron, rudder, elevator and thrust required to trim aircraft in steady sideslip, roll, coordinated turn, engine out condition. Cross wind landings.

UNIT- IV

Aircraft Equations of Motion- Perturbed Motion- Linearised, Decoupled Equations : Description of motion of flight vehicle- systems of reference frames- Euler angles, angles of attack and sideslip– definitions- earth to body axis transformation, Rotating axis system- expressions for linear and angular momenta of rigid body, time derivatives- inertia tensor, components of linear and angular velocities, accelerations. Resolution of aerodynamic, gravity forces, moments acting 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. Determination of vehicle trajectory- outline of method.

Description of motion as perturbation over prescribed reference flight condition. Equation of motion in perturbation variables. Assumption of small perturbations, first order approximations- linearised equations of motion. Decoupling into longitudinal and lateral-directional motions- conditions for validity- role of symmetry. Linearised longitudinal and lateral-directional equations of perturbed motion.

UNIT- V

Longitudinal and Lateral-Directional Dynamic Stability: Linearised longitudinal equations of motion of aircraft - three degree of freedom analysis- characteristic equations- solutions- principal modes of motion- characteristics- 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- comparison with three degree of freedom solutions- justification of approximations. Lateral directional equations- three degree of freedom analysis. Principal modes- characteristics- mode shapes- significance, lower order analysis- approximate solutions.

Determination of longitudinal and lateral stability from coefficients of characteristic equation- stability criteria, approximate roots. Special problems in aircraft dynamics- roll coupling, high angle of attack operation. Aircraft spin- entry, balance of forces in steady spin, recovery, pilot techniques.

TEXT BOOKS

1. Yechout, T.R. et al., *Introduction to Aircraft Flight Mechanics*, AIAA education Series, 2003, ISBN 1-56347-577-4.
2. Nelson, R.C., *Flight Stability and Automatic Control*, 2nd edn., Tata McGraw Hill, 2007, ISBN 0-07-066110-3.

REFERENCES

1. Etkin, B. and Reid, L.D., *Dynamics of Flight*, 3rd edn., John Wiley, 1998, ISBN 0-47103418-5.
2. Schmidt, L.V., *Introduction to Aircraft Flight Dynamics*, AIAA Education Series, 1998, ISBN A-56347-226-0.
3. McCormick, B.W., *Aerodynamics, Aeronautics, and Flight Mechanics*, 2nd edn., Wiley India, 1995, ISBN 978-

Outcome: *The student should be able to estimate the aerodynamic derivatives of a given airplane, determine its stability and compute the control deflections and control forces required to trim the airplane in any given flight configuration.*

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(A52107) AERODYNAMICS – II

Aim:

The student will learn about varied phenomena involving compressible flows. He/she will learn to do elementary calculations using Normal shock tables, Oblique shock charts, Prandtl-Meyer Function tables as a preparation toward design of high speed aircrafts and high speed wind tunnels.

Tables and charts required to be supplied to candidates for reference during examination:

- *Tables:*

o *1. Isentropic Flow Properties, 2. Normal Shock Properties, 3. Prandtl – Meyer Function and Mach Angle, 4. One Dimensional Flow with Heat Addition, 5. One Dimensional Flow with Friction, 6. Properties of International Standard atmosphere and Chart: 7. Oblique Shock Properties.*

UNIT– I

Thermodynamics in Fluid Motion: Definition of compressibility of flow, measure, flow regimes. Review of thermodynamics – concept of equilibrium, Thermodynamic systems, Variables of state, The first law of thermodynamics, Reversible & irreversible processes, Perfect gases, internal energy and enthalpy, specific heats, Adiabatic reversible process, Relations for Thermally & Calorically perfect gas, First law applied to irreversible processes, The throttling process or Joule-Thompson Process (considered most important for application to fluid mechanics), Entropy and second law, Entropy change relations, isentropic relations.

UNIT– II

One Dimensional Flows : One dimensional approximation, continuity equation for 1-D flows, Energy equation — incorporation of kinetic energy in Joule Thompson Process, Reservoir conditions, 1-D momentum equation for inviscid flow, Bernoulli equation for compressible flow, Mach number , 1-D area-velocity relation, Convergent-divergent channel & throat, Relations between stagnation pressure/density and Mach number, Local reservoir and actual reservoir, sonic variables and reservoir variables, Di9fferent forms of energy equation, Constant area duct as a special case of 1-D flow,, Continuity and momentum equations for constant area ducts, Experimental flow visualization of a bluff body in supersonic flow and picture of a normal shock—

constant area ducts formed by streamlines entering and leaving perpendicular to the shock. Normal shock waves: basic equations, relations across a normal shock, calculation of normal shock wave properties, measurement of air speed in compressible subsonic and supersonic flows. Entropy rise across normal shock and its relation to pressure rise,. Numerical exercises with normal shock tables.

UNIT– III

Oblique Shock and Expansion Waves: Oblique shock relations, supersonic flow over wedges with attached shock, large wedge angle and shock detachment, Oblique shock charts: strong shock and weak shock boundary, pressure, density and entropy rise, Oblique shock of vanishing strength and Mach wave, Mach line, Mach angle, Supersonic compression by turning, smooth nearly isentropic turn, Numerical exercises with oblique shock charts,

Regular reflections from solid wall, pressure deflection diagrams, phenomenological description of shock-boundary layer interaction at the wall, intersection of shocks, Mach reflection and slip stream. Numerical exercises with shock reflection and shock intersection, detached shock wave in front of a bluff 2-D body — variation of its strength starting from normal shock, strong oblique shock, weak oblique shock to Mach wave, shock wave in front of a three dimensional body (phenomenological description only),

Supersonic expansion by turning, Prandtl-Meyer function & expansion fan, Shock expansion theory- application to supersonic airfoils. Supersonic flows — over a flat plate at angle of attack, over a diamond airfoil at angle of attack, determination of the slip stream angle, Wave drag and lift, Numerical exercises with Prandtl-Meyer Function Tables. Numerical exercises determining shock-expansion-slipstream configuration & force calculation on airfoils.

UNIT– IV

More One Dimensional Flows and Subsonic & Transonic Airfoils: Adiabatic flow in straight, variable area channels- Laval nozzles, diffusers. Governing equations, area-velocity relation. Mass flow rate, effect of stagnation conditions, back pressure. Choked flow, isentropic flow, ideally expanded, over-expanded, under-expanded flows- appearance of normal shock, Wave reflection from free boundary, Brief outline of operation of supersonic wind tunnels employing convergent-divergent nozzles.

One-dimensional piston motion in a constant area tube, Jump start, propagation of shock wave in front and expansion wave behind, x-t diagram, particle velocity, pressure density& temperature relations,

SUBSONIC FLOW: The velocity potential, perturbation potential, linearized governing equation in two dimension, The pressure coefficient- Prandtl-Glauert compressibility correction, application to swept wings, critical Mach no., drag divergence Mach no.,

TRANSONIC FLOW: The sound barrier. Buffeting, Supercritical airfoils, swept wings at transonic speeds, 2nd order equation for transonic flow, Wing-body combination, Whitcomb's Transonic area rule: application to transonic aircraft.

UNIT– V

Airfoil, Wing and Cone in Supersonic Flow: Point mass in stationary air moving in subsonic speed and moving in supersonic speed & propagation of wave front, In supersonic case influence zone limited within Mach lines/ waves/cones, Principle of limited upstream influence in supersonic flow.

Brief outline of method of characteristics — Statement (without proof) of compatibility relations, application to supersonic nozzle design.

Linearised supersonic flow- governing equations, boundary conditions. Pressure coefficient, application to supersonic airfoils — Lift, drag, pitching moment. Wedge, flat plate, diamond and biconvex airfoils at small angle of attack.

Airloads over flat rectangular wings of finite span, Delta wing with supersonic leading edge and subsonic leading edge,

Cone at zero angle of attack with attached conical shock: Limited upstream influence in supersonic flow – comparison of finite cone and semi-infinite cone, Dimensional analysis and dimensionless conical variable, Ordinary differential equation for conical flow, mention of availability of computed solution, how to use the standard computed chart, Comparison of pressure rise for wedge and cone of equal semi-angle.

Qualitative aspects of hypersonic flow, Newtonian flow model: windward surface and Lee surface , Lift and drag of flat plate wings at hypersonic speeds.

TEXT BOOKS

1. Liepmann, H.W., and Roshko, A., *Elements of Gas Dynamics*, John Wiley, 1957.
2. Bertin, J.J., *Aerodynamics for Engineers*, 4th edn., Indian reprint, Pearson Education, 2004, ISBN: 8-1-297-0486-2
3. Rathakrishnan E., Has Dynamics, Prentice-Hall of India.
4. Anderson, J.D., *Modern Compressible Flow with Historical Perspective*, 3rd edn., McGraw-Hill, 2003, ISBN: 0-07-112161-7.

REFERENCES

1. McCormick, B.W., *Aerodynamics, Aeronautics & Flight Mechanics*, 2nd edn., John Wiley, 1995, ISBN: 0-471-57506-2.
2. Shapiro, A.H., *The Dynamics and Thermodynamics of Compressible Fluid Flow, Vols. I and II*, John Wiley, 1953.
3. Landau, L.D., & Lifshitz, E.M., *Fluid Mechanics*, 2nd edn., Course of Theoretical Physics, vol. 6, Maxwell Macmillan International Edition, Pergamon, 1989, ISBN: 0-02-946234-7.

Outcome :

Students will be able to prepare the design of high speed aircrafts and high speed wind tunnels.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A52109) AEROSPACE VEHICLE STRUCTURES- II

UNIT- I

Thin Plate Theory, Structural Instability: 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, Tension field beams- complete diagonal tension, incomplete diagonal tension.

UNIT- II

Bending, Shear and Torsion Of Thin Walled Beams: 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 - 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- III

Structural Idealisation of Thin Walled Beams: Structural idealization-principal assumptions, idealization of panel, effect on the analysis of thin walled beams under bending, shear, torsion loading- application to determining deflection.

UNIT- IV

Structural and Loading Discontinuities in Thin Walled Beams: Closed section beams- shear stress distribution of a closed section beam built in at one end under bending, shear and torsion loads.

Open section beams- I section beam subjected to torsion, torsion of beam of arbitrary section, torsion bending constant, distributed torque loading-extension of theory for general systems of loading.

Shear lag- effect of shearing strains in beams- redistribution of bending stresses due to restraining of warping, limitation of elementary bending theory, effect of accounting for shear lag on the estimated strength.

UNIT- V

Stress Analysis of Aircraft Components- Wing, Fuselage: Wing spars and box beams- tapered wing spar, open and closed section beams, beams having variable stringer areas. Wings- Three-boom shell in bending, torsion, shear, tapered wings, deflections, cut-outs in wings.

Bending, shear, torsion, cut-outs in fuselages. Fuselage frames and wing ribs- principles of stiffener/ web construction, fuselage frames, wing ribs.

TEXT BOOKS

1. Megson, T.H.G., *Aircraft Structures for Engineering Students*, 4th edn., Elsevier, 2007, ISBN 0-750-667397.
2. Peery, D.J. and Azar, J.J., *Aircraft Structures*, 2nd edn., McGra-Hill, 1982, ISBN 0-07-049196-8.

REFERENCES

1. Allen, D.H. and Haisler, W.E., *Introduction to Aerospace Structural Analysis*, John Wiley, 2010.
2. Bruhn. E.H, *Analysis and Design of Flight Vehicles Structures*, Tri-state Off-set Company, USA, 1965.
3. Lakshmi Narasaiah, G., *Aircraft Structures*, BS Publications, 2010.
4. Sechler.E.E. and Dunn, L.G., *Airplane Structural Analysis and Design*, John Wiley & Sons.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A52108) AEROSPACE PROPULSION- I

Objective:

To acquaint the student with the operating principles, construction, thermodynamic modeling and analysis of aircraft gas turbine engines and the principal components.

UNIT-I

Flight Propulsion- Aircraft Gas Turbine Engines- Generation of Thrust- Engine Performance Parameters : History of flight propulsion. Role of reciprocating engines. Operating envelope of flight vehicles. Engine operational limits. Air breathing engines- types. Aircraft gas turbine engines- types, operating principles, distinguishing features- schematic diagrams, relative merits, applications. Engine components- function, schematic diagram, layout, engine station numbering. Thrust generation- momentum equations. Gross, net, uninstalled, installed thrust, propulsive efficiency. Engine performance parameters- specific thrust, specific fuel consumption, total efficiency- performance trends. Effect of flight conditions, jet exit speed, exit pressure. Role of propulsion in aircraft performance. Criteria for engine selection, airframe-engine matching.

UNIT- II

Aerothermodynamic Modeling of Engine and Components- Parametric Cycle Analysis of Engines: Engine components- performance requirements, thermodynamic processes- pressure ratios, temperature ratios. Energy transfer, losses. Performance- polytropic, stage and component efficiencies, burning efficiency, under and over expansion- figures of merit- significance- ideal component characteristics.

Aircraft gas turbine engines- cycle representation- turbojet, turbojet with reheat, turbofan. Computation of nett work, thermal efficiency- application to thrust equation. Parametric cycle analysis- definition, purpose- determination of engine performance parameters- effect of component performance, engine design choices, design constraints, flight conditions, operating parameters- determination of engine design point, design point performance- computation for ideal turbojet, turbofan engines.

UNIT-III

Aircraft Engine Components- Non-Rotating- Inlets and Exhaust Nozzles, Combustion Systems- Combustors, Afterburners, Ducts And Mixers: Subsonic inlets- function, performance requirements, geometry, operating conditions, flow field, capture area, sizing. Flow distortion, diffuser losses-

methods for mitigation. Performance characteristics. Supersonic inlets- compression process, types, construction, losses, performance characteristics.

Exhaust nozzles- primary nozzle, fan nozzle- governing equations of flow-choking, engine back pressure control, nozzle-area ratio, thrust reversing, vectoring- mechanisms. Performance- performance maps.

Combustion process- characteristics- effects of fuel-air mixture ratio, mass flow rate, combustor volume, pressure. Combustion loading parameter, sizing of combustor. 1-D modeling of flow. Burners- types, components- function, schematic diagram, airflow distribution, cooling- types, cooling effectiveness. Combustor performance parameters- effect of combustor design. Fuel injection, atomisation, vaporisation, recirculation- flame stabilisation, flame holders. Afterburners, function, components, design requirements, design parameters. The bypass duct- total pressure losses. Mixing process- pressure losses. Aircraft gas turbine engine fuels- composition, specifications of commonly used fuels.

UNIT- IV

Rotating Machinery- Axial Flow Compessors, Axial Flow Turbines: Axial flow compressors- operating principle, description of flow field- construction. Flow analysis- Euler's turbo-machinery equations. - velocity diagram analysis. Stage parameters. Flow losses- causes- efficiency, relation to total pressure loss coefficient. Axial flow turbines- similarities and differences with compressors. Velocity diagram analysis- no exit swirl condition, flow losses-causes. Computation of stage parameters for ideal and real compressors and turbine of given cascade blade geometry and initial flow conditions and turbine speed- procedure.

Limits on achievable performance of compressors and turbines- flow problems- surge, separation, rotating stall, wind-milling, blade stresses, temperatures- solutions- variable stators, multi-staging, multi-spooling, blade cooling. Operation at off design speeds. Range of typical axial flow compressor and turbine design parameters. Typical blade profiles.

UNIT- V

Performance Analysis- Component Matching: Non-dimensionalisation and correction of engine and component characteristic parameters- merits-corrected performance. Performance analysis of compressor, fan, burner, turbine, exhaust nozzle. Relation between compressor pressure ratio, mass flow rate, efficiency, engine speed. Engine control- throttle lever setting, fuel flow, burner temperature ratio, turbine speed, flow coefficient, mass flow rate- relations. Off design performance of compressor- compressor operating line- significance, application to engine performance analysis. Engine thrust ratings.

Component matching- significance, requirements, simplifying assumptions-choked turbine and exhaust nozzle flow, constant component efficiencies. Turbine inlet temperature as control parameter. Engine working lines. Effect of exhaust nozzle area, turbine inlet vane. Component matching for gas generator, turbo jet engine. Engine performance maps. Use of matching data to second stage design. Review of aircraft-engine matching.

TEXT BOOKS

1. Mattingly, J.D., *Elements of Gas Turbine Propulsion*, McGraw-Hill, 1996, ISBN0-07-912196-9.
2. Flack, R.D., *Fundamentals of Jet Propulsion with Applications*, Cambridge University Press, 2005, ISBN 0-521-81983-0.
3. *The Jet Engine*, Rolls Royce plc, 1986, ISBN 0-902121-2-5.

REFERENCES

1. Cumpsty, N., *Jet Propulsion*, 2nd edn., Cambridge University Press, 2005, ISBN 0-521-54144-1.
2. Kerrebrock, J.L., *Aircraft Engines and Gas Turbines*, 2nd edn. , MIT Press, 1992, ISBN 0-262-11162-4.
3. Hill, P.G. and Peterson, C.R., *Mechanics and Thermodynamics of Propulsion*, 2nd edn. , Addison Wesley, 1992.
4. Saravanamuttoo, H.I.H., Rogers, G.F.C. and Cohen, H., *Gas Turbine Theory*, 5th edn., Prentice Hall, 2001.
5. El-Sayed, A.F., *Aircraft Propulsion and Gas Turbine Engines*, CRC Press, 2008, ISBN 978-0-8493-9196-5.
6. Boyce, M.P., *Gas Turbine Engineering Handbook*, 2nd edn., Gulf Professional Publishing, 2002, ISBN 0-88415-732-6.
7. *The Aircraft Gas Turbine Engine and Operation*, Pratt& Whitney, 1988.
8. Oates, G.C., ed., Aerothermodynamics of Aircraft Engine Components, AIAA, 1985, ISBN 0-915928-97-3.

Outcome: *The student should be able to estimate the performance of the engine,and its components, in terms of the design choice parameters and constraints, flight conditions and engine operating conditions.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A52110) AIR TRANSPORTATION SYSTEMS

Aim & Objectives:

The subject will introduce the air transportation systems in detail.

UNIT- I

Aviation industry & its regulatory authorities: Introduction, history of aviation- evolution, development, growth, challenges. Aerospace industry, air transportation industry- economic impact- types and causes. Airline Industry- structure and economic characteristics.

The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.

UNIT-II

Airspace: 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.

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.

UNIT- III

Aircraft: 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: Setting up an airport- airport demand, airport siting, runway characteristics- length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity- evaluating runway capacity- sustainable runway capacity. Runway pavement length, Manoeuvring area- airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay.

UNIT-V

Airlines: 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.

TEXT BOOK

1. Hirst, M., *The Air Transport System*, Woodhead Publishing Ltd, Cambridge, England, 2008.

REFERENCES

1. Wensven, J.G., *Air Transportation: A Management Perspective*, Ashgate, 2007.
2. Belobaba, P., Odoni, A. and Barnhart, C., *Global Airline Industry*, Wiley, 2009.
3. M. Bazargan, M., *Airline Operations and Scheduling*, Ashgate, 2004.
4. Nolan, M.S., *Fundamentals of Air Traffic Control*, 4th edn., Thomson Learning, 2004.
5. Wells, A. and Young, S., *Airport Planning and Management*, 5th edn., McGraw-Hill, 1986.

Outcome: The student with aquire the operational knowledge of air transport.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A52184) AEROSPACE STRUCTURES LAB

EXERCISES

1. Study of construction and use of Universal Testing Machine, mechanical and optical extensometers- application to determine stress-strain curves and tensile and compressive strength of various engineering materials.
2. Bending tests- deflection of slender and short beams for various loading and end conditions- determination of influence coefficients- verification of Maxwell's and Castigliano's theorems.
3. Compression tests on long and short columns- determination of buckling loads– Southwell plot.
4. Determination of the strength and deformation of riveted and bolted joints.
5. Methods of inspection and non-destructive testing (NDT) of aircraft structural components.
6. Strain gauge techniques- measurement of strain in beams, thin and thick walled cylinders subjected to internal pressure, shaft subjected to combined loading.
7. Shear Centres of open and closed sections- determination of the elastic axis of beams.
8. Post buckling behavior of shear panels- measurements on semi-tension field webs of beams.
9. Determination of elastic constants of composite materials- flexural test on composites.
10. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
11. Study and use of seismic pickups for the measurement of amplitude and frequency of vibration of structural components.
12. Determination of critical fracture toughness of aerospace materials.

REFERENCE BOOKS

1. Megson, T.H.G., *Aircraft Structures for Engineering Students*, 4th edn., Elsevier, 2007, ISBN 0-750-667397.
2. Bruhn. E.H, *Analysis and Design of Flight Vehicles Structures*, Tri-state Off-set Company, USA, 1965.

EQUIPMENT REQUIRED

1. UTM- 20/ 40 tonnes- with requisite jigs and fixtures for compression and tensile tests and precision extensometers.
2. Beam deflection test rigs with requisite precision dial gages.
3. Test rig for determination of shear centre.
4. NDT equipment for a) Ultrasonic testing, b) Magnetic particle testing, c) Dye penetration test.
5. Strain measuring equipment: a) various electrical resistance strain gages and rosettes, b) Multi-channel strain measuring equipment.
6. Experimental rigs and set-ups required for conducting specific tests.

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III Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A52183) AERODYNAMICS AND PROPULSION LAB

AERODYNAMICS LAB

1. Fluid flow studies using blower
2. Calibration of low speed wind tunnel
3. Drag of different bodies
4. Pressure distribution studies on two-dimensional models
5. Pressure distribution over an airfoil at different angles of attack
6. Aerodynamic characterization of NACA - 0012 airfoil
7. Axial Flow Compressor
8. Centrifugal Flow Compressor
9. Flow visualization techniques

PROPULSION LAB

1. Study of piston engine (Valve timing and port timing diagram)
2. Stripping of a piston engine, visual inspection and reasoning for common troubles and trouble-shooting
3. Performance of piston engine
4. Heat balancetest on piston engine
5. Engine balancing
6. Characterization of aviation fuels

EQUIPMENT REQUIRED

1. Low Speed Wind-Tunnel Test Rig with a test section of 1 meter X 1 meter with necessary accessories.
2. Test Rig for Axial Flow Compressor
3. Test Rig for Centrifugal Flow compressor.
4. Heat Engine Test Rig.
5. Balancing Test Rig
6. Calorimeter Apparatus
7. Piston Engine

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A62114) COMPUTATIONAL AERODYNAMICS

Aim:

To impart to the students knowledge in various aspects of CFD approach.

UNIT- I

Basic Aspects, Governing Equations and Physical Boundary Conditions of Computational Aerodynamics : Why Computational Fluid Dynamics? What is 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: Classification of quasi-linear partial differential equations by Cramer's rule and eigen value method. General behaviour 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, Grid Types and Characteristics: Introduction to finite differences- finite difference approximation for first order, second order and mixed derivatives. Pros and cons of higher order difference schemes. Difference equations- 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- Cartesian 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/ hexahedra cells.

UNIT-IV

Finite Volume Methods: 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.

UNIT-V

CFD Techniques: 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.

TEXT BOOKS

1. Anderson, J.D., Jr., *Computational Fluid Dynamics- The Basics with Applications*, McGraw-Hill Inc., 1995.
2. Anderson, D.A., Tannehill, J.C., Pletcher, R.H., *Computational Fluid Mechanics and Heat Transfer*, Second Edition, Taylor and Francis, 1997.

REFERENCES

1. Hirsch, C., *Numerical Computation of Internal and External Flows-Fundamentals of Computational Fluid Dynamics*, Second Edition, Elsevier, 2007.
2. Versteeg, H.K. and Malalasekera, W., *An Introduction to Computational Fluid Dynamics-The Finite Volume Method,* Second Edition, Pearson Education Ltd, 2010.
3. Tu, J., Yeoh, G.H., Liu, C., *Computational Fluid Dynamics-A Practical Approach,* Butterworth-Heinemann, 2008.

Outcome:

The student will be motivated and equipped solve simple fluid dynamical problems using CFD techniques.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A62115) CONCEPTUAL DESIGN OF FLIGHT VEHICLES

Objective:

To familiarize the student with the principles and practice of conceptual design of flight vehicles.

UNIT– I

Overview of The Design Process, Sizing from a Conceptual Sketch-Airfoil and Geometry Selection, Selection of Thrust to Weight Ratio, Wing Loading: Phases of aircraft design. Aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, aircraft requirements, configuration options. Integrated product development and aircraft design. The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, empty weight estimation – historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions.

Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio and other airfoil considerations. Wing geometry and wing vertical location, wing tip shapes. Tail geometry and arrangements.

Thrust to weight ratio - statistical estimation, thrust matching. Wing loading – performance constraints. Selection of thrust-to-weight ratio and wing loading.

UNIT- II

Initial Sizing & Configuration Layout : Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, wing, tail, control surfaces.

Development of configuration layout from conceptual sketch. The inboard profile drawing, wetted area, volume distribution and fuel volume plots. Lofting- definition, significance and methods, flat wrap lofting.

Special consideration in configuration layout. Isobar tailoring, Sears-Haack volume distribution, structural load paths. Radar. Considerations of vulnerability, crashworthiness, producibility, maintainability. Fuselage design-crew station, passenger compartment, cargo provisions, weapons carriage, gun installation.

UNIT- III

Propulsion & Fuel System Integration, Landing Gear & Subsystems : Propulsion system selection, jet engine integration, engine dimensions, inlet geometry, inlet location, capture area calculation, boundary layer diverters, nozzle integration, engine cooling provisions, engine size estimation. Fuel system design and integration. Landing gear arrangements, guidelines for

layout. Shock absorbers – types, sizing, stroke determination, gear load factors. Gear retraction geometry. Aircraft subsystems, significance to configuration layout. Baseline design layout and report of initial specifications.

UNIT– IV

Baseline Design Analysis- Aerodynamics & Propulsion, Structures & Weight and Balance : Estimation of lift curve slope, maximum lift coefficient, complete drag build up. Installed performance of an engine, net propulsive force, part power operation. Aircraft loads, categories– manoeuvre, gust, inertial, power plant, landing gear loads. Limit loads, the V, n diagram. 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– V

Baseline Design Analysis– Stability & Control, Performance and Constraint Analysis : Estimation of static pitch stability, velocity stability and trim. Estimation of stability and control derivatives. Static lateral-directional stability & 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, instantaneous turn rate, sustained turn rate. Energy manoeuvrability 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.

TEXT BOOKS

1. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.
2. Howe, D., *Aircraft Conceptual Design Synthesis*, Professional Engineering Publishing, London, 2000, ISBN: 1-86058-301-6.
3. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.

REFERENCES

1. *AIAA Aerospace Design Engineer's Guide*, 5th edn., AIAA Education Series, 2003, ISBN 1-56347-590-1.
2. Jenkinson, L.R. and Marchman III, J. F., *Aircraft Design Projects for*

Engineering Students, Butterworth Heinemann, 2003, ISBN: 0 7506 5772 3.

3. Brandt, S.A. et. al., *Introduction to Aeronautics: A Design Perspective*, 2nd edn., AIAA Education Series, AIAA, 2004, ISBN: 1-56347-701-7
4. Anderson, J.D. Jr., *Aircraft Performance and Design*, McGraw-Hill, 1999, ISBN: 0-07-001971-1.
5. Dole, C.E., *Flight Theory and Aerodynamics: A Practical Guide to Operational Safety*, Wiley, 1981, ISBN: 0-471-09152-9
6. Taylor, J., *Jane's All the World Aircraft*, latest edition, Jane's, London.
7. Stinton, The Design of the Airplane, second edition, AIAA, 2001, ISBN: 0-56347-524-6.
8. Kroo I., *Applied Aerodynamics: A Digital Textbook*, Desktop Aeronautics Inc., http://www.desktopaero.com/appliedaero/preface/welcome.html
9. Keane, A.J. And Nair, P.B., *Computational Approaches for Aerospace Design,* Wiley, 2005, ISBN:0-470-85540-1.

Outcome:

The student should be able to obtain the baseline design of flight vehicles to specified requirements.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**1/-/-**	**4**

(A62112) AEROSPACE PROPULSION- II

Objective:

To acquaint the student with propulsive systems including scramjets and chemical rocket and electrical thrusters, for trans-atmospheric and space flight.

UNIT- I

Trans-Atmospheric and Space Flight Mission Propulsion Requirements- Propulsion Systems- Classification, Performance Characteristics: Hypersonic transport vehicles, military missiles, space launch vehicles, spacecraft- role, types, missions- profile, trajectories, operating conditions- gravity, atmosphere. Incremental flight velocity budget for climb out and acceleration, orbital injection- Breguet equation for cruise– mission propulsion requirements- thrust levels, burning time, economy.

High speed propulsion systems- types, construction, operating principles- sources of energy, generation of power, momentum, propellants,- applications, performance parameters- specific thrust, specific impulse, internal efficiency, propulsive efficiency- typical values. Reaction control systems- applications.

UNIT- II

Air Breathing Enines for Hypersonic Transport Planes and Militarymissiles- Supersonic Combustion- The Scram-Jet Engine : Performance of turbojets, ramjets at high speeds- limitations. Need for supersonic combustion- implications- criticality of efficient diffusion and acceleration, problems of combustion in high speed flow. The scramjet engine- construction, flow process- description, control volume analysis- spill-over drag, plume drag. Component performance analysis- isolator, combustor- flow detachment and reattachment, thermal throat, scheduled, distributed fuel injection. Nozzle flow, losses- failure to recombination, viscous losses, plume losses. Scramjet performance, applications.

Combined cycle engines- turbo-ramjet, air turbo-rocket (ATR), ejector ramjet- Liquid-air collection engine (LACE)- need, principle, construction, operation, performance, applications to hypersonic transport plane and missile propulsion.

UNIT- III

Chemical Rocket Engines : Rocket propulsion- history, principles, types, applications. The rocket equation. Vehicle velocity, jet exit velocity, mass ratio. Effect of atmosphere. Engine parameters, propellants.

Cheical rockets- the thrust chamber- processes- combustion, expansion- propellants. Thermo-chemical analysis of combustion, equilibrium energy balance, mass balance, combustion efficiency. Equilibrium composition, recombination. Nozzle expansion, performance, design parameters, analysis- non-equilibrium expansion- frozen equilibrium, shifting equilibrium. One dimensional, two dimensional flows, presence of liquid drops and solid particles- two phase flow, losses, efficiency.

Performance measures of chemical rocket engines- thrust coefficient, specific impulse; engine parameters- thrust chamber pressure, temperature, characteristic velocity, exhaust velocity, effective velocity. Computing rocket engine performance- theoretical, delivered performance, performance at standard operating conditions, guaranteed minimum performance.

UNIT- IV

Liquid Propellant Rocket Engines, Solid Propellant Rocket Motors: Liquid propellant rocket engines- structure- principal components, basic parameters- propellant combination, chamber pressure, nozzle area ratio, feed system, thrust level. Propellants – properties- considerations for selection- storage, feed, control, injection, ignition. Combustion chamber and nozzle, shape, size, materials, cooling- thrust vector control, combustion instabilities. Engine control, optimisation, system integration. Liquid propellant rocket performance data.

Solid propellant rocket motors- basic configuration, essential differences from liquid propellant rocket engines, propellant composition, combustion chambers, ignition, surface recession rate, gas generation rate, effect of propellant temperature, combustion pressure, charge design- thrust profile, burning stability, erosive burning. Combustion chamber integrity- thermal protection. Combustion instabilities- types, corrective measures. Solid propellant motor components and motor design. Applications, performance analysis. Examples of solid propellant boosters. Hybrid propellant rockets, selection of rocket propulsion systems.

Advanced thermal rockets- fundamental physical limitations of thermal rockets, improving efficiency of thermal rockets in the atmosphere, pulse detonation engine, rotary rocket engine, variable exhaust velocity, Particulars of propulsion systems of selected space vehicles and military missiles.

UNIT- V

Electric Thrusters- Mission Applications to Space Flight: Limitations of chemical rocket engines. Electric propulsion systems- structure, types, generation of thrust. System parameters- interrelations. Electrothermal thrustors- resistojet, arcjet, solar/ laser/ microwave thermal propulsion- operating principles, components, system parameters, performance, applications.

Electrostatic thrusters- ionisation potenial, ionisation schemes. Beam current, power, acceleration, voltage, power efficiency, thrust-to-power ratio, specific impulse. Screen, accelerator grids, potential, charge distribution, saturated current density, electric field intensity, exhaust neutralisation, propellant choice. Estimation of performance, electrical efficiency, power to thrust ratio, thrust per unit area, applications.

Electromagnetic thrusters- magneto plasma dynamic (MPD), pulsed plasma (PPT), Hall effect and variable I_{SP} thrusters- principle, construction, operation, performance, applications. Electric space power supplies and power conditioning- batteries, fuel cells, solar cell arrays, solar generators, nuclear power generators. Current technology of electric propulsion engines, applications- overview. The problem of gravity loss. Criteria for selection of engine. Particulars of select current electric propulsion systems.

TEXT BOOKS

1. Sutton, G.P. and Biblarz, O., *Rocket Propulsion Elements*, 7th edn., Wiley, 2001, ISBN: 0-471-32642-9.
2. Hill, P.G. and Peterson, C.R., *Mechanics and Thermodynamics of Propulsion*, 2nd edn. , Addison Wesley, 1992.
3. Kerrebrock, J.L., *Aircraft Engines and Gas Turbines*, 2nd edn. , MIT Press, 1992, ISBN: 0-262-11162-4.

REFERENCES

1. Jensen, G.E. and Netzer, D.W., ed. *Tactical Missile Propulsion*, AIAA, 1996, ISBN 1-56347-118-3.
2. NASA JPL Advanced Propulsion Concepts Notebook Online, http://sec353.jpl.nasa.gov/apc/
3. *Encyclpedia Astronautica,* http://www.astronautix.com/
4. Turner, M.J.L., Rocket and Spacecraft Propulsion, 2nd edn., Springer, 2005, ISBN: 3 540 22190.
5. Tajmar, M., Advanced Space Propulsion Systems, Springer, 2003, ISBN: 3-211-83862-7.

Outcome:

The student should be able estimate the performance of given propulsive systems and select suitable propulsion systems and estimate principal design parameters to meet specified flight propulsion requirements.

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(A62113) AIRCRAFT SYSTEMS

Aim: The student will be introduced to basic aircraft system components.

UNIT- I

Introduction to aircraft systems and integration: Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems. Specification of requirements- mission requirements, performance requirements. Operating environment conditions.

Interdependence of aircraft systems and need for integration- examples. Systems integration- the concept- examples. Levels of integration- component, system, process, function, information levels- examples. Enumeration of aircraft systems and some subsystems- purpose, brief description, aspects of safety/ integrity, integration, interfaces, design drivers.

UNIT-II

Electrical systems & flight control systems: Electrical loads in aircraft. Electrical power generation and control- DC, AC- types. Power distribution- primary, secondary. Power conversion and energy storage. Load protection. Eelectrical load management systems, variable speed constant frequency (VSCS) cycloconverter, 27/ V DC systems.

Flight control systems- primary and secondary flight control- control linkages, actuation- types, description, redundancy. Fly-by-wire control- control laws, implementation.

UNIT- III

Hydraulic Systems: Aircraft hydraulic systems- function, merits, application, system loads, design requirements. Principal components. Flight control actuation- importance, need for redundancy- types- description, applications. Advanced actuation implementations. The 'fly-by-wire' actuation, fly-by-wire control laws. Hydraulic fluid- required properties, operating fluid pressures, temperatures, and flow rates. Hydraulic piping, pumps, reservoir, accumulator. Landing gear and brake management systems.

UNIT- IV

Pneumatic and Environmental Control Systems: Engine as source of high pressure air- engine bleed air- user systems- environment control, windscreen, wing and engine anti-ice, engine start, hydraulic, pitot-static systems. Bleed air control- structure, components, operation. Need for controlled cabin environment. Principal heat sources in aircraft. Methods of cooling- ram air, engine bleed air, fuel cooling. Cooling systems- air cycle refrigeration- types- turbo fan, bootstrap, reverse bootstrap systems. Vapour

cycle refrigeration. Humidity control. Air distribution systems, cabin pressurization, molecular-sieve oxygen concentrators, g tolerance and protection.

UNIT- V

Engine Control and Fuel Systems : 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 offtakes- need, types, effect on engine performance. Fuel systems- characteristics, components, operating modes. Fuel tank safety- fuel inerting system.

TEXT BOOKS

1. Aircraft systems by David A Lombaro Tata Mc Greaw Hill. Ed: 2009.

REFERENCES

1. Moir, I. and Seabridge, A., *Design and Development of Aircraft Systems- an Introduction*, AIAA Education Series, AIAA, 2004.
2. Moir, I. and Seabridge, A., *Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration*, 3rd edn, John Wiley, 2008, ISBN 978-0-470-05996-8.
3. Pallett, E.H.J., *Aircraft Instruments and Integrated Systems*, 10th edn., Longman Scientific &Technical, 1992.
4. Harris, D., *Flight Instruments and Automatic Flight Control Systems*, 6th edition, Ground Studies for Pilots, Blackwell Science, 2004, ISBN 0-632-05951-6.
5. Bolton, W., *Pneumatic and Hydraulic Systems*, Butterworth-Heinemann.
6. *Jet Engine*, Rolls Royce.

Outcome: The student will gain insights of functioning of aircraft systems.

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(A60330) FINITE ELEMENT METHODS

UNIT – I:

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain – Displacement relations. Stress – strain relations for 2-D and 3-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: 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:

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of Load Vector, 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: 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: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation, techniques such as semi automatic and fully Automatic use of softwares such as ANSYS, NISA, NASTRAN, etc.

TEXT BOOKS:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.

2. Finite Element Methods: Basic Concepts and applications/ Alavala/ PHI.

REFERENCE BOOKS :

1. Introduction to Finite Elements in Engineering/Chandrupatla, Ashok and Belegundu/ Prentice – Hall.
2. Finite Element Method /Zincowitz / Mc Graw Hill.
3. Introduction to Finite element analysis/ S.Md.Jalaludeen/Anuradha Publications, print-2012.
4. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition.
5. Finite Element Method/Krishna Murthy / TMH.
6. Finite Element Analysis /Bathe / PHI.

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(A60117) DISASTER MANAGEMENT

(Open Elective)

Unit-I

Environmental Hazards & Disasters: Meaning of Environmental hazards, Environmental Disasters and Environmental stress. Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Different approaches & relation with human Ecology - Landscape Approach - Ecosystem Approach - Perception approach - Human ecology & its application in geographical researches.

Unit –II

Types of Environmental hazards & Disasters: Natural hazards and Disasters - Man induced hazards & Disasters - Natural Hazards- Planetary Hazards/ Disasters - Extra Planetary Hazards/ disasters - Planetary Hazards- Endogenous Hazards - Exogenous Hazards –

Unit –III

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 & mitigation of earthquake.

Unit –IV

Exogenous hazards/ disasters - Infrequent events- Cumulative atmospheric hazards/ disasters

Infrequent events: Cyclones – Lightning – Hailstorms

Cyclones: Tropical cyclones & Local storms - Destruction by tropical cyclones & local storms (causes , distribution human adjustment, perception & mitigation) Cumulative atmospheric hazards/ disasters : - Floods- Droughts- Cold waves- Heat waves Floods:- Causes of floods- Flood hazards India- Flood control measures (Human adjustment, perception & mitigation) Droughts:- Impacts of droughts- Drought hazards in India- Drought control measures- Extra Palnetary Hazards/ Disasters- Man induced Hazards / Disasters- Physical hazards/ Disasters-Soil Erosion

Soil Erosion:— Mechanics & forms of Soil Erosion- Factors & 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 & Environmental problems- Corrective measures of Erosion & Sedimentation

Biological hazards/ disasters:- Population Explosion.

Unit –V

Emerging approaches in Disaster Management- Three Stages

1. Pre- disaster stage (preparedness)
2. Emergency Stage
3. Post Disaster stage-Rehabilitation

TEXT BOOKS:

1. Disaster Mitigation: Experiences And Reflections by Pardeep Sahni.
2. Natural Hazards & Disasters by Donald Hyndman & David Hyndman – Cengage Learning.

REFERENCES

1. R.B.Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990.
2. Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
3. Kates,B.I & White, G.F The Environment as Hazards, oxford, New York, 1978.
4. R.B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000.
5. H.K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.
6. R.B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
7. Dr. Satender , Disaster Management t in Hills, Concept Publishing Co., New Delhi, 2003.
8. A.S. Arya Action Plan For Earthquake,Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994.
9. R.K. Bhandani An overview on Natural & Man made Disaster & their Reduction,CSIR, New Delhi.
10. M.C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management,IIPA, New Delhi, 2001.

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(A60017) INTELLECTUAL PROPERTY RIGHTS

(Open Elective)

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 trade marks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents : Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets : Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition : Misappropriation right of publicity, False advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law ; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, international development in trade secrets law.

TEXT BOOKS & REFERENCES:

1. Intellectual property right, Deborah. E. Bouchoux, cengage learing.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate Mc Graw Hill Publishing company ltd.,

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(A60018) HUMAN VALUES AND PROFESSIONAL ETHICS

(Open Elective)

Objectives : This introductory course input is intended

- To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behavior and mutually enriching interaction with Nature.

Unit I:

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit II:

Understanding Harmony in the Human Being - Harmony in Myself! : Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit III:

Understanding Harmony in the Family and Society- Harmony in Human - Human Relationship : Understanding harmony in the Family- the basic unit

of human interaction. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; **Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.** Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!

Unit IV:

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence : Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Unit V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics : Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics:

a) Ability to utilize the professional competence for augmenting universal human order,

b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,

c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order:

a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b) At the level of society: as mutually enriching institutions and organizations

TEXT BOOK

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

2. Prof. KV Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications,3rd Edition.

REFERENCE BOOKS

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
6. A.N. Tripathy, 2003, Human Values, New Age International Publishers.
7. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethichs (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story

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(A60086) ADVANCED COMMUNICATION SKILLS (ACS) LAB

Introduction

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

Objectives:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

Syllabus:

The following course content to conduct the activities is prescribed for the

Advanced Communication Skills (ACS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading & effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

Minimum Requirement:

The Advanced Communication Skills (ACS) Laboratory shall have the following infra-structural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate acoustics.**
- **Round Tables with movable chairs**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ**

- **T. V, a digital stereo & Camcorder**
- **Headphones of High quality**

Prescribed Lab Manual: A book titled ***A Course Book of Advanced Communication Skills (ACS) Lab*** published by Universities Press, Hyderabad.

Suggested Software:

The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 7th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
  - **Preparing for being Interviewed**
  - **Positive Thinking**
  - **Interviewing Skills**
  - **Telephone Skills**
  - **Time Management**

Books Recommended:

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2. Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.
3. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
4. Business and Professional Communication: Keys for Workplace Excellence. Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications. 2011.
5. The Basics of Communication: A Relational Perspective. Steve Duck & David T. McMahan. Sage South Asia Edition. Sage Publications. 2012.
6. English Vocabulary in Use series, Cambridge University Press 2008.
7. Management Shapers Series by Universities Press(India)Pvt Ltd.,

Himayatnagar, Hyderabad 2008.

8. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
9. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
10. Handbook for Technical Writing by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
11. Job Hunting by Colm Downes, Cambridge University Press 2008.
12. Master Public Speaking by Anne Nicholls, JAICO Publishing House, 2006.
13. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.
14. Books on TOEFL/GRE/GMAT/CAT/ IELTS by Barron's/DELTA/

Cambridge University Press.

15. International English for Call Centres by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

DISTRIBUTION AND WEIGHTAGE OF MARKS:

***Advanced Communication Skills Lab Practicals**:*

1. The practical examinations for the ACS Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned, by inviting the External Examiner from outside. In case of the non-availability of the External Examiner, other teacher of the same department can act as the External Examiner.

Mini Project: As a part of Internal Evaluation

1. Seminar/ Professional Presentation

2. A Report on the same has to be prepared and presented.

* ***Teachers may use their discretion to choose topics relevant and suitable to the needs of students.***

* ***Not more than two students to work on each mini project.***

* ***Students may be assessed by their performance both in oral presentation and written report.***

Outcomes

- Accomplishment of sound vocabulary and its proper use contextually.
- Flair in Writing and felicity in written expression.
- Enhanced job prospects.
- Effective Speaking Abilities

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(A62185) FLIGHT VEHICLE DESIGN & INSTRUMENTATION LAB

1. Specification of design requirements- mission profile-conceptual sketches, initial sizing.
2. Airfoil and geometry selection, determination of thrust to weight ratio, wing loading.
3. First sizing & configuration layout, crew station, passengers & payload.
4. Baseline design- stability & control, performance and constraint analysis.
5. Cost estimation, parametric analysis, optimization, refined sizing & trade studies.
6. Determination of final baseline design configuration, preparation of specification report.
7. Hydraulic system.
8. Pneumatic system.
9. Demonstration on (a) Landing gears (b) Shock absorbers (c) Electro-mechanical operations of Elevators, Rudder, Flap etc on an actual aircraft (d) Artificial Horizon, Airspeed Indicator, Instrument landing system.

REFERENCES

1. Jenkinson, L.R. and Marchman III, J. F., *Aircraft Design Projects for Engineering Students*, Butterworth Heinemann, 2003, ISBN: 0 7506 5772 3.
2. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.
3. *Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.AIAA Aerospace Design Engineer's Guide*, 5th edn., AIAA Education Series, 2003, ISBN 1-56347-590-1.
4. Keane, A.J. And Nair, P.B., *Computational Approaches for Aerospace Design,* Wiley, 2005, ISBN:0-470-85540-1.
5. Taylor, J., *Jane's All the World Aircraft*, latest edition, Jane's, London.
6. Stinton, The Design of the Airplane, second edition, AIAA, 2001, ISBN: 0-56347-524-6.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
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(A72118) AIRFRAME STRUCTURAL DESIGN

Objective:

To introduce to the student, the basic concepts, specification of design requirements and methodology of Aircraft Structural Design.

UNIT-I

Introduction and Airworthiness Requirements: Structural design and sizing stages, Principal structural components of aircraft Design requirements- structural integrity, stiffness, service life, Constraints- baseline aerodynamic configuration, external loading, weight, operating conditions, conformity to government regulations. Design for durability, damage tolerance.

Airworthiness requirements - loads, safety margins, material properties, methods of estimation- construction, operation, maintenance, training-procedures. Critical load conditions. Limit and ultimate loads- definition, significance. Aircraft materials- mechanical properties- design data-allowable, allowable bases. Failure theory. Flight loads- atmospheric, maneuver- construction of flight envelope.

UNIT-II

External Loads – Estimation, Fasteners and Structural Joints: Wing loads- air load span wise distribution, effect of fuselage, engine nacelle, wing stores, control surfaces, landing, taxi, dynamic gust loads, wing weight distribution. Empennage loads- gust, maneuver, control surface. Fuselage loads- distribution of weight, fore body loads, after body loads, internal pressure, propulsion loads. Landing gear loads- landing conditions, ground handling loads, retraction loads. Miscellaneous loads. Airplane weight data, stiffness data. Theories of Failure.

Fasteners and fittings- role, significance, general design considerations, criteria for allowable strength. Margins of safety. Fastener systems, types, fastener information, dimensions, material, allowable strength- tensile, shear, bending, bearing, Rivets, bolts and screws, nuts- detail design considerations. Fastener selection. Fittings- lugs, bushings and bearings- loading, design and analysis. Joints- spliced, eccentric, gusset, welded, brazed, bonded-types, methods of joining, failure modes. Fatigue design considerations. Stress concentration- causes, methods of reduction. Fastener load distribution and by-pass load- severity factor, structural joint life prediction. Shim control and requirement.

UNIT- III

Design of Wing, Tail Unit Structures : The wing- role- summary of wing loads, structural components- wing box, leading and trailing edges. Wing layout- location of spars, ailerons and flaps, rib spacing and direction, root rib bulkhead, span wise stiffeners, wing covers- skin-stringer panels, integrally stiffened panels, access holes, and attachment of leading edge and trailing edge panels. Spars- general rules of spar design. Ribs and bulkheads- rib spacing and arrangement. Wing root joints, carry through structure. Fighter wing design- problems with swept wings

Wing box, root rib bulkhead- estimation of loads, stress analysis, design parameters, optimisation, sizing, margins of safety. Leading and trailing edge assembly- control surfaces, flaps- structure.

UNIT-IV

Design of Fuselage, Landing Gear, Engine Mounts : Function of fuselage- loading, general requirements. Ultimate strength of stiffened cylindrical structure- review, Principal structural components- skin and stringers, frame and floor beam, pressure bulkhead, wing and fuselage intersection- lay out, loading, stress analysis, sizing. Forward fuselage, aft fuselage structures, fuselage openings- windows, doors- design considerations.

Landing gear- purpose, types, general arrangement, loads- design considerations- ground handling, take-off, landing, braking, pavement loading, support structure. Stowage and retraction, gear lock- kinematic design. Shock absorbers- function, types, components, operation, loads, materials, design. Wheels and brakes, tire selection Engine mounts- types- wing pod, rear fuselage, tail, fuselage mount, loads, design considerations.

UNIT- V

Fatigue Life, Damage Tolerance, Fail-Safe Design- Weight Control and Balance: Catastrophic effects of fatigue failure- examples- modes of failure- design criteria- fatigue stress, fatigue performance, fatigue life. Fatigue design philosophy- fail-safe, safe life. Service behaviour of aircraft structures- effect of physical and load environment design and of detail of fabrication Structural life- methods of estimation- the scatter factor- significance Fail-safe design- the concept, requirements, damage tolerance- estimation of fatigue strength

TEXT BOOKS

1. Niu, M.C., Airframe Structural Design, second edition, Hongkong Conmlit Press, 1988, ISBN: 962-7128- 09-0.
2. Niu, M.C., Airframe Stress Analysis and Sizing, second edition, Hongkong Conmlit Press, 1997, ISBN: 962-7128-08-2.

REFERENCES

1. Bruhn, E.H., Analysis and Design of Flight Vehicles Structures, Tri - state Offset Company, USA, 1965.
2. Peery, D.J, and Azar, J.J., Aircraft Structures, second edition, Mc Graw-Hill, N.Y., 1993.
3. Megson, T.H.G., Aircraft Structures for Engineering Students, Butterworth-Heinemann/ Elsevier, 2007.
4. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347- 281-0.
5. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.

Outcome: The student should be able to estimate the major loads on the principal structural components of the aircraft, prepare the layout, determine the principal design parameters of the components, conduct stress analysis of the structural elements and prepare the necessary drawings and reports..

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72122) MECHANICAL VIBRATION AND STRUCTURAL DYNAMICS

Objectives: The course provides essential background on Structural Dynamics require for Aeronautical Engineers. The course will help students to solve many practical engineering problems using the techniques developed in this course. With knowledge in finite element method one can solve more complex structural dynamics problem using general purpose FE codes. The course will also provide foundation for advance course in structural dynamics and aeroelasticity.

UNIT – I

Free Vibration of Single-Degree-Of-Freedom-System: Importance of the Study of Vibration; Basic Concepts of Vibration - Elementary Parts of Vibrating Systems, Number of Degrees of Freedom, Discrete and Continuous Systems; Classification of Vibration - Free and Forced Vibration, Undamped and Damped Vibration, Linear and Nonlinear Vibration, Deterministic and Random Vibration; Vibration Analysis Procedure, Spring Elements, Mass or Inertia Elements, Damping Elements, Harmonic Motion, Harmonic Analysis.

Introduction, Free Vibration of an Undamped Translational System, Free Vibration of an Undamped Torsional System, Response of First Order Systems and Time Constant, Rayleigh s Energy Method, Free Vibration with Viscous Damping, Graphical Representation of Characteristic Roots and Corresponding Solutions, Parameter Variations and Root Locus Representations, Free Vibration with Coulomb Damping, Free Vibration with Hysteretic Damping, Stability of Systems

UNIT - II

Vibration Under Harmonic Forcing Conditions: Introduction, Equation of Motion, Response of an Undamped System Under Harmonic Force, Response of a Damped System Under Harmonic Force, Response of a Damped System Under $F(t)=F_0e^{i\omega t}$, Response of a Damped System Under the Harmonic Motion of the Base, Response of a Damped System Under Rotating Unbalance, Forced Vibration with Coulomb Damping, Forced Vibration with Hysteresis Damping, Forced Motion with Other Types of Damping, Self-Excitation and Stability Analysis, Transfer-Function Approach.

UNIT - III

Vibration Under General Forcing Conditions: Introduction, Response Under a General Periodic Force, Response Under a Periodic Force of Irregular Form, Response Under a Nonperiodic Force, Convolution Integral, Response Spectrum, Laplace Transform, Numerical Methods, Response to

Irregular Forcing Conditions Using Numerical Methods

UNIT - IV

Two-Degree- and Multi-Degree-of-Freedom Systems: Introduction, Equations of Motion for Forced Vibration, Free Vibration Analysis of an Undamped System, Torsional System, Coordinate Coupling and Principal Coordinates, Forced-Vibration Analysis, Semi-definite Systems, Self-Excitation and Stability Analysis

Modeling of Continuous Systems as Multi-degree-of-Freedom Systems, Using Newton s 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, Using Lagrange s Equations to Derive Equations of Motion, Equations of Motion of Undamped Systems in Matrix Form, Eigenvalue Problem, Solution of the Eigenvalue Problem, Expansion Theorem, Unrestrained Systems, Free Vibration of Undamped Systems, Forced Vibration of Undamped Systems Using Modal Analysis, Forced Vibration of Viscously Damped Systems, Self-Excitation and Stability Analysis

UNIT – V

Continuous Systems: Introduction, Transverse Vibration of a String or Cable, Longitudinal Vibration of a Bar or Rod, Torsional Vibration of a Shaft or Rod, Lateral Vibration of Beams, The Rayleigh-Ritz Method

TEXT BOOKS

1. Rao, S.S., Mechanical Vibrations, Fifth Edition, Prentice-Hall, 2011.
2. Thomson, W.T., Theory of vibrations with applications, CBS Publishers, Delhi.
3. Meirovitch, L., Fundamentals of vibrations, McGraw Hill International Edition, 2001.

REFERENCES

1. Leissa, A.W., Vibration of continuous system, The McGraw-Hill Company, 2011.
2. Inman, D.J., Vibration Engineering, Third Edition, Prentice Hall Int., Inc., 2001,
3. Kelly, S.G., Schaum's Outline of The Theory and Problems of Mechanical Vibrations, Schaum's Outline Series, McGraw-Hill, 1996.

Outcome: At the end of the course students will be in a position to solve simple vibration problem using techniques described in units I to III. With some knowledge in general purpose software, students will be in a position to solve more complex vibration of flight vehicles.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A70328) CAD / CAM

UNIT – I

Fundamentals of CAD/CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD , Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT-II

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming : Methods of NC part programming, Manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning.

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM /Groover M.P./ Pearson education
2. CAD/CAM Concepts and Applications/ Alavala/ PHI

REFERENCE BOOKS :

1. CAD/CAM Principles and Applications/P.N.Rao/ TMH
2. CAD / CAM Theory and Practice/ Ibrahim Zeid/TMH
3. CAD / CAM / CIM/Radhakrishnan and Subramanian/ New Age
4. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
5. Computer Numerical Control Concepts and programming/Warren S Seames/ Thomson

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72119) CONTROL THEORY- APPLICATION TO FLIGHT CONTROL SYSTEMS

Objectives: *To acquaint the student with methods of modeling, performance analysis, and synthesis of control systems and application to aircraft flight control systems.*

UNIT- I

Control Systems- Modeling- Feedback Control: Dynamical systems- input, output- process (plant)- block diagram representation. Control input, noise. Function of control as regulation (hold), tracking (command)- examples. Sensitivity of output to control input, noise and to system parameters- robustness. Deterministic and stochastic control. Need for stable, effective (responsive), robust control system. Modeling of dynamical systems by differential equations- system parameters. Order of the system. Single input single output systems, multiple-input-multiple-output systems- linear and nonlinear systems. Linearisation of nonlinear systems. Time invariant linear systems.

The concept of feedback- open loop control, closed loop control. Effect of feedback on input-output relation, stability, robustness. Merits of feedback control. Loop gain, feedback gain- significance. System type, steady state error, error constants- overall system stability. Application of feed back 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.

UNIT- II

Performance– Time, Frequency and S-Domain Description- : Control system performance- time domain description- output response to control inputs— impulse and indicial response- characteristic parameters - relation to system parameters. Synthesis of response to arbitrary input functions from impulse and indicial response. Review of Laplace transforms- applications to differential equations. 's' domain description of input-output relations- transfer functions- system parameters- gain, poles and zeroes. Partial fraction decomposition of transfer functions- significance. . Dominant poles. Relation of transfer function to impulse response. Frequency domain description- frequency response- gain and phase shift- significance-

asymptotic (Bode) plots, polar (Nyquist) plots, frequency transfer functions. Characteristic parameters- corner frequencies, resonant frequencies, peak gain, bandwidth- significance. First and second order systems- extension to higher order systems.

System identification from input output measurements- importance. Experimental determination of system transfer functions by frequency response measurements. Example.

UNIT- III

Specification of Control System Performance Requirements- System Synthesis- Controllers- Compensation Techniques : Control system performance requirements- transient and steady state- specification- desired input-output relation- speed of response, stability, accuracy, steady state error, robustness. Relation with system parameters. Examples of first and second order systems. Specifications in time, frequency, and 's' domains. Conflicting requirements- need for compromise- scope for optimisation. The primacy of stability.

System synthesis- need for compensation- design of controllers- active, passive- series, feed forward, feedback controllers. Proportional, integral, proportional plus derivative control- the problem with derivative control - lead, lag, lead-lag, wash-out, notch filters/ networks- properties- effect on transfer function, stability, robustness- relative merits. Adaptive control- definition, merits, implementation- gain scheduling. Non linear control, merits, constraints. Feedback controllers. Significance of loop transfer function, loop gain. Stability of closed loop system- frequency response methods and root locus methods of analysis and compensation- Nyquist's criterion- stability margins- phase margin, gain margin- interpretation, significance- compensation by pole zero cancellation. Design of multi loop feedback systems.

UNIT- IV

Aircraft Response to Controls- Flying Qualities- Stability and Control Augmentation- Autopilots: Approximations to aircraft transfer functions, control surface actuators- review. Response of aircraft to pilot's control inputs, to atmosphere. The control task of the pilot. Flying qualities of aircraft- relation to airframe transfer function. Reversible and irreversible flight control systems. Pilot's opinion ratings. Flying quality requirements- pole-zero, frequency response and time-response specifications. Stability augmentation systems- displacement and rate feedback- determination of gains- conflict with pilot inputs- resolution- control augmentation systems. Full authority fly-by-wire control- need for automatic control.

Autopilots- purpose, functioning- inputs- hold, command, track. Displacement autopilots- pitch, yaw, bank, altitude and velocity hold- purpose, relevant

simplified aircraft transfer functions, feedback signals, control actuators-operation, analysis, performance. Manoeuvering autopilots- normal acceleration, turn rate, pitch rate commands- applications. Autopilot design by displacement and rate feedback- iterative methods, design by displacement feedback and series PID compensator - Zeigler and Nichols method. Autopilots viewed as stability augmenters. Robust control. Typical aircraft autopilots of civil and military aircraft- description of design, construction, operation, performance.

UNIT- V

Modern Control Theory- State Space Modeling, Analysis: Limitations of classical methods of control system modeling, analysis and design, applied to complex, multiple input multiple output systems. State space modeling of dynamical systems- state variables-definition- state equations. The output variable- the output equation- representation by vector matrix first order differential equations. General form, time invariant linear systems. Matrix transfer function. State transition matrix- matrix exponential- properties-numerical solution of state equations- illustrative examples. Canonical transformation of state equations- significance- eigenvalues- real distinct, repeated, complex. Controllability and observability- definition- significance. Digital control systems- overview- advantages, disadvantages.

TEXT BOOKS

1 Kuo, B.C., *Automatic Control Systems,* Prentice Hall India, 1992, ISBN 0-87692-133-0.

2 Stevens, B.L. and Lewis, F.L., Aircraft Control and Simulation, John Wiley, 1992, ISBN0-471-61397-5.

3 Nelson, R.C., *Flight Stability and Automatic Control,* second edition, Tata McGraw-Hill, 2007, ISBN: 0-07-066110-3.

4 Yechout, T.R. et al., Introduction to Aircraft Flight Mechanics, AIAA, 2003, ISBN 1-56347-577-4.

REFERENCES

1. Mc Lean, D., *Automatic Flight Control Systems,* Prentice Hall, 1990, ISBN: 0-13-154008-0.

2. Bryson, A.E., *Control of Aircraft and Spacecraft,* Princeton University Press, 1994, ISBN: 0-691-08782-2.

3. Collinson, R.P.G., *Introduction to Avionics Systems,* second edition, Springer, 2003, ISBN: 978-81-8489-795-1.

Outcome: *The student should be able to model and estimate the performance of a specified control system including aircraft flight control systems.*

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72116) ADVANCED COMPUTATIONAL AERODYNAMICS

(Elective- I)

Aim: To impart knowledge and equip the students which CFD tools in subsonic, transonic super solic inviscid and viscous flows.

UNIT- I

Panel Methods: 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. Two-dimensional constant-strength singularity elements-sources, doublets and vortices, Two-dimensional constant strength singularity solutions using Neumann and Dirichlet boundary conditions-constant source, doublet and vortex methods

UNIT- II

Method of Characteristics, Boundary Conditions: 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.

Concept of dummy cells, Solid wall-inviscid flow, Viscous flow, Farfield-concept of characteristic variables, modifications for lifting bodies, Inlet/output boundary, Injection boundary, symmetry plane, coordinate cut, periodic boundaries, interface between grid blocks, flow gradients at boundaries of unstructured grids

UNIT- III

Numerical Solution of Transonic Small Disturbance Equation: Physical aspects of transonic flows-critical Mach number, drag divergence Mach number, area rule, supercritical airfoils, theoretical aspects of transonic flows-transonic similarity. Derivation of Transonic Small Disturbance(TSD) equation, finite difference formulation of TSD equation, Murman- Cole switching/ upwinding in supersonic flow regions, boundary conditions, iterative solution methods for discretized TSD equation

UNIT- IV

Numerical Solution of Euler Equations, Boundary Layer 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.

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.

UNIT- V

Time Dependent Methods: Stability of solution, explicit methods, FTFS, FTCS, FTBS, Lax method- 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

TEXT BOOKS

1. Tannehill, John C , Anderson, Dale A, , Pletcher Richard H., *Computational Fluid Mechanics and Heat Transfer*, Second Edition, Taylor & Francis, 1997
2. Chung, T. G., *Computational Fluid Dynamics*, Second Edition, Cambridge University Press, 2010

REFERENCES

1 Katz, Joseph and Plotkin, Allen, *Low-Speed Aerodynamics,* Second Edition, Cambridge University Press, 2006.
2 Anderson, J. D., *Modern Compressible Fluid Flow,* McGraw Hill, 1982.
3 Anderson, J. D., *Fundamentals of Aerodynamics,* Fifth Edition, Tata McGraw Hill, 2010
4 Anderson, J. D., *Computational Fluid Dynamics,* McGraw Hill
5 Rathakrishnan, E., *Gasdynamics*, Prentice-Hall India, 2004
6 Laney, C. B., *Computational Gasdynamics,* Cambridge University Press, 1998
7 Schlichting, H. and Gersten, K., *Boundary-Layer Theory,* Springer, 2000
8 Blazek, J., Computational Fluid Dynamics: Principles and Applications, 2nd Edition, Elsevier, 2007

Outcome:

The students will able to solve complex aerodynamic problems relating to aero space vehicles using CFD techniques.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72121) FLIGHT SCHEDULING AND OPERATIONS

(Elective- I)

Aim: To against the students with various aspects of flight operations & scheduling.

UNIT-I

Network Flows And Integer Programming Models : 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, traveling salesman problem- mathematical formulation- decision variables, objective function, constraints, methods of solution. Solution by simulation.

UNIT-II

Aircraft routing & management of irregular operations: 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. The problem statement, the time band approximation model- formulation of the problem- the scenarios- solution.

UNIT-III

Flight Scheduling: 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.

UNIT-IV

Fleet Assignment & Crew and Manpower Scheduling : Purpose of fleet assignment. Fleet types, fleet diversity, fleet availability- performance measures, Formulation of the fleet assignment problem- decision variables, objective function, constraints, solution. Scenario analysis, fleet assignment models.

Crew scheduling process- significance. Development of crew pairing- pairing generators- mathematical formulation of crew pairing problem- methods of solution. Crew rostering- rostering practices. The crew rostering problem- formulation, solutions. Manpower scheduling- modeling, formulation of the problem, solutions.

UNIT-V

Gate Assignment and Aircraft Boarding Strategy: 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.

TEXT BOOK

1 Bazargan, M.,'Airline Operations and Scheduling', 2nd edn., Ashgate Publishing Ltd, 2010.

REFERENCES

1. Belobaba, P., Odoni, A., Barnhart, C. 'The Global Airline Industry', Wiley, 2009.
2. Wu, Cheng-Lung, 'Airline Operations and Delay Management', Ashgate Publishing Ltd, 2010.
3. Wensveen, J.G., 'Air Transportation: A Management Perspective', 6th edn., Ashgate Publishing Ltd, 2007.
4. Ahuja,R. et al, 'Network Flows-Theory, Algorithms and Applications', Prentice-Hall, 1993.
5. Yu, G., "Operations Research in Airlines Industry", Academic Publishers, 1998.
6. www.airlinestechnology.net

Outcome: The student will be able to do some trouble shooting of flight scheduling & operations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72123) MECHANISMS AND MECHANICAL DESIGN

(Elective – I)

Aim: The subject gives in depth knowledge on general mechanisms and mechanical design of which aircraft systems are important component.

UNIT – I

Mechanisms: Elements of links : classification, Types of kinematic pairs: Lower and higher pairs, closed and open pairs. Constrained motion. Kinematic chain, inversions of mechanisms: inversion of quadratic cycle. Chain – single and double slider crank chains.

Exact and approximate straight line mechanisms - Peaucellier, Hart Tchebicheff, Pantograph.

Steering gear mechanisms: Condition for correct steering – Davis steering gear, Ackerman's steering gear– Hook's Joint: single and double Hooks joint , applications.

UNIT – II

Kinematic Analysis and Design of Mechanisms:

Kinematic analysis: 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.

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.

Kinematic Design: Four bar mechanism, Freudenstein equation. Precession point synthesis, Chebyshev's method, structural error

UNIT – III

Gyroscope – Precessional Motion: 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: 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.

UNIT – V

Gears and Gear Trains: 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.

TEXT BOOKS

1. . The Theory of machines- Thomas Beven., Third Edition – Pearson Publishers.
2. Theory of machines and Mechanisms Third Edition- John J. Uicker, Jr. Gordon R. Pennock, Joseph E. Shigley, Oxford Publisher.

REFERENCES

1. Mechanism and MachineTheory – J. S. Rao, R.V.D. Dukkipati, New Age Publishers.
2. Theory of Machines,- IIIrd Edition Sadhu Singh, Pearson Publishers.
3. Mechanism and MachineTheory – Ambekar-,PHI.
4. Theory of Machines IIIrd edition S. S. Rattan, Mc. Graw - Hill.
5. A Text books of Theory of Machines by Dr. R. K. Bansal, Dr. J. S. bra r- Lakshmi Publications.

Outcome: The student shall be able to decipher basic mechanisms and mechanical design of aircraft.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72125) THEORY OF ELASTICITY

(Elective – I)

Aim and Objectives: The objective of the course is to provide advance knowledge in theory of elasticity. This will help students in understanding, modeling and interpreting flight vehicle structure using finite element method.

UNIT-I

Two-Dimensional Problems- I Two dimensional problems in rectangular co-ordinates-solution by polynomials - Saint-venant's principle- determination of displacements-bending of simple beams-application of Fourier series methods for two dimensional problems - gravity loading.

UNIT-II

Two-Dimensional Problems- II Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates – displacements - displacement for symmetrical stress distribution - simple symmetric and asymmetric problems - general solution of two-dimensional problem in polar coordinates - application of general solution in polar coordinates.

UNIT-III

Three-Dimensional Problems Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses - maximum shear stresses - homogeneous deformation - principal axes of strain rotation. General theorems.

UNIT-IV

Torsion Torsion of prismatic bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars-solution of torsional problems by energy method - use of soap films in solving torsion problem - hydro dynamical analogies - torsion of shafts, tubes, bars etc.

UNIT-V

Bending Bending of prismatic Bars: Stress function - bending of cantilever - circular cross section – elliptical cross section – rectangular cross section - bending problems by soap film method - displacements

TEXT BOOK

1. Timoshenko, S.P. and Goodier, J.N., *Theory of Elasticity*, Tata McGraw Hill.

2. Sadd, M.H., Elasticity: Theory, Applications, and Numerics, Elsevier Pub, 2009.

REFERENCES

1. Chakrabarty, *Theory of Plasticity,* McGraw-Hill Publications.

2. Fung, Y.C., An Introduction to the Theory of Aeroelasticity, Dover Publications.

3. Gurucharan Singh, *Theory of Elasticity.* 4 Sadhu Singh, *Theory of Elasticity*, Khanna Publications.

Outcome: At the end of this course, students will be in a position to handle complex problems for flight structural analysis.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A70008) PROBABILITY AND STATISTICS

(Elective – I)

Objectives: To learn

- Understand a random variable that describes randomness or an uncertainty in certain realistic situation. It can be of either discrete or continuous type.
- In the discrete case, study of the binomial and the Poisson random variables and the Normal random variable for the continuous case predominantly describe important probability distributions. Important statistical properties for these random variables provide very good insight and are essential for industrial applications.
- Most of the random situations are described as functions of many single random variables. In this unit, the objective is to learn functions of many random variables through joint distributions.
- The types of sampling, Sampling distribution of means ,Sampling distribution of variance,Estimations of statistical parameters, Testing of hypothesis of few unknown statistical parameters.
- The mechanism of queuing system ,The characteristics of queue,The mean arrival and service rates
- The expected queue length, The waiting line
- The random processes, The classification of random processes, Markov chain, Classification of states
- Stochastic matrix (transition probability matrix),Limiting probabilities, Applications of Markov chains

UNIT-I

Single Random variables and probability distributions: 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.

Binomial, Poisson & normal distributions and their properties. Moment generating functions of the above three distributions, and hence finding the mean and variance.

UNIT-II

Multiple Random variables, Correlation & Regression: Joint probability distributions- Joint probability mass / density function, Marginal probability

mass / density functions, Covariance of two random variables, Correlation - Coefficient of correlation, The rank correlation.

Regression- Regression Coefficient, The lines of regression and multiple correlation & regression.

UNIT-III

Sampling Distributions and Testing of Hypothesis

Sampling: Definitions of population, sampling, statistic, parameter. Types of sampling, Expected values of Sample mean and varience, sampling distribution, Standard error, Sampling distribution of means and sampling distribution of varience.

Parameter estimations – likelihood estimate, interval estimations.

Testing of hypothesis: Null hypothesis, Alternate hypothesis, type I, & type II errors – critical region, confidence interval, Level of significance. One sided test, two sided test,

Large sample tests:

(i) Test of Equality of means of two samples equality of sample mean and population mean (cases of known varience & unknown varience, equal and unequal variances)

(ii) Tests of significance of difference between sample S.D and population S.D.

(iii) Tests of significance difference between sample proportion and population proportion&difference between two sample proportions.

Small sample tests:

Student t-distribution,its properties; Test of significance difference between sample mean and population mean; difference between means of two small samples Snedecor's F- distribution and it's properties. Test of equality of two population variences Chi-square distribution , it's properties, Chi-square test of goodness of fit

UNIT-IV

Queuing Theory: Structure of a queuing system, Operating Characteristics of queuing system, Transient and steady states, Terminology of Queuing systems, Arrival and service processes- Pure Birth-Death process Deterministic queuing models- M/M/1 Model of infinite queue, M/M/1 model of finite queue .

UNIT-V

Stochastic processes: Introduction to Stochastic Processes –Classification of Random processes, Methods of description of random processes, Stationary and non-stationary random process, Average values of single random process and two or more random processes. Markov process,

Markov chain, classification of states – Examples of Markov Chains, Stochastic Matrix.

TEXT BOOKS:

1) Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers
2) Probability and Statistics for Engineers and Scientists by Sheldon M.Ross, Academic Press
3) Operations Research by S.D. Sarma,

REFERENCE BOOKS:

1. Mathematics for Engineers by K.B.Datta and M.A S.Srinivas,Cengage Publications
2. Probability and Statistics by T.K.V.Iyengar & B.Krishna Gandhi Et
3. Fundamentals of Mathematical Statistics by S C Gupta and V.K.Kapoor
4. Probability and Statistics for Engineers and Scientists by Jay l.Devore.

Outcomes:

- Students would be able to identify distribution in certain realistic situation. It is mainly useful for circuit as well as non-circuit branches of engineering. Also able to differentiate among many random variable involved in the probability models. It is quite useful for all branches of engineering.
- The student would be able to calculate mean and proportions (small and large sample) and to make important decisions from few samples which are taken out of unmanageably huge populations .It is Mainly useful for non-circuit branches of engineering.
- The students would be able to find the expected queue length, the ideal time, the traffic intensity and the waiting time. These are very useful tools in many engineering and data management problems in the industry. It is useful for all branches of engineering.
- The student would able to understand about the random process, Markov process and Markov chains which are essentially models of many time dependent processes such as signals in communications, time series analysis, queuing systems. The student would be able to find the limiting probabilities and the probabilities in n^{th} state. It is quite useful for all branches of engineering

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72124) SPACE MECHANICS

(Elective- II)

Aim: The Concepts of space mechanics are taught to familiarize the student with satellite and missile launch vehicle dynamics.

UNIT- I

Basic Concepts: The solar system, comets and meteors, Kepler's laws and Newton's law of gravitation, concept of celestial sphere, vernal equinox, ecliptic. Coordinate systems- ECI system, geographic coordinate system, azimuth-elevation coordinate system, ecliptic system, Time systems- sidereal time, mean solar time, Julian date, universal time, ephemeris time.

UNIT- II

Two-Body and Restricted Three Body Problems : N-body problem, two-body problem- simplifying assumptions. Equations of relative motion. Constants of the motion- conservation of angular momentum, Trajectory equation, elliptical orbit- geometry of the ellipse, period of an elliptical orbit, circular orbit, parabolic orbit, hyperbolic orbit. Geometry of the hyperbola, hyperbolic excess speed. Orbital elements.

Introduction, equations of motion, Lagrangian points, stability of the Lagrangian points, Jacobi's integral, accessible regions.

UNIT- III

Basic Orbital Maneuvres and Orbit Perturbations : Low altitude earth orbits- effect of orbital altitude on satellite life times, direct ascent to orbit, perturbations of low earth orbits due to the oblate shape of the Earth. High altitude earth orbits- the synchronous satellite, launching a high altitude satellite. In-plane orbit changes- adjustment of perigee and apogee height, Hohmann transfer, general coplanar transfer between circular orbits, Out-of plane orbit changes-simple plane change.

General overview of orbit perturbations, Earth gravity harmonics, lunisolar gravitational attractions, solar radiation pressure effects, atmospheric drag effects, tidal friction effects and mutual gravitational attraction. earth's oblateness (J_2) effects, critical inclination. Sun-synchronous orbits, J_3 effects and frozen orbits, Earth's triaxiality effects and east-west station keeping.

UNIT- IV

Ballistic Missile Trajectories: The general ballistic missile problem-geometry of the trajectory, free flight range equations, flight path angle equation, maximum range trajectory, time of free flight. Effect of launching

errors on range- effect of lateral displacement of the burnout point, cross range error due to incorrect launch azimuth, effect of down range displacement of the burnout point, errors in burn-out flight-path angle, down range errors caused by incorrect burnout height and in correct speed at burnout. The effect of earth rotation- compensating for the initial velocity of missile due to earth rotation, compensating for movement of the target due to earth rotation.

UNIT- V

Interplanetary Trajectories: Patched-conic approximation-heliocentric transfer orbit, phase angle at departure, escape from the earth's sphere of influence, arrival at the target planet, effective collision cross-section. Locating the planets- launch opportunity, synodic period, trajectory type and class, ephemeris calculations, Non-coplanar interplanetary trajectories, Gravity-assist manoeuvre. Fast interplanetary trajectories.

TEXT BOOKS

1 Bate, R.R., Mueller, D.D. and White, J.E., *Fundamentals of Astrodynamics*, Dover Publications Inc., New York, 1971.

REFERENCES

1. Wiesel, W.E., *Space?ight Dynamics,* 2nd edn., McGraw-Hill, New York, 1995.
2. Hale, F.J., *Introduction to Space Flight,* Prentice Hall, 1994.
3. Sellers, J.J., *Understanding Space: An Introduction to Astronautics*, 2nd edn., McGraw-Hill, 2004
4. Chobotov, V.A., ed, *Orbital Mechanics* 3rd edn., AIAA Education Series, 2002.

Outcome: The student will be able to estimate space mechanics associated space vehicles.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72120) EXPERIMENTAL AERODYNAMICS

(Elective- II)

Aim: The student will learn fundamental underlying theory of all experiments and in particular about different aerodynamic measurement techniques in a wind tunnel. He/she will acquire skills to design wind tunnels and to use various instruments and sensors used in a wind tunnel. He will appreciate how essential it is to perform experiments for the advancement of theory.

UNIT- I

Aerodynamic Experiments- History, Model Testng, Types Of Wind Tunnels: Forms of aerodynamic experiments- observation, measurement- objectives. History – Wright brothers' wind tunnel,, Model testing- wind tunnel- principles- scaling laws, scale parameters, similarity- geomnetric,, kinematic & dynamic.

Wind tunnels- low speed- types, description. High speed tunnels- transonic, supersonic, hypersonic, shock tubes, special tunnels- low turbulence, high Re, environmental, automobile- function, distinctive features, application.

UNIT- II

Low Speed Wind Tunnels- Detailed Design Features & Corrections: Low speed wind tunnel- principal components- working section, diffuser, corners, turning vanes, fan, straighteners, honeycombs, screens, contraction cone, fan, motor- function, description, design requirements, constraints, construction, performance- loss coefficients. Wind tunnel performance- flow quality, power losses.

Wind tunnel corrections. Sources of inaccuracies- bouyancy, solid blockage, wake blockage, streamline curvature- causes, estimation and correction..

UNIT- III

Low Speed Balances & High Speed Tunnels : Load measurements- Low speed wind tunnel balances – MECHANICAL & strain gage types, Null displacement method & Strain method, sensitivity, Weighbeams – Steelyard type and Current-balance type, Balance Linkages - Levers & Pivots, Model support – three point wire support, three-point strut support,. Mechanical balance – Platform balance , Yoke balance; What is a strain gage, 3-component straingage balance. description, application.

Basic features of Transonic wind tunnels, Supersonic wind tunnels— Blow Down and Suction – basic features, Shock tubes & hypersonic gun tunnel.

UNIT- IV

Pressure Velocity Temperature Measurements & Flow Visualisation Techniques -1: LOW SPEED MEASUREMENTS: Streamlines, Streak lines, Path lines, Time lines.

measurement of airspeed, flow direction, boundary layer profile using Pitot-static tubes, 5 hole probe yaw meter,, total head rake- function, working principle,

Flow visualisation- need,, types- tufts, china clay, oil film, smoke, hydrogen bubble - working principle, description, setting up, operation, observation, recording, interpretation of imagery, relative merits, applications.

HIGH SPEED MEASUREMENTS: Static pressure — surface pressure orifice, static probes, Pitot probe for total pressure, Mach number from pressure measurements, Wedge & Cone measurements — static pressure & flow angularity, Temperature & heat transfer measurements.

Flow Visualization in High speed flows- optical methods- Density & refractive index, Schlieren system — convex lenses, knife edge, concave mirrors as replacement for lenses; Shadowgraph ;, interferometer.

UNIT-V

Pressure Velocity Temperature Measurements & Flow Visualisation Techniques – 2: Steady and unsteady pressure measurements and various types of pressure probes and transducers, errors in pressure measurements; measurement of temperature using thermocouples, resistance thermometers, temperature sensitive paints and liquid crystals

Hot Wire Anemometry, Laser Doppler Anemometry, Partcle Image Velocimetry- working principles, description of equipment, experimental setup, settings, calibration, measurement, data processing, applications.

TEXT BOOKS

1. Low Speed Wind Tunnel Testing, Barlow, J.B., Rae, W.H., Pope, A., Wiley 1999.
2. High Speed Wind Tunnel Testing, Pope, A. and Goin, K.L., Wiley, 1965.
3. Bradshaw, P., *Experimental Fluid Mechanics,* Pergamon Press, 1970.
4. Liepmann, H.W., and Roshko, A., *Elements of Gas Dynamics*, John Wiley, 1957 (Chapter 6: Methods of Mesurement).

REFERENCES

1. Yang, W.J., *Handbook of Flow Visualization,* 2nd edition, Taylor and Francis, 2001.

2. Goldstein, R.J., (Ed.) *Fluid Mechanics Measurements*, Taylor Francis, Washington 1996. 84.

3. Tropea, C., Yarin, A. L., Foss, J. F., *Handbook of Experimental Fluid Mechanics*, Springer, 2007.

Outcome: Students will be able to know how to use instruments and sensors used in wind tunnels.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A70352) OPERATIONS RESEARCH

(Elective-II)

UNIT – I

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT – II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT – III

Sequencing – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT – V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming:

Introduction – Terminology- Bellman's Principle of Optimality – Applications

of dynamic programming- shortest path problem – linear programming problem.

Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages- applications of simulation to queuing and inventory.

TEXT BOOK :

1. Operations Research /J.K.Sharma 4e. /MacMilan
2. Introduction to O.R/Hillier & Libermann/TMH

REFERENCE BOOKS :

1. Introduction to O.R /Taha/PHI
2. Operations Research/ NVS Raju/ SMS Education/3rd Revised Edition
3. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research / Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K, Vijaya Kumar Reddy, J. Suresh Kumar/ Cengage Learning.

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IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A72117) AIRCRAFT MAINTENANCE ENGINEERING

(Elective- II)

Aim: To familiarize the students with various aspects of aviation maintenance.

UNIT- I

Philosophy of Aircraft Maintenance: Definition of maintenance, Objectives of a maintenance program, Outline of aviation maintenance program, summary of FAA requirements, additional maintenance program requirements; Organization of maintenance and engineering, organization structure, M&E organization chart, general groupings, Managerial Level Functions-technical services, aircraft maintenance, overhaul shops, material, maintenance program evaluation directorates, summary of management levels, organization structure and TPPM, variations from the typical organization role of the engineer, role of the mechanic, two types of maintenance, reliability, redesign, failure rate patterns, other maintenance considerations, establishing a maintenance program. Goals and objectives of maintenance, Discussion of the five objectives

UNIT- II

Development of Maintenance Programs: Maintenance Steering Group(MSG) Approach, Process-Oriented maintenance, Task-oriented maintenance, Current MSG process-MSG-3, Maintenance program documents, maintenance intervals defined, changing basic maintenance intervals, maintenance program content

UNIT- III

Technical Services: Engineering: makeup of engineering, mechanics and engineers, engineering department functions, engineering order preparation; Production Planning & Control-forecasting, production planning, production control, feedback for planning, organization of PP&C; Technical Publications-functions of technical publications, airline libraries, control of publications, document distribution; Technical Training-organization, training for aviation maintenance, airframe manufacturer's training courses, other airline training courses; Computer support-airlines uses of computers

UNIT- IV

Maintenance and Material Support: Line Maintenance(on-aircraft)-makeup of line maintenance, functions that control maintenance, maintenance control centre responsibilities, general line maintenance operations, aircraft logbook, ramp and terminal operations, other line maintenance activities, line station activities, maintenance crew requirements, morning meeting; Hangar

Maintenance(on-aircraft)-organization of hangar maintenance, problem areas in hangar maintenance, maintenance support shops, ground support equipment, typical C-check; Maintenance overhaul shops(off-aircraft)-organization, types and operation of overhaul shops, Shop data collection; Material support-organization and function of material, material directorate, M&E support functions

UNIT- V

Maintenance Documentation and Quality Assurance : Aircraft certification, delivery inspection, operator certification, certification of personnel, aviation industry interaction; Types of documentation, manufacturer's documentation, regulatory documentation, airline generated documentation, ATA document standards, closer look of TPPM, Quality Assurance-requirements for QA, quality audits, ISO 9000 quality standard, technical records, other functions of QA; Quality Control-quality control organization, FAA and JAA differences, QC inspector qualifications, basic inspection policies, other QC activities; Reliability-definition and types of reliability, elements of a reliability program,

TEXT BOOKS

1. Kinnison, H.A., *Aviation Maintenance Management*, McGraw-Hill, 2004.
2. McKinley, J. L., Bent, R.D., *Maintenance and Repair of Aerospace Vehicles*, Northrop Institute of Technology, McGraw Hill, 1967.

REFERENCES

1. Friend, C.H., *Aircraft Maintenance Management*, Longman, 1992.
2. Kroes, M., Watkins, W., and Delp, F. *Aircraft Maintenance and Repair,* Tata McGraw-Hill, 2010.
3. Patankar, M.S. And Taylor, J.C., Risk Management and Error Reduction in Aviation Maintenance, Ashgate, 2004, ISBN 0-7546-1941-9.
4. *Aircraft Communication & Navigation System- Principles, maintenance & Operation*, Mike Tooley & David Wyatt, Rootledge, 2013
5. *Engineering Maintenance- A Modern Approach, B.S. Dhillon, CRC Press, 2013.*

Outcome: The Students will be able to trouble shoot problems in aircraft maintenance.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A72187) COMPUTATIONAL STRUCTURES LAB

1, 2. Introduction to the features and application of any one of the professional software employed in modelling and analysis of aircraft structures.

MODELING, ANALYSIS (MAXIMUM STRESSES, DEFLECTIONS) AND CODE DEVELOPMENT, OF STRUCTURAL ELEMENTS UNDER ARBITRARY STATIC LOADING- VALIDATION OF SOLUTIONS WITH PROFESSIONAL SOFTWARE

3. Bending of uniform cantilever beams.
4. Compressive strength of rectangular stiffened plane panels of uniform cross-section.
5. Shear and torsion of stiffened thin walled open and closed sections.
6. Statically indeterminate trusses.
7. Free vibrations of uniform cantilever beams- determination of natural frequencies and mode shapes.

MODELING AND ANALYSIS OF SIMPLE AIRCRAFT COMPONENTS USING PROFESSIONAL SOFTWARE

8. 3 dimensional landing gear trusses.
9. Tapered wing box beams.
10. Fuselage bulkheads.

Suggested soft wares

ANSYS

NASTRAN

PATRAN

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-I Sem	**L**	**T/P/D**	**C**
	-	**-/3/-**	**2**

(A72186) COMPUTATIONAL AERODYNAMICS LAB

1. Introduction to any one of the suitable software employed in modelling and simulation of aerodynamics problems.

2, 3. Solution for the following equations using finite difference method (Code development):

   i) One-dimensional wave equation using explicit method of Lax

   ii) One-dimensional heat conduction equation using explicit method

4, 5. Generation of the following grids (Code development):

   i) Algebraic grids

   ii) Elliptic grids

6,7,8,9,10. Numerical Simulation of the following flow problems using commercial software packages:

   i) Flow over an airfoil

   ii) Supersonic flow over a wedge

   iii) Flat plate boundary layer

   iv) Laminar pipe flow

   v) Flow past a cylinder

Suggested Software:

FLUENT

CFX

MATLAB

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82129) AVIONICS AND INSTRUMENTS & SYSTEMS

Objective: *To introduce to the student the Avionics and instruments systems installed on aircraft.*

UNIT– I

Avionics- Introduction- Avionics Standards: Importance and role of Avionics in modern aircraft– core avionics systems and interface with pilot – aircraft state sensor systems, outside world sensor systems – task automation systems. Requirements of avionics equipment and systems– environmental, weight, reliability.

Standardisation and specifications of avionics equipment and systems- the ARINC and MIL specifications. Electrical and optical data bus systems – Integrated modular avionics architectures – avionics packaging.

UNIT– II

Displays- Man Machine Interaction and Communication Systems: Introduction to aircraft displays – head-up displays (HUD) – basic principles. Helmet mounted displays, head tracking systems. Head down displays – civil cockpit, military cockpit. Solid state standby display systems. Data fusion in displays – intelligent display management systems.

Introduction to voice and data communication systems - HF, VHF, UHF and satellite communications - Data recorders – Audio management systems – In-flight entertainment systems – ACARS data communication systems.

UNIT– III

Inertial Sensors and Global Positioning Systems: Basic principles of gyroscopes and accelerometers – Angular momentum gyros – dynamically tuned gyro – micro machined vibrating mass rate gyro. Introduction to optical gyroscopes– ring laser gyros- principles. Specific force measurements with accelerometers – spring restrained pendulous accelerometers, torque balance pendulous accelerometers. Stable platform systems– strap down systems– errors in inertial systems and compensations.

Global Navigational Satellite Systems- the Global Positioning System (GPS)– description and basic principles– integration of GPS and INS– differential GPS– augmented satellite navigation systems.

UNIT– IV

Navigation, Ranging and Landing Systems: Introduction and basic principles of navigation– types of navigation systems– Radio-navigation systems- VHF omni-range, distance measuring equipment, automatic direction finders. Attitude and heading reference systems. Inertial Navigation Systems (INS) - platform axes– angular rate corrections, acceleration correction, initial alignment and gyro compassing - strap-down INS computing. Aided INS- Kalman filters.

Landing systems– localiser and glide-slope- marker systems. Categories of instrument landing systems.

UNIT– V

Surveillance Systems and Autoflight Systems: Traffic alert and collision avoidance systems (TCAS) – Enhanced ground proximity warning systems – Air traffic control systems – Mode S transponders – Predictive wind shear warning systems – Weather radar systems – Enhanced Ground Proximity warning systems.

Longitudinal and lateral control and response of aircraft- powered flight controls- auto-stabilisation systems. Autopilots – principles- height control – heading control – ILS coupled autopilot control – automatic landing systems – satellite landing guidance systems – speed control and auto throttle control systems. Flight management systems – principles- flight planning – navigation and guidance – flight path optimization and performance prediction – cost index.

TEXT BOOKS

1. Collinson, R.P.G., *Introduction to Avionics Systems*, second edition, Springer, 2003, ISBN 978-81-8489-795-1
2. Moir, I. and Seabridge, A., *Civil Avionics Systems,* AIAA Education Series, AIAA, 2002, ISBN 1-56347589-8.
3. Moir, I., Seabridge, A. & Jukes, M., *Military Avionics Systems (Aerospace)*, Wiley, 2006, ISBN 9780470016329.

REFERENCES

1. Tooly, Mill and Wyatt, David, *Aircraft Communication and Navigation Systems,* ELSEVIER, 2007, ISBN 978-0-7506-81377.
2. Kayton, M., & Fried, W.R., *Avionics Navigation Systems,* Wiley, 1997, ISBN 0-471-54795-6.

3. Helfrick, A., *Principles of Avionics, Avionics Communications,* Inc. Leesburg, 2000, VA 20177, USA, ISBN 1-885544-10-3.

4. Moir, I. and Seabridge, A., *Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration,* AIAA Education Series, AIAA, 2001, ISBN 1-56347506-5.

5. Harris, D., *Ground Studies for Pilots: Flight Instruments and Automatic Flight Control Systems*, sixth edition, Blackwell Science, 2004, ISBN 0-632-05951-6.

6. Pallett, E.H.J., *Aircraft Instruments & Integrated Systems,* 1996, Longman Scientific & Technical.

Outcome: *The student would gain an understanding of the basic principles of the above systems and their application in the operation of aircraft.*

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IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82127) AIRPORT PLANNING AND OPERATIONS

(Elective- III)

Aim: *To introduce to the student the* airport planning and operations.

UNIT- I

Airport as an Operational System: 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.

UNIT- II

Airport Planning: Airport system planning, airport master plan, airport layout plan- forecasting, facilities requirements, design alternatives. Financial plans, land use planning, environmental planning.

UNIT-III

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 Baggage operations-operating characteristics of baggage handling systems-inbound baggage system, outbound baggage system-operating performance-organizing for the task.

UNIT-IV

Passenger Terminal Operations and Cargo Operations: Functions of the passenger terminal, philosophies of terminal management. Direct passenger services, airline related passenger services. Airline related operational functions. Governmental requirements-non-passenger related airport authority functions, processing very important persons. Passenger information systems. Space components and adjacencies- aids to circulation-hubbing considerations.

Air cargo market- expanding the movement. Flow through the cargo terminal-unit loading devices.-Handling within the terminal-Cargo apron operation-Computerisation of facilitation-Examples of modern cargo designs-Freight operations for the integrated carrier.

UNIT-V

Airport Technical Services and Access: Scope of technical services- air traffic control- telecommunications- meteorology- aeronautical information.

Access as part of airport system- access users and modal choice, access interaction with passenger terminal operation, access modes- in-town and off-airport terminals. Factors affecting access mode choice.

TEXT BOOK

1. Wells, A.T. and Young, S.B., *Airport Planning and Management*, 5th edn, McGraw-Hill, 2004.

REFERENCES

1. Kazda, A. and Caves, R.E., *Airport Design and Operation,* 2nd edn., Elsevier, 2007.
2. *Horonjeff, R., McKelvey, F.X., Sproule, W.J. and Young, S.B., Planning and Design of Airports*, 5th edn., McGraw-Hill, 2010.
3. Ashford, N., Stanton, H. P. M. and Moore, C.A., *Airport Operations,* McGraw-Hill, 1997

Outcome: *The student would gain an understanding of the basic planning and operations involved in airport.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82128) ANALYSIS OF COMPOSITE STRUCTURES

(Elective– III)

Aim: To familiarize students on the various composite materials their properties and methods for analysis.

UNIT- I

Properties of Constituent Materials and Composite Laminates: Introduction to laminated composite plates- mechanical properties of constituent materials such as matrices and filaments of different types.

Netting analysis of composite materials, determination of properties of laminates with fibers and matrices.

UNIT- II

Elastic Properties: Stress-strain relations of isotropic, orthotropic and anisotropic materials, transformation of material properties for arbitrary orientation of fibers.

UNIT- III

Methods of Analysis: Mechanics of materials approach to determine Young's modulus, shear modulus and Poisson's ratio. Brief mention of elasticity approach and macro mechanics of laminates.

Anisotropic elasticity, stress –strain relations in material coordinates - Transformation of geometric axes, strength concepts, biaxial strength theories, maximum stress and maximum strain.

UNIT-IV

Analysis of Laminated Beams and Plates: Classical plate theory, Classical lamination theory – Special cases of single layer, symmetric, antisymmetric & unsymmetric composites with cross ply, angle ply lay up. Deflection analysis of laminated plates, Analysis of laminated beams and plates.

UNIT-V

Shear Deformation and Buckling Analysis: Shear deformation theories for composite laminated beams, plates- first, second and third order theories. nth order theory.

Buckling analysis of laminated composite plates with different orientation of fibers, Tsai-wu criteria and Tsai – Hill Criteria.

TEXT BOOKS

1. Agarwal B. D., Broutman. L. J., *Analysis and Performance of Fibre Composites*, John Wiley and sons – New York, 1980.

2. Lubin. G, *Hand Book on Advanced Plastics and Fibre Glass* , Von. Nostrand, Reinhold Co. New york, 1989.

REFERENCES

1. Gupta, L., *Advanced Composite Materials,* Himalayan Books, New Delhi, 1998.
2. Jones, R.M., *Mechanics of Composite Materials,* McGrawHill Kogakusha, ltd. Tokyo.
3. Reddy, J.N., *Mechanics of Composite Materials*.

Outcome: The students will be able to select appropriate composite materials and analyzes for different elastic properties by using various methods.

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IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82130) HELICOPTER ENGINEERING

(Elective-III)

Aim: To familiarize students on the elements of helicopter aerodynamics and ground effect machines.

UNIT - I

Elements of Helicopter Aerodynamics: Configurations based on torque reaction - Jet rotors and compound helicopters- Methods of control- Collective and cyclic pitch changes – Lead – Lag and flapping hinges.

UNIT – II

Ideal Rotor Thory: Hovering performances - Momentum and simple blade element theories - Figures of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

UNIT - III

Power Estimates, Stability and Trim: Induced, Profile and Parasite power requirements in forward flight - Performances curves with effects of altitude. Preliminary ideas on helicopter stability.

UNIT - IV

Lift and Control of V/Stol Aircraft: Various configuration - Propeller, Rotor ducted fan and jet lift - Tilt wing and vectored thrust - Performances of VTOL and STOL aircraft in hover, Transition and Forward motion.

UNIT - V

Ground Effect Machines: Types - Hover height, Lift augmentation and power calculations for plenum chamber and peripheral jet machines - Drag of hovercraft on land and water. Applications of hovercraft.

TEXT BOOKS

1. Johnson, W., Helicopter Theory, Princeton University Press,1980.
2. McCormick, B.W., Aerodynamics, Aeronautics & Flight Mechanics, John Wiley, 1995.
3. Gessow, A., and Myers, G.C., Aerodynamics of Helicopter, Macmillan & Co., N.Y.1987.

REFERENCES

1. McCormick, B.W., Aerodynamics of V/STOL Flight, Academics Press, 1987.
2. Gupta, L Helicopter Engineering, Himalayan books, 1996.

Outcome: The students will be able to take up design and analysis works relating to helicopter.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82131) HYPERSONIC AERODYNAMICS

(Elective- III)

Aim: To familiarize the students on the various elements of hypersonic aerodynamics and their effects.

UNIT- I

Introduction: History of hypersonic flight- a logical progression in the light of advancing technical findings. Hypersonic flow- definition, importance, physical aspects. Brief descriptive introductory pre-view of various phenomena such as Thin shock layer, Entropy layer, Viscous interaction, Effects of high temperature and communication black out. Low density flow, free molecular flow.

Hypersonic Shock and Expansion Wave Relations: Oblique shock relations for high Mach numbers, Expansion wave relations for high Mach numbers. Theoretical basis of Mach number independence principle-corroboration by experimental results. Importance of experiments.

UNIT- II

Local Surface Inclination Methods: Newtonian flow and the hypersonic double limit of M ? ? & γ ? 1, Modified Newtonian flow, Centrifugal force correction to Newtonian flow, Tangent wedge and tangent cone methods.

Hypersonic Inviscid Flows- I: Hypersonic small disturbance theory, Equivalence principle and hypersonic similarity parameter; Hypersonic shock relations in terms of similarity parameter.

UNIT- III

Hypersonic Inviscid Flows– II : Application of small disturbance theory and equivalence of 1-dimensional piston motion with 2-dimansional hypersonic flow, Flat plate at an angle of attack by piston theory and comparison with exact shock expansion method, Bi-convex airfoil at zero angle of attack: comparison of piston theory and exact shock expansion method, Phenomenological aspects of hypersonic blunt body problem, Importance of blunt body problem and brief outline of computational time-marching finite difference method and its advantage over other methods.

UNIT- IV

Viscous Flows: Derivation of compressible boundary layer equations, Brief introduction to the flat plate case and some important results and conclusions for high Mach number flows, Special characteristics of hypersonic boundary layers, Introduction to hypersonic interaction parameters – weak & strong.

UNIT- V

Shock Tube Based Experimental Facilities: Shock tunnel, Gun tunnel, Free piston wind tunnel, Ludweig tube, Measurement techniques, Samples of comparison of experimental and theoretical results.

Other Hypersonic Facilities: Continuous hypersonic tunnel free flight experiments in tunnels and ballistic ranges- Measurement techniques. Role of experiments in computer code validation and calibration, Brief introduction to heat transfer measurements.

TEXT BOOKS

1. Anderson J D, *Hypersonic and High Temperature Gas Dynamics*, 2nd Edition, AIAA Education series, 2000.
2. Bertin, J. J. , *Hypersonic Aerothermo-dynamics*, AIAA Education series, 1994.
3. Spurk, J., *Fluid Mechanics,* Springer, Heidelberg, 1997.

REFERENCES

1. Hayes & Probstein, *Hypersonic Flow Theory.*
2. Wendt J F, *European Hypersonic Wind Tunnels,* AGARD Conference Proceedings No. 428, Nov. 1987, Paper 2.
3. Canning T. N., Seiff A. and James, C. S., *Ballistic Range Technology*, AGARDograph Report AD 07 13915, Aug. 1970.
4. Brun, Raymond, *Introduction to Reactive Gas Dynamics,* Oxford Univ. Press, 2009, Chapter 11: Facilities and Experimental Methods.
5. Harry J Davies, H.J. and Churchack, H.D., *Shock Tube Techniques & Instrumentation,* 1969, US Army Material Command, Harry Diamond Lab, Washington DC (available on net – Free Copy).
6. Burtschell, Y., Brun, R., and Zeitoun, D., *Shock Waves,* Springer Verlag, Berlin , 1992.
7. *An Album of Supersonic Flow Visualization,* Edited by P I Kovalev & N P Mende, National Defence industry press (Write to Prof S V Bobashev, 26 politechnicheskaya street, St. Petersburg 194021, Russia).
8. Curtis, P. *Shock tubes,* Pegasus Eliot Mackenzie Publishers, October 2004.

Outcome: The students will be able to take up design and analysis works relating to hypersonic aerodynamics.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A80331) HEAT TRANSFER

(Elective-IV)

UNIT – I

Introduction**,** Basic Modes of heat transfer – Fundamental laws of heat transfer – Simple General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier Heat transfer equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions.

UNIT – II

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation-Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface and fins.

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance –Chart solutions of transient conduction systems.

UNIT – III

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham π Theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – use of empirical correlation for convective heat transfer.

Forced convection: External Flows: Flat plates and Horizontal pipes.

Free Convection: Vertical plates and pipes-concepts about Hydrodynamic and thermal boundary layer along a vertical plate.

UNIT – IV

Heat Transfer With Phase Change:

Boiling: – Pool boiling– Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation –Film Condensation on a vertical and horizontal cylinders using empirical correlations.

Radiation Heat Transfer : Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, 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.

UNIT V

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

TEXT BOOK :

1. Heat& Man Transfer-D.S.Kumar/S.K.Kataria& sons.
2. Heat Transfer-P.K.Nag /Mc Graw Hill/Third Edition.

REFERENCE BOOKS:

1. Heat Transfer: A Practical Approach /Yunus Cengel, Boles / TMH.
2. Heat Transfer: A Conceptual Approach/PK Sharma, K. Rana Krishna/ New age International Publishers.
3. Heat Transfer / HOLMAN/TMH.
4. Heat and Mass Transfer/ R. Yadav /CPH.
5. Essential Heat Transfer/ Christopher A Long / Pearson Education.
6. Fundamentals of Engineering, Heat & Man Transfer/R.C.Sachdeva/ NewAge.

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IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82132) LAUNCH VEHICLE AND MISSILE TECHNOLOGY

(Elective- IV)

Aim: The student shall be introduced to the launch vehicle & Missile technologies.

UNIT- I

Introduction: Space launch vehicles and military missiles- function, types, role, mission, mission profile, thrust profile, propulsion system, payload, staging, control and guidance requirements, performance measures, design, construction, operation- similarities and differences. Materials used for launch vehicles & missiles and their selection criteria.

UNIT-II

Solid & Liquid Propellant Rocket Motor Systems: Solid propellant rocket motors, principal features, applications. Solid propellants, types, composition, properties, performance. Propellant grain, desirable properties, grain configuration, Liners, insulators and inhibitors- function, requirements, materials. Rocket motor casing- materials. Nozzles- types.

Liquid propellants- types, composition, properties, performance. Propellant tanks, feed systems- pressurisation, turbo-pumps- valves and feed lines, injectors, starting and ignition. Engine cooling, support structure. Control of engine starting and thrust build up.

UNIT-III

Aerodynamics of Rockets And Missiles: Classification of missiles. Airframe components of rockets and missiles, Forces acting on a missile while passing through atmosphere, method of describing aerodynamic forces and moments, lateral aerodynamic moment, lateral damping moment, longitudinal moment of a rocket, lift and drag forces, drag estimation, body upwash and downwash in missiles. Rocket dispersion, re-entry body design considerations.

UNIT-IV

Dynamics & Attitude Control of Rockets & Missiles: Tsiolskovsky's rocket equation- range in the absence of gravity, vertical motion in the earth's gravitational field, inclined motion, filght path at constant pitch angle, motion in the atmosphere, the gravity turn- the culmination altitude. Multi staging. Earth launch trajectories- vertical segment, the gravity turn, constant pitch trajectory, orbital injection.

Rocket thrust vector control-methods of thrust vector control for solid and liquid propulsion systems, thrust magnitude control, thrust termination; Stage

separation dynamics, separation techniques.

UNIT- V

Rocket Testing: Ground testing and flight testing- types of tests, test facilities and safeguards, monitoring and control of toxic materials, instrumentation and data management. Ground testing, flight testing, trajectory monitoring, post accident procedures. Description of a typical space launch vehicle launch procedure.

TEXT BOOKS

1. Sutton, G.P., and Biblarz, O., *Rocket Propulsion Elements*, 7th edition, Wiley-Interscience, 2000.
2. Turner, M.J.L., *Rocket and Spacecraft Propulsion*, Springer, 2001.

REFERENCES

1. Cornelisse, J.W., Schoyer H.F.R. and Wakker, K.F., *Rocket Propulsion and Space-flight Dynamics,* Pitman, 1979.
2. Chin, S.S., *Missile Configuration Design,* McGraw Hill, 1961.
3. Ball, K.J., Osborne, G.F., *Space Vehicle Dynamics*, Oxford University Press, 1967.
4. Parker, E.R., *Materials for Missiles and Spacecraft,* McGraw Hill, 1982.
5. Mouritz, A. and Bannister, M., *Introduction to Aerospace Materials*, CRC Press, 2010.

Outcome: The student shall be able to recognize various systems in launch vehicle & Missile technologies.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82133) WIND ENGINEERING AND INDUSTRIAL AERODYNAMICS (ELECTIVE- IV)

Aim:

The student will learn about the origin and nature of different types of Atmospheric winds from gentle breeze to destructive cyclones. He/she will gain insight into how Atmospheric wind affects civil structure, occasionally resulting in failure. He/she will also learn how Atmospheric wind is used to produce power and how Aerodynamics can be applied to improve performance of ground vehicles like cars, trucks etc.

UNIT- I

Atmospheric Winds & Atmospheric Boundary Layer: Causes of wind-thermal drive, Coriolis effect, pressure gradient effect. Geotrophic winds.

Land and sea breeze,mountain winds, thermals, cause of turbulence at ground level. Atmospheric boundary layer, velocity profile laws- effect of terrain on atmospheric boundary layer. Wind tunnels- basic features and components. Wind tunnel models- role of non-dimensional groups. Creation of atmospheric boundary layer type flow in a wind tunnel.

UNIT– II

Wind Energy: Ship propulsion- sails- lift and drag translators- modern yachts. Horizontal (HAWT) and vertical axis (VAWT) wind turbines- history, first example of automatic feedback control for yaw in 16th century English windmills, classification. Horizontal Axis Wind Turbine (HAWT —elementary actuator disc theory- Betz coefficient. Definition of Power coefficient & Torque coefficient for all wind turbines.

Working principle, power coefficients & tip speed ratio, explanation: by Introductory blade element theory — conventional Horizontal Axis Wind Turbine (HAWT), Savonious Vertical Axis Wind Turbine (VAWT) & Darrieus VAWT, Merits and demerits of HAWTs and VAWTs.

UNIT- III

Vehicle Aerodynamics: Relative importance of Rolling resistance and Aerodynamics resistance, Power requirements and drag coefficients of automobiles – notch front and notch rear windscreens versus streamlined shape, causes of vortex formation and drag— attached transverse vortex, trailing vortex, trailing vortex drag – effect of floor height on lift, effects of cut back angle, rear end taper: side panels and bottom. Effect of chamfering of edges and cambering of roof & side panels. Racing cars — ,traction, steering

grip and use of airfoils, high cornering speed. Commercial transport vehicles-drag reduction in buses, trucks; Driver cabin and trailer combinations.

UNIT– IV

Building Aerodynamics: Use of light-weight components in modern buildings, Pressure distribution on low-rise buildings, Wind forces on buildings— aerodynamics of flat plate and circular cylinder, Critical Reynolds No., Sub-, Super- & ultra-critical Reynolds No. Role of wind tunnel experiments in determining Shape Factors (Drag Coefficients) of building/ structure shapes such as circular cylinder (chimneys & towers), rectangle, D-shape, L-shape, H-shape etc. Vortex shedding & transverse oscillating loads. Slenderness ratio & correction factor. special problems of tall buildings, Interference effect of building.

UNIT– V

Flow Induced Vibrations: Classification — Vortex induced vibration & Flow induced instability such as Galloping & Stall flutter. Effects of Reynolds number on wake formation of bluff shapes. Vortex induced vibrations — Experimental determination of Strouhal numbers for different shapes such as circular cylinder, Square, rectangle, L-shape etc, Universal Strouhal No., Unsteady Bernoulli equation, Concept of added mass, Resonance, Fluid-structure interaction — effect of transverse cylinder motion on flow and wake, "Lock-in" of vortex shedding near resonant frequency, Experimental evidence of cylinder motion influencing flow and thereby reducing strength of shed vortices. Methods of suppression of vortex induced vibration.

Galloping & Stall Flutter — Motion of one degree-of-freedom, Quasi-steady flow assumption, aerodynamic damping, Galloping — force in the direction of plunging (transverse motion) and positive force coefficient,, Critical Speed, galloping of transmission wire with winter ice, Stall flutter of airfoils.

TEXT BOOKS

1. Blevins, R.D., Flow Induced Vibrations, Van Nostard, 1990.
2. Sachs. P., *Wind Forces in Engineering*, Pergamon Press, 1988.
3. Calvert, N.G., Wind Power Principles, Charles Griffin & Co., London, 1979.

REFERENCES

1. Scorer, R.S., *Environmental Aerodynamics,* Ellis Harwood Ltd, England, 1978.
2. Sovran, M., *Aerodynamics Drag Mechanisms of Bluff Bodies and Road Vehicles*, Plenum Press, N.Y., 1978.

Outcome: Students will be able to know different types of atmospheric winds and their effects on civil structures. Further will be able to apply to know how atmospheric wind is used to produce power and improve the performance of ground vehicle like cars, trucks etc .

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IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	4	**-/-/-**	**4**

(A82126) AEROELASTICITY

(Elective-IV)

Objectives: The course starts with basic definitions of aeroelastic problems. It is assumed that students are familiar with aircraft structures, structural dynamics and steady aerodynamics; therefore only necessary basics on these subjects are provided to help to formulate different static and dynamic aeroelastic problems.

UNIT – I

Introduction to Aeroelasticity : Collar's aeroelastic triangle, interaction of aerodynamic, structural and inertial forces, static aeroelasticity phenomena, dynamic aeroelasticity phenomena, aeroelastic problems at transonic speeds, aeroelastic tailoring, active flutter suppression.

UNIT - II

Structural Dynamic and Unsteady Aerodynamic Aspects: Generalized coordinates and generalized forces, Strain energy, kinetic energy and dissipation function, Lagrange's equations of motion, Formulations of structural dynamics equation, Hamilton's principle, and orthogonality conditions.

Small perturbation theory, Two-dimensional unsteady flow over wings, simple harmonic motion, Theodorsen's function, arbitrary motion and Wagner function, gust problem, Küssner function.

UNIT - III

Static Aeroelastic Problems: Static aeroelastic studies using strip theory - divergence, control effectiveness and control reversal; slender straight wing and swept wings, Static aeroelastic problems of low aspect ratio wings.

UNIT - IV

Dynamic Aeroelastic Phenomenon – Flutter Formulation of aeroelastic equations for a typical section, Torsion-flexure flutter – solution of flutter determinant, Method of determining the classical flutter speed using Theodorsen's and U-g methods, Modal aeroelastic equations including lifting surface theory, flutter analysis using k- and p-k methods, Flutter prevention and control,

UNIT - V

Dynamic Aeroelastic Response Gust and turbulence, Gust response in time domain – heave motion of rigid aircraft, heaving-pitching motion of rigid aircraft, flexible aircraft; General form of equations in the time domain,

Turbulence response in the frequency domain - rigid aircraft in heave, rigid aircraft in heave/pitch, flexible aircraft, General form of equations in the frequency domain, Representation of the flight control system (FCS).

TEXT BOOKS

1. Wright, J.R., and Cooper, J.E., Introduction to Aircraft Aeroelasticity and Loads, John Wiley and Sons Ltd, 2007.
2. Bisplinghoff, R. L., Ashley, H. and Halfman, R. L., *Aeroelasticity,* Addison-Wesley Publishing Company, Cambridge, Mass., 1955., Dover Pub., Inc., 1996, (BAH).
3. Fung, Y.C., An Introduction to the Theory of Aeroelasticity, Dover Publication, Inc., 1969.
4. Scanlan, R.H., and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, The MacMillan Co., 1962.
5. Dowell, E.H., (Editor), et al, A Modern Course in Aeroelasticity, Fourth Revised and Enlarged Edition, Kluwer Academic Publishers, 2004. (Advanced text).

REFERENCES

1. F?rsching, H.W., Grundlagen der Aeroelastik, Springer-Verlag, 1974. (Excellent book, written in German but easy to understand).
2. Bisplinghoff, R. L., and Ashley, H., *Principles of Aeroelasticity,* John Wiley and Sons, Inc., New York, N.Y., 1962. Also available in Dover Edition. (BA).
3. AGARD Manual on Aeroelasticity, Vols. I-VII, Beginning 1959 with continual updating. (AGARD).
4. Broadbent, E.G., *The Elementary Theory of Aeroelasticity,* Aircraft Engineering, 1954.
5. Abramson, H.N., An Introduction to the Dynamics of Airplanes, Ronald Press Co., 1958 (reprinted by Dover).

Outcome: At the end of this course students will be in a position to solve aeroelastic divergence, control effectiveness, control reversal, flutter and aeroelastic response problems using strip theory aerodynamics.

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IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	-	**-/-/-**	**2**

(A80087) INDUSTRY ORIENTED MINI PROJECT

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	-	**-/6/-**	**2**

(A80089) SEMINAR

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	-	**-/15/-**	**10**

(A80088) PROJECT WORK

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. AE-II Sem	**L**	**T/P/D**	**C**
	-	**-/-/-**	**2**

(A80090) COMPREHENSIVE VIVA