HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

Department of Aeronautical Engineering

B.Tech. Aero with specialization in Avionics

Curriculum & Syllabus

2014 Regulations

ACADEMIC REGULATIONS (B.Tech)
(Full /Part Time) (Effective 2014-15)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the Institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of Science, Humanities, Engineering, Technology and allied branches.

1.3 Aims and Objectives of the Institute are focused on

- Providing world class education in engineering, technology, applied sciences and management.
- Keeping pace with the ever changing technological scenario to help the students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1. The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the B.Tech programme will be decided by BOM as per the directives from MHRD, Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2. (i) Full-Time :

At the time of applying for admission, the candidates should have passed / appeared and be awaiting results of the final examination of the 10+2 system or its equivalent with Mathematics, Physics and Chemistry as subjects of study.

(ii) Part -Time:

At the time of applying for admission, the candidates should have a Diploma in Engineering/Technology in the relevant branch of specialization awarded by the State Board of Technical Education, Tamil Nadu or any other authority accepted by the Board of Management of the University as equivalent thereto and a minimum of one year practical experience.

2.3. The selected candidates will be admitted to the B.Tech. programme after he/she fulfills all the admission requirements set by the Institute and after the payment of the prescribed fees.

2.4. In all matters relating to admission to the B.E. / B.Tech. programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5. If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1. The programme of instruction will have the following structure:

i) A general (common) core programme comprising basic sciences, engineering sciences, humanities, technical arts and mathematics.

ii) An engineering core programme introducing the student to the foundations of engineering in the respective branch.

iii) An elective programme enabling the student to opt and undergo a set of courses of interest to him/ her.

iv) Professional practice including project, seminar and industrial training.

v) General elective courses, such as, Environmental Studies, Physical Education, Professional ethics, and National Service Scheme.

The distribution of total credits required for the degree programme into the above five categories will nominally be 20%, 50%, 15%, 5%, and 10% respectively.

3.2.(i) Full-Time:

The duration of the programme will be a minimum of 8 semesters. Every branch of the B.E. / B.Tech. programme will have a curriculum and syllabi for the courses approved by the Academic Council.

ii) Part – Time:

The duration of the programme will be a minimum of 7 semesters. Every branch of the B.Tech. programme will have a curriculum and syllabi for the courses approved by the Academic Council

3.3 The academic programmes of the Institute follow the credit system. The general pattern is:

- One credit for each lecture hour per week per semester;
- One credit for each tutorial hour per week per semester;
- Two credit for each laboratory practical/ drawing of three hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 4 hours of project per week per semester

3.4. (i) Full-Time:

For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits of 190-200.

(ii) Part-Time:

For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits of 110-120.

3.5. The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1. To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iv) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

6.2 GPA and CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of C_i for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from the first semester onwards.

6.3. For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	--

6.4 Raw marks will be moderated by a moderation board appointed by the Vice Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrolment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel and Library up to the end of the previous semester and (ii) he/she is not debarred from enrollment by a disciplinary action of the University.

7.3. Students are required to submit registration form duly filled in.

8. Registration requirement

8.1.(i). Full -Time:
A full time student shall not register for less than 16 credits or more than 30 credits in any given semester.

(ii). Part -Time:
A part time student shall not register for less than 10 credits or more than 20 credits in any given semester

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Continuation of the programme

9.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his/her parents regarding the shortage of his/her credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

10.1.(i) Full - Time
The normal duration of the programme is eight semesters. However a student may complete the programme at a slower pace by taking more time, but in any case not more than 14 semesters excluding the semesters withdrawn on medical grounds or other valid reasons.

(ii) Part - Time
The normal duration of the programme is seven semesters. However a student may complete the programme at a slower pace by taking more time,

but in any case not more than 12 semesters excluding the semesters withdrawn on medical grounds or other valid reasons

11. Temporary discontinuation

11.1. A student may be permitted by the Director (Academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1. Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2. Any act of indiscipline of a student reported to the Director (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on a suitable punishment if the charges are substantiated. The committee will also authorize the Director (Academic) to recommend to the Vice Chancellor the implementation of the decision. The student concerned may appeal to the Vice Chancellor whose decision will be final. The Director (Academic) will report the action taken at the next meeting of the Council.

12.3. Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1. A student whose attendance is less than 75% in a semester is not eligible to appear for the end – semester examination for that semester. The details of all students who have less than 75% attendance in a course will be announced by the teacher in the class. These details will be sent to the concerned HODs and Director (Academic).

13.2. Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However, a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3 As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer – in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director (Academic) within seven instructional days after the programme / activity.

14. Assessment Procedure

14.1. The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weigh - tage	Duration of Test / Exam
First Periodical Test *	10%	2 Periods
Second Periodical Test *	10%	2 Periods
Model Exam	20%	3 hours
Seminar/ Assignments/Quiz	10%	-
Attendance	10%	
End – semester examination	50%	3 Hours

*Best out of the two test will be considered.

14.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records – weightage 60%.
(ii) End semester examination of 3 hours duration including viva – weightage 40%.

14.4 For courses on Physical Education, NSS, etc the assessment will be as satisfactory/not satisfactory only.

15. Make up Examination/Model Exam

15.1. Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2. Permission to appear for make-up examination / model examination will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10 %
Second Review	20 %
Third Review	20 %
End-semester Examination	50 %

For end – semester examination, the student will submit a Project Report in a format specified by the Director (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end – semester examination will be conducted by a Committee constituted by the Registrar / Controller of examination. This will include an external expert.

17. Declaration of results

17.1.(i) A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

(ii) To be Eligible to appear for the end semester examinations for a particular course, a candidate will have to secure a minimum of 40% marks in the sessional for that course.

(iii) Candidates are required to obtain all credits assigned to the first two semesters of the programme within the first four semesters of the programme. Candidates failing to satisfy this requirement will not be allowed to proceed to the fifth semester until the condition is satisfied. Further, candidates will not be allowed to proceed to seventh semester if they have not cleared all the courses assigned during third & fourth semesters.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of UG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, and wishes to improve on his/her sessional marks, he/she will have to register for the particular course and attend the course with permission of the HOD concerned and Director(Academic) with a copy marked to the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 After ten semesters, the sessional marks of the candidate will not be considered for a pass in a course. A candidate who secures 50% in the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

18. Grade Card

18.1 After results are declared, grade sheet will be issued to each student which will contain the following details:

(i) Program and branch for which the student has enrolled.
(ii) Semester of registration.
(iii) List of courses registered during the semester and the grade scored.
(iv) Semester Grade Point Average (GPA)
(v) Cumulative Grade Point Average (CGPA).

19. Class/Division

19.1 Classification is based on CGPA and is as follows:

CGPA ≥ 8.0 : **First Class with distinction**
6.5 ≤ CGPA < 8.0 : **First Class**
5.0 ≤ CGPA < 6.5 : **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses **within 10 semesters.**

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1. Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so consulted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

20.2 The Academic Council may also approve admission of lateral entry (who hold a diploma in Engineering/ technology) candidates with advance credit based on the recommendation of the transfer of credits committee on a case to case basis.

21. Eligibility for the award of B.Tech. Degree

21.1. A student will be declared to be eligible for the award of the B.Tech. Degree if he/she has

i) registered and successfully acquired the credits for the core courses;
ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time;
iii) has no dues to all sections of the Institute including Hostels, and
iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Change of Branch

22.1 If the number of students in any branch of B.Tech. class as on the last instructional day of the First Semester is less than the sanctioned strength, then the vacancies in the said branches can be filled by transferring students from other branches. All such transfers will be allowed on the basis of merit of the students. The decision of the Chancellor shall be final while considering such requests.

22.2 All students who have successfully completed the first semester of the course will be eligible for consideration for change of branch subject to the availability of vacancies.

23. Power to modify

23.1. Notwithstanding all that has been stated above, the Academic Council shall modify any of the above regulations from time to time subject to approval by the Board of Management.

SCHOOL OF AERONAUTICAL ENGINEERING

Semester I

(Common to all Branches)

Sl.No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	EL 1101	Technical English	3	0	0	3	3
2.	MA 1101	Engineering Mathematics-I	3	1	0	4	4
3.	PH 1001/ CY 1001	Engineering Physics / Engineering Chemistry *	3	0	0	3	3
4.	ME 1101	Engineering Graphics	1	0	3	3	4
5.	CS 1101	Computer Programming	3	0	0	3	3
PRACTICAL							
1.	CS 1131	Computer Programming Laboratory	0	0	3	2	3
2	GE 1131	Engineering Practices Laboratory-I	0	0	3	2	3
3.	EL 2131	Communication Skills Laboratory I	0	0	3	2	3
4	PH 2031/ CY 2031	Physics Laboratory / Chemistry Laboratory *****	1	0	3	3	4
		Total				**25**	**30**

*** Depending upon the number of batches, it will be alternated between Semesters 1 & 2**

Semester –II

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
THEORY							
1	EL 2231	Communication Skills	3	1	0	4	4
2	MA 2201	Engineering mathematics-II	3	1	0	4	4
3	PH 2001 / CY 2001	Engineering Physics / Engineering Chemistry	3	0	0	3	3
4	AE 2201	Elements of Aeronautics	3	1	0	4	4
5	AE 2202	Engineering Mechanics	3	1	0	4	4
6	EL 2205	Basic Electrical & Electronics Engineering	3	0	0	3	3
PRACTICAL							
1	PH 2031	Physics Laboratory	1	0	3	**3**	4
2	EL 2231	Communication skills laboratory-II #	2	0	2	3	4
3	GE 2231	Engineering Practices Laboratory-II #	0	0	3	2	3
4	EE 2236	Electrical & Electronics Laboratory	0	0	3	2	3
Total						**28**	**32**

**** Common to** Automobile, Aeronautical, Electronics & Instrumentation, Mechanical Engineering

Semester – III

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
THEORY							
1	MA 2301	Engineering Mathematics III *	3	1	0	4	4
2	AE 2301	Solid Mechanics	3	0	0	3	3
3	AE 2302	Aero Engineering Thermodynamics	3	1	0	4	4
4	AE 2303	Fluid Mechanics and Machinery	3	1	0	4	4
5	AE 2304	Aircraft Materials	3	0	0	3	3
PRACTICAL							
1	AE 2331	Strength of Materials Lab	0	0	3	2	3
2	AE 2332	Fluid Mechanics and Machinery Lab	0	0	3	2	3
3	AE 2333	Design & Drafting Laboratory	0	0	3	2	3
4	AE 2334	Thermodynamics Lab	0	0	3	2	3
Total						**26**	**30**

***Common to** Automobile, Aeronautical, Mechanical Engineering

semester – IV

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
THEORY							
1	MA 2401	Numerical Methods*	3	1	0	4	4
2	AE 2401	Aircraft Systems & Instruments	3	0	0	3	3
3	AE 2402	Mechanics of Machines	3	1	0	4	4
4	AE 2403	Aircraft Structure-I	3	1	0	4	4
5	AE 2404	Aerodynamics-I	3	1	0	4	4
PRACTICAL							
1	AE 2431	Computer Aided Design and Modelling Lab	0	0	3	2	3
2	AE 2432	Aircraft Structures Laboratory	0	0	3	2	3
3	AE 2433	Aerodynamics Laboratory	0	0	3	2	3
4	AE 2434	Project Work	0	0	6	2	6
Total						**27**	**34**

***** Common to Aeronautical, Civil, Mechanical Engineering

Semester – V

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
THEORY							
1	EC 2512	Micro processor & Applications	3	0	0	3	3
2	AE 2501	Propulsion-I	3	1	0	4	4
3	AE 2502	Aerodynamics-II	3	1	0	4	4
4	AE 2503	Aircraft Structure-II	3	1	0	4	4
5		Elective –I	3	0	0	3	3
6		Elective-II	3	0	0	3	3
PRACTICAL							
1	AE 2531	Propulsion Laboratory	0	0	3	2	3
2	AE 2532	Aircraft Structural Repair Laboratory	0	0	3	2	3
Total						**25**	**27**

Semester – VI

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
THEORY							
1	AE 2601	Flight Dynamics	3	1	0	4	4
2	AE 2602	Control Engineering	3	1	0	4	4
3	AE 2603	Experimental Stress Analysis	3	0	0	3	4
4	AE 2604	Propulsion –II	3	1	0	4	4
5		Elective-III	3	0	0	3	3
6		Elective - IV	3	0	0	3	3
PRACTICAL							
1	AE 2631	Aircraft Design Project	0	0	3	2	3
2	AE 2632	Aircraft Systems Laboratory	0	0	3	2	3
3	EL 2431	Communication skills and Personality Development	2	0	2	3	4
Total						**25**	**29**

Semester – VII

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
THEORY							
1	AE 2701	Heat transfer	3	1	0	4	4
2	AE 2702	Composite Materials and Structures	3	1	0	4	4
3		Elective –V	3	1	0	4	4
4		Elective -VI	3	0	0	3	3
5		Elective -VII	3	1	0	4	4
6		Elective-VIII	3	0	0	3	3
PRACTICAL							
1	AE 2731	Avionics Laboratory	0	0	3	2	3
2	AE 2732	Aero Engine Repair And Maintenance Laboratory	0	0	3	2	3
Total						**26**	**28**

Semester – VIII

Sl. No.	Course Code	Course Title	L	T	P	Credit	TCH
PRACTICAL							
1	AE 2831	Project & Viva-voce	0	0	24	6	24
Total						**9**	**27**

TOTAL CREDITS = 194

SEMESTER - I

EL 2101	TECHNICAL ENGLISH	L T P C 3 0 0 3
Goal	The goal of the programme is to provide a theoretical input towards nurturing accomplished learners who can function effectively in the English language skills; to cultivate in them the ability to indulge in rational thinking, independent decision-making and lifelong learning; to help them become responsible members or leaders of the society in and around their workplace or living space; to communicate successfully at the individual or group level on engineering activities with the engineering community in particular, and on multi-disciplinary activities in general, with the world at large.	

Objectives	**Outcome**
1. To widen the capacity of the learners to listen to English language at the basic level and understand its meaning. 2. To enable learners to communicate in an intelligible English accent and pronunciation. 3. To assist the learners in reading and grasping a passage in English. 4. To learn the art of writing simple English with correct spelling, grammar and punctuation. 5. To **c**ultivate the ability of the learners to think and indulge in divergent and lateral thoughts.	1. The learners will have the self-confidence to improve upon their informative listening skills by an enhanced acquisition of the English language. **2.** The learners will be able to speak English at the formal and informal levels and use itfor daily conversation, presentation, group discussion and debate. 3. The learners will be able to read, comprehend and answer questions based on literary, scientific and technological texts. 4. The learners will be able to write instructions, recommendations, checklists, process-description, letter-writing and report writing. **5.** The learners will have the confidence to develop thinking skills and participate in brainstorming, mind-mapping, audiovisual activities, creative thinking and also answer tests in the job-selection processes.

Unit I: Listening Skill **9**

Topics: Listening to the sounds, silent letters & stress in English words & sentences – Listening to conversation & telephonic conversation -- Listening for general meaning & specific information -- Listening for positive & negative comments – Listening to technical topics – Listening to prose & poetry reading -- Listening exercises.

Embedded language learning: Sentence definition -- Spelling & punctuation -- Imperative form – Sequencing of sentences -- Gerunds -- Infinitives -- 'Wh-'questions.

Unit II: Speaking Skill **9**

Topics: Self-introduction – Expressing personal opinion – Dialogue – Conversation – Simple oral interaction -- Speaking on a topic -- Expressing views for & against -- Speaking on personal topics like hobbies, topics of interest, present & past experiences, future plans – Participating in group discussions, role plays, debates, presentations, power-point presentations & job-interviews.

Embedded language learning: Adverbs –Adjectives – Comparative and Numerical adjectives -- Nouns & compound nouns -- Prefixes and suffixes.

Unit III: Reading Skill **9**

Topics: Reading anecdotes, short stories, poems, parts of a novel, notices, message, time tables, advertisements, leaflets, itinerary, content page – Reading pie chart & bar chart -- Skimming and scanning -- Reading for contextual meaning – Scanning for specific information -- Reading newspaper & magazine articles – Critical reading -- Reading-comprehension exercises.

Embedded language learning: Tenses – Active and passive voice -- Impersonal passive -- Words and their function -- Different grammatical forms of the same word.

Unit IV: Writing Skill **9**

Topics: Writing emails, notes, messages, memos, notices, agendas, advertisements, leaflets, brochures, instructions, recommendations & checklists -- Writing paragraphs -- Comparisons & contrasts – Process description of Flow charts – Interpretation of Bar charts & Pie charts – Writing the minutes of a meeting -- Report writing -- Industrial accident reports -- Letter-writing -- Letter to the editors – Letter inviting & accepting or declining the invitation – Placing orders – Complaints -- Letter requesting permission for industrial visits or implant training, enclosing an introduction to the educational institution -- Letters of application for a job, enclosing a CV or Resume – Covering letter.

Embedded language learning: Correction of errors – Subject-verb Concord -- Articles – Prepositions -- Direct and indirect speech.

Unit V: Thinking Skill **9**

Topics: Eliciting & imparting the knowledge of English using thinking blocks – Developing thinking skills along with critical interpretation side by side with the acquisition of English -- Decoding diagrams & pictorial representations into English words, expressions, idioms and proverbs.

Embedded language learning: General vocabulary -- Using expressions of cause and effect -- Comparison & contrast -- If-conditionals -- Expressions ofpurpose and means.

TOTAL=45

Reference Books

1. Norman Whitby. *Business Benchmark: Pre-Intermediate to Intermediate* – BEC Preliminary. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).
2. Norman Whitby. *Business Benchmark: Pre-Intermediate to Intermediate* – Preliminary—Personal Study Book. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).
3. *Cambridge BEC Preliminary: Self-study Edition* – Practice Tests. New Delhi: Cambridge University Press, 2008 or latest South Asian edition.
4. Devaki Reddy & Shreesh Chaudhary. *Technical English***.** New Delhi: Macmillan, 2009.
5. Rutherford, Andrea J. *Basic Communication Skills for Technology*. 2nd edition. New Delhi: Pearson Education, 2006.

MA2101	ENGINEERING MATHEMATICS - I	L T P C 3 1 0 4
Goal	To create the awareness and comprehensive knowledge in engineering mathematics.	

Objectives	Outcome
The course should enable the students to:	The students should be able to:
• Find the inverse of the matrix by using Cayley Hamilton Theorem and Diagonalisation of matrix using transformation.	• Identify Eigen value problems from practical areas and obtain its solutions and using transformation diagonalising the matrix which would render Eigen values.
• Understand the Evolutes and Envelope of the curve.	• Find out effectively the geometrical aspects of curvature and appreciates mathematical skills in constructing evolutes and envelopes in mechanics and engineering drawing.
	• Recognize and to model mathematically and solving, the differential equations arising in science and engineering.
• Learn the solutions of second order linear differential equations of standard types and Legendre's linear differential equation.	• Understand and model the practical problems and solve it using maxima and minima as elegant applications of partial differentiation.
• Learn partial differentiations involving two and three variables and expansions of functions using Taylor series.	• Acquire skills in using trigonometric and hyperbolic and inverse hyperbolic functions.
• Learn the expansions of trigonometric, hyperbolic functions and their relations.	

UNIT I MATRICES 12

Review: Basic concepts of matrices-addition, subtraction, multiplication of matrices – adjoint –inverse – solving cubic equations.

Characteristic equation – Properties of Eigen values – Eigen values and Eigen vectors –Cayley Hamilton theorem (without proof) – Verification and inverse using Cayley Hamilton theorem.Diagonalisation of matrices – Orthogonal matrices– Quadratic form – Reduction of symmetric matrices to a Canonical form using orthogonal transformation – Nature of quadratic form.

UNIT II DIFFERENTIAL CALCULUS 12

Review: Basic concepts of differentiation – function of function, product and quotient rules.

Methods of differentiation of functions - Cartesian form – Parametric form – Curvature – Radius of curvature – Centre of curvature – Circle of curvature. Evolutes of parabola, circle, ellipse, hyperbola and cycloid –Envelope.

III ORDINARY DIFFERENTIAL EQUATIONS 12

Review: Definition, formation and solutions of differential equations.

Second order differential equations with constant coefficients – Particular integrals – e^{ax}, $Sinax (or) Cosax, x^m$, e^{ax}Cosbx, e^{ax}Sinbx. Euler's homogeneous linear differential equations – Legendre's linear differential equation - Variation of parameters.

UNIT IV PARTIAL DIFFERENTIATION 12

Partial differentiation – differentiation involving two and three variables – Total differentiation –Simple problems. Jacobian – verification of properties of Jacobians – Simple problems. Taylor's series – Maxima and minima of functions of two and three variables.

UNIT V TRIGONOMETRY 12

Review: Basic results in trigonometry and complex numbers - De Moivre's theorem.Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ where n is apositive integer. Expansions of $\sin^m \theta$, $\cos^n \theta$, $\sin^m \theta \cos^n \theta$ interms of sines and cosines of multiples of θ where m and n are positive integers.Hyperbolic and inverse hyperbolic functions – Logarithms of complex numbers – Separation of complex functions into real and imaginary parts – Simple problems.

Note: Questions need not be asked from review part.

TOTAL: 60

TEXT BOOKS

1. Erwin Kreyzig, *A Text book of Engineering Mathematics*, John Wiley, 1999.
2. Grewal B.S, *Higher Engineering Mathematics,* Thirty Eighth Editions, Khanna Publisher, Delhi, 2004.
3. Chandrasekaran A, *A Text book of Engineering Mathematics I,* Dhanam Publications, Chennai, 2010.

REFERENCES

1. Venkataraman M.K, *Engineering Mathematics, Volume I*, The National Publishing Company, Chennai, 1985.
2. Kandaswamy P, Thilagavathy K and Gunavath K, *Engineering Mathematics, Volume I & II*, S.Chand and Company, New Delhi, 2005.
3. Bali N.P, Narayana Iyengar. N.Ch., *Engineering Mathematics*, Laxmi Publications Pvt. Ltd, New Delhi, 2003.
4. Veerarajan T, *Engineering Mathematics (*for first year), Fourth Edition,Tata McGraw – Hill Publishing Company Limited, New Delhi, 2005.

PH2001	ENGINEERING PHYSICS	L T P C 3 0 0 3
Goal	To impart fundamental knowledge in various fields of Physics and its applications.	
OBJECTIVES	**OUTCOMES**	
➢ To develop strong fundamentals of properties and behavior of the materials ➢ To enhance theoretical and modern technological aspects in acoustics and ultrasonics. ➢ To enable the students to correlate the theoretical principles with application oriented study of optics. ➢ To provide a strong foundation in the understanding of solids and materials testing. ➢ To enrich the knowledge of students in modern engineering materials.	The student will ➢ Be able to understand the properties and behaviour of materials. ➢ Have a fundamental knowledge of acoustics which would facilitate in acoustical design of buildings and on ultrasonics and be able to employ it as an engineering tool. ➢ Understand the concept, working and application of lasers and fiber optics. ➢ Know the fundamentals of crystal physics and non destructive testing methods. ➢ Have an understanding of the production, characteristics and application of the new engineering materials. This would aid them in the material selection stage.	

UNIT I – PROPERTIES OF MATTER 9

Elasticity – types of moduli of elasticity – Stress-Strain diagram – Young's modulus of elasticity – Rigidity modulus – Bulk modulus – Factors affecting elasticity – twisting couple on a wire – Torsional pendulum – determination of rigidity modulus of a wire – depression of a cantilever – Young's modulus by cantilever – uniform and non-uniform bending - viscosity – Ostwald's viscometer – comparison of viscosities.

UNIT II – ACOUSTICS AND ULTRASONICS 9

Classification of sound – characteristics of musical sound – intensity - loudness – Weber Fechner law – Decibel – Reverberation – Reverberation time, derivation of Sabine's formula for reverberation time(Jaeger's method) – absorption coefficient and its determination – factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies. Ultrasonics - production – Magnetostriction and Piezoelectric methods – properties – applications of ultrasonics with particular reference to detection of flaws in metal (Non – Destructive testing NDT) – SONAR.

UNIT III - LASER AND FIBRE OPTICS 9

Principle of lasers – Stimulated absorption – Spontaneous emission, stimulated emission – population inversion – pumping action – active medium – laser characteristics – Nd-Yag laser – CO_2 laser – Semiconductor laser – applications - optical fiber – principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – types of optical fibers – single and multimode, step index and graded index fibers – applications – fiber optic communication system.

UNIT IV – CRYSTAL PHYSICS AND NON- DESTRUCTIVE TESTING 9

Crystal Physics: Lattice – Unit cell - Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – coordination number – Packing factor for SC, BCC, FCC and HCP structures.

Non Destructive Testing: Liquid penetrate method – Ultrasonic flaw detection – ultrasonic flaw detector (block diagram) – X-ray Radiography – Merits and Demerits of each method.

UNIT V –MODERN ENGINEERING MATERIALS AND SUPERCONDUCTING MATERIALS 9

Modern Engineering Materials: Metallic glasses: Preparation properties and applications. Shape memory alloys (SMA): Characteristics, applications, advantages and disadvantages of SMA. Nano Materials: Synthesis –Properties and applications.

Superconducting Materials: Superconducting phenomena – Properties of superconductors – Meissner effect – Type I and Type II superconductors – High Tc superconductors (qualitative) – uses of superconductors.

TOTAL = 45

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L., "*Engineering Physics* ", 8th edition, Dhanpat rai publications (P) Ltd., New Delhi 2010.
2. P.Mani, "*Engineering Physics* ", Vol-I, Dhanam Publications, Chennai 2011.
3. Rajendran V. an Marikani A., "*Applied Physics for engineers*" , 3rd edition, Tata Mc Graw –Hill publishing company Ltd., New Delhi,2003.

REFERENCES:

1. Uma Mukherji, "*Engineering Physics* ", Narosa publishing house, New Delhi, 2003.
2. Arumugam M., "*Engineering Physics* ", Anuradha agencies, 2007.
3. Palanisamy P.K., "*Engineering Physics* ", SciTech Publications, Chennai 2007.
4. Arthur Beiser, "*Concepts of Modern Physics",* Tata Mc Graw –Hill Publications, 2007.
5. P.Charles, Poople and Frank J. Owens, "Introduction to Nanotechnology", Wiley India, 2007

CY2001	ENGINEERING CHEMISTRY	L T P C 3 0 0 3
Goal	To impart basic principles of chemistry for engineers.	
OBJECTIVES	OUTCOME	
The objective of the course is • To make the students conversant with the basics of (a) Water technology and (b) Polymer science	Upon successful completion of the course, the utcomes are as follows: • The students will gain basic knowledge in water analysis and suitable water treatment method. • The study of polymer chemistry will give an idea on the type of polymers to be used in engineering applications.	
• To provide knowledge on the requirements and properties of a few important engineering materials.	• Exposure of the students to the common engineering materials will create awareness among the students to search for new materials.	
• To educate the students on the fundamentals of corrosion and its control.	• Knowledge on the effects of corrosion and protection methods will help the young minds to choose proper metal / alloys and also to create a design that has good corrosion control.	
• To give a sound knowledge on the basics of a few significant terminologies and concepts in thermodynamics.	• Students with good exposure on the important aspects of basic thermodynamics will be able to understand the advanced level thermodynamics in engineering applications.	
• To create an awareness among the present generation about the various conventional energy sources.	• A good background on the various aspects of energy sources will create awareness on the need to utilize the fuel sources effectively and also for exploring new alternate energy resources.	

UNIT I: WATER TECHNOLOGY AND POLYMER CHEMISTRY 9

Hardness (Definition, Types, Units) – problems - Estimation of Hardness (EDTA Method) – Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment- Desalination - Reverse Osmosis.

Classification of Polymers - PVC, Bakelite - preparation, properties and applications - Effect of Polymer Structure on Properties - Compounding of Plastics- Polymer Blends and Polymer Alloys – Definition, Examples.

UNIT II: ENGINEERING MATERIALS 9

Properties of Alloys – Heat Treatment of Steel – Polymer Composites – types and applications.- Lubricants – Classification, properties and applications - Mechanism of Lubrication – MoS_2 And Graphite – Adhesives – classification and properties – Epoxy resin (Preparation, properties and applications) – Refractories – Classification, Properties and General Manufacture – Abrasives – Classification , Properties and Uses – Carbon nano tubes – preparation, properties and applications.

UNIT III: ELECTROCHEMISTRY AND CORROSION 9

Conductometric Titration – HCl vs NaOH and mixture of acids vs NaOH - Electrochemical Series and its applications - Nernst Equation – problems - Polarization, Decomposition Potential, Over-voltage (definitions only) - Galvanic series -Corrosion (Definition, Examples, effects) – Mechanism of Dry Corrosion and Wet Corrosion – Differential aeration Corrosion , examples – Factors Influencing Corrosion – Metal and Environment – Corrosion Control – Design –Cathodic Protection methods – Protective Coatings – Galvanising - Anodising – Electroplating (Cu and Ni) and Electroless plating (Cu and Ni) – Constituents of Paints and varnish.

UNIT IV: CHEMICAL THERMODYNAMICS 9

Thermodynamic terminology- First Law of Thermodynamics-Internal energy- enthalpy - heat capacity – work done in isothermal expansion of an ideal gas –problems - second law of thermodynamics – entropy change – phase transformations and entropy change – problems - Work Function &Free Energy Function- Maxwell's Relations-Gibbs Helmholtz equation- van't Hoff Isotherm- van't Hoff Isochore – Problems.

UNIT V: FUELS ANDENERGY SOURCES 9

Fuels – classification - Calorific Value – Dulong's Formula – Problems - Determination of Calorific Value by Bomb Calorimeter – Coal – Proximate Analysis – problems - Octane Number – Cetane Number – Diesel Index (Definitions only) – Bio Gas – Producer Gas –Water Gas – Preparation, Properties and Uses – Batteries – Primary Cells – Leclanche Cell –Secondary Cell – Nickel Cadmium Battery – Fuel Cells – Hydrogen –Oxygen Fuel Cell – Solar Battery – Lead Acid Storage Cell – Nuclear Energy – Light water nuclear power plant.

Total 45

Text Books

1.S. S. Dara, *Text Book of Engineering Chemistry*, S. Chand &Company Ltd., New Delhi, 2003

2. Murthy, Agarwal &Naidu, *Text Book of Engineering Chemistry*, BSP, 2003.

3. S.Sumathi, *Engineering Chemistry*, Dhanam Publications, 2008.

4.S.Sumathi and P.S.Raghavan, *Engineering Chemistry II*, Dhanam Publications, 2008.

References

1. B. K. Sharma, *Engineering chemistry*, Krishna Prakasam Media (P) Ltd., 2003

2. A 1. Vogel, *A text book of Qualitative Inorganic Analysis*, ELBS, London, 2004

3. A. Gowarikar, *Text Book of Polymer Science*, 2002

4. Kuriacose &Rajaram, Vols. 1 &2, *Chemistry in Engineering and Technology*, 2004

5. Puri, Sharma and Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co. Jalandar, 2004.

ME 2101	ENGINEERING GRAPHICS	L T P C 1 3 3 4
Goal	To develop graphical skills for communicating concepts, ideas and designs of engineering products and to give exposure to national standards relating to technical drawings.	

Objectives	Outcome
The course should enable the students to 1. Introduce drawing standards and use of drawing instruments. 2. Introduce first angle projection. 3. Practice of engineering hand sketching and introduce to computer aided drafting 4. Familiarize the students with different type of projections. 5. Introduce the process of design from sketching to parametric 3D CAD and 2D orthographic drawings to BIS	The students should be able to 1. Develop Parametric design and the conventions of formal engineering drawing 2. Produce and interpret 2D & 3D drawings 3. Communicate a design idea/concept graphically 4. Examine a design critically and with understanding of CAD – The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software. 5. Get a Detailed study of an engineering artifact

Note: Only first angle projection is to be followed

BASICS OF ENGINEERING GRAPHICS **2**

Importance of graphics Use of drawing instruments - BIS conventions and specifications – drawing sheet sizes, layout and folding - lettering - Dimensioning - Geometrical constructions - Scales. Construction of curves like ellipse, parabola, cycloids and involutes.

UNIT I PROJECTION OF POINTS, LINES AND SURFACES **15**

General principles of presentation of technical drawings as per BIS - Introduction to Orthographic projection - Naming views as per BIS - First angle projection. Projection of points. Projection of straight lines located in first quadrant (using rotating line method only). Projection of plane surfaces like polygonal lamina and circular lamina. Drawing views when the surface of the lamina is inclined to one reference plane.

UNIT II PROJECTION OF SOLIDS **10**

Projections of simple solids like prism, pyramid, cylinder and cone - Drawing views when the axis of the solid is inclined to one reference plane.

UNIT III DEVELOPMENT OF SURFACES **10**

Introduction to sectioning of solids. Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

UNIT IV ORTHOGRAPHIC PROJECTIONS 10

Orthographic projections - Conversion of orthographic views from given pictorial views of objects, including dimensioning. Free hand sketching of Orthographic views from Pictorial views.

UNIT V PICTORIAL PROJECTIONS 10

Isometric projection - Isometric scale - Isometric views of simple solids like prisms, pyramids, cylinders and cones. Introduction to perspective Projections.

COMPUTER AIDED DRAFTING (Demonstration Only) 3

Introduction to computer aided drafting and dimensioning using appropriate software. 2D drawing commands Zoom, Picture editing commands, Dimensioning, Isometric drawing, Iso-Planes and 3D drafting. Plotting of drawing. Practice includes drawing the projection of lines and solids. Prepare isometric view of simple solids like prisms, pyramids, cylinders and cones.

T**OTAL : 60**

TEXT BOOKS:

1. Jeyapoovan T, "*Engineering Drawing and Graphics Using AutoCAD*", Vikas Publishing House Pvt. Ltd., New Delhi, 2010.

2. Warren J. Luzadder and Jon. M.Duff, "*Fundamentals of Engineering Drawing*", Prentice Hall of India Pvt. Ltd., Eleventh Edition, 2003.

REFERENCE BOOKS

1. Bhatt N.D and Panchal V.M, *"Engineering Drawing: Plane and Solid Geometry*", Charotar Publishing House, Anand-3001, 2007.

2. Thomas E. French, Charles J.Vierck and Robert J.Foster, " Engineering *Drawing and Graphic Technology,* McGraw- Hill Book company 13th Edition.1987.

3. Venugopal K., "*Engineering Graphics*", New Age International (P) Limited, New Delhi, 2008.

CS2101	COMPUTER PROGRAMMING	L T P C 0 0 3 2
Goal	To introduce computers and programming and to produce an awareness of the power of computational techniques that are currently used by engineers and scientists and to develop programming skills to a level such that problems of reasonable complexity can be tackled successfully.	

Objectives	Outcome
The course should enable the students to: (i) Learn the major components of a Computer system. (ii) Learn the problem solving techniques. (iii) Develop skills in programming using C language.	The student should be able to: (i) Understand the interaction between different components of Computer system and number system. (ii) Devise computational strategies for developing applications. (iii) Develop applications (Simple to Complex) using C programming language.

UNIT - I COMPUTER FUNDAMENTALS 9

Introduction – Evolution of Computers – Generations of Computer – Classification of Computers – Application of Computers - Components of a Computer System – Hardware - Software - Starting a Computer (Booting) – Number Systems.

UNIT- II COMPUTER PROGRMMING AND LANGUAGES 9

Introduction - Problem-Solving Techniques: Algorithms, Flowchart, Pseudocode - Program Control Structures – Programming Paradigms – Programming languages – Generations of Programming Languages – Language Translators – Features of a Good ProgrammingLanguages.

UNIT - III PROGRAMMING WITH C 9

Introduction to C - The C Declaration - Operators and Expressions – Input and Output in C – Decision Statements – Loop Control Statements.

UNIT- IV FUNCTIONS, ARRAYS AND STRINGS 9

Functions – Storage Class – Arrays – Working with strings and standard functions.

UNIT - V POINTERS, STRUCTURES AND UNION 9

Pointers – Dynamic Memory allocation – Structure and Union – Files.

TOTAL = 45

TEXT BOOK:

1. ITL Education Solution Limited, Ashok Kamthane, “Computer Programming”, Pearson Education Inc 2007 (Unit: I to V).

REFERNCES:

1. Byron S. Gottfried, “Programming with C”, Second Edition, Tata McGraw Hill 2006.
2. Yashvant Kanetkar, “Let us C”, Eighth edition, BPP publication 2007.
3. Stephen G.Kochan, “Programming in C - A Complete introduction to the C programming language” , Pearson Education, 2008.
4. T.JeyaPoovan, “Computer Programming Theory and Practice”, Vikas Pub, New Delhi.

CS2131	COMPUTER PROGRAMMING LABORATORY	2 CREDITS
Goal	To provide an awareness to develop the programming skills using computer languages.	

Objectives	Outcome
The course should enable the students to: (i) To gain knowledge about Microsoft office, Spread Sheet. (ii)To learn a programming concept in C. .	The student should be able to: (i) Use MS Word to create document, table, text formatting and Mail merge options. (ii) Use Excel for small calculations using formula editor, creating different types of charts and including pictures etc, (iii) Write and execute the C programs for small applications.

LIST OF EXPERIMENTS:

a) Word Processing 15

1. Document creation, Text manipulation with Scientific notations
2. Table creation, Table formatting and Conversion
3. Mail merge and Letter preparation
4. Drawing - flow Chart

b) Spread Sheet 15

5. Chart - Line, XY, Bar and Pie
6. Formula - formula editor
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document

c) Programming in C :

8. To write a C program to prepare the electricity bill
9. Functions:

(a) Call by value (b) Call by reference

10.To write a C program to print the Fibonacci series for the given number
11.To write a C program to find the factorial of number using recursion
12.To write a C program to implement the basic arithmetic operations using Switch Case Statement
13.To write a C program to check whether the given number is an Armstrong number
14.To write a C program to check whether the given string is a Palindrome
15.To write a C program to create students details using Structures
16. To write a C program to demonstrate the Command Line Arguments
17.To write a C program to implement the Random Access in Files
18.To write C programs to solve some of the Engineering applications

TOTAL = 45

GE 2131	ENGINEERING PRACTICE LABORATORY – I (common to all branches)	L T P C 0 0 3 2
Goal	To provide the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.	

Objectives	Outcomes
The course should enable the students to 1. Relate theory and practice of basic Civil and Mechanical Engineering 2. Learn concepts of welding and machining practice 3. Learn concepts of plumbing and carpentry practice	The students should be able to 1. Indentify and use of tools, Types of joints used in welding, carpentry and plumbing operations. 2. Have hands on experience on basic fabrication techniques such as carpentry and plumbing practices. 3. Have hands on experience on basic fabrication techniques of different types of welding and basic machining practices.

LIST OF EXPERIMENTS

1. Mechanical Engineering

1. Welding

Arc welding - butt joints, lap joints and T joints.

2. Basic Machining

Facing, Turning, Threading and Drilling practice.

3. Machine assembly practice

Study of centrifugal pump

4. Study on

a. Smithy operations- Production of hexagonal headed bolt.

b. Foundry operations – mould preparation for gear and step cone pulley.

2. Civil Engineering

1. Basic pipe connection using valves, couplings, unions, reducers, elbows in household fitting.
2. Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.
3. Wood work: Sawing, Planning and making common joints.
4. Study of joints in door panels, wooden furniture.

Text Book:

T. Jeyapoovan, M.Saravanapandian and S. Pranitha, "*Engineering Practices Lab Manual*", 3rd Edition 2006, Vikas Publishing house (P) Ltd., New Delhi.

EL2131	COMMUNICATION SKILLS LABORATORY 1	L T P C 0 0 3 2
Goal	The goal of the programme is to provide **a practical input** towards nurturing accomplished learners who can function effectively in the English language skills.	

Objectives	Outcomes
1. To extend the ability of the learners to be able to listen to English and comprehend its message. 2. To enable the learners to have a functional knowledge of spoken English. 3. To assist the learners to read and grasp the meaning of technical and non-technical passages in English. 4. To help the learners develop threat of writing without mistakes. 5. To expand the thinking capability of the learners so that they would learn how to view things from a different angle.	1. The learners will be able to listen to and evaluate English without difficulty and comprehend its message. 2. The learners would have developed a functional knowledge of spoken English so as to use it in the institution and at job interviews. 3. The learners will be able to read and comprehend the meaning of technical and non-technical passages in English. 4. The learners will have developed theart of writing so as to put down their thoughts and feelings in words. 5. At the end of the course, the learners will be able to think independently and contribute creative ideas.

Unit I: Listening Skill

Topics: Listening to conversations and interviews of famous personalities in various fields -- Listening practice related to the TV-- Talk shows – News – Educative programmes -- Watching films for critical comments – Listening for specific information – Listening for summarizing information – Listening to monologues for taking notes – Listening to answer multiple-choice questions.

Unit II: Speaking Skill

Topics: Self-introduction -- Group discussion – Persuading and negotiating strategies – Practice in dialogues -- Presentations based on short stories / poems -- Speaking on personal thoughts and feelings -- academic topics – News reading – Acting as a compere -- Speaking about case studies on problems and solutions – Extempore speeches.

Unit III: Reading Skill

Topics: Reading anecdotes to predict the content – Reading for interpretation -- Suggested reading -- Short stories and poems -- Critical reading – Reading for information transfer – Reading newspaper and magazine articles for critical commentary – Reading brochures, advertisements, pamphlets for improved presentation.

Unit IV: Writing Skill

Topics: At the beginning of the semester, the students will be informed of a mini dissertation of 1000 words they need to submit individually on any non-technical topic of their choice. The parts of the dissertation will be the assignments carried out during the semester and submitted towards the end of the semester on a date specified by the department. This can be judged as part of the internal assessment.

Unit V: Thinking Skill

Topics: Practicein preparing thinking blocks to decodediagrammatical representations into English words, expressions, idioms and proverbs – Inculcating interest in English using thinking blocks. Making pictures and improvising diagrams to form English words, phrases and proverbs -- Picture reading.

Reference Books

Raman, Meenakshi, and Sangeetha Sharma. *Technical Communication: English Skills for Engineers.* 2nd edition. New Delhi: Oxford University Press, 2010.
Riordian, Daniel. *Technical Communication.* New Delhi. Cengage Learning, 2009

Websites for learning English

1. **British: Learn English – British Council (Listen & Watch) -** <http://learnenglish.britishcouncil.org/>
2. **American: Randall's ESL Cyber Listening Lab -** <http://www.esl-lab.com/>
3. **Intercultural: English Listening Lesson Library Online** http://www.elllo.org/

PH 2031 PHYSICS LABORATORY

L	T	P	C
1	0	3	3

List of Experiments

1. Torsional Pendulum - Determination of rigidity modulus of the material of a wire.
2. Non Uniform Bending - Determination of Young's Modulus.
3. Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.
4. Lee's Disc - Determination of thermal conductivity of a bad conductor.
5. Air Wedge - Determination of thickness of a thin wire.
6. Spectrometer - Refractive index of a prism.
7. Semiconductor laser - Determination of wavelength of Laser using Grating.

REFERENCES:

1. P.Mani, Engineering Physics Practicals, Dhanam Publications, Chennai, 2005.

CY2031 - CHEMISTRY LABORATORY

L T P C

1 0 3 3

List of Experiments

1. Estimation of Commercial soda by acid-base titration
2. Determination of Percentage of nickel in an alloy
3. Determination of Temporary, permanent and total hardness of water by EDTA method
4. Determination of Chloride content in a water sample
5. Potentiometric Estimation of iron
6. Conductometric Titration of a strong acid with a strong base
7. Conductometric Titration of mixture of acids.
8. Determination of Degree of polymerization of a polymer by Viscometry

References:

1. J.Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel's Textbook of Quantative Chemical Analysis, 6th Edition, Pearson Education, 2004.
2. C. W. Garland, J. W. Nibler, D. P. Shoemaker, ;"Experiments in Physical Chemistry, 8th ed.," McGraw-Hill, New York, 2009.
3. S. Sumathi, Engineering Chemistry Practicals, Dhanam Publications, 2011.

Semester-II

MA2201	ENGINEERING MATHEMATICS II	L T P C 3 1 0 4
Goal	To create the awareness and comprehensive knowledge in engineering mathematics.	

Objectives	Outcome
The course should enable the students to: 1) Understand the evaluation of the doubleand triple integrals in Cartesian and polar forms. 2) Know the basics of Vector calculus. 3) Know Cauchy - Riemann equations, Milne – Thomson method and Conformal mapping 4) Grasp the concept of Cauchy's integral formula, Cauchy's residue theorem and contour integration. 5) Know Laplace transform and inverse Laplace transform and their properties.	The students should be able to: 1) Find area as double integrals and volume as triple integrals in engineering applications. 2) Evaluatethe gradient, divergence, curl, line, surface and volume integrals along with the verification of classical theorems involving them. 3) Applies analytic functions and their interesting properties inscience and engineering. 4) Evaluate the basics of complex integration and the concept of contour integration which is important for evaluation of certain integrals encountered in practice. 5) Have a sound knowledge of Laplace transform and its properties and their applications in solving initial and boundary value problems.

UNIT I MULTIPLE INTEGRALS 12

Review: Basic concepts of integration- Standard results – Substitution methods – Integration by parts - Simple problems.

Double integrals: Cartesian and polar co-ordinates –Change of variables – simple problems - Area as a double integral. Triple integrals: Cartesian co ordinates – Volume as a triple integral– simple problems.

UNIT II VECTOR CALCULUS 12

Review: Definition – vector, scalar – basic concepts of vector algebra - dot and cross products-properties.

Gradient, Divergence and Curl –Unit normal vector, Directional derivative – angle between surfaces-Irrotational and solenoidal vector fields.Verification and evaluation of Green's theorem- Gauss divergence theorem and Stoke's theorem.Simple applications to regions such as square, rectangle, triangle, cuboids and rectangular parallelopipeds.

UNIT III ANALYTIC FUNCTIONS 12

Review: Basic results in complex numbers - Cartesian and polar forms - Demoivre's theorem.

Functions of a complex variable – Analytic function – Necessary and sufficient conditions (without proof) – Cauchy - Riemann equations – Properties of analytic function – Harmonic function – Harmonic conjugate - Construction of Analytic functions by Milne – Thomson method.Conformal mapping: $w = z + a$, az, $1/z$ and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Statement and application of Cauchy's integral theorem and Integral formula– Evaluation of integrals using the above theorems –Taylor and Laurent series expansions–Singularities – Classification. Residues – Cauchy's residue theorem (without proof)– Contour integration over unit circle and semicircular contours (excluding poles on boundaries).

UNIT V LAPLACE TRANSFORM 12

Laplace transform – Conditions of existence – Transform of elementary functions – properties– Transforms of derivatives and integrals – Derivatives and integrals of transforms - Initial and final value theorems – Transforms of unit step function and impulse function – Transform of periodic functions. Inverse Laplace transform – Convolution theorem – Solution of linear ODE of second order with constant coefficients.

TOTAL: 60

Note: Questions need not be asked from review part.

TEXT BOOKS

1. VenkatramanM.K, *Mathematics, Volume II*, National Publishing Company, Chennai, 1985.
2. Grewal B.S, *Higher Engineering Mathematics*, Thirty Eighth Editions, Khanna Publisher, Delhi, 2004.
3. Chandrasekaran A, *Engineering Mathematics, Volume – II*, Dhanam Publication, 2008.

REFERENCE:

1. Kandasamy P, *Engineering Mathematics Volume II*, S. Chand & Co., New Delhi, 1987.
2. GrewalB.S, *"Engineering Maths – II*", Sultan Chand, New Delhi, 1993.
3. Bali N.P, Manish Goyal, *Text book of Engineering Mathematics*, 3rd Edition, Lakshmi Publications, 2003.

PH2001	ENGINEERING PHYSICS	L T P C 3 0 0 3

Goal	To impart fundamental knowledge in various fields of Physics and its applications.

OBJECTIVES	OUTCOME
➢ To develop strong fundamentals of properties and behavior of the materials ➢ To enhance theoretical and modern technological aspects in acoustics and ultrasonics. ➢ To enable the students to correlate the theoretical principles with application oriented study of optics. ➢ To provide a strong foundation in the understanding of solids and materials testing. ➢ To enrich the knowledge of students in modern engineering materials.	The student will ➢ Be able to understand the properties and behavior of materials. ➢ Have a fundamental knowledge of acoustics which would facilitate in acoustical design of buildings and on ultrasonics and be able to employ it as an engineering tool. ➢ Understand the concept, working and application of lasers and fiber optics. ➢ Know the fundamentals of crystal physics and non destructive testing methods. ➢ Have an understanding of the production, characteristics and application of the new engineering materials. This would aid them in the material selection stage.

UNIT I – PROPERTIES OF MATTER **9**

Elasticity – types of moduli of elasticity – Stress-Strain diagram – Young's modulus of elasticity – Rigidity modulus – Bulk modulus – Factors affecting elasticity – twisting couple on a wire – Torsional pendulum – determination of rigidity modulus of a wire – depression of a cantilever – Young's modulus by cantilever – uniform and non-uniform bending - viscosity – Ostwald's viscometer – comparison of viscosities.

UNIT II – ACOUSTICS AND ULTRASONICS **9**

Classification of sound – characteristics of musical sound – intensity - loudness – Weber Fechner law – Decibel – Reverberation – Reverberation time, derivation of Sabine's formula for reverberation time(Jaeger's method) – absorption coefficient and its determination – factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies. Ultrasonics - production – Magnetostriction and Piezoelectric methods – properties – applications of ultrasonics with particular reference to detection of flaws in metal (Non – Destructive testing NDT) – SONAR.

UNIT III - LASER AND FIBRE OPTICS **9**

Principle of lasers – Stimulated absorption – Spontaneous emission, stimulated emission – population inversion – pumping action – active medium – laser characteristics – Nd-Yag laser – CO_2 laser – Semiconductor laser – applications - optical fiber – principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – types of optical fibers – single and multimode, step index and graded index fibers – applications – fiber optic communication system.

UNIT IV – CRYSTAL PHYSICS AND NON- DESTRUCTIVE TESTING 9

Crystal Physics: Lattice – Unit cell - Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – coordination number – Packing factor for SC, BCC, FCC and HCP structures.

Non Destructive Testing: Liquid penetrate method – Ultrasonic flaw detection – ultrasonic flaw detector (block diagram) – X-ray Radiography – Merits and Demerits of each method.

UNIT V –MODERN ENGINEERING MATERIALS AND SUPERCONDUCTING MATERIALS 9

Modern Engineering Materials: Metallic glasses: Preparation properties and applications. Shape memory alloys (SMA): Characteristics, applications, advantages and disadvantages of SMA. Nano Materials: Synthesis –Properties and applications.

Superconducting Materials: Superconducting phenomena – Properties of superconductors – Meissner effect – Type I and Type II superconductors – High Tc superconductors (qualitative) – uses of superconductors.

TOTAL 45

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L., *"Engineering Physics* ", 8th edition, Dhanpat rai publications (P) Ltd., New Delhi 2010.

2. P.Mani, "*Engineering Physics ", Vol-I*, Dhanam Publications, Chennai 2011.

3.Rajendran V. an Marikani A., "*Applied Physics for engineers*" , 3rd edition, Tata Mc Graw –Hill publishing company Ltd., New Delhi,2003.

REFERENCES:

1.Uma Mukherji, "*Engineering Physics* ", Narosa publishing house, New Delhi, 2003.

2.Arumugam M., "*Engineering Physics* ", Anuradha agencies, 2007.

3.Palanisamy P.K., "*Engineering Physics* ", SciTech Publications, Chennai 2007.

4.Arthur Beiser, "*Concepts of Modern Physics*", Tata Mc Graw –Hill Publications, 2007.

5.P.Charles, Poople and Frank J. Owens, "*Introduction to Nanotechnology*", Wiley India, 2007

CY2001	ENGINEERING CHEMISTRY	L T P C 3 0 0 3
Goal	To impart basic principles of chemistry for engineers.	
OBJECTIVES	**OUTCOME**	
The objective of the course is • To make the students conversant with the basics of (c) Water technology and (d) Polymer science	Upon successful completion of the course, the outcomes are as follows: • The students will gain basic knowledge in water analysis and suitable water treatment method. • The study of polymer chemistry will give an idea on the type of polymers to be used in engineering applications.	
• To provide knowledge on the requirements and properties of a few important engineering materials.	• Exposure of the students to the common engineering materials will create awareness among the students to search for new materials.	
• To educate the students on the fundamentals of corrosion and its control.	• Knowledge on the effects of corrosion and protection methods will help the young minds to choose proper metal / alloys and also to create a design that has good corrosion control.	
• To give a sound knowledge on the basics of a few significant terminologies and concepts in thermodynamics.	• Students with good exposure on the important aspects of basic thermodynamics will be able to understand the advanced level thermodynamics in engineering applications.	
• To create an awareness among the present generation about the various conventional energy sources.	• A good background on the various aspects of energy sources will create awareness on the need to utilize the fuel sources effectively and also for exploring new alternate energy resources.	

UNIT I:WATER TECHNOLOGY AND POLYMER CHEMISTRY 9

Hardness (Definition, Types, Units) – problems - Estimation of Hardness (EDTA Method) – Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment- Desalination - Reverse Osmosis.

Classification of Polymers - PVC, Bakelite - preparation, properties and applications - Effect of Polymer Structure on Properties - Compounding of Plastics- Polymer Blends and Polymer Alloys – Definition, Examples.

UNIT II: ENGINEERING MATERIALS 9

Properties of Alloys – Heat Treatment of Steel – Polymer Composites – types and applications.- Lubricants – Classification, properties and applications - Mechanism of Lubrication – MoS_2 And Graphite – Adhesives – classification and properties – Epoxy resin (Preparation, properties and applications) – Refractories – Classification, Properties and General Manufacture – Abrasives – Classification , Properties and Uses – Carbon nano tubes – preparation, properties and applications.

UNIT III: ELECTROCHEMISTRY AND CORROSION 9

Conductometric Titration – HCl vs NaOH and mixture of acids vs NaOH - Electrochemical Series and its applications - Nernst Equation – problems - Polarization, Decomposition Potential, Over-voltage (definitions only) - Galvanic series -Corrosion (Definition, Examples, effects) – Mechanism of Dry Corrosion and Wet Corrosion – Differential aeration Corrosion , examples – Factors Influencing Corrosion – Metal and Environment – Corrosion Control – Design –Cathodic Protection methods – Protective Coatings – Galvanising - Anodising – Electroplating (Cu and Ni) and Electroless plating (Cu and Ni) – Constituents of Paints and varnish.

UNIT IV: CHEMICAL THERMODYNAMICS 9

Thermodynamic terminology- First Law of Thermodynamics-Internal energy- enthalpy - heat capacity – work done in isothermal expansion of an ideal gas –problems - second law of thermodynamics – entropy change – phase transformations and entropy change – problems - Work Function &Free Energy Function- Maxwell's Relations-Gibbs Helmholtz equation- van't Hoff Isotherm- van't Hoff Isochore – Problems.

UNIT V: FUELS ANDENERGY SOURCES 9

Fuels – classification - Calorific Value – Dulong's Formula – Problems - Determination of Calorific Value by Bomb Calorimeter – Coal – Proximate Analysis – problems - Octane Number – Cetane Number – Diesel Index (Definitions only) – Bio Gas – Producer Gas –Water Gas – Preparation, Properties and Uses – Batteries – Primary Cells – Leclanche Cell –Secondary Cell – Nickel Cadmium Battery – Fuel Cells – Hydrogen –Oxygen Fuel Cell – Solar Battery – Lead Acid Storage Cell – Nuclear Energy – Light water nuclear power plant.

Total 45

Text Books

1. S. S. Dara, Text Book of *Engineering Chemistry*, S. Chand &Company Ltd., New Delhi, 2003
2. Murthy, Agarwal &Naidu, Text Book of *Engineering Chemistry*, BSP, 2003.
3. S.Sumathi, *Engineering Chemistry*, Dhanam Publications, 2008.
4. S.Sumathi and P.S.Raghavan, *Engineering Chemistry II*, Dhanam Publications, 2008.

References

1. B. K. Sharma, *Engineering chemistry*, Krishna Prakasam Media (P) Ltd., 2003
2. A 1. Vogel, A text book of *Qualitative Inorganic Analysis*, ELBS, London, 2004
3. A. Gowarikar, Text Book of *Polymer Science*, 2002
4. Kuriacose &Rajaram, Vols. 1 &2, *Chemistry in Engineering and Technology*, 2004
5. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing Co. Jalandar, 2004.

AE 2201	ELEMENTS OF AERONAUTICS	L T P C 3 0 0 3
GOAL	To introduce the basic concepts of aerospace engineering and the current developments in the field.	

OBJECTIVES	OUTCOME
The course should enable the student to :	The student should be able to understand :
1. Understand the Historical evaluation of Airplanes	1. The history of aircraft & developments over the years
2. Study the different component systems and functions	2. The types & classifications of components and control systems
3. Understand the basic properties and principles behind the flight	3. The basic concepts of flight & Physical properties of Atmosphere
4. Study the different structures & construction	4. The types of fuselage and constructions and Landing gear systems
5. Study the various types of power plants used in aircrafts	5. Different types of Engines and principles of Rocket

UNIT I- HISTORICAL EVALUATION **8**

Early airplanes, biplanes and monoplanes, Developments in aerodynamics, materials, Structures and propulsion over the years.

UNIT II- AIRCRAFT CONFIGURATIONS **5**

Components of an airplane and their functions. Different types of flight vehicles, classifications. Conventional control, Powered control, Basic instruments for flying, typical systems for control Actuation.

UNIT III - INTRODUCTION TO PRINCIPLES OF FLIGHT **10**

Physical properties and structure of the atmosphere, Temperature, pressure and altitude Relationships, Evolution of lift, drag and moment. Aerofoils, Mach number, Manoeuvres.

UNIT IV - INTRODUCTION TO AIRPLANE STRUCTURES **12**

General types of construction, Monocoque, semi-monocoque and geodesic construction, Typical wing and fuselage structure. Landing Gear Structure

UNIT V - POWER PLANTS USED IN AIRPLANES **10**

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust Production. Comparative merits, Principles of operation of rocket, types of rockets and typical Applications, Exploration into space

Total **45**

TEXT BOOKS

1. Anderson, J.D., *"Introduction to Flight",* McGraw-Hill, 1995.

REFERENCE

1. Kermode, A.C., *"Flight without Formulae*", McGraw-Hill, 1997.

AE2202	ENGINEERING MECHANICS	L T P C 3 1 0 4
OBJECTIVES		**OUTCOME**
The course should enable the student to : Understand the Basics & Statics of particles Study the Equilibrium of rigid bodies and resolution of forces Understand the basics of properties of surfaces & solids Study the Dynamics of particles Study the friction and elements of rigid body dynamics		The student should be able to understand : The Vectorial representation of forces & Moment And principle of transmissibility The types of supports & Reactions and Equilibrium of Rigid bodies in two & Three dimensions First moment of area and the Centroid of various shapes & sections The Relative motion particles and Impact of elastic bodies The frictional force & types of friction and Translation and Rotation of Rigid Bodies

UNIT I BASICS & STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Frictional force – Laws of Coulomb friction – simple contact friction – Rolling resistance – Belt friction. Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TOTAL : 60

TEXT BOOK

1. Beer, F.P and Johnson Jr. E.R. *"Vector Mechanics for Engineers",* Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).

REFERENCES

1. Rajasekaran, S, Sankarasubramanian, G., *"Fundamentals of Engineering Mechanics"*, Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeller, R.C., *"Engineering Mechanics*", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., *"Engineering Mechanics* – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, *"Engineering Mechanics* – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, *"Interactive Engineering Mechanics* – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

BASIC Electrical & Electronic Engineering

PH 2031 PHYSICS LABORATORY

L T P C

1 0 3 3

List of Experiments

1. Torsional Pendulum - Determination of rigidity modulus of the material of a wire.
2. Non Uniform Bending - Determination of Young's Modulus.
3. Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.
4. Lee's Disc - Determination of thermal conductivity of a bad conductor.
5. Air Wedge - Determination of thickness of a thin wire.
6. Spectrometer - Refractive index of a prism.
7. Semiconductor laser - Determination of wavelength of Laser using Grating.

REFERENCES:

1. P.Mani, *Engineering Physics Practicals*, Dhanam Publications, Chennai, 2005.

CY 2031 - Chemistry laboratory

L T P C

1 0 3 3

List of Experiments

1. Estimation of Commercial soda by acid-base titration.
2. Determination of Percentage of nickel in an alloy
3. Determination of Temporary, permanent and total hardness of water by EDTA method.
4. Determination of Chloride content in a water sample.
5. Potentiometric Estimation of iron.
6. Conductometric Titration of a strong acid with a strong base
7. Conductometric Titration of mixture of acids.
8. Determination of Degree of polymerization of a polymer by Viscometry.

References:

1. J.Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, *Vogel's Textbook of Quantative Chemical Analysis*, 6th Edition, Pearson Education, 2004.
2. C. W. Garland, J. W. Nibler, D. P. Shoemaker, *;"Experiments in Physical Chemistry, 8th ed.,"* McGraw-Hill, New York, 2009.
3. S. Sumathi, *Engineering Chemistry Practicals,* Dhanam Publications, 2011.

GE 2231 - ENGINEERING PRACTICES LABORATORY II

L	T	P	C
0	0	3	2

LIST OF EXPERIMENTS

1. Electrical Engineering

1. Wiring for a tube light.
2. Wiring for a lamp and fan.
3. Staircase wiring.
4. Study of (i) Iron box and (ii) Fan with Regulator.

2. Electronics Engineering

1. Study of Electronic components and Equipments.
2. Characteristics of PN junction diode & measurement of Ripple factor or half wave and full wave rectifier.
3. Applications of OP-AMP – Inverter, Adder and Subtractor.
4. Study and verification of Logic Gates.

Total = 30

Text Book:

T. Jeyapoovan, M.Saravanapandian and S. Pranitha, "*Engineering Practices Lab Manual", 3rd Edition 2006, Vikas Publishing house (P) Ltd.*, New Delhi.

EL2231	COMMUNICATION SKILLS LABORATORY 2	L T P C 2 0 2 3
Goal	The goal of the programme is to provide an **advanced practical input** towards moulding student-achievers who can use the English language with ease.	

OBJECTIVES	OUTCOME
1. To extend the power of the learners to listen to English at an advanced level and comment on it. 2. To guide the learners to speak English at the formal and informal levels. 3. To enable learners to read and grasp the in-depth meaning of technical and non-technical passages in English. 4. To help the learners develop the art of writing at the formal and informal levels. 5. To expand the thinking capability of the learners so that they would learn how to be original in their thoughts.	1. The learners will be able to listen to and understand English at an advanced level and interpret its meaning. 2. The learners would have developed English at the formal and informal levels and thus gained the confidence to use it without fear. 3. The learners will be able to read and grasp the in-depth meaning of technical and non-technical passages in English. 4. The learners will have developed the art of formal and informal writing. 5. The learners will be able to think independently and creatively and also verbalize their thoughts fearlessly.

Unit I: Listening Skill

Topics: Listening to telephonic conversations -- Listening to native British speakers -- Listening to native American speakers – Listening to intercultural communication -- Listening to answer questions as one-liners and paragraphs -- Listening practice to identify ideas, situations and people -- Listening to group discussions -- Listening to films of short duration.

Unit II: Speaking Skill

Topics: Interview skills – People skills – Job interview – Body language and communication -- How to develop fluency -- Public speaking -- Speaking exercises involving the use of stress and intonation – Speaking on academic topics – Brain storming & discussion – Speaking about case studies on problems and solutions – Extempore speeches – Debating for and against an issue – Mini presentations – Generating talks and discussions based on audiovisual aids.

Unit III: Reading Skill

Topics: Reading exercises for grammatical accuracy and correction of errors --Reading comprehension exercises with critical and analytical questions based on context – Evaluation of contexts – Reading of memos, letters, notices and minutes for reading editing and proof reading -- Extensive reading of parts of relevant novels after giving the gist of the same.

Unit IV: Writing Skill

Topics: At the beginning of the semester, the students will be informed of a mini dissertation of 2000 words they need to submit individually on any non-technical topic of their choice. The parts of the dissertation will be the assignments carried out during the semester and submitted towards the end of the semester on a date specified by the department. This can be judged as part of the internal assessment.

Unit V: Thinking Skill

Topics: Practice in preparing thinking blocks to decode pictorial representations into English words, expressions, idioms and proverbs – Eliciting the knowledge of English using thinking blocks -- Picture rereading -- Finding meaning in the meaningless – Interpreting landscapes, simple modern art and verbal and non-verbal communication.

Reference Books

Ibbotson, Mark. *Cambridge English for Engineering*. New Delhi: Cambridge University Press, 2009.
Smith-Worthington Jefferson. *Technical Writing for Success.* New Delhi. Cengage Learning, 2007.

Websites for learning English

1. **British: Learn English – British Council (Business English) -** <http://learnenglish.britishcouncil.org/>

2. **BBC Learning English (General and Business English) -** <http://www.bbc.co.uk/worldservice/learningenglish/>
3. **Intercultural: English Listening Lesson Library Online** <http://www.elllo.org/>

BEEE Lab to be introduced

SEMESTER-III

MA2301	ENGINEERING MATHEMATICS III	L T P C 3 1 0 4
Goal	To create the awareness and comprehensive knowledge in engineering mathematics	

Objectives	Outcome
The course should enable the students to: 1) Learn techniques of solving the standard types of first and second partial differential equations. 2) Grasp the Fourier series expansions for the given periodic function in the specific intervals and their different forms. 3) Learn solving one dimensional wave equation, One and two dimensional heat equation using Fourier series. 4) Understand the problems using Fourier transform and learns their properties. 5) Understand the problems using Z – transform and learns their properties.	The students should be able to: 1) Formulate mathematically certain practical problems in terms of partial differential equations, solve them and physically interpret the results. 2) Use the knowledge of Fourier series, their different possible forms and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data. 3) Formulate and identify certain boundary and initial value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve the vibration and heat flow problems and then interpret the results. 4) Apply Fourier transform pair, their properties, with the possible special cases with attention to their applications 5) Apply the basics of Z – transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z – transform technique bringing out the elegance of the procedure involved.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order non linear partial differential equations- simple problems – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

UNIT III BOUNDARY VALUE PROBLEMS 12

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – simple problems.

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform - Elementary properties – Inverse Z – transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60

TEXT BOOKS

1. Grewal, B.S., "*Higher Engineering Mathematics*", Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., *"Engineering Mathematics Volume III",* S. Chand & Company ltd., New Delhi, 1996.
3. Wylie C. Ray and Barrett Louis, C., "*Advanced Engineering Mathematics*", Sixth Edition, McGraw-Hill, Inc., New York, 1995.

REFERENCES

1. Andrews, L.A., and Shivamoggi B.K., "*Integral Transforms for Engineers and Applied Mathematicians,"* MacMillan, New York, 1988.
2. Narayanan, S., Manikavasagom Pillai, T.K. and Ramaniah, G., *"Advanced Mathematics for Engineering Students", Volumes II and III*, S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai, 2002.
3. Churchill, R.V. and Brown, J.W., "*Fourier Series and Boundary Value Problems",* Fourth Edition, McGraw-Hill Book Co., Singapore, 1987.

AE 2301	Solid Mechanics	L T P C 3 1 0 4
Goal	Understanding effects of loads on structures --- loads could be tension, compression, bending, twisting --- arriving at the stresses & strains and establish factors of safety	

Objectives	Outcomes
The course should enable the student : 1. Stress and Strain – Hooke's Law – Elastic constants and their relationship– Statically determinate cases - bar with uniform and varying section statically indeterminate cases –composite bar. Thermal Stresses – stresses due to freely falling weight. 2. Shear force and bending moment diagrams for simply supported and cantilever beams – Bending stresses in straight beams – Shear Stresses in bending of beams with various cross sections – beams of uniform strength 3. Beam Deflections though various methods **4.** Torsion of circular shafts - shear stresses and twist in solid and hollow circular shafts – closely coiled helical springs. **5.** Stresses in thin circular cylinder and spherical shell under intl pressure, volumetric Strain. Combined loading, Principal and maximum Shear Stresses - Analytical and Graphical methods.	The students should be able to: 1. Proportional Limit, Elastic Limit, Elastic Constants and relations. Determinacy and indeterminacy. Elongation of bars with uniform varying section. Elongation of compound bars and thermal stresses 2. Calculation of reaction forces. Differentiate between cantilever and simple support beams. Draw the shear force and bending moment diagrams for various load cases. Establish the relation between Moment, Moment of Inertia, Radius of curvature, Young's modulus. Understand shear stresses and obtain shear stress for various cross sections. 3. Double integration method – McCauley's method - Area moment method – Conjugate beam method. 4. Distinguish difference between bending moment & twisting moment and effects of twisting moment. Find out shear stresses for solid & hollow shafts and study of helical springs 5. Understand Hoops stress, Meridonal stress for thin cylinders and obtain pressure for spherical shell. Calulate principal planes and find principal stresses. Represent as Mohor's circles in graphical form

UNIT I - BASICS AND AXIAL LOADING **12**

- Stress and Strain – Hooke's Law – Elastic constants and their relationship– Statically determinate cases - bar with uniform and varying section statically indeterminate cases –composite bar. Thermal Stresses – stresses due to freely falling weight.

UNIT II - STRESSES IN BEAMS **12**

- Shear force and bending moment diagrams for simply supported and cantilever beams – Bending stresses in straight beams – Shear Stresses in bending of beams with various cross sections – beams of uniform strength

UNIT III - DEFLECTION OF BEAMS **12**

- Double integration method – McCauley's method - Area moment method – Conjugate beam method.

UNIT IV – TORSION **12**

- Torsion of circular shafts - shear stresses and twist in solid and hollow circular shafts – closely coiled helical springs.

UNIT V - BI AXIAL STRESSES **12**

- Stresses in thin circular cylinder and spherical shell under internal pressure, volumetric Strain. Combined loading, Principal Stresses and maximum Shear Stresses - Analytical and Graphical methods.

Total **60**

TEXT BOOKS

Nash William – *"Strength of Materials",* TMH, 1991

Timoshenko.S. and Young D.H. – *"Elements of strength materials* Vol. I and Vol. II"., T. Van Nostrand Co-Inc Princeton-N.J. 1990.

REFERENCES

1. Dym C.L. and Shames I.H. – *"Solid Mechanics*", 1990.

AE 2302	AERO ENGINEERING THERMODYNAMICS	L T P C 3 1 0 4

GOAL: To give a brief background of application of various laws of thermodynamics and its application in heat transfer, refrigeration and air-conditioning, jet propulsion system.

OBJECTIVES	OUTCOME
1. The subject should enable the students to have a basic idea about Thermodynamic Systems, and processes.	1.The student should be able to understand the basic thermodynamic systems.
2. The student should understand the air cycles like (**Otto**, Diesel, Dual combustion and Brayton combustion cycles) ,They should understand PV diagrams of four stroke and two stroke IC Engines.	2.Understanding about the air cycles, and understanding about the plot of the PV diagrams of four stroke and two stroke IC Engines
3.To understand the thermodynamics of One Dimensional fluid flow and the application of Continuity and energy equations Properties of steam .To understand the Simple jet propulsion system and Thrust rocket motor	3.Understand about the One Dimensional fluid flow and the applications of the Continuity equation and understand about the simple jet propulsion systems.
4.To understand about the refrigeration and Principles of Air conditioning and understand the Coefficient of performance and Properties of refrigerants.	4.Understand about the Principles of refrigeration and Air conditioning and understand the Coefficient of performance and Properties of refrigerants.

UNIT I BASIC THERMODYNAMICS 12

Systems, Zeroth Law, First Law - Heat and work transfer in flow and non-flow processes, Second law, Kelvin- Planck statement - Clausius statement - concept of entropy - Clausius inequality - entropy change in non-flow processes.

UNIT II AIR CYCLES 12

Otto, Diesel, Dual combustion and Brayton combustion cycles – Air standard efficiency - Mean effective pressure – Actual and theoretical PV diagrams of four stroke and two stroke IC Engines.

UNIT III THERMODYNAMICS OF ONE DIMENSIONAL FLUID FLOW 12

Application of Continuity and energy equations- Properties of steam - Rankine cycle - Isentropic flow of ideal gases through nozzles - Simple jet propulsion system - Thrust rocket motor – Specific impulse.

UNIT IV REFRIGERATION AND AIR CONDITIONING 12

Principles of refrigeration, Air conditioning - Heat pumps - Vapour compression - Vapour absorption types - Coefficient of performance, Properties of refrigerants.

UNIT V AIR COMPRESSORS 12

Classification and working principle, work of compression with and without clearance, Isothermal and Isentropic efficiency of reciprocating air compressors, multistage compression and intercooling. Various types of compressors (Descriptive treatment only.

Total 60

TEXT BOOKS

1. Rathakrishnan, E, "*Fundamentals of Engineering Thermodynamics",* Prentice – Hall, India, 2000

2. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hills Co., Ltd., Seventh Edn., 1993

3.Yunus A.Cengal. *"Thermodynamics an Engineering Approach"*, Tata McGraw-Hill Co. Ltd., 3rd Edition, 2002.

REFERENCES

1. Mayhew, A. and Rogers, B., *"Engineering Thermodynamics"*, Longman Green & Co. Ltd., London, E.L.B.S. Edition, 1990.

2. Van Wylen, G.J. and Sonntag, R.E., *"Fundamentals of Classical Thermodynamics* (S.I.Version)", Second Edition, 1986.

3. Bacon, D.H., *"Engineering Thermodynamics*", Butterworth & Co., London, 1989.

4. Saad, M.A., *"Thermodynamics for Engineers*", Prentice-Hall of India Pvt. Ltd., 1989.

5. Reynolds*, "Thermodynamics*", Int. Student Edn., McGraw-Hill Book Co., Ltd., 1990

AE 2303	FLUID MECHANICS AND MACHINERY	L T P C 3 1 0 4
GOAL	To introduce the behaviour of fluids, kinematics and dynamics of fluids and hydraulic Machines	

OBJECTIVES	OUTCOME
The course should enable the student to :	The student should be able to understand :
1. Understand the principles of Basic concepts and properties of Fluid	1. The basic terms like Pressure , Density, Surface Tension & Fluid Statics
2. Understand the Fluid Kinematics and its Dynamics	2. The types of flows , stream functions, Velocity Potential & familiarize in equations of Fluid Motion
3. Study the basic concepts of Incompressible Flows	3. The Laminar Flows , Flow through Pipes , Boundary Layers
4. Study the basic concepts of Fluid Machines and Hydraulic turbines	4. The working Principles of Various Turbines like Keplon , Pelton , Francis
5. To study the Hydraulic pumps & its applications	5. The working Principles of Pumps like Centrifugal & Reciprocating Pumps

UNIT I BASIC CONCEPTS AND PROPERTIES 6

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT II FLIUD KINEMATICS AND FLUID DYNAMICS 12

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms). Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's π theorem- applications - similarity laws and models.

UNIT III INCOMPRESSIBLE FLUID FLOW 12

Viscous flow - Navier-Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy -weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

UNIT IV HYDRAULIC TURBINES 8

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines.

UNIT V HYDRAULIC PUMPS 7

Pumps: definition and classifications - Centrifugal pump: Classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump: classification, working principles, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps, working principles of gear and vane pumps

TOTAL: 45

TEXT BOOKS

1. Anderson, J.D., *"Fundamentals of Aerodynamics*", McGraw-Hill Book Co., New York, 1985.

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., "*Aerodynamics for Engineering students*", Edward Arnold Publishers Ltd., London, 1989.

2. Milne Thomson, L.H., "*Theoretical aerodynamics*", Macmillan, 1985.

3. Clancey, L.J., "*Aerodynamics"*, Pitman, 1986

AE 2304	AIRCRAFT MATERIALS	L T P C 3 0 0 3
GOAL:To introduce various materials used in Aerospace industry, their behaviour and testing methods		

OBJECTIVES	OUTCOME
1. To know about various types of materials and Knowledge of various types of hardness testing machines and various types of hardness numbers Linear and non-linear elastic properties- Stress and Strain Curves.	1. Understand the different materials used and know the various types of hardness testing machine. Knowledge of Stress-strain curves for different type of materials.
2. To know about the materials used in aircraft construction- Aluminium, Magnesium and Titanium	2. Knowledge about the properties of the material, the process of machining them and heat treating them.
3. To know about the materials used in aircraft construction- Steel, Copper alloys and Super alloys.	3. Knowledge about the specification of materials, their structural applications and properties.
4. To know about the adhesives and sealants used in aircraft industries.	4. Finding out the different types of adhesives and sealant used, their advantages and the knowledge of the sandwich and honeycomb structure.
5. To know about the non metals used in aircraft construction.	5. Knowledge about the non metals like wood, fabrics, glass, plastics and the use of composite materials.

UNIT I MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS 9 Knowledge of various types of hardness testing machines and various types of hardness numbers Linear and non-linear elastic properties - Stress and Strain Curves – Yielding and strain Hardening ,Toughness – Modules of resilience -– Bauchinger's effect – Effect of notches – Testing and flaw detection of materials and components.

UNIT II MATERIALS IN AIRCRAFT CONSTRUCTION - I 9

Aluminium and its alloys: Types and identification. Properties – Castings – Heat treatment processes – Surface treatments.

Magnesium and its alloys: Cast and Wrought alloys – Aircraft application, features specification, fabrication problems, Special treatments.

Titanium and its alloys: Applications, machining, forming, welding and heat treatment.

UNIT III MATERIALS IN AIRCRAFT CONSTRUCTION - II 9

Steels : Plain and low carbon steels , various low alloy steels , aircraft steel specifications ,corrosion and heat resistant steels , structural applications .

Maraging Steels: Properties and Applications

Copper Alloys – Monel, K Monel

Super Alloys: Use – Nickel base – Cobalt base – Iron base – Forging and Casting of Super alloys – Welding, Heat treatment.

UNIT IV ADHESIVE AND SEALANTS FOR AIRCRAFT 9

Advantages of Bonded structure in airframes – Crack arresting – Weight saving – Technology of adhesive Bonding Structural adhesive materials – Test for bonding structure

Typical bonded joints &non destructive tests for bonded joint

Bonded Sandwich structures - Materials – Methods of construction of honeycombs

UNIT V NON METALS IN AIRCRAFT CONSTRUCTION 9

Wood and fabric in aircraft construction and specifications –Glues Use of glass, plastics and rubber in aircraft, Introduction to glass and carbon composite

TEXT BOOKS

Lalith Gupta, "*Aircraft General Engineering*" Himalaya Book House, Delhi 2003

HajiraChowdhry, "*Workshop Technology* " – Vol 1 & 2 ,Nedia Promoters, Mumbai

REFERENCE

"Aircraft Material & Process" , Titterton 2004

"Advanced Composite Materials " ,Lalith Gupta 2006, Himalaya Book House, Delhi

AE 2331	STRENGTH OF MATERIALS LABORATORY	L T P C 0 0 3 2
GOAL	To develop the knowledge in testing the materials for hardness, fatigue, impact, tension and torsion.	

S.No	OBJECTIVE	OUTCOME
1	To test a specimen using Brinell hardness testing machine.	The hardness of the material is found out and verified.
2	To test a specimen using Rockwell hardness testing machine.	The hardness of the material is found out and verified.
3	To perform tension test on mild steel a rod using universal testing machine.	The yield load, ultimate load of the mild steel rod is found out.
4	To perform torsion test on a mild steel rod using universal testing machine.	The ultimate torque of the mild steel rod is found out.
5	To perform impact test using Izod impact testing machine.	The impact load of the material is found out.
6	To perform impact test using Charpy impact testing machine.	The impact load of the material is found out.
7	To perform fatigue test in rotating beam using fatigue tester	The fatigue load of the rotating beam is found out.
8	To perform tension and compression test on open and closed helical spring setup.	The ultimate compressive load and tensile loads are found out.
9	To perform tension and compression test on wood using UTM .	The ultimate compressive load is found out
10.	To verify Maxwell reciprocal therom	Maxwell reciprocal thermo is verified.

LIST OF EXPERIMENTS

1. Hardness test - a)Vickers b) Brinell c) Rockwell
2. Tension test
3. Torsion test
4. Impact test – a) Izod b) Charpy c) Drop Test.
5. Fatigue test - a) Reverse plate bending b) Rotating Beam
6. Testing of springs
7. Block Compression Test

LIST OF EQUIPMENTS

S.No	Details of Equipments	Qty Required	For Experiments
1	Brinell Hardness Testing Machine	1	1
2	Rockwell Hardness Testing Machine	1	1
3.	Universal Testing Machine	1	2,3,7
4.	Izod Impact Testing Machine	1	4
5.	Charpy Impact Testing Machine	1	4
6.	Fatigue tester- Rotating Beam	1	5
7.	Fatigue tester –Reverse plate bending	1	5

AE 2332	FLUID MECHANICS AND MACHINERY LAB	L T P C 0 0 3 2
GOAL	To find the performance of pump like centrifugal pump, reciprocating pump, Gear pump. To find the coefficient of discharge of orifice meter and venturimeter. Conducting the characteristic curves of Kaplan turbine, Francis turbine and Pelton wheel.	

OBJECTIVES	OUTCOME
The subject should enable the student to:	The students should be able to:
1. Understand the properties of the fluid and also to learn about the pressure and velocity of the flowing fluid using venturimeter, orifice meter.	1. Determine the coefficient of discharge of orifice meter and venturimeter.
2. Understand the discharge of fluid by using pump like centrifugal, reciprocating and gear pump and also to find the rate of flow using rota meter.	2. Conduct experiments and draw the characteristic curves of centrifugal pump, submergible pump, reciprocating pump, Gear pump and also can find the discharge of the pump.
3. Understand the efficiency of turbine like Kaplan and francis.	3. Conduct experiments and draw the characteristics curves of Francis turbine and Kaplan turbine and also can find the efficiency of the turbine.
4. Understand the change in pressure (friction factor) of given set of pipes.	4. Conduct experiments and draw the characteristics curves of Pelton wheel.
5. Understand the efficiency of Pelton wheel.	5. Determine the friction factor of given set of pipes when there is change in pressure& Calculate the rate of flow using Rotameter.

LIST OF EXPERIMENTS

1. Calibration of venturimeter
2. Pressure measurement with Pitot static tube
3. Determination of pipe flow losses.
4. Verification of Bernoulli's theorem
5. Flow visualization by Heleshaw apparatus
6. Performance test on centrifugal pumps
7. Performance test on reciprocating pumps
8. Performance test on pelton wheel turbine
9. Performance test on Francis turbine
10. Determination of Viscosity of a Fluid

LIST OF EQUIPMENTS

Sl.No	Details of Equipments	Qty Req.	Experiment No.
1.	Venturimeter setup	1	1,3
2.	Pipe friction set up	1	3
3.	Pitot tube set up	1	2,4
4.	Jet pump	1	6
5.	Submersible pump	1	6
6.	Centrifugal pump	1	6
7.	Reciprocating pump	1	7
8.	Pelton wheel turbine and Francis turbine	1	8,9
9.	Viscosity Meter	1	10
10.	Hele-shaw apparatus	1	5

AE 2333	DESIGN AND DRAFTING LAB	L T P C 0 0 3 2

GOAL: To introduce the concept of design of basic structural components and to draft both manually and using modelling package.

OBJECTIVES	OUTCOME
The Subject should enable the student to:	**The students should be able to:**
1. Understand the design of riveted joints (Lap joint), learn the advantages and disadvantages.	1. Design of riveted joints (Lap joint).
2. Understand the design of riveted joints (Butt joint); learn the advantages and disadvantages and types of riveted joints.	2. Design of riveted joints (Butt joint with single and double straps).
3. Understand the design of the welded joint.	3. Design of welded joints.
4. Understand Layout of typical wing structure	4. Layout of typical wing structure.
5. Understand Layout of typical fuselage structure.	5. Layout of typical fuselage structure.
6. Understand the Computer aided modelling of typical aircraft wing.	6. Computer aided modelling of typical aircraft wing.
7. Understand the Computer aided modelling of typical fuselage structure.	7. Computer aided modelling of typical fuselage structure.
8. Understand the Computer aided modelling of landing gear	8. Computer aided modelling of landing gear
9. Understand the design of Three view diagram of a typical aircraft	9. Three view diagram of a typical aircraft
10. Understand the concepts and design of control system.	10. Layout of control systems

LIST OF EXERCISES

11. Design of riveted joints (Lap joint).
12. Design of riveted joints (Butt joint with single and double straps).
13. Design of welded joints.
14. Layout of typical wing structure.
15. Layout of typical fuselage structure.
16. Computer aided modelling of typical aircraft wing.
17. Computer aided modelling of typical fuselage structure.
18. Computer aided modelling of landing gear
19. Three view diagram of a typical aircraft
20. Layout of control systems

LIST OF EQUIPMENT

Sl.No	**Equipments**	**Quantity**	**Experiments No.**
1	Drawing Boards, Drafting machines	30	1 – 5
2	Computer and modeling software	Pentium IV PC's, - 30 Nos. License of Software – 30	6 – 10

AE 2334	THEROMODYNAMICS LAB	L T P C 0 0 3 2
GOAL	To make the students understand the basics of Thermodynamics and carry out various experiments on Heat exchanger and stroke engines	

OBJECTIVES	OUTCOME
1.To carry out performance test on a 4 stroke region	1.Understand the 4 stroke engine cycle and performance
2. To carry out valve timing of a 4 stroke engine and Port timing of a 2 stroke engine	2.Clearly understand the port timing mechanism and valve timing mechanism of stroke engine
3.To carry out test on effectiveness of a parallel flow heat exchanger	3. To get a clear idea about effectiveness of a parallel flow heat exchanger
4. To carry out test on effectiveness of a counter flow heat exchanger	4. To get a clear idea about effectiveness of a counter flow heat exchanger
5.To carry out test for determination of viscosity of a given liquid	5.Understand the viscosity effects in a given fluid flow
6. To carry COP test on a vapour compression refrigeration test rig.	6. To carry COP test on a vapour compression refrigeration test rig
7. To carry COP test on a vapour compression A/C test rig	7. To carry COP test on a vapour compression A/C test rig
8.To study about the characteristics of a Gas turbine Engine	8.Can clearly understand the performance of a Gas Turbine Engine
9.To carry out experiment on evaluation of conductive Heat transfer coefficient	9. To understand importance of thermal resistance of composite wall
10. To carry out experiment on evaluation of thermal resistance of composite wall	10.To understand importance of thermal resistance of composite wall

LIST OF EXPERIMENTS

1. Performance test on a 4-stroke engine
2. Valve timing of a 4 – stroke engine and port timing of a 2 stroke engine
3. Determination of effectiveness of a parallel flow heat exchanger
4. Determination of effectiveness of a counter flow heat exchanger
5. Determination of the viscosity coefficient of a given liquid
6. COP test on a vapour compression refrigeration test rig
7. COP test on a vapour compression air-conditioning test rig
8. Study of a Gas Turbine Engine.
9. Determination of Conductive Heat Transfer Coefficient.
10. Determination of Thermal Resistance of a Composite wall.

LIST OF EQUIPMENTS

Sl.No	**Details of Equipments**	**Qty Req.**	**Experiment No.**
1.	4 stroke twin cylinder diesel engine	1	1
2.	Cut section model of 4 stroke kirloskar diesel engine and cut section model of 2 stroke petrol engine	1	2
3.	Parallel and counter flow heat exchanger test rig	1	3,4
4.	Red wood viscometer	1	5
5.	Vapour compression refrigeration test rig	1	6

SEMSESTER - IV

MA 2401	NUMERICAL METHODS	L T P C 3 1 0 4
Goal	To create the awareness and comprehensive knowledge in numerical solutions.	

Objectives	Outcome
The course should enable the students to: 1) Learn the techniques of solving the algebraic and transcendental equations. 2) Learn to interpolate using Newton's forward and backward difference formulae for equal and unequal intervals 3) Understand the use of numerical differentiation and understands to find the approximate area using numerical integration. 4) Understand solving numerically the initial value problems for ordinary differential equations using single step and multi step method. 5) Learn the methods of solving second order partial differential equations numerically and use it to solve initial and boundary value problems for partial differential equations.	The students should be able to: 1) Find out the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations by direct and indirect methods. 2) Solve problems where huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values. 3) Use the numerical differentiation and integration when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information. 4) Solve engineering problems which are characterized in the form of nonlinear ordinary differential equations, since many physical laws are couched in terms of rate of change of oneindependent variable 5) Solve the initial and boundary value problems related heat flow, both one and two dimensional and vibration problems. Understands the numerical techniques of solving the partial differential equation in engineering applications.

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 12

Linear interpolation methods (method of false position) – Newton's method – Statement of Fixed Point Theorem - Fixed point iteration: x=g(x) method. Solution of linear algebraic system of equations – Direct methods - Gauss-Jordon method and Crout's method - Iterative method: Gauss-Seidel method.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation – equal intervals – Newton's forward and backward difference formulae – problems. Interpolation-unequal intervals – Newton's divided difference formula – Lagrange's and inverse interpolation-problems.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical differentiation – Newton's forward and backward difference - Divided differences and finite differences – Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules. Two and Three point Gaussian quadrature formulae – Double integrals using trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods: Taylor series method – first order-second order and simultaneous – Euler and Modified Euler methods. Fourth orderRunge – Kutta method for solving first and second order equations – Multi-step methods: Milne's and Adam's predictor and corrector methods.

UNIT V INITIAL AND BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference solution of second order ordinary differential equation – classification of partial differential equations - Finite difference solution of two dimensional heat flow equations Laplace and Poisson equations. One dimensional heat equation by explicit and implicit methods – One dimensional wave equation

TOTAL: 60

TEXT BOOKS

1. Kandasamy P, Thilagavathy K, Gunavathy K, "*Numerical Methods*", S.Chand Co. Ltd., New Delhi, 2003.
2. Chandrasekaran A. and Beena James, "*Numerical Methods*", Dhanam publications, Chennai, 2011.

REFERENCES

1. Burden R.L, and Faires T.D, "*Numerical Analysis*", Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
2. Gerald C.F, Wheatley P.O, "*Applied Numerical Analysis*", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3. Balagurusamy E, "*Numerical Methods*", Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.

AE 2401	AIRCRAFT SYSTEMS AND INSTRUMENTS	L T P C 3 0 0 3

GOAL	To make the student to understand the principle and working of aircraft systems and Instruments.

OBJECTIVES	OUTCOME
The course should enable the students : 1. To know the various types of Airplanes control systems, its components & its applications. 2. To know the working principle of Autopilot system, ILS & communication system.	The students should be able to : 1. Understand the working principle of modern control system & its advantages. 2. Describe the working principle of communication & navigation system.
3. To understand the purpose of hydraulic system & its component requirement in a modern aircraft.	3. Draw a schematic diagram of a hydraulic system for a modern aircraft and explain its function in detail.
4. Study of piston and gas turbine engine system and the various components of engines, its material requirements.	4. Describe the various systems of piston & gas turbine engines and the purpose of each system.
5. To know the various auxiliary system used in the modern Jet aircraft & its purpose.	5. Describe the working principle of air-conditioning system & Fire protection system.
6. To study the various instruments used in a modern aircraft and its purpose	6. Understand the working principle of aircraft instruments and engine instruments in detail.

UNIT I AIRPLANE CONTROL SYSTEMS 10

Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems – Engine control systems - Push pull rod system, flexible push pull rod system - Components - Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology, Communication and Navigation systems Instrument landing systems, VOR - CCV case studies.

UNIT II AIRCRAFT SYSTEMS 10

Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers - Modes of operation - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification – Shock absorbers - Retractive mechanism.

UNIT III ENGINE SYSTEMS 8

Fuel systems for Piston and jet engines, - Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

UNIT IV AUXILLIARY SYSTEM 8

Basic Air cycle systems - Vapour Cycle systems, Boost-Strap air cycle system - Evaporative vapour cycle systems - Evaporative air cycle systems - Oxygen systems - Fire protection systems, De-icing and anti icing systems.

UNIT V AIRCRAFT INSTRUMENTS 9

Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators – TAS, EAS- Mach Meters - Altimeters - Principles and operation - Study of various types of engine instruments - Tachometers - Temperature gauges - Pressure gauges - Operation and Principles.

TOTAL 45

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., *"Aircraft Maintenance & Repair*", McGraw-Hill, 1993.
2. *"General Hand Books of Airframe and Powerplant Mechanics"*, U.S. Dept. of Transportation, Federal Aviation Administation, The English Book Store, New Delhi1995.

REFERENCES

1. Mekinley, J.L. and Bent, R.D*., "Aircraft Power Plants*", McGraw-Hill, 1993.
2. Pallet, E.H.J., *"Aircraft Instruments & Principles",* Pitman & Co., 1993.
3 .Treager, S., "*Gas Turbine Technology*", McGraw-Hill, 1997.

AE 2402	MECHANICS OF MACHINES	L T P C 3 1 0 4
GOAL	To expose the students the different mechanisms, their method of working, Forces involved and consequent vibration during working	

OBJECTIVE	**OUTCOME**
The subject should enable the student to: 1. The Kinematic analysis of simple mechanisms and its velocity and accelerations. 2. To know the various belt and rope drives and friction in screw and nut. 3. To know the Gear and cam profile and geometry. 4. To study the Static and dynamic balancing of the various masses 5. To study the vibrations of single degree of freedom systems and Vibration isolation and absorption	The students should be able to : 1. Understand the various mechanisms and its degree of freedom 2. Learn to find out the effect of centrifugal and initial tension in both drives and Condition for maximum power transmission. 3. Learn to determine the speed and torque of the various types of gear geometry and also the follower motions of cam profile. 4. Understand the concept of balancing in rotating mass and Balancing of radial V engine (reciprocating mass). 5. Understand the Free, forced and damped vibrations and its force transmitted to supports

UNIT I MECHANISMS 12

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

UNIT II FRICTION 12

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT III GEARING AND CAMS 12

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque - Cams – Types of cams – Design of

profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

UNIT IV BALANCING 12

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method

UNIT V VIBRATION 12

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

TOTAL 60

TEXT BOOKS

1. Rattan.S.S, "*Theory of Machines*", Tata McGraw–Hill Publishing Co, New Delhi, 2004.
2. Ballaney.P.L, "*Theory of Machines",* Khanna Publishers, New Delhi, 2002.

REFERENCES

1. Rao, J.S and Dukkipati, R.V, "*Mechanism and Machine Theory",* Second Edition, Wiley Eastern Ltd., 1992.

2. Malhotra, D.R and Gupta, H.C., *"The Theory of Machines*", SatyaPrakasam, Tech. India Publications, 1989.

3. Gosh, A. and Mallick, A.K., *"Theory of Machines and Mechanisms",* Affiliated East West Press, 1989.

4. Shigley, J.E. and Uicker, J.J., *"Theory of Machines and Mechanisms",* McGraw-Hill, 1980.

5. Burton Paul, "*Kinematics and Dynamic of Planer Machinery",* Prentice Hall

AE 2403	AIRCRAFT STRUCTURES – I	L T P C 3 1 0 4
GOAL	Analysis and design simple a/c structural components	

OBJECTIVES	OUTCOME
The course should enable the student : 1. Understand various structural elements 2. Understand statically determinate and indeterminate structural analysis. 3. Understand various energy method 4. able to understand columns with various end condition. 5. To understand various failure theories	The students should be able to: 1. Analysis structural elements in aircraft. 2. Solve three moment equation and moment distribution. 3. To make simplified analysis of a/c structures & apply energy methods. 4. Understand and solve the column problems 5. Apply failure theories for various loading conditions

UNIT I STATICALLY DETERMINATE STRUCTURES **12**

Analysis of plane truss – Method of joints – 3 D Truss - Plane frames

UNIT II STATICALLY INDETERMINATE STRUCTURES **12**

Composite beam - Clapeyron's Three Moment Equation - Moment Distribution Method.

UNIT III ENERGY METHODS **12**

Strain Energy due to axial, bending and Torsional loads – Castigliano's theorem - Maxwell's Reciprocal theorem, Unit load method - application to beams, trusses, frames, rings, etc.

UNIT IV COLUMNS **12**

Columns with various end conditions – Euler's Column curve – Rankine's formula - Column with initial curvature - Eccentric loading – South well plot – Beam column.

UNIT V FAILURE THEORY **12**

Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum Strain energy theory – Application to aircraft Structural problems.

TOTAL 60

TEXT BOOK1. Donaldson, B.K., "*Analysis of Aircraft Structures – An Introduction*", McGraw-Hill, 1993.

REFERENCE

Timoshenko, S., "*Strength of Materials",* Vol. I and II, Princeton D. Von Nostrand Co, 1990.

AE 2404	AERODYNAMICS – I	L T P C 3 1 0 4
GOAL	To study aerodynamic concepts and understanding motion of air around an object enables the calculation of forces and moments acting on the object.	

OBJECTIVES	OUTCOME
The course should enable the student : 1) To understand the fluid mechanics concepts for advanced applications 2) To study two dimensional flows in aerodynamics 3) To integrate the mathematics with aerodynamics 4) To study ideal flows over wings 5) To study real time viscous flows	Student should able to: 1) Should be able to apply fluid mechanics concepts 2) Should be able to model flow over wing 3) Should be able to differentiate between ideal and real flows 4) Develops mathematical modelling ability. 5) Understand the real time viscous flow and Boundary Layer behaviour.

UNIT I REVIEW OF BASIC FLUID MECHANICS 6

Continuity, momentum and energy equations.

UNIT II TWO DIMENSIONAL FLOWS 14

Basic flows – Source, Sink, Free and Forced vortex, uniform parallel flow. Their combinations,Pressure and velocity distributions on bodies with and without circulation in ideal and real fluidflows. KuttaJoukowski's theorem.

UNIT III CONFORMAL TRANSFORMATION 12

Joukowski transformation and its application to fluid flow problems, Kutta condition, Blasius theorem.

UNIT IV AIRFOIL AND WING THEORY 14

Joukowski, Karman - Trefftz, Profiles - Thin aerofoil theory and its applications. Vortex line, Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations

UNIT V VISCOUS FLOW 14

Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum thickness, Flow over a flat plate, Blasins solution.

TOTAL 60

TEXT BOOKS

1. Anderson, J.D., *"Fundamentals of Aerodynamics",* McGraw-Hill Book Co., New York, 1985.

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., *"Aerodynamics for Engineering students",* Edward Arnold Publishers Ltd., London, 1989.

2. Milne Thomson, L.H., "*Theoretical aerodynamics*", Macmillan, 1985.

3. Clancey, L.J., "*Aerodynamics",* Pitman, 1986

AE 2431	COMPUTER AIDED DRAFTING AND MODELLING LAB	L T P C 0 0 3 2
GOAL	To aid in the design, analysis, and manufacture of products	

OBJECTIVES	OUTCOME
The course should enable to 1. Understand the drawing with curves like parabola, spiral, involute 2. Understand the three view of simple solids. 3. Creation of 3D models of simple objects. 4. Understand a simple steel truss. 5. Understand the isometric projection of simple objects	Student should able to 1. Draw the different curves with B spline or cubic spline method. 2. Draw the front view, side view and top view of solids. 3. Obtaining 2D and multi view drawing of 3D models. 4. Analyze the truss problems using CAD. 5. Plotting the drawings of prism, pyramid, cylinder, and cone.

List of exercises using software capable of drafting and modelling:

1**.** Study of capabilities of software for drafting and modelling –Co-ordinate system-Creation of simple figures like polygon and general multi line figures

2. Drawing a title block with necessary text and projection symbols

3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline

4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone. etc

5. Drawing of front view, side view and top view of objects from the given pictorial views

6. Drawing of a plan of residential building

7. Drawing of a simple steel truss

8. Drawing sectional views of prism, pyramid, cylinder, cone. etc,

9. Drawing isometric projection of simple objects

10. Creation of 3D models of simple objects and obtaining 2D and multi view drawing of 3D models

Note: Plotting of drawings must be made for each exercise and attached to the records written by students

AE 2432	AIRCRAFT STRUCTURES LABORATORY	L T P C 0 0 3 2
GOAL	The objective of conducting the Aircraft structure laboratory is to make the students understand and appreciate various principle and theorems involved in the theory of aircraft structures, vibrations and experimental stress analyzing the results. This will immensely help the students to enrich their knowledge in the design of various aircraft structural components, namely, wings, fuselage, landing gear, control surfaces, etc.	

OBJECTIVES	OUTCOME
1.Determination of young's modulus of steel using mechanical extensometers.	To understand the basic concepts of material and science and real experience getting to determine a young's modulus value of Aluminium.
2. Determination of young's modulus of steel using Electrical extensometers.	To understand the difference of accuracy and precision value from both mechanical and electrical extensometer.
3. Determination of fracture strength and fracture pattern of ductile materials.	To understand the breaking strength which specimen fail via fracture. Determined by given the specimen by tensile load test. More understand about materials stress strain relationship.
1. Determination of fracture strength and fracture pattern of brittle materials.	To understand the difference of brittle and ductile materials. Studies on deformation elastic and plastic and metal fatigue. More understand that failure of compressive stress.
2. Stress strain curve for various engineering materials	To understand the application of Aircraft material science.
3. Deflection of beams at various end condition	To determine the deflection of a simply supported beams and better understand of types of beams and application.
4. Verification of Maxwell's reciprocal theorem and principle of super position	To verify the Maxwell's theorem using the supported beam and tested.
5. Column Testing	To determine the buckling load of the column in various section like fixed and hinged.
6. South – Well's plot	To determine the buckling load of the column in various section like fixed and hinged and more understand about the south well's theorem.
7. Riveted joints	To analyze the riveted joints and type s. and more understand about the high strength structural steel rivet, semi tabular rivet, blind rivet, drive rivet, flush and frictional lock rivet.

LIST OF EXPERIMENTS

1. Determination of Young's modulus of steel using mechanical extensometers.
2. Determination of Young's modulus of aluminium using electrical extensometers
3. Determination of fracture strength and fracture pattern of ductile materials
4. Determination of fracture strength and fracture pattern of brittle materials
5. Stress Strain curve for various engineering materials.
6. Deflection of beams with various end conditions.
7. Verification of Maxwell's Reciprocal theorem & principle of superposition
8. Column – Testing
9. South – well's plot.
10. Riveted Joints.

LIST OF EQUIPMENTS

Sl. No.	Equipments	Qty	Experiments No.
1.	Universal Testing Machine	1	1,2,3,4,5,10
2.	Mechanical Extensometer	1	1
3.	Electrical stain gauge	10	2
4.	Stain indicator	1	2,5
5.	Dial Gauges	12	3,4
6.	Beam Test set up with various end conditions	2	6,7
7.	Weight 1 Kg	10	6,7
8.	Weight 2 Kg	10	6.7.8
9.	Weight Pans	6	6,7,8
10.	Column Test Apparatus	1	5,6.7,8
11.	Rivet	30	10

AE 2433	AERODYNAMICS LAB	L T P C 0 0 3 2
GOAL	To study experimentally the aerodynamic forces on different bodies at low speeds.	

OBJECTIVES	OUTCOME
The course should enable the student :	The students should be able to:
1. To study performance of subsonic wind tunnel.	1. Measure the velocity of the subsonic wind tunnel at various RPM
2.To study experimentally the pressure distribution of circular, symmetric and unsymmetrical aerofoil	2. Pressure distribution of various aerofoils can be identified and lift can be calculated.
3. To know theForce measurement using wind tunnel balance	
4. To study Flow visualization studies in low speed flow over airfoil with different angle of incidence	3. Coefficient of Lift and drag for symmetric and unsymmetricalaerofoils are analysed.
5. To study performance of supersonic wind tunnel.	4. Identify the various flows acting on the aerofoil
	5. Study the Supersonic flow and characteristics of it.

To study experimentally the aerodynamic forces on different bodies at low speeds.

LIST OF EXPERIMENTS

1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoil.
4. Pressure distribution over cambered airfoil& thin airfoils
5. Force measurement using wind tunnel balance.
6. Flow over a flat plate at different angles of incidence
7. Flow visualization studies in low speed flow over cylinders
8. Flow visualization studies in low speed flow over airfoil with different angle of incidence
9. Calibration of supersonic wind tunnel.
10. Supersonic flow visualization with Schlieren system.

LIST OF EQUIPMENT

Sl. No.	Items	Quantity	Experiment No.
1.	Wind Tunnel test section size around 300 x 300 mm with test section flow speed of 70 m/s.	1 No.	1, 2,3,4,5
2.	Wings of various airfoil sections (Symmetrical & cambered airfoils)	2 Nos. each	3, 4
3.	Angle of incidence changing mechanism	1 No.	3, 4
4.	Multiple Manometer stands with 20 – 30 manometer tubes	4 Nos.	2,3,4
5.	U-Tube Manometer	1 No.	1,2,3,4
6.	Static Pressure Probes	4 Nos.	1,2,3,4
7.	Total Pressure Probest	4 Nos.	1,2,3,4
8.	Pitot-Static Tubes	4 Nos.	1,2,3,4
9.	Wooden Models of Three Dimensional bodies (eg. Cylinder etc.,)	2 Nos. each	2
10.	Wind Tunnel balances (3 or 5 or 6 components)	1 No.	5
11.	Pressure Transducers with digital display	1 No.	1,2,3,4
12.	Hele-Shaw apparatus, Smoke Tunnel, Water flow channel	1 each	6,7,8
13.	Supersonic Wind tunnel of test section size 100 x 100 mm with storage tank capacity of $500ft^2$ at 20 bar	1 No.	9,10
14.	Wooden models of cone, wedge and blunt body configurations of suitable size for flow visualization in a supersonic wind tunnel test section	1 No.	9,10
15.	Schlieren System	1 No.	9,10

AE 2434 PROJECT WORK L T P C

0 0 6 2

The students should undertake Aircraft Design oriented project. The students are able refer data sheets, standard charts during their project work.

SEMESTER – V

EC2512	MICROPROCESSOR AND APPLICATIONS	L T P C 3 0 0 3
GOAL	To excel in the Architecture of 8086 & 8051 and to develop skill in simple program writing, to study simple applications.	

OBJECTIVES The course should enable the student to	OUTCOME The students should be able to:
(i) Study The Architecture of 8086 & 8051.	(i) Understand the functional block diagram, Timing Diagram, Interrupt structure and Multiprocessor configurations of 8086 Microprocessors.
(ii) Understand The addressing modes & instruction set of 8086 & 8051.	(ii) Develop the Programming skills using Loop structure with counting & Indexing, Look up table, Subroutine instructions stack.
(iii) Interrupt The need & use of Interrupt structure.	(iii) Interface ICs 8255 PPI, 8259 PIC, 8257 DMA , 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter ,A/D and D/A converter.
(iv) Impact knowledge on commonly used peripheral / interfacing ICs .	(iv) Comprehend the Functional block diagram ,Instruction format and addressing modes, Interrupt structure ,I/O Ports and Serial communication of 8051 Microcontroller.

UNIT I SEMICONDUCTOR DEVICES 10

Transistors – FET and MOSFET – Silicon Controlled Rectifiers And Triacs – their Applications - Principles and Types of Transistor Amplifiers – RC Coupled, Transformer Coupled, Direct Coupled – Multistage, FET and Power Amplifiers.

UNIT II LINEAR AND DIGITAL ICS 8

IC Technology – Elements of Fabrication of Linear and Digital IC's –Comparison Between Analog and Digital Systems – Number Representation – Binary, Octal and Hexadecimal Number Systems– Half Adder and Full Adder –Multiplexers- Demultiplexers – Decoders – Encoders.

UNIT III MICROPROCESSORS 12

Architecture of Intel 8085– Instruction Formats – Addressing Modes – Simple Assembly Language Programs – Architecture and Functioning of Intel 8086 Processor - Instruction Formats – Addressing Modes.

UNIT IV INTERFACING AND MEMORY DEVICES 10

Keyboards and Displays Interfacing – Parallel and Series Communication – Synchronous and Asynchronous Data Transfer – DMA Data Transfer. RAM, ROM, EPROM – Magnetic Bubble Memory – Floppy and Hard Disc.

UNIT V APPLICATIONS 5

Microprocessor Applications in aerospace – Case study.

TOTAL 45

TEXT BOOKS

1. "*Computer principles of architecture*", Tata McGraw-Hill, New Delhi. 4th Edition 2002.
2. Goankar. R.S., "*Microprocessors, Programming to Architecture 8085",* Penram International publishing PVT Ltd, New Delhi. 5th Edition 2002
3. V.K. Mehta, "*Principles of Electronics*", S. Chand & Co, New Delhi, 2nd Edition 2002

REFERENCES

1. Malvino A.P. Leach, D.P., "*Digital Principles & Applications*", Tata McGraw– Hill, 1990.
2. Goankar R.S., *"Microprocessors Architecture. Programming and Applications",* Wiley Eastern, 1992.
3. Ajit Pal., "*Microprocessors",* Tata McGraw-Hill, Revised Edition 1995.
4. Douglas, Hall, *"Microprocessors and Interfacing*", Tata McGraw–Hill, Revised Edition 1990.
5. Mathur A.P., "*Introduction to Microprocessors*", Tata McGraw–Hill, Revised Edition 1995.

AE 2501	PROPULSION-I	L T P C 3 1 0 4
GOAL	To study in detail about fundamentals of aircraft propulsion, advanced propulsion systems in gas turbine engine. To understand the principles of operation and design of aircraft power plants.	

Objectives	Outcome
The course should enable the student to :	The student should be able to understand :
1. To know the fundamentals of gas turbines and its components	Understand the working principle of gas turbine engines, thermodynamic cycles and performance characteristics of gas turbine engines.
2. To know the design and performance of subsonic and supersonic inlets	To understand the internal flow and external characteristics near the inlets. Starting problems and different modes of operation in supersonic inlets.
3. To know the different types of combustion chambers and factors affecting the combustors.	To understand the types and working methods in combustion chambers. The flame stabilization and flame techniques.
4. To study the types of nozzles and flow conditions in nozzles.	To understand the flow through nozzle, choking, losses in nozzle, variable area nozzle and thrust vectoring.
5. To study the types of compressors and their working principles	To know the types and working principles of compressors, velocity diagrams, blade design and performance characteristics of compressors.

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES 12

Illustration of working of gas turbine engine – Thrust equation – Factors affecting thrust. Effect of pressure, velocity and temperature changes of air entering compressor. Methods of thrust augmentation. Characteristics of turboprop, turbofan and turbojet – Performance characteristics.

UNIT II SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES 12

Internal flow and Stall in subsonic inlets – Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and external deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration – Modes of inlet operation.

UNIT III COMBUSTION CHAMBERS 12

Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders.

UNIT IV NOZZLES 11

Theory of flow in isentropic nozzles – Convergent nozzles and nozzle choking – Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust reversal.

UNIT V COMPRESSORS 13

Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of prewhirl – Rotation stall – Elementary theory of axial flow compressor – Velocity triangles – degree of reaction – Three dimensional – Air angle distributions for free vortex and constant reaction designs – Compressor blade design – Centrifugal and Axial compressor performance characteristics.

TOTAL 45

TEXT BOOKS

1. Hill, P.G. & Peterson, C.R. *"Mechanics & Thermodynamics of Propulsion*" Addison – Wesley Longman INC, 1999.

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "*Gas Turbine Theory",* Longman, 1919.
2. Oates, G.C., "*Aero thermodynamics of Aircraft Engine Components*", AIAA Education Series, New York, 1915.
3. *"Rolls Royce Jet Engine*" – Third Edition – 1913.
4. Mathur, M.L. and Sharma, R.P., *"Gas Turbine, Jet and Rocket Propulsion",* Standard Publishers & Distributors, Delhi, 1999.

AE 2502	AERODYNAMICS - II	L T P C 3 1 0 4
GOAL	To understand the behaviour of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows	

OBJECTIVES	OUTCOME
The course should enable the student to :	The student should be able to understand :
1.Understand the Fundamentals of Gas Turbine Engines	1.The Characteristics of Gas turbine Engines
2.Study the Subsonic and Supersonic inlets for Jet Engines	2.The effects due to various types of Inlets
3.Study the Combustion chamber classifications and performance	3.The factors affecting Combustion chamber design & performance
4.Study the Various types of Nozzles and its parameters	4.The efficiency of different Nozzles and flow pattern in nozzles
5.Study the compressor performance characteristics	5.The centrifugal and axial flow compressor performance and characteristics

UNIT I ONE DIMENSIONAL COMPRESSIBLE FLOW 10

Energy, Momentum, continuity and state equations. Velocity of sound, Adiabatic steady state flow equations, Flow through converging, diverging passages. Performance under various back pressures.

UNIT II NORMAL, OBLIQUE SHOCKS AND EXPANSION WAVES 15

Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations. Hodograph and pressure turning angle, shock polars, flow past wedges and concave corners, strong, weak and detached shocks, Rayleigh and Fanno Flow. Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion waves, Families of shocks, Methods of Characteristics, Two dimensional supersonic nozzle contours.

UNIT III DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS 12

Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert affine transformation relations for subsonic flows, Linearised two dimensional supersonic flow theory, Lift, drag pitching moment and center of pressure of supersonic profiles.

UNIT IV AIRFOIL IN HIGH SPEED FLOWS 12

Lower and upper critical mach numbers, Lift and drag divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects.

UNIT V HIGH SPEED WIND TUNNELS 11 Blow down, indraft and induction tunnel layouts and their design features. Transonic, supersonic and hypersonic tunnels and their peculiarities. Helium and gun tunnels, Shock tubes, Optical methods of flow visualization.

Total 60

TEXT BOOK

1. Rathakrishnan, E., *"Gas Dynamics*", Prentice Hall of India, 2003.

REFERENCES

1. Shapiro, A.H., "*Dynamics and Thermodynamics of Compressible Fluid Flow",* Ronold Press, 1912.
2. Zucrow, M.J. and Anderson, J.D., "*Elements of gas dynamics",* McGraw-Hill Book Co., New York, 1919.
3. McCornick. W., "*Aerodynamics, Aeronautics and Flight Mechanics*", John Wiley, New York, 1979.
4. Anderson Jr., D., – "*Modern compressible flows",* McGraw-Hill Book Co., New York 1999.

AE 2503	AIRCRAFT STRUCTURES –II	L T P C 3 1 0 4
GOAL	ANALYSIS AND DESIGN OF AIRCRAFT STRUCTURES	

OBJECTIVES	OUTCOME
The course should enable to 1.Understand Unsymmetrical bending 2. Understand shear centre and shear flow 3.Resistance of torque by cells 4. Understand buckling problems 5.Study Tension field beams	Student should able to 1.Analyze for maximum bending stress in unsymmetrical sections 2.Analyze for flexural shear stress 3.Analyze for Torsional shear stress 4.Panel Buckling allowable load 5.Analyze for flange and web load

UNIT I - UNSYMMETRICAL BENDING 12

Bending stresses in beams of unsymmetrical sections – Bending of symmetric sections with Skew loads.

UNIT II - SHEAR FLOW IN OPEN SECTIONS 12

Thin walled beams, Concept of shear flow, shear centre, Elastic axis. With one axis of Symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections.

UNIT III -SHEAR FLOW IN CLOSED SECTIONS 12

Bredt – Batho formula, Single and multi cell structures. Approximate methods. Shear flow in single & multi cell structures under torsion. Shear flow in single and multicell under bending with walls effective and ineffective.

UNIT IV- BUCKLING OF PLATES 12

Rectangular sheets under compression, Local buckling stress of thin walled sections, Crippling stresses by Needham's and Gerard's methods. Thin walled column strength. Sheet stiffener panels. Effective width, inter rivet and sheet wrinkling failures.

UNIT V STRESS ANALYSIS IN WING AND FUSELAGE 12

Shear and bending moment distribution for semi cantilever and other types of wings and Fuselage, thin webbed beam. With parallel and non parallel flanges, Shear resistant web beams, Tension field web beams (Wagner's).

TOTAL :60

TEXT BOOK

1.Bruhn. E.H. "*Analysis and Design of Flight vehicles Structures*", Tri – state off set company, USA, 1973.

REFERENCES

1. Peery, D.J., and Azar, J.J., "*Aircraft Structures*", 2nd edition, McGraw–Hill, N.Y., 1993.

2. Megson, T.M.G., "*Aircraft Structures for Engineering Students",* Edward Arnold, 1995.

3.Rivello, R.M., "*Theory and Analysis of Flight Structures*", McGraw-Hill, 1993.

AE 2531	PROPULSION- I LAB	L T P C 0 0 3 2
GOAL	To understand concepts of aircraft propulsion and carry out experiments	

OBJECTIVES	OUTCOME
1. To study aircraft piston engine, and the assembly of sub systems	1.Knowledge about the various systems of aircraft piston engine and show the systems on the engines available in the Lab
2. To understand aircraft piston engine's components, functions, operating principles	2. Learn about the working cycle of the aircraft piston engine and description of various components and its functions.
3. To study aircraft jet engine, and the assembly of sub systems	3.Gain knowledge about systems that form a jet engine by showing the systems on the engines that are available in the Aero Hangar
4. To understand aircraft jet engine's components, functions, operating principles	4. Learn about the working cycle of the aircraft jet engine and description of various components and its functions by visually them on the engines available in the Aero Hangar.
5. To study about forced Convective Heat transfer	5.Understanding the concept of forced convective heat transfer and perform experiment on the heat transfer apparatus
6. To study about free Convective heat transfer	6.Understanding the concept of free convection heat transfer and perform experiment on the heat transfer apparatus

LIST OF EXPERIMENTS

1. Study of an aircraft piston engine - assembly of sub systems
2. Study of an aircraft piston engine - various components, their functions and operating principles
3. Study of an aircraft jet engine - assembly of sub systems,
4. Study of an aircraft jet engine - various components, their functions and operating principles
5. Study of forced convective heat transfer.
6. Study of free convective heat transfer.

LIST OF EQUIPMENTS

Sl.No	Equipments	Qty	Experiments No.
1	Piston engines	2	1
2	Jet Engine /Engine model	1	2
3	Forced Convective apparatus	1	3
4	Free Convective apparatus	1	4

AE 2532	AIRCRAFT STRUCTURAL REPAIR LAB	L T P C 0 0 3 2
GOAL	To give training on riveting, patchwork and welding	

OBJECTIVES	OUTCOME
The course should enable the student to learn and practice: 1. Welded patch repair by TIG in Aluminium sheet. 2. Welded patch repair by MIG in mild steel. 3.Riveted patch repairs in Aluminium sheet. 4.Sheet metal forming. 5.Control cable inspection and repair. 6.Repair on Perspex glass panels. 7.Pipe flaring.	The student should be able to understand and do 1.The TIG welding. 2.The MIG welding. 3.The Riveted patch repair by manual and pneumatic. 4.The forming of different shapes in sheet metal. 5.The repair techniques of control cables 6.The repairing of non metallic window panels of Aircraft 7.The preparation of pipe ends for connecting components.

LIST OF EXPERIMENTS

1. Sheet Metal Forming.
2. Lap Joint by MIG Welding.
3. Butt Joint by TIG Welding.
4. Lap Joint by Riveting.
5. Butt Joint by Riveting.
6. Surface Patch Repair by Riveting (Using Pneumatic Gun).
7. Control cable inspection and repair.
8. Repair on Perspex glass panels.
9. Pipe flaring.
10. Composite Materials – Fabrication and Repair.

LIST OF EQUIPMENT

S.No.	Name of the Equipment	QTY	Experiment No.
1	Shear cutter pedestal type	1	1,4,5,6
2	Drilling Machine	4	4,5,6,8
3	Bench Vices	20	2,3,4,5,6,8
4	Radius Bend bars	1	1
5	Pipe Flaring Tools	5	9
6	MIG Weld Plant	1	2
7	TIG Weld Plant	1	3
8	Pneumatic Riveting Gun	2	6
9	Composite Moulding Machine	1	10

SEMESTER- VI

AE 2601	FLIGHT DYNAMICS	L T P C 3 1 0 4
GOAL	To understand the performance of an aircraft in various operating conditions, and static, dynamic response for different disturbances	

OBJECTIVES	OUTCOME
1. To understand drag force acting on an airplane, and variations due to velocity and altitude	1.Know about the forces and moments that are acting on an aircraft, the different types of drag, drag polar, ISA, variation of thrust, power, SFC with velocity and altitude
2. To understand elements of airplane performance	2.Have understanding about performance in level flight, minimum drag and power required, climbing, gliding and turning flight, VN diagram and load factor
3. To understand static longitudinal stability of an aircraft	3.Knowledge about degrees of stability, stick fixed and stick free stability, stability criteria, effect of fuselage and CG location, stick forces, aerodynamic balancing.
4. To understand lateral and directional stability	4.Understanding about lateral control, rolling and yawing moments, static directional stability, rudder and aileron control requirements and rudder lock
5. To understand dynamic stability of an aircraft	5.Understanding about dynamic longitudinal stability, stability derivatives, modes and stability criterion, lateral and directional dynamic stability

UNIT I DRAG ON THE AIRPLANE 12

International Standard Atmosphere - Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag - Drag polars of vehicles from low speed to high speed - Variation of thrust, power and SFC with velocity and altitudes for air breathing engines and rockets - Power available and power required curves.

UNIT II AIRCRAFT PERFORMANCE 15

Performance of airplane in level flight - Maximum speed in level flight - Conditions for minimum drag and power required - Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate, turn radius). Bank angle and load factor - Limitations of pull up and push over - V-n diagram and load factor.

UNIT III STATIC LONGITUDINAL STABILITY 15

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric manoeuvres - Stick force gradients - Stick force per 'g' - Aerodynamic balancing. Determination of neutral points and manoeuvre points from flight test.

UNIT IV LATERAL AND DIRECTIONAL STABILITY 8

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

UNIT V DYNAMIC STABILITY 10

Dynamic longitudinal stability: Equations of motion - Stability derivatives - Characteristic equation of stick fixed case - Modes and stability criterion - Effect of freeing-the stick - Brief description of lateral and directional. Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

TOTAL 60

TEXT BOOK

1. Perkins, C.D., and Hage, R.E., "*Airplane Performance stability and Control*", John Wiley & Son:, Inc, New York, 1911.

REFERENCES

1. Etkin, B., *"Dynamics of Flight Stability and Control*", Edn. 2, John Wiley, New York, 1912.

2. Babister, A.W., "*Aircraft Dynamic Stability and Response*", Pergamon Press, Oxford, 1910.

3. Dommasch, D.O., Shelby, S.S., and Connolly, T.F., *"Aeroplane Aero dynamics*", Third Edition,

4.Issac Pitman, London, 1911.4. Nelson, R.C. "*Flight Stability and Automatic Control*", McGraw-Hill Book Co., 1991

AE 2602	CONTROL ENGINEERING	L T P C 3 1 0 4
GOAL	To understand the basic concepts of flight control system.	

OBJECTIVES	OUTCOME
The course should enable the student to :	The student should be able to understand :
1.Study and solve problems on Simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies.	1.The Simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies based problems.
2.Study and solve problems on Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph.	2.The Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph and problems based on it.
3.Study and solve problems on Response of systems to different inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.	3.The Response of systems to different inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit and problems based on it.
4.Study and solve problems on Routh − Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response	4.The Routh – Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response and problems based on it.
5.Study about digital control system, Digital Controllers and Digital PID Controllers.	5.The digital control system, Digital Controllers and Digital PID Controllers.

UNIT I INTRODUCTION 6

Historical review - Simple pneumatic, hydraulic and thermal systems, Series and parallel systems, Analogies - Mechanical and electrical components, Development of flight control systems.

UNIT II OPEN AND CLOSED LOOP SYSTEMS 6

Feedback control systems – Block diagram representation of control systems, Reduction of block diagrams, Output to input ratios, Signal flow graph.

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS 10

Laplace transformation, Response of systems to different inputs viz., Step input, impulse, ramp, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV CONCEPT OF STABILITY 15

Necessary and sufficient conditions, Routh – Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V SAMPLED DATA SYSTEMS 8

Introduction to digital control system, Digital Controllers and Digital PID Controllers.

TOTAL 45

TEXT BOOKS

1. OGATO, *"Modern Control Engineering*", Prentice – Hall of India Pvt. Ltd. New Delhi, 1991.
2. GOPAL.M. *"Control Systems, Principles and design*" – Tata McGraw-Hill Publication, New Delhi, 2000.

REFERENCES

1. Azzo, J.J.D. and C.H. Houpis, "*Feed back control system analysis and synthesis*", McGraw – Hill International, 3rd Edition, 1998.
2. Kuo, B.C., "*Automatic control systems*", Prentice – Hall of India Pvt. Ltd., New Delhi, 1998.
3. Houpis, C.H. and Lamont, G.B., *"Digital Control Systems*", McGraw-Hill Book Co. New York, USA 1995.
4. Naresh K. Sinha, "*Control Systems*", New Age International Publishers, New Delhi

AE 2603	EXPERIMENTAL STRESS ANALYSIS	L T P C 3 0 0 3
GOAL	To determines the stress and strain in materials and structures subjected to static or dynamic forces or loads.	

OBJECTIVES	OUTCOMES
The course should enable the student : 1. To understand instrumentation concepts 2. To understand optics and its application to photo elasticity 3. To understand strain gauges and their applications 4. Understand significance of NDT Methods. 5. Understand the Concept of two dimensional photo elasticity	The students should be able to: 1. Analyze instruments for measurements 2. Awareness of NDT methods 3. Use strain gauge effectively 4. Analyze photo elastic results 5. To estimate the Interpretation of fringe pattern

UNIT I - MEASUREMENTS **4**

Principles of measurements, Accuracy, Sensitivity and range of measurements.

UNIT II - EXTENSOMETERS **6**

Mechanical, Optical, Acoustical and Electrical extensometers and their uses. Advantages and disadvantages.

UNIT III - ELECTRICAL RESISTANCE STRAIN GAUGES **10**

Principle of operation and requirements of electrical strain gauges. Types and their uses,
Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosetteanalysis. Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT IV - PHOTOELASTICITY **10**

Two dimensional photo elasticity, Concept of light – photo elastic effects, stress optic law,
Interpretation of fringe pattern, Compensation and separation techniques, Photo elasticmaterials. Introduction to three dimensional photo elasticity.

UNIT V - NON – DESTRUCTIVE TESTING **15**

Fundamentals of NDT. Radiography, ultrasonic, magnetic particle inspection, Fluorescent
penetrant technique, Eddy current testing, Acoustic Emission Technique, Fundamentals of brittlecoating methods, Introduction to Moiré techniques, Holography, ultrasonic C- Scan, Thermograph,Fiber – optic Sensors.

TOTAL	45

TEXT BOOKS

1. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "*Experimental Stress Analysis*", Tata McGraw-Hill, New Delhi, 1914.

REFERENCES

1. Dally, J.W., and Riley, W.F., "*Experimental Stress Analysis*", McGraw-Hill Inc., New York, 1991.
2. Hetyenyi, M., "*Hand book of Experimental Stress Analysis*", John Wiley and Sons Inc., New York, 1972.
3. Pollock A.A., "*Acoustic Emission in Acoustics and Vibration Progress*", Ed. Stephens R.W.B., Chapman and Hall, 1993.

AE 2604	PROPULSION-II	L T P C 3 1 0 4
GOAL	To have introduction of advanced propulsion system	

Objectives	Outcome
The course should enable the student to :	The student should be able to understand :
1. To study about the turbines and its performance for various conditions.	To understand the working of turbine, blade profiles, performance, cooling methods in turbine blades and its limitations.
2. To study the basics of ramjet and scramjet with their performance characteristics	To understand the operating principle of ramjet, combustion and its performance. Basics of scramjet engine and integral ram engine.
3. To study the types of rockets and their working principles	To understand the rocket operating principles. Rocket nozzle classifications and performance of rockets.
4. To study about chemical rockets and propellants used in chemical rockets.	To understand in detail about solid and liquid propellant rockets and the various types of propellants used with their grain structure and their burning rates.
5. To study the advances in rocket propulsion and space propulsion	To understand about electric, ion and nuclear rockets. The basics of solar sails and its operating principle.

UNIT I AIRCRAFT GAS TURBINES

Impulse and reaction blading of gas turbines – Velocity triangles and power output – Elementarytheory – Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance– Limiting factors in gas turbine design- Overall turbine performance – Methods of blade cooling –Matching of turbine and compressor – Numerical problems.

UNIT II RAMJET PROPULSION

Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet Engine – Ramjet performance – Sample ramjet design calculations – Introduction to scramjet Preliminary concepts in supersonic combustion – Integral ram- rocket- Numerical problems.

UNIT III FUNDAMENTALS OF ROCKET PROPULSION

Operating principle – Specific impulse of a rocket - Rocket nozzle classification – Rocket performance considerations – Numerical Problems.

UNIT IV CHEMICAL ROCKETS

Solid propellant rockets – Selection criteria of solid propellants – Important hardware components of solid rockets – Propellant grain design considerations – Liquid propellant rockets– Selection of liquid propellants – Thrust control in liquid rockets – Cooling in liquid rockets –Limitations of hybrid rockets – Relative advantages of liquid rockets over solid rockets- Numerical Problems.

UNIT V ADVANCED PROPULSION TECHNIQUES

Electric rocket propulsion – Ion propulsion techniques – Nuclear rocket – Types – Solar sail- Preliminary Concepts in nozzle less propulsion.

TEXT BOOKS

1. Sutton, G.P., "*Rocket Propulsion Elements*", John Wiley & Sons Inc., New York, 5th Edn., 1993.

2. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.

REFERENCES

1. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., "*Gas Turbine Theory*", Longman Co., ELBS Ed., 1919.

2.Gorden, C.V., "*Aero thermodynamics of Gas Turbine and Rocket Propulsion*", AIAA Education Series, New York, 1919.

3. Mathur, M., and Sharma, R.P., "Gas *Turbines and Jet and Rocket Propulsion*", Standard Publishers, New Delhi, 1911.

AE 2631	AIRCRAFT DESIGN PROJECT	L T P C 0 0 3 2
GOAL	To develop the basic concept of aircraft design by assigning each student a preliminary specification to design an airplane or helicopter or any flight vehicle	

OBJECTIVES	OUTCOME
The course should enable the student to:	The student should be able to understand :
1.To compare different configuration of airplanes on Specifications and performance details of aircraft.	1.Student at the end of this phase should be able to see how aircraft design changes from one mission to another.
2.To prepare comparative data sheets.	2.Based upon the mission of the aircraft the students designated for a collection of data are collected from different aircraft having the same mission as selected by the student.
3.To compare different graph and selection of main parameters for the design.	3.Here the main design parameter for the aircraft is selected.
4.To calculate the preliminary weight estimations, power plant selection, airfoil selection, wing tail and control surfaces.	4.Student should be able to give the approximate weight of the aircraft that they design by specifying the different types of weight of the aircraft, the types of power plant selected as well as aerofoil selection and tail empennage.
5.To estimate the drag of the aircraft.	5.Student should be able to estimate the overall drag of the newly designed aircraft for further calculation on performance of the aircraft.

EXPERIMENTS

Comparative configuration study of different types of airplanes

Comparative study on specification and performance details of aircraft

Preparation of comparative data sheets

Work sheet layout procedures

Comparative graphs preparation and selection of main parameters for the design

Preliminary weight estimations, selection of main parameters,

Power plant selection, Aerofoil selection, Wing tail and control surfaces

Preparation of layouts of balance diagram and three view drawings

Drag estimation

Detailed performance calculations and stability estimates

LIST OF EQUIPMENTS

Sl.No.	Name of the Equipment	Quantity	Experiments Number
1	Engineering Drawing Board	30	3
2	Engineering Drawing Instruments	30	3

AE 2632	AIRCRAT SYSTEM LABORATORY	L T P C 0 0 3 2
GOAL	To get the practical knowledge and "On-HAND" experience in maintenance of various aircraft systems and common snags rectification procedure un various aircraft system	

OBJECTIVE	OUTCOME
The subject should enable the students to	The students should be able to
1. Understand the aircraft jacking up procedure and its precaution.	1. Carry out aircraft jacking safely without any damage to men equipment.
2. Understand the various methods of aircraft levelling and its procedure.	2. Carry out aircraft levelling as per procedure. .
3. Understand the various check to be carried out to ensure the alignment of control surfaces.	3. Describe the various checks to be carry out to ensure the alignment of control surfaces.
4. Know the procedure and precaution of aircraft symmetry check.	4. Carryout aircraft symmetry check, as per procedure.
5. Understand the various test carried out on hydraulic system components to assess leakage and blockage.	5. Carryout flow test, and pressure test on hydraulic system.
6. Know the procedure for carrying out the landing gear retraction test.	6. Describe the procedure for landing gear retraction test and various precautions to be undertaken before carrying out the test.
7. Understand the various common snags in aircraft hydraulic and fuel systems and its rectification procedure.	7. Carry out rectification of common snags in aircraft hydraulic system as per procedure.

LIST OF EXPERIMENTS

1. **Aircraft "Jacking Up" procedure**
2. Aircraft "Levelling" procedure
3. Control System "Rigging check" procedure
4. Aircraft "Symmetry Check" procedure
5. "Flow test" to assess of filter element clogging
6. "Pressure Test" To assess hydraulic External/Internal Leakage
7. "Functional Test" to adjust operating pressure
8. "Pressure Test" procedure on fuel system components
9. "Brake Torque Load Test" on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.

LIST OF EQUIPMENTS

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S.No.	**Items**	**Quantity**	**Experiment No.**
1.	Serviceable aircraft with all above systems	1	1,2,3,4,5,6,7,1,9,10
2.	Hydraulic Jacks (Screw Jack)	5	1,2,4,1
3.	Trestle adjustable	5	1,2,4,1
4.	Spirit Level	2	1
5.	Levelling Boards	2	1
6.	Cable Tensiometer	1	1
7.	Adjustable Spirit Level	1	1
8.	Plumb Bob	1	1

EL 2431	COMMUNICATION SKILLS & PERSONALITY DEVELOPMENT	L T P C 2 0 0 3
Goal	The goal of the programme is to provide the learners with the methods and materials required for becoming accomplished personalities through the medium of English.	

Objectives	Outcome
The course is expected to enable students to: 1. Be aware of self-knowledge by exposure to soft skills, values, behaviour, attitudes, temperamental changes, and a positive attitude to life.	On completion of the course, the students will be able to: 1. Apply the knowledge gained to improve upon their values, behaviour, attitude, and develop the soft skills required for home, workplace and the society.
2. Learn personality traits and undergo personality tests to determine their own personality characteristics and the scope for improvement.	2. Employ the concept of personality traits and build up an accomplished personality that would be pleasing to people around so as to influence them positively.
3. Cultivate the art of speaking fluently making use of proper gestures, tone and voice modulation, adding humour to the speech.	3. Develop a personal style and communicate fearlessly and effectively in a convincing manner so as to impress listeners or the audience.
4. Figure out the need to work in teams, adorn or accept team leadership, and make use of body language to enhance team spirit.	4. Participate in presentations, group discussions, debates and mock interviews making good use of language skills and interpersonal relationships.
5. Be familiar with the art of managing self, people, work and time, keeping in mind problems like time-wasters and stress-builders.	5. Comprehend stress-management tips to overcome stress-prone habits and develop a career plan with personal, familial and societal goals for success.

UNIT I **12**

Values and attitudes – Value-formation – Values & education – Terminal & Instrumental values – Civic responsibilities – The power of Personal/ Cultural/ Social valves -- Behaviour and attitudes -- Features of attitudes – Developing positive attitude – Overcoming negative attitude -- People skills – Soft skills as per the Work Force Profile – The four temperaments – Sanguine – Choleric – Melancholic – Phlegmatic -- Tests for Personal Chemistry.

UNIT II **12**

What is personality development? – Types of personalities as per (i) Heredity (ii) Environment (iii) Situation – the 16 personality factors – MBTI Tests – Personality types – Increasing self awareness: Assessing one's locus of control, Machiavellianism, self-esteem, self-monitoring, risk-taking, Type A, Type B personality elements – Intellectual and physical abilities for jobs -- Personality tests.

UNIT III **12**

Developing the art of speaking – How to get rid of stage fright? – Enhancing fluency – Modulating voice – Enunciation – Positive and negative gestures – Preparation – How to begin? – How to convince the listeners? – How to wind up the speech? – Adding humour and illustration – Developing one's own style – Types of style – How to influence the audience? – How to become an effective speaker? -- Tests for effective speaking.

UNIT IV **12**

Team work – Team building – Team leadership -- How to face an interview? -- How to participate in a group discussion? – How to argue for or against in a debate? – Body language – Non-verbal communication – Personal appearance – Facial expression – Posture – Gestures – eye contact – Etiquette – Voluntary and involuntary body language – Gender implications -- Tests.

UNIT V **12**

Managing self, people, work, situations – Time-management – Secrets of time-management – Time-wasters – Stress -- Kinds of stress – Spotting stress – Stress-builders – Stress -management tips – Stress-prone habits -- Goals – Career planning – Interpersonal interaction – Interpersonal relationships -- Tests.

References:

1. Burlington, V.T. *Group Interaction in High Risk Environments*. Ashgate Publication, 2004.
2. Fisher, Kimball. *Leading Self-directed Work Terms: A Guide to Developing New Team Leadership Skills.* New York, NY: McGraw Hill, 2000.
3. Ted W. Engstrom and R. Alec Mackenzie. *Managing Your Time: Practical Guidelines on the Effective Use of Time*. 2008.
4. Burnard, Philip. *Training Games for Interpersonal Skills.* McGraw Hill, Inc., New York, 1992.
5. Greenwich, Carolyn. *The Fun Factor,* McGraw Hill, Inc., New York, 1997.

- **Study material will be prepared by the Department of Languages.**
- **Tests suggested will be prepared by a senior faculty of the department.**
- **Movies will be screened to discuss and debate on the topics introduced in each unit.**

SEMESTER VII

AE 2701	HEAT TRANSFER	L T P C 3 1 0 4
GOAL	Thecourseisintendedtobuildupnecessarybackgroundforunderstandingthephysical behaviour of various modes of heat transfer, like, conduction, convection and radiation	

OBJECTIVE	OUTCOME
The subject should enable the student to: 1. The physical behaviour of various modes of heat transfer, like, conduction, convection and radiation. 2. The application of various experimental heat transfer correlations in engineering calculations. 3. The thermal Analysis and sizing of heat exchangers. 4. The basic concept of mass transfer, its types & its correlations. 5. To study the Heat Transfer problems in aircraft and rocket engine combustion chamber.	The students should be able to : 1. Understand the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction. 2. Learn to use the basic methods in Conduction. Understand the concept of Lump Parameter analysis and when it is applicable and earn the concepts of boundary layer. 3. Learn to apply various correlation used in Convective Heat Transfer and Understand the concepts of Black Body, Grey Body, View factor, Radiation shielding. 4. Design/size Heat Exchanger and understand the concept of Mass transfer, its types & laws associated with it. 5. Learn to apply various technique used for high speed flow heat transfer.

UNIT I HEAT CONDUCTION 11

Basic Modes of Heat Transfer – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces – Unsteady state.

Heat Conduction: Lumped System Analysis – Heat Transfer in Semi infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.

UNIT II CONVECTIVE HEAT TRANSFER 12

Introduction – Free convection in atmosphere free convection on a vertical flat plate – Empirical relation in free convection – Forced convection – Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations, application of numerical techniques in problem solving.

UNIT III RADIATIVE HEAT TRANSFER 12

Introduction to Physical mechanism – Radiation properties – Radiation shape factors – Heat exchange between non – black bodies – Radiation shields.

UNIT IV HEAT EXCHANGERS 13

Classification – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method.

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 12

High-Speed flow Heat Transfer, Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.

TOTAL 60

TEXT BOOKS

1. Yunus A. Cengel., "Heat *Transfer – A practical approach"*, Second Edition, Tata McGraw-Hill, 2002.

2. Incropera. F.P.andDewitt.D.P. *" Introduction to Heat Transfer*", John Wiley and Sons – 2002.

REFERENCES

1. Lienhard, J.H., "*A Heat Transfer Text Book*", Prentice Hall Inc., 1911.

2. Holman, J.P. "*Heat Transfer*", McGraw-Hill Book Co., Inc., New York, 6thEdn., 1991.

3. Sachdeva, S.C., *"Fundamentals of Engineering Heat & Mass Transfer*", Wiley Eastern Ltd., New Delhi, 1911.

4. Mathur, M. and Sharma, R.P. "*Gas Turbine and Jet and Rocket Propulsion",* Standard Publishers, New Delhi 1911.

AE 2702	COMPOSITE MATERIALS AND STRUCTURES	L T P C 3 1 0 4
GOAL	Analysis and design of composite structures using moulding methods of construction, fabrication to evaluate and understand the concept of laminated plates.	

OBJECTIVES	OUTCOMES
The course should enable the student to : 1. know the types of composites 2. Understand the need for stress strain relation 3. Understand the fabrication methods 4. Understand the laminated plates 5. Study and understand the different methods & analysis of composite materials.	The students should be able to: 1. Analysis of composite structures 2. Should do microscopic and macroscopic analysis 3. Should analyze sandwich and laminated plates 4. Should be aware of fabrication techniques 5. Should be able to construct and analysis different composite technique.

UNIT I- STRESS STRAIN RELATION **6**

Introduction- Advantages and application of composite materials, reinforcements and matrices – Generalised Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

UNIT II - METHODS OF ANALYSIS **12**

Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis –Determination of material properties. Experimental characterization of lamina.

UNIT III -LAMINATED PLATES **12**

Governing differential equation for a general laminate, angle ply and cross ply laminates.
Failure criteria for composites.

UNIT IV - SANDWICH CONSTRUCTIONS **8**

Basic design concepts of sandwich construction -Materials used for sandwich construction - Failure modes of sandwich panels.

UNIT V - FABRICATION PROCESS **7**

Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

TOTAL :45

TEXT BOOKS

1. Calcote, L R. "*The Analysis of laminated Composite Structures*", Von – Noastrand Reinhold Company, New York 1991.
2. Jones, R.M., "*Mechanics of Composite Materials*", McGraw-Hill, Kogakusha Ltd., Tokyo, 1915.

REFERENCES

1. Agarwal, B.D., and Broutman, L.J., "*Analysis and Performance of Fibre Composites*", John Wiley and sons.Inc., New York, 1995.
2. Lubin, G., "*Handbook on Advanced Plastics and Fibre Glass*", Von Nostrand Reinhold Co., New York, 1919.

AE 2731	AVIONICS LABORATORY	L T P C 0 0 3 2
GOAL	This laboratory is divided into three parts to train the students to learn about basic digital electronics circuits, programming with microprocessors, design and implementation of data buses in avionics with MIL – Std. 1553B and remote terminal configuration and their importance in different applications in the field of Avionics.	

OBJECTIVES	OUTCOME
The subject should enable the students to 1. Understand the addition, subtraction of binary numbers using logic gates. 2. To know about the multiplexer and demultiplexer circuits, encoder and decoder circuits. 3. To understand the addition, subtraction for 8-bit and 16-bit numbers using microprocessor. 4. To understand the ascending and descending order of data in microprocessor. 5. To understand the series with or without carry in microprocessor. 6. To understand the avionics data bus MIL STD 1553B.	The students must be able to 1. Describe the logic gates and truth table for addition, subtraction. 2. Carry out the multiplexer and demultiplexer, encoding and decoding circuits in digital electronics. 3. Understand the addition, subtraction concepts and storing the data in microprocessor. 4. Understand the data flow by ascending or descending order. 5. Understand how the microprocessor handles the carry data. 6. Understand the avionics data bus MIL STD 1553B and how the data's are transmitting and receiving.

LIST OF EXPERIMENTS
DIGITAL ELECTRONICS

1. Addition/Subtraction of binary numbers.
2. Multiplexer/Demultiplexer Circuits.
3. Encoder/Decoder Circuits.
4. Timer Circuits, Shift Registers, Binary Comparator Circuits.

MICROPROCESSORS

5. Addition and Subtraction of 8-bit and 16-bit numbers.
6. Sorting of Data in Ascending & Descending order.
7. Sum of a given series with and without carry.
8. Greatest in a given series & Multi-byte addition in BCD mode.
9. Interface programming with 4 digit 7 segment Display & Switches & LED's.
10. 16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave by Digital to Analog Converter.

AVIONICS DATA BUSES

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

LIST OF EQUIPMENT

S.No.	Details of Equipments	Quantity	Experiment Nos.
1.	Adder/Subtractor Binary bits Kit	6	1
2	Timer Kit	6	1
3	Encoder Kit	6	3
4	Decoder Kit	6	3
5	Comparator Kit	6	4
6	Multiplexer Kit	6	2
7	Demultiplexer Kit	6	2
8	Shift Registers Kit	6	4
9	Microprocessor 8085 Kit	9	5,6,7,8,9
10	4 Digit 7 Segment Display	3	9
11	Switches & LED's Circuit	3	9
12	16 Channel AD Converter	6	10
13	Digital to Analog Converter	6	10
14	Cathode Ray Oscilloscope	3	9,10
15	Regulated Power Supply (5V DC)	9	1, 2,3,4
16	MIL-Std 1553B Setup with Remote Terminal	1	12,13
17	Computers	2	11,12,13

AE 2732	AERO ENGINE REPAIR & MAINTENANCE LABORATORY	L T P C 0 0 3 2
GOAL	To make the students to understand the maintenance and repair procedures of both Piston and Gas Turbine Engines and their procedures followed for overhaul of aero engines	

OBJECTIVES	OUTCOMES
The course should enable the students to	The students should be able to
1. Understand the procedure for stripping of piston engines	1. Carry out stripping of aircraft piston engine as per standard procedure.
2. Know the detailed procedure for cleaning, inspection & NDT checks on Piston engine components.	2.Carry out dimensional check and NDT checks on piston engine components .
3. Understand the procedure & Precautions of Piston engine Re-assembly.	3.Carry out Piston engine Re-assembly as per standard procedure
4.Know the detailed procedure for stripping of Aircraft Gas Turbine Engine(APU)	4.Carryout stripping of APU with proper precautions
5.To familiarise with various checks carried out on A/C Gas Turbine Engine components	5.Carryout NDT checks and dimensional checks on A/C Gas Turbine Engine components
6. To know the procedure and precautions to be followed for Re-assembly of an APU.	6. Carry out re-assembly of an APU as per standard procedures.
7. To study the Piston and Gas Turbine Engine starting procedure.	7. Understand the precautions of Aero engine with precautions.
8. Study of different types of propellers and its pitch setting.	8.Describe the types of propeller and it's pitch setting

LIST OF EXPERIMENTS

1. Stripping of a piston engine
2. Engine (Piston Engine) - cleaning, visual inspection, NDT checks.
3. Piston Engine Components - dimensional checks.
4. Piston – Engine reassembly.
5. Propeller Pitch Setting
6. Stripping of a jet engine
7. Jet Engine – identification of components & defects.
8. Jet Engine – NDT checks and dimensional checks
9. Jet Engine – reassembly.
10. Engine starting procedures

LIST OF EQUIPMENTS

Sl.No	Equipments	Qty	Experiments No.
1	Piston Engines	2	1,2,3,4
2	Jet Engines	2	6,7,1,9
3	Propeller pitch setting stand	1	5
4	Aircraft with serviceable stand	1	1 to 10
5	Precision instruments (VernierCaliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector and DTI	2 each	3,5,1
6	NDT Equipments (Defectoscope, Dyepenetrant method, Hot oil Chalk Method	1 each	2,1

SEMESTER-VIII

AE 2831 PROJECT &VIVA VOCE	**L T P C**
	0 0 24 6

To Implement the students idea and improve their thought process based on their study and practical laboratory work, carryout a project work which will enhance their application in the industry work.

SEMESTER – V (Electives)

AE 7001	**ELECTROMAGNETIC AND WAVE PROPAGATION**	L T P C 3 1 0 4
GOAL	To familiarize the student to the concepts, calculations pertaining to electric, magnetic and electromagnetic fields so that an in depth understanding of antennas, electronic devices, Waveguides is possible	

OBJECTIVE	**OUTCOME**
The course should enable the student to 1. Review the basics of Coordinate systems and Vector Calculus static Electric fields and Electric Potential, flux density, 2. Be familiarized with the fundamental theory of static magnetic fields, Obtain field distribution of various sources, to introduce the fundamentals of Magnetic forces and torque , 3. Understand the Laplace's and Poisson's equations, Capacitance of various geometries, boundary conditions for electric fields, Study the Inductance, Study Magnetic boundary conditions, 4. Study understand Maxwell's equations, the meaning and physical significance, Express Maxwell's four equations in integral and differential forms Study the power flow, 5. Know the concept of plane waves, mathematically represent it in various forms, study wave propagation through various media. And wave passage between dissimilar media.	At the end of the course the student should be able to 1. Solve problems of 3D coordinate systems and vector calculus, Coulomb's law to solve problems related to electrical force, Solve problems related to charge, electric field, and forces, 2. Develop field equations starting from a basic knowledge of Biot-Savart Law, Ampere's law, Develop field equations for various sources of magnetic field and plot the field distribution using any of the software, 3. Solve problems using Laplace's and Poisson's, Calculate capacitance of various geometries, Apply boundary conditions to solve electromagnetic problems, Understand the inductance of different types of conductors, Apply boundary conditions to solve electromagnetic problems, 4. Solve problems using Maxwell's equations, Apply Maxwell's theory to understand the concept of wave propagation, Solve problems of Power flow using Poynting vector, 5. Know how the electromagnetic waves are propagating, Solve problems using various conditions of field propagation, differentiate between different media based on wave propagation and related phenomena and solve problems of reflection and refraction of complex wave propagation.

UNIT I STATIC ELECTRIC FIELDS **9**

Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co-ordinate System – Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Strokes theorem and Divergence theorem Coulomb's Law in Vector Form – Definition of Electric Field Intensity – Principle of Superposition– Electric Field due to discrete charges – Electric field due to continuous charge distribution

-Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet Electric Scalar Potential – Relationship between potential and electric field - Potential due to infinite uniformly charged line – Potential due to electrical dipole - Electric Flux Density – GaussLaw – Proof of Gauss Law – Applications.

UNIT II STATIC MAGNETIC FIELD 9

The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wirecarrying a current I – Magnetic field intensity on the axis of a circular and rectangular loop carryinga current I – Ampere's circuital law and simple applications. Magnetic flux density – The Lorentz force equation for a moving charge and applications –Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.

UNIT III ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 9

Poisson's and Laplace's equation – Electric Polarization-Nature of dielectric materials-Definition of Capacitance – Capacitance of various geometries using Laplace's equation – Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current. Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance –simple examples. Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability - magnetic boundary conditions.

UNIT IV TIME VARYING ELECTRIC AND MAGNETIC FIELDS 9

Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form .Displacement current – Ampere's circuital law in integral form – Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form.Maxwell's four equations in integral form and differential form.Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector.

UNIT V ELECTROMAGNETIC WAVES 9

Derivation of Wave Equation – Uniform Plane Waves – Maxwell's equation in Phasor form – Wave equation in Phasor form – Plane waves in free space and in a homogenous material. Wave equation for a conducting medium – Plane waves in lossy dielectrics – Propagation ingood conductors – Skin effect.Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence.Dependence on Polarization.Brewster angle.

TOTAL = 60

TEXT BOOKS

1. William H. Hayt, John. A. Buck "Engineering Electromagnetics" 7th edition, Tata McGraw Hill, 2005
2. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems." Prentice Hallof India 2nd edition 2003. (Unit IV, V). McGraw-Hill, 9th reprint
3. Mathew . N. O. Sadiku " Principles of Electromagnetics", "4th edition, Oxford university Press, 2009

REFERENCE BOOKS

1.NarayanaRao.N : "Elements of Engineering Electromagnetics" 6th edition, Prentice Hall of India, New Delhi, 2012.
2. David. K. Cheng, "Fields and Wave electromagnetics, 2nd edition, Pearson Education, 2004

E 7002	SIGNALS AND SYSTEMS	L T P C 3 1 0 4
GOAL	To study and analyze characteristics of continuous, discrete signals and systems.	

OBJECTIVE	OUTCOME
The course should enable the students to: 1. Understand the representation of Signals, classification of signals, signal transforms and their properties, 2. Understand the concepts in the analysis of continuous time signals and systems, 3. Understand Sampling Theorem and ZTransform, 4. Understand the concepts of Discrete Time systems, 5. Understand the finite and infinite Impulse response. media. And wave passage between dissimilar media.	At the end of the course the student should be able to: 1. Understand the properties and representation of discrete and continuous signals. 2. Analyze and transform signals to different domains, 3. Perform sampling on the continuous signals along with the analysis of discrete systems using Z-transforms, 4. Perform the analysis and synthesis of discrete time systems, 5. Perform the finite and infinite impulse response analysis of discrete time systems.

UNIT I REPRESENTATION OF SIGNALS **9**

Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity – properties of discrete time complex exponential unit impulse – unit step impulse functions – Transformation in independent variable of signals: time scaling, time shifting. Determination of Fourier series representation of continuous time and discrete time periodic signals – Explanation of properties of continuous time and discrete time Fourier series.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS **9**

Continuous time Fourier Transform and Laplace Transform analysis with examples – properties of the Continuous time Fourier Transform and Laplace Transform basic properties, Parseval's relation, and convolution in time and frequency domains. Basic properties of continuous time systems: Linearity, Causality, time invariance, stability, magnitude and Phase representations of frequency response of LTI systems -Analysis and characterization of LTI systems using Laplace transform: Computation of impulse response and transfer function using Laplace transform.

UNIT III SAMPLING THEOREM AND Z-TRANSFORMS **9**

Representation of continuous time signals by its sample - Sampling theorem – Reconstruction of a Signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals. Basic principles of Z-transform - Z-transform definition – region of convergence – properties of ROC – Properties of Z-transform – Poles and Zeros – inverse Ztransform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion, Relationship between z-transform and Fourier transform.

UNIT IV DISCRETE TIME SYSTEMS **9**

Computation of Impulse & response & Transfer function using Z Transform. DTFT Properties and examples – LTI-DT systems -Characterization using difference equation – Block diagram representation – Properties of convolution and the interconnection of LTI Systems – Causality and stability of LTI Systems.

UNIT V SYSTEMS WITH FINITE AND INFINITE DURATION IMPULSE

RESPONSE **9**

Systems with finite duration and infinite duration impulse response – recursive and nonrecursive discrete time system – realization structures – direct form – I, direct form – II, Transpose , cascade and parallel forms.

TOTAL = 60

TEXT BOOK

1. AlanV.Oppenheim, Alan S.Willsky with S.Hamid Nawab, Signals & Systems, 2nd edn., Pearson Education, 1997.

REFERENCES

1. John G.Proakis and Dimitris G.Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, 4th Edition, PHI, 2006.
2. M.J.Roberts, Signals and Systems Analysis using Transform method and MATLAB, McGraw Hill, 2003.
3. Simon Haykin and Barry Van Veen, Signals and Systems, 2nd Edition, John Wiley, 2007.
4. K.Lindner, Introduction to signals and systems, McGraw Hill International, 1999.
5. Michael J Roberts, Fundamentals of Signals and systems, McGraw Hill, 2008.

SEMESTER – VI

AE 7003	DIGITAL SIGNAL PROCESSING	L T P C 3 1 0 4
GOAL	To provide basic knowledge about various signal processing techniques and their importance	

OBJECTIVE	OUTCOME
The course should enable the students to : 1. Study the DFT and FFT, 2. Study the IIR Filters, 3. Study the FIR filter and Finite Word Length Problems, 4. Study the Sampling rate conversion, 5. Study the fundamentals of Digital Signal Processors.	At the end of the course the student should be able to: 1. Understand the concept of Fourier Transform Technique and it's efficient computation, 2. Understand the design techniques of IIR and FIR filter types, 3. Understand the limitations of Digital processors and to handle various Quantization noises due to finite word length problems, 4. Understand to Decimate and interpolate the signal to convert the sampling rate of the known signal, 5. Know the various type of Digital Signal Processors and their special hardware descriptions.

UNIT I FFT **12**

Introduction to DFT – Efficient computation of DFT –Properties of DFT – FFT algorithms – Radix-2 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms –Use of FFT algorithms in Linear Filtering and correlation.

UNIT II IIR DIGITAL FILTERS DESIGN **12**

IIR Filters – Magnitude response – Phase response – Design and Implementation of Analog Low Pass Butterworth filter - Bilinear transformation –Prewarping, Impulse invariant transformation.

UNIT III FIR DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS **12**

Linear phase filters – Windowing techniques – design of linear phase FIR filters – Rectangular, Hamming – Frequency sampling techniques.
Quantization effects – Input, Product and Co-efficient quantization error - Limit cycle oscillations – Signal scaling.

UNIT IV MULTIRATE DIGITAL SIGNAL PROCESSING **12**

Decimation– Interpolation– Sampling rate conversion– Implementation of sampling rate onversion. Polyphase implementation of FIR filters for Interpolator and decimator.

UNIT V DIGITAL SIGNAL PROCESSORS **12**

Introduction to DSP architecture – Harvard architecture - Dedicated MAC unit - Multiple ALUs, Advanced addressing modes, Pipelining, Overview of instruction set of TMS320C5X and C54X.

TOTAL = 60

TEXT BOOKS

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing Principles, Algorithms and Application, PHI, 4th Edition, 2006.
2. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital Signal Processing A Practical Approach, Pearson Education India, 2nd Edition.
3. B.Venkataramani & M. Bhaskar, Digital Signal Processor Architecture, Programming and Application, TMH 2002. (UNIT – V)

REFERENCES

1. Alan V. Oppenheim, Ronald W. Schafer, "Discrete Time Signal Processing", PHI, 3rd Edition, 2009.
2. Sanjit .K. Mitra, "Digital Signal Processing-A Computer based approach", McGraw-Hill, 4th edition, 2010.
3. S.Salivahanan, A.Vallavaraj, Gnanapriya," Digital Signal Processing", Tata McGraw-Hill /TMH, 2000
4. M.H. Hayes, "Schaums Outline of Digital Signal Processing", Schaum's Outline Series, 2nd Edition, 2011.
5. Avtar singh, S.Srinivasan, "DSP Implementation using DSP microprocessor with Examples" from TMS32C54XX -Thamson / Brooks cole Publishers, 2003

AE 7004	DIGITAL COMMUNICATION	L T P C 3 1 0 4
GOAL	To introduce the basic concepts of digital modulation techniques to baseband pulse, pass band data transmission, to give an exposure to error control coding and finally to discuss about the spread spectrum modulation schemes.	

OBJECTIVE	OUTCOME
The course should enable the students to: 1. Understand different methods of pulse digital modulation and demodulation schemes, 2. Analyze baseband pulse transmission and reception, its noise occurrence and noise reduction in communication channel, 3. Analyze pass band digital modulation and demodulation schemes and compare its bit error probability, 4. Understand error control codes with different coding techniques and decoding techniques in data transmission channel, 5. Understand the spread spectrum modulation techniques which are used in digital communication.	At the end of the course the student should be able to: 1.Understand the different methods of PCM, PAM, DPCM, DM, ADM schemes which are used in digital communication, 2.Understand the analysis of matched filter, ISI, nyquiest's criterion, correlative level coding, adaptive equalization and eye pattern in digital communication channel, 3. Understand the analysis of ASK, FSK, PSK, DPSK, DEPSK, QPSK, MSK and GMSK schemes and comparison of bit error probability, 4.Understand the linear block codes, cyclic codes convolution codes and viterbi decoding techniques in data transmission channel, 5. Understand the PN sequence, DSSS-BPSK, FHSS and gold codes in digital communication.

UNIT I PULSE DIGITAL MODULATION **9**

Elements of digital communication systems, advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error. PAM and Other forms of pulse modulations Differential PCM system (DPCM), TDM, Delta modulation, adaptive delta modulation, comparison of PCM and DM systems, noise in PCM and DM systems.

UNIT II BASE BAND PULSE TRANSMISSION AND RECEPTION **9**

Base band signal receiver, probability of error, the optimum filter, Matched Filter, , probability of error using matched filter, Inter symbol Interference, Nyquist's criterion for Distortion less Base band Binary Transmission, Correlative level coding, Adaptive Equalization, Eye pattern analysis.

UNIT III MODULATION SCHEMES **9**

Introduction of digital modulation techniques- Generation, Detection, Signal space diagram, calculation bit error probability and Power spectra of ASK, FSK, PSK, DPSK, DEPSK, QPSK, MSK and GMSK, similarity of BFSK and BPSK, Comparison of Digital modulation systems using bit error probability.

UNIT IV ERROR CONTROL CODING **9**

Introduction to linear block codes, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes, Algebraic structure, encoding, syndrome calculation, Introduction to convolution codes, encoding of convolution codes, time domain approach, transform domain approach. Graphical approach: state, tree and trellis diagram, decoding using Viterbi algorithm.

UNIT V SPREAD SPECTRUM MODULATION **9**

Pseudo- noise sequences, a notion of spread spectrum – Direct sequence spread spectrum with coherent binary phase shift keying, Signal space Dimensionality and processing gain, Probability of error, Frequency –hop spread spectrum -Maximum length and Gold codes.

TOTAL : 45

TEXT BOOKS

1. Simon Haykin, "Digital communications", John Wiley, 2005.
2. H. Taub and D. Schilling, "Principles of Communication Systems", TMH, 2003.
3. Bernard Sklar, "Digital Communication",Paerson Education, 2nd Edition , 2006.

REFERENCES

1. Sam Shanmugam, " Digital and Analog Communication Systems", -, John Wiley, 2005.
2. B.P.Lathi, "Modern Analog and Digital Communication", Oxford reprint, 3rd edition, 2004.
3. Amitabha Bhattacharya, "Digital Communications", Tata McGraw Hill, 2006.
4. John.G. Proakis, "Fundamentals of Communication Systems", Pearson Education, 2006.
5. Michael. B. Purrsley, "Introduction to Digital Communication", Pearson Education, 2006.
6. Herbert Taub , Donald L Schilling, " Principles of Communication Systems", 3rd Edition, Tata McGraw Hill, 2008.

SEMESTER – VII (ELECTIVES)

AE 7005	CONTROL AND GUIDENCE SYSTEMS	L T P C 3 1 0 4
GOAL	To introduce the concept of Control of an aircraft to the engineers and to provide the necessary mathematical knowledge that are needed in modeling the guidance and control methods.	

OBJECTIVE	OUTCOME
The course should enable the students to: 1. Acquire the knowledge on basic guidance and control concepts, 2. Acquire the knowledge on augmentation systems. 3. Acquire the knowledge on designing the longitudinal autopilot 4. Acquire the knowledge on designing the lateral autopilot 5. Acquire the knowledge on Operating principles and design of guidance laws.	At the end of the course the student should be able to: 1. Understand the basic guidance and control concepts, 2. Know the principles of Stability augmentation systems and control augmentation Systems. 3. Understand the Autopilot-Pitch Orientation Control system , Automatic Flare Control and Flight path stabilization 4. Understand the Methods of Obtaining Coordination, 5. Understand the Operating principles and design of guidance laws

UNIT I INTRODUCTION **4**

Introduction to Guidance and control - definition, Historical background

UNIT II AUGMENTATION SYSTEMS **7**

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts.

UNIT III LONGITUDINAL AUTOPILOT **12**

Displacement Autopilot-Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

UNIT IV LATERAL AUTOPILOT **10**

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm.

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE **12**

Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes

TOTAL: 45

Textbook:

- Franklin, Powell, Feedback Control of Dynamic Systems, Pearson Education India.
- Paul Zarchan, Tactical and Strategic Missile Guidance, AIAA (2010).
- Yanushevsky, Guidance of Unmanned Aerial Vehicles, CRC Press.

REFERENCES:

1. Blake Lock, J.H 'Automatic control of Aircraft and missiles ', John Wiley Sons, New York, 1990.
2. Stevens B.L & Lewis F.L, 'Aircraft control & simulation', John Wiley Sons,
New York, 1992.
3. Collinson R.P.G, 'Introduction to Avionics', Chapman and Hall, India, 1996.
4. Garnel.P. & East.D.J, 'Guided Weapon control systems', Pergamon Press, Oxford, 1977.
5. Nelson R.C 'Flight stability & Automatic Control', McGraw Hill, 1989.
6. Bernad Etikin,'Dynamic of flight stability and control', John Wiley, 1972.

AE 7006	INSTRUMENTATION AND MEASUREMENT	L T P C 3 1 0 4
GOAL	To introduce the concept of measurement and the related instrumentation requirement as a vital ingredient of electronics and communication engineering	

OBJECTIVE	OUTCOME
The course should enable the students to: 1. Acquire the knowledge on basic measurement concepts, 2. Acquire the knowledge on basic electronic measurements, 3. Acquire the knowledge on signal generators and analyzers, 4. Acquire the knowledge on digital instruments, 5. Acquire the knowledge on data Acquisition Systems and Fiber Optic Measurements .	At the end of the course the student should be able to: 1. Understand Measurement systems, Bridge measurements, 2. Know the principles of cathode ray oscilloscopes and other measuring instruments, 3. Understand Function generators, Spectrum analyzer and Wave analyzer, 4. Compare analog and digital techniques, and measurement errors, 5. Understand elements of a digital data acquisition system, Fiber optic measurements.

UNIT I BASIC MEASUREMENT CONCEPTS **9**

Measurement systems – Static and dynamic characteristics – units and standards of measurements – error analysis – moving coil, moving iron meters – multimeters – True RMS meters – Bridge measurements – Maxwell, Hay, Schering, Anderson and Wien bridge.

UNIT II BASIC ELECTRONIC MEASUREMENTS **9**

Force on charge in electric field – Motion of Charge in uniform and time varying electric fields – Force on a moving charge in a magnetic field – Cathode ray oscilloscopes – block schematic – applications – special oscilloscopes – Q meters – Vector meters – RF voltage and power measurements.

UNIT III SIGNAL GENERATORS AND ANALYZERS **9**

Function generators – RF signal generators – Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer – spectrum analyzer.

UNIT IV DIGITAL INSTRUMENTS **9**

Comparison of analog and digital techniques – digital voltmeter – multimeters – frequency counters – measurement of frequency and time interval – extension of frequency range – measurement errors.

UNIT V DATA ACQUISITION SYSTEMS AND FIBER OPTIC MEASUREMENTS **9**

Elements of a digital data acquisition system – interfacing of transducers – multiplexing – computer controlled instrumentation – IEEE 488 bus – fiber optic measurements for power and system loss – optical time domains reflectometer.

TOTAL :45

TEXT BOOKS

1. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India, 2003.
2. S.Salivahanan, N.Sureshkumar and A.Vallavaraj, Electronic Devices and Circuits, TMH, 1998.

REFERENCES

1. Alan. S. Morris, Principles of Measurements and Instrumentation, Prentice Hall of India, 2nd edn., 2003.
2. Ernest O. Doebelin, Measurement Systems- Application and Design-Tata McGraw-Hill-2004.

AE 7007	**RADAR SYSTEMS**	L T P C 3 1 0 4
GOAL	To introduce the basic concepts of Microwave engineering and RADAR concepts to the engineers and to provide the necessary mathematical knowledge that are needed in modeling physical processes	

OBJECTIVE	**OUTCOME**
The course should enable the students to: 1. To know the Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, 2. Analyze Receiver noise and signal to noise ratio, 3. Analyze Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium- 4. To know the Radar requirements , Radar ambiguity function and Optimum waveforms for detection in clutter 5. To know the limitations to tracking Accuracy- Kalman Tracker.	At the end of the course the student should be able to: 1.Understand the Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons 2.Understand the Receiver noise and signal to noise ratio 3. Understand the Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium- 4.Understand the Radar requirements , Radar ambiguity function and Optimum waveforms for detection in clutter 5. Understand the limitations to tracking Accuracy- Kalman Tracker

UNIT I MICROWAVE SOURCES **10**

Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS – solid state source - TEDS, IMPATTS, TRAPATT, GaAs FETs and Tunnel diode.

UNIT II RADAR PRINCIPLES **8**

Introduction to Radar – Radar range equation – Receiver noise and signal to noise ratio- Radar cross section (RCS) – Radar system – Radar Antennas

UNIT III TYPES OF RADARS **10**

CW and FMCW radars-Tracking radars-MTI radar -Principles of coherent MTI radars - Digital MTI, Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium-PRF Mode.

UNIT IV RADAR SIGNAL PROCESSING **9**

Radar requirements –Matched filters- Radar ambiguity function – Optimum waveforms for detection in clutter – Classes of waveforms – Digital representation of signals -Pulse compression

UNIT V TRACKING RADAR **8**

Tracking with radar – Monopulse Tracking – conical scan and sequential lobing – limitations to tracking Accuracy- Kalman Tracker -Fundamentals of Airborne radar

TOTAL: 45

Textbooks:

1. M.I. Skolnik, Introduction to Radar Systems, McGraw hill, 2000.
2. M.I. Skolnik, Radar Handbook, McGraw hill, 2nd edition, 1990.
3. A.K. Sen and A.B. Battacharya, Radar Systems andRadar Aids to Naviation, Khanna Publications, 1988

REFERENCES:

1. Fred E.Nathanson " Radar design Principles " Signal processing and the environment, Prentice Hall, 2004
2. Y. Liao, Microwave Devices and Circuits, Prentice Hall, 1980.
3. Guy V. Morris, Linda L. Harkness, Airborne Pulsed Doppler radar, Second Edition, Artech House Publishers, 1996.
4. Blackman S.S., "Multiple target tracking with radar applications" Artech House 1986.

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AE 7008	NAVIGATION SYSTEMS AND SENSORS	L T P C 3 1 0 4
GOAL	To study the advanced concepts of Aircraft Navigation to the engineers and to provide the necessary mathematical knowledge that are needed in modeling the navigation process and methods.	

OBJECTIVE	**OUTCOME**
The course should enable the students to: 1. Understand the Introduction to navigation and Inertial Sensors 2. Understand the concepts in INS components: transfer function and errors 3. Understand the Different types of radio navigation 4. Understand the concepts of Discrete Time systems, 5. Understand the Introduction to Kalman filtering-Estimation and mixed mode navigation- Integration of GPS and INS-utilization of navigation systems in aircraft	At the end of the course the student should be able to: 1. Understand Introduction to navigation and Inertial Sensors 2. Analyze INS components: transfer function and errors 3. To analyze the Different types of radio navigation 4. Perform the analysis and synthesis of discrete time systems, 5. Perform the Introduction to Kalman filtering-Estimation and mixed mode navigation- Integration of GPS and INS-utilization of navigation systems in aircraft

UNIT I NAVIGATION SYSTEMS & INERTIAL SENSORS **6**

Introduction to navigation – Types – Introduction to Inertial Sensors - Mechanical - Ring Laser gyro- Fiber optic gyro – MEMS system

UNIT II INERTIAL NAVIGATION SYSTEMS **9**

INS components: transfer function and errors- Earth in inertial space - coriolis effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors - Gimbal lock - Initial calibration and Alignment Algorithms

UNIT III RADIO NAVIGATION **12**

Different types of radio navigation- ADF, VOR,DME - Doppler – Hyperbolic Navigations -LORAN, DECCA and Omega – TACAN

UNIT IV APPROACH AND LANDING AIDS **6**

ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter

UNIT V SATELLITE NAVIGATION & HYBRID NAVIGATION **12**

Introduction to GPS -system description -basic principles -position and velocity determination signal structure-DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation-Integration of GPS and INS-utilization of navigation systems in aircraft

TEXT BOOKS

1. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
2. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
3. Sen, A.K. & Bhattacharya, A.B. "Radar System and Radar Aids to Navigation", Khanna Publishers, 1988.
4. Slater, J.M. Donnel, C.F.O and others, "Inertial Navigation Analysis and Design", McGraw-HillBook Company, New York, 1964

REFERENCES:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2nd edition, 1997
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.
3. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.

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