GITAM UNIVERSITY

(Declared as Deemed to be University U/S 3 of UGC Act, 1956)

REGULATIONS & SYLLABUS

OF

B.Tech. (Aeronautical Engineering)

(w.e.f 2013 -14 admitted batch)

Hyderabad Campus, Rudraram

HYDERABAD - 502329

Website: www.gitam.edu

REGULATIONS

(W.e.f. 2013-14 admitted batch)

1.0 ADMISSIONS

1.1 Admissions into B.Tech (Aeronautical Engineering) programme of GITAM University are governed by GITAM University admission regulations.

2.0 ELIGIBILTY CRITERIA

1.2 A pass in 10+2 or equivalent examination approved by GITAM University with Physics, Chemistry and Mathematics.

1.3 Admissions into B.Tech will be based on an All India Entrance Test (GAT) conducted by GITAM University and the rule of reservation, wherever applicable.

2.0 STRUCTURE OF THE B.Tech. PROGRAMME

3.1 The Programme of instruction consists of :

(i) A general core programme comprising Basic Sciences, Basic Engineering,
Humanities & Social Sciences and Mathematics.
(ii) An engineering core programme imparting to the student the fundamentals of engineering in the branch concerned.
(iii) An elective programme enabling the students to take up a group of departmental / interdepartmental courses of interest to him/her.

In addition, a student has to

(i) Carry out a technical project approved by the department and submit a report.
(ii) Under-go summer training in an industry for a period prescribed by the department and submits a report.

3.2 Each academic year consists of two semesters. Every branch of the B.Tech programme has a curriculum and course content (syllabi) for the courses recommended by the Board of Studies concerned and approved by Academic Council.

4.0 CREDIT BASED SYSTEM

4.1 Each course is assigned certain number of credits which will depend upon the number of contact hours (lectures & tutorials) per week.

4.2 In general, credits are assigned to the courses based on the following contact hours per week per semester.

One credit for each Lecture / Tutorial hour.
One credit for two hours of Practical's.
Two credits for three (or more) hours of Practical's.

4.3 The curriculum of B.Tech programme is designed to have a total of 190 to 200 credits for the award of B.Tech degree.

4.4 Every course of the B Tech programme will be placed in one of the nine groups of courses with minimum credits as listed in the Table 1.

Table 1: Group of Courses

S.No,	Group of Courses	Code	Minimum credits
1	Humanities & Social Sciences	HS	12
2	Basic Sciences	BS	17
3	Mathematics	MT	10
4	Basic Engineering	BE	26
5	Core Engineering	CE	68
6	Departmental Elective	DE	9
7	Inter Departmental Elective	IE	8
8	Project Work	PW	8
9	Industrial Training	IT	2
	Total		160

4.0 MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7.0 CONTINUOUS ASSESSMENT AND EXAMINATIONS

7.1 The assessment of the student's performance in each course will be based on continuous internal evaluation and semester-end examination. The marks for each of the component of assessment are fixed as shown in the Table 2.

Table 2: Assessment Procedure

S.No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Best two mid examinations of the three mid examinations for 15 marks each for a total of 30 marks (ii) Remaining 10 marks are given by the teacher by conducting quiz / assignments / surprises tests etc.
		60	Semester-end examination	The semester-end examination in theory courses will be for a maximum of 60 marks.
	Total	100		
2	Practical's	100	Continuous evaluation	(i) 40 marks are allotted for record work and regular performance of the student in the lab. (ii) One examination for a maximum of 20 marks shall be conducted by the teacher handling the lab course at the middle of the semester (iii) One examination for a maximum of 40 marks shall be conducted at the end of the semester (as scheduled by the Head of the Department concerned).
3	Project work (VII & VIII semester)	100	Project evaluation	(i) 50 marks are allotted for continuous evaluation of the project work throughout the semester by the guide. (ii) 50 marks are allotted for the presentation of the project work & viva-voce at the end of the semester.*
4	Industrial Training (VII semester)	100	Industrial training evaluation	(i) 50 marks are allotted for report submission and seminar presentations after completion of the training. (ii) 50 marks are allotted for the viva-voce at the end of the semester.*
5	Comprehensive Viva (VIII semester)	100	Viva-voce	100 marks are allotted for comprehensive viva to be conducted at the end of programme.*

* Head of the Department concerned shall appoint two examiners for conduct of the examination.

8.0 RETOTALLING, REVALUATION & REAPPEARANCE

8.1 Retotalling of the theory answer script of the end-semester examination is permitted on a request made by the student by paying the prescribed fee within ten days of the announcement of the result.

8.2 Revaluation of the theory answer script of the end-semester examination is also permitted on a request made by the student by paying the prescribed fee within fifteen days of the announcement of the result.

8.3 A Student who has secured 'F' Grade in any theory course / Practicals of any semester shall have to reappear for the semester end examination of that course / Practicals along with his / her juniors.

8.4 A student who has secured 'F' Grade in Project work / Industrial Training shall have to improve his report and reappear for viva – voce Examination of project work at the time of special examination to be conducted in the summer vacation after the last academic year.

9.0 SPECIAL EXAMINATION

9.1 A student who has completed the stipulated period of study for the degree programme concerned and still having failure grade ('F') in not more than 5 courses (Theory / Practicals), may be permitted to appear for the special examination, which shall be conducted in the summer vacation at the end of the last academic year.

9.2 A student having 'F' Grade in more than 5 courses (Theory/practicals) shall not be permitted to appear for the special examination.

10.0 ATTENDANCE REQUIREMENTS

10.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She has to repeat the semester along with his / her juniors.

10.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the University College / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

11.0 GRADING SYSTEM

11.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 3.

Table 3: Grades & Grade Points

Grade	Grade points	Absolute Marks
O	10	90 and above
A+	9	80 – 89
A	8	70 – 79
B+	7	60 – 69
B	6	50 – 59
C	5	40 – 49
F	Failed, 0	Less than 40

11.2 A student who earns a minimum of 5 grade points (C grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course. However, a minimum of 24 marks is to be secured at the semester end examination of theory courses in order to pass in the theory course.

12.0 GRADE POINT AVERAGE

12.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

12.2 Semester Grade Point Average (SGPA) is awarded to those candidates who pass in all the courses of the semester.

12.3 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken in all the semesters completed up to the particular point of time.

12.4 The requirement of CGPA for a student to be declared to have passed on successful completion of the B.Tech programme and for the declaration of the class is as shown in Table 4.

Table 4: CGPA required for award of Degree

Distinction	≥ 8.0*
First Class	≥ 7.0
Second Class	≥ 6.0
Pass	≥ 5.0

* In addition to the required CGPA of 8.0, the student must have necessarily passed all the courses of every semester in **first attempt**.

13.0 ELIGIBILITY FOR AWARD OF THE B.TECH DEGREE

13.1 **Duration of the programme**:

A student is ordinarily expected to complete the B Tech. programme in eight semesters of four years. However a student may complete the programme in not more than six years including study period.

13.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

13.3 A student shall be eligible for award of the B.Tech degree if he / she fulfils all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

13.4 The degree shall be awarded after approval by the Academic Council.

RULES

1. With regard to the conduct of the end-semester examination in any of the practical courses of the programme, the Head of the Department concerned shall appoint one examiner from the department not connected with the conduct of regular laboratory work, in addition to the teacher who handled the laboratory work during the semester.

2. In respect of all theory examinations, the paper setting shall be done by an external paper setter having a minimum of three years of teaching experience. The panel of paper setters for each course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council. The paper setters are to be appointed by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations.

3. The theory papers of end-semester examination will be evaluated by internal/external examiner

4. Panel of examiners of evaluation for each course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council.

5. The examiner for evaluation should possess post graduate qualification and a minimum of three years teaching experience.

6. The appointment of examiners for evaluation of theory papers will be done by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations from a panel of examiners approved by the Academic Council.

7. The attendance marks (maximum 5) shall be allotted as follows :

Percentage of Attendance	Marks
76% to 80%	1
81% to 85%	2
86% to 90%	3
91% to 95%	4
96% to 100%	5

B. Tech. (Aeronautical Engineering)

Details of category wise minimum credits as per AICTE norms and actual credits allocated are as follows:

S.No.	Category	Code	Allocated Credits	Minimum Credits as per AICTE
01.	Humanities & Social Sciences	HS	12	12
02.	Basic Sciences	BS	18	17
03.	Mathematics	MT	18	10
04.	Basic Engineering	BE	37	26
05.	Core Engineering	CE	82	68
06.	Departmental Electives	DE	12	09
07.	Inter-Departmental Elective	IE	08	08
08.	Project Work	PW	11	08
09.	Industrial Training	IT	02	02
TOTAL			200	160

B. Tech. (Aeronautical Engineering)

I SEMESTER

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	D/P	Total hours	C	S	T	
1	EUREG101	Engineering English-I	HS	3		---	3	40	60	100	3
2	EURMT102	Engg. Mathematics –I	MT	4		---	4	40	60	100	4
3	EURPH103	Engg. Physics – I	BS	4			4	40	60	100	4
4	EURCH104	Engg. Chemistry –I	BS	4		---	4	40	60	100	4
5	EURCS105	Programming with C	BE	3		---	3	40	60	100	3
6	EURME106	Engineering Drawing	BE	2		3	5	40	60	100	3
7	EURME111	Workshop practice	BE			3	3	100	--	100	2
8	EURCS 113	Programming with C Lab	BE			3	3	100	--	100	2
9	EURCH114	Engineering Chemistry Lab	BS			3	3	100	--	100	2
		TOTAL									**27**

II SEMESTER

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EUREG201	Engineering English-II	HS	3		---	3	40	60	100	3
2	EURMT202	Engg. Mathematics –II	MT	3		---	3	40	60	100	3
3	EURAE203	Engineering Mechanics	BE	3			3	40	60	100	3
4	EURPH204	Engg. Physics-II	BS	3		---	3	40	60	100	3
5	EURCH205	Engg. Chemistry –II	BS	3		---	3	40	60	100	3
6	EURAE206	Introduction to Aeronautics	CE	3		---	3	40	60	100	3
7	EURPH212	Engineering Physics Lab	BS			4	4	100	--	100	2
8	EURAE213	Aeronautical Engineering Workshop	CE			3	3	100	--	100	2
9	EURME215	Engineering graphics Lab	BE			3	3	100	--	100	2
		TOTAL									**24**

L-Lectures T-Tutorials P-Practicals D-Drawing

C-Continuous Evaluation S-Semester End Examination T-Total

III Semester:

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE301	Engineering Mathematics -III	MT	3			3	40	60	100	3
2	EURAE302	Fluid Mechanics	BE	3			3	40	60	100	3
3	EURAE303	Thermodynamics	BE	3			3	40	60	100	3
4	EURAE304	Production Technology	BE	3			3	40	60	100	3
5	EURAE305	Mechanics of Solids	BE	3			3	40	60	100	3
6	EURAE306	Basic Electrical and Electronics Engg.	BE	3			3	40	60	100	3
7	EURAE311	Fluid Mechanics and Mechanics of Solids Lab	BE			3	3	100	--	100	2
8	EURAE312	Electrical and Electronics Lab	BE			3	3	100	--	100	2
9	EURAE313	Computer Aided Aircraft Drawing Lab	CE			3	3	100	--	100	2
10	EURAE314	Industrial Tour	IT					7-10 Days	--		NA
		TOTAL									24

IV Semester:

S.no	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE401	Engineering Mathematics-IV	MT	3			3	40	60	100	3
2	EURAE402	Aerodynamics-I	CE	3			3	40	60	100	4
3	EURAE403	Aircraft Materials and Processes	CE	3			3	40	60	100	3
4	EURAE404	Aircraft Propulsion	CE	3	1		4	40	60	100	4
5	EURAE405	Aircraft Structures-I	CE	3	1		4	40	60	100	4
6	EURAE406	Numerical Methods	MT	3			3	40	60	100	3
7	EURAE411	Numerical Simulation Lab	MT			3	3	100	--	100	2
8	EURAE412	Aircraft Materials and Processing Lab	CE			3	3	100	--	100	2
9	EURAE413	Advanced Communication Skills Laboratory	HS			3	3	100	--	100	2
TOTAL											27

L-Lectures T-Tutorials P-Practicals D-Drawing
C-Continuous Evaluation S-Semester End Examination T-Total

V Semester:

S. No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE501	Environmental Studies	HS	3	1		4	40	60	100	4
2	EURAE502	Aerodynamics-II	CE	3			3	40	60	100	3
3	EURAE503	Flight Mechanics	CE	3			3	40	60	100	3
4	EURAE504	Aircraft Systems & Instruments	CE	3			3	40	60	100	3
5	EURAE505	Aircraft Structures-II	CE	3			3	40	60	100	3
6	EURAE506	Theory of Vibrations	CE	3			3	40	60	100	3
7	EURAE511	Aerodynamics Lab	CE			3	3	100	--	100	2
8	EURAE512	Aircraft Systems Lab	CE			3	3	100	--	100	2
9	EURAE513	Aircraft Structures Lab	CE			3	3	100	--	100	2
		TOTAL									25

VI Semester:

S.no	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE601	Finite Element Analysis	CE	3			3	40	60	100	3
2	EURAE602	Aircraft Stability and Control	CE	3			3	40	60	100	3
3	EURAE603	Control Systems and Instrumentation	BE	3			3	40	60	100	3
4	EURAE604	Aerospace Propulsion	CE	3			3	40	60	100	3
5	EURAE605	Computational Aerodynamics	CE	3			3	40	60	100	3
6	EURAE606	Composite Materials and Mechanics	CE	3			3	40	60	100	3
7	EURAE611	Computational Structural Analysis Lab	CE			3	3	100	--	100	2
8	EURAE612	Aircraft Propulsion Lab	CE			3	3	100	--	100	2
9	EURAE613	Computational Aerodynamics Lab	CE			3	3	100	--	100	2
	TOTAL										24

L-Lectures T-Tutorials P-Practicals D-Drawing

C-Continuous Evaluation S-Semester End Examination T-Total

VII Semester:

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE701	Introduction to Space Technology	CE	3			3	40	60	100	3
2	EURAE702	Aircraft Design	CE	3			3	40	60	100	3
3	EURAE703	Airport and Airline Management	CE	3			3	40	60	100	3
4	EURAE721-725	Department Elective-I	DE	3	1		4	40	60	100	4
5	EURAE731-735	Inter Departmental Elective-I	IE	3	1		4	40	60	100	4
6	EURAE711	Personality Development	HS			3	3	100	--	100	
7	EURAE712	Aircraft Maintenance and Design Lab	CE			3	3	100	--	100	2
8	EURAE713	Industrial Training	IT			6	6	100		100	2
9	EURAE714	Project Phase-I	PW								3
TOTAL											24

Note: Inter Departmental Elective will be from other departments. The list of courses that would be offered by the department in any semester will be notified from which the student may select a course.

L-Lectures **T-Tutorials** **P-Practicals** **D-Drawing**
C-Continuous Evaluation **S-Semester End Examination** **T-Total**

DEPARTMENT ELECTIVE-I

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE721	Helicopter Engineering	DE	4
2	EURAE722	Boundary Layer Theory	DE	4
3	EURAE723	Automatic Flight Control	DE	4
4	EURAE724	Theory of Elasticity	DE	4
5	EURAE725	Introduction to Combustion	DE	4

INTER DEPARTMENT ELECTIVE-I

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE731	Nano Science and Technology	IE	4
2	EURAE732	Theory of Plates and Shells	IE	4
3	EURAE733	Heat and Mass Transfer	IE	4
4	EURAE734	CNC	IE	4
5	EURAE735	Object Oriented Programming with Java	IE	4

VIII semester:

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE801	Avionics	CE	3	-		3	40	60	100	3
2	EURAE821-825	Department Elective-II	DE	3	1		4	40	60	100	4
3	EURAE831-835	Department Elective –III	DE	3	1		4	40	60	100	4
4	EURAE841-845	Inter Departmental Elective-II	IE	3	1		4	40	60	100	4
4	EURAE811	Seminar	CE			3	3	100	-	100	2
5	EURAE812	Project Phase-II	PW			9	9	100	-	100	6
6	EURAE813	Comprehensive Viva-Voce	PW					100	-	100	2
	Total										25

Note: Inter Departmental Elective will be from other departments. The list of courses that would be offered by the department in any semester will be notified from which the student may select a course.

L-Lectures **T-Tutorials** **P-Practicals** **D-Drawing**

C-Continuous Evaluation **S-Semester End Examination** **T-Total**

DEPARTMENT ELECTIVE-II

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE821	High Temperature Materials	DE	4
2	EURAE822	Fatigue and Facture Mechanics	DE	4
3	EURAE823	Rockets and Missiles	DE	4
4	EURAE824	Advanced CFD	DE	4
5	EURAE825	Hypersonic Aerodynamics	DE	4

DEPARTMENT ELECTIVE-III

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE831	Experimental Stress Analysis	DE	4
2	EURAE832	Industrial Aerodynamics	DE	4
3	EURAE833	Wind Tunnel Techniques	DE	4
4	EURAE834	Air Transportation System	DE	4
5	EURAE835	Aerodynamics of Turbo Machinery	DE	4

INTER DEPARTMENTAL ELECTIVE- II

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE841	Microprocessors and Applications	IE	4
2	EURAE842	Neural Networks & Fuzzy Logic	IE	4
3	EURAE843	CAD/CAM and CIM	IE	4
4	EURAE844	Robotics & Automation	IE	4
5	EURAE845	Data Base Management System	IE	4

B. Tech. (Aeronautical Engineering)

I SEMESTER

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	D/P	Total hours	C	S	T	
1	EUREG101	Engineering English-I	HS	3		---	3	40	60	100	3
2	EURMT102	Engg. Mathematics –I	MT	4		---	4	40	60	100	4
3	EURPH103	Engg. Physics – I	BS	4			4	40	60	100	4
4	EURCH104	Engg. Chemistry –I	BS	4		---	4	40	60	100	4
5	EURCS105	Programming with C	BE	3		---	3	40	60	100	3
6	EURME106	Engineering Drawing	BE	2		3	5	40	60	100	3
7	EURME111	Workshop practice	BE			3	3	100	--	100	2
8	EURCS 113	Programming with C Lab	BE			3	3	100	--	100	2
9	EURCH114	Engineering Chemistry Lab	BS			3	3	100	--	100	2
		TOTAL									**27**

B.Tech. (Aeronautical Engineering) - I Semester
EUREG101: ENGINEERING ENGLISH-I

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
HS	3	---	3	60	40	3

Objective:
The fundamental aim of this course is to help the student to become a confident and competent communicator in written and spoken English. The methodology in teaching and evaluation shall be oriented towards this end, rather than rote memorization.
Prerequisite: Acquaintance with basic High School Grammar and Composition.

UNIT - I
INTRODUCTION TO COMMUNICATION: Role and Importance of Communication, Features of Human Communication, Process of Communication,
Types of Communication: Verbal and Non-Verbal,
Importance of Listening in Effective Communication, Barriers to Communication

UNIT - II
EFFECTIVE VOCABULARY: Words Often Confused, One-word Substitutes, Idiomatic Usage, Using Dictionary and Thesaurus.

UNIT - III
FUNCTIONAL GRAMMAR: Functions: Making proposals, Offering suggestions, Apologizing, Requesting, Offering and Refusing help, Giving and asking for information, Making complaints, Interrupting, Giving and asking directions, Inviting, Asking Permission, Expressing ability, etc.,

Articles,
Prépositions
Tenses
Concord

UNIT - IV
COMMUNICATION THROUGH WRITING: Paragraph writing,
Communication through letters: official and personal letters, letters of complaint, letters of enquiry and responses.
Résumé writing, Cover letters, E-mail etiquette, Punctuation

UNIT - V
READING FOR ENRICHMENT: Sachin Tendulkar, Michael Jackson

TEXT BOOKS PRESCRIBED:

1. *E. Suresh Kumar et al.,* Enriching Speaking and Writing Skills, Orient Blackswan, 2012.

REFERENCE BOOKS:

1. *E. Suresh Kumar et al*., Communication Skills and Soft Skills, Pearson, 2010.
2. *Jayashree Mohanraj et al*., Speak Well, Orient Black Swan, 2011.
3. Oxford Advanced Learners' Dictionary, 2010 Edition

B.Tech. (Aeronautical Engineering) - II Semester
EURMT102: ENGINEERING MATHEMATICS – I

Category	Scheme of Instruction		Scheme of Examination			Credits to be Awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
MT	4	---	3	60	40	4

OBJECTIVE:
The course is to impart knowledge in Basic concepts of Mathematics relevant to Engineering applications.

UNIT - I
LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER : Definition, Complete solution, Operator D, Rules for finding complementary function, Inverse operator, Rules for finding particular integral, Method of variation of parameters.

UNIT-II
EQUATIONS REDUCIBLE TO LINEAR DIFFERENTIAL EQUATIONS AND APPLICATIONS: Cauchy's and Legendre's linear equations, Simultaneous linear equations with constant coefficients and applications of linear differential equations to Oscillatory Electrical circuits L-C, LCR – Circuits, Electromechanical Analogy.

UNIT –III
MULTIPLE INTEGRALS AND ITS APPLICATIONS: Double integrals, Change of order of integration, Double integrals in Polar coordinates, Areas enclosed by plane curves, Triple integrals, Volume of solids, Change of variables, Area of a curved surface.

UNIT –IV
SPECIAL FUNCTIONS AND ITS APPLICATIONS: Beta function, Gamma function, Relation between beta and gamma functions, Dirichlet integrals of type I and type II.

UNIT-V
INFINITE SERIES : Definitions of convergence, divergence and oscillation of a series, General properties of series, Series of positive terms, Comparison tests, Integral test, D' Alembert's Ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's rule, Power series, Convergence of exponential, Logarithmic and binomial series (without proofs).

TEXT BOOK PRESCRIBED :

1. *Higher Engineering Mathematics*, Dr.B.S Grewal, Khanna Publishers.

REFERENCES:

1. *Advanced Engineering Mathematics*, Erwin Kreyszig.Wiley Eastern Pvt. Ltd.
2. *Textbook of Engineering Mathematics*, N.P.Bali. Laxmi Publications (P) Ltd.
3. *Higher Engineering Mathematics*, Dr.M.K.Venkata Raman. National Pub. Co.

B.Tech. (Aeronautical Engineering) -I Semester
EURPH103: ENGINEERING PHYSICS – I

Category	Scheme of instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BS	4	---	3	60	40	4

OBJECTIVE:
The aim of the course is to impart knowledge in Basic Concepts of Physics relevant to Engineering applications.

UNIT – I
THERMODYNAMICS: Heat and Work - First Law of Thermodynamics and Applications - Reversible and Irreversible Processes - Carnot's Cycle and Efficiency - Second Law of Thermodynamics - Carnot's Theorem - Entropy - Entropy in Reversible and Irreversible Processes - Entropy and Second Law - Entropy and Disorder - Third Law of Thermodynamics.

UNIT – II
ELECTROMAGNETIC OSCILLATIONS AND ALTERNATING CURRENTS: Energy Stored in a Capacitor and an Inductor - LC Oscillations (Qualitative and Quantitative) - Analogy to Mechanical Motion-Damped Oscillations - Damped Oscillations in an RLC Circuit - Alternating Current (Including Equations for Voltages and Currents) - Fundamental Definitions - (Cycle, Time period, Frequency, Amplitude, Phase, Phase Difference, Root Mean Square (RMS) value, Average Value, Form Factor, Quality Factor, Power in Alternating Current Circuits) - Forced Oscillations and Resonance - The Series RLC Circuit.

ELECTROMAGNETIC WAVES: Induced Magnetic Fields - Displacement Current - Maxwell's Equations - Traveling Waves and Maxwell's Equations - The Poynting Vector - Light and the Electromagnetic Spectrum.

UNIT – III
DIELECTRIC PROPERTIES: Introduction - Fundamental Definitions - Local Field – Claussius - Mossotti Relation -Different Types of Electric Polarizations (electronic, ionic, and dipolar polarizations) - Frequency and Temperature Effects on Polarization - Dielectric Loss - Dielectric Breakdown - Determination of Dielectric Constant - Properties and Different Types of Insulating Materials - Ferroelectric Materials - Spontaneous Polarization in $BaTiO_3$ - Electrets

UNIT-IV

MAGNETIC PROPERTIES: Introduction - Fundamental Definitions - Different Types of Magnetic Materials - Weiss Theory of Ferromagnetism - Domain Theory of Ferromagnetism – Hysteresis - Hard and Soft Magnetic Materials - Ferrites - Microwave Applications - Magnetic Bubbles.

UNIT-V

SUPERCONDUCTIVITY: Introduction - BCS Theory - Meissner Effect - Properties of Superconductors - Type-I and Type-II Superconductors - High Tc Superconductors - Applications.

ULTRASONICS: Introduction - Production of Ultrasonics by Magnetostriction and Piezo-electric Effects - Detection and Applications of Ultrasonics.

PRESCRIBED BOOKS :

1. *Physics part I & II*, Robert Resnick and David Halliday, Wiley- Eastern Limited.
2. *Engineering Physics*, P.K. Palanisamy, Scitech Publications (India) Pvt. Ltd, Chennai.

REFERENCE BOOKS:

1. *Heat, Thermodynamics, and Statistical Physics,* Agarwal, Singhal, Satya Prakash. Pragati Prakashan, Meerut.
2. *Solid State physics*, S.O.Pillai. New Age International (P)Limited, New Delhi.
3. *Materials Science*, M. Arumugam. Anuradha Agencies, Kumbhakonam.
4. *A Text Book of Engg. Physics*, Kshirsagar & Avadhanulu. S.Chand and Co.The Feynman Lectures on Physics, Addison-Wesley.

B.Tech. (Aeronautical Engineering) -I Semester
ERUCH104: ENGINEERING CHEMISTRY-I

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BS	4	---	3	60	40	4

OBJECTIVE:

The objective of the syllabus is to provide knowledge in the basic concepts of the Chemistry of Engineering materials.

UNIT –I

WATER TECHNOLOGY - SOURCES AND PURIFICATION OF WATER: Sources of Water – Impurities in Water- Hardness of Water – Temporary and Permanent Hardness- Units. Municipal Water treatment- Sedimentation – Coagulation–Filtration-Sterilisation - Desalination of Brackish Water - Reverse Osmosis and Electrodialysis.

UNIT – II

WATER TECHNOLOGY-SOFTENING METHODS AND BOILER TROUBLES: Industrial Water treatment- Lime - Soda Ash Method - Chemical reactions –Problems - Zeolite and Ion exchange processes. Boiler Troubles – Boiler corrosion- Scale and Sludge formation - Caustic Embrittlement-Priming and Foaming – Internal conditioning methods like – phosphate, carbonate conditioning.

UNIT – III

SURFACE CHEMISTRY AND NANOCHEMISTRY:

Colloids: Types of Colloids – Preparation of Colloidal solutions – Micelles – Applications of Colloids.

Adsorption : Classification – Adsorption of Gasses on solids - Applications of Adsorption

Nanochemistry : Introduction – Wet chemical methods of preparation (Microemulsion – Solvent Extraction Reduction – Chemical Oxidation / Reduction).

UNIT – IV

POLYMERS: Types of Polymerization– Mechanism of addition polymerization-Moulding constituents and Moulding techniques. Differences between Thermo Plastic and Thermosetting Resins. Preparation and Properties of Polyethylene, PVC, Polystyrene, Polyamides (Nylon-6:6), Polycarbonates and Bakelite - Engineering applications of Plastics, Poly Siloxanes, Polyphosphines.

UNIT – V

ENGINEERING MATERIAL SCIENCE :

REFRACTORIES:– Classification - criteria of a good refractory. Preparation and properties of silica, magnesite and silicon carbide refractories - clay bond, silica nitride bond and self bond in silicon carbide.

GLASS: – Manufacture of glass – types of glasses: Soft glass, hard glass and pyrex glass.
CERAMICS: – Structural clay products, white wares and chemical stone wares.
CEMENT:- Chemical composition of Portland cement. Manufacture, Setting and Hardening of Cement.

TEXT BOOKS PRESCRIBED:

1. *Engineering Chemistry*, P.C. Jain and M. Jain, Dhanapat Rai & Sons, Delhi.
2. *Engineering Chemistry,* B.K.Sharma. Krishna Prakashan, Meerut.
3. *A Textbook of Engineering Chemistry*, Sashi Chawla. Dhanapath Rai & Sons, Delhi.
4. *Text Book of NanoScience and NanoTechnology* , by B.S. Murthy and P. Shankar, University Press

REFERENCE BOOKS :

1. *A Textbook of Engineering Chemistry,* S.S. Dara. S. Chand & Co. New Delhi.
2. *Material Science and Engineering*, V. Raghavan. Prentice-Hall India Ltd.

B.Tech. (Aeronautical Engineering) -I Semester
EURCS105: PROGRAMMING with C

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BE	3	---	3	60	40	3

OBJECTIVE:
The Aim of the course is to acquaint the student with C and the applications of C.

UNIT – I
Algorithm, flowchart, program development steps, structure of C program, Compilers, Linker, Preprocessor, identifiers, basic data types and sizes, Constants, variables, operators, expressions, type conversions, conditional expressions, precedence and order of evaluation. Input-output statements, statements and blocks, programming examples.

UNIT – II
CONTROL STRUCTURES: if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels.
Designing structured programs, Functions, basics, parameter passing, block structure, user defined functions, standard library functions, recursive functions, Comparison of Iteration and Recursion, header files, C preprocessor, storage classes- extern, auto, register, static, scope rules, example c programs.

UNIT – III
ARRAYS: concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays.
POINTERS: concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory management functions, command line arguments, c program examples.

UNIT – IV
STRINGS: What are Strings, Arrays of Strings and Standard Library String Functions.
DERIVED TYPES: structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples.

UNIT – V

Input and output - concept of a file, , File Structure , text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling, C program examples.

TEXT BOOKS:

1. *Computer science, A structured programming approach using C*, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
2. *MASTERING C,* byK R Venugopal, S R Prasad published by Tata McGraw Hill

REFERENCE BOOKS:

1. *Programming with ANSI and Turbo C, by* Ashok N. Kamthane, published by PEARSON Education
2. *Let us C* by Yashwant Kanetkar, published by BPB Publications.

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B.Tech. (Aeronautical Engineering) - I Semester
EURME106: ENGINEERING DRAWING

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BE	2	3	3	60	40	3

OBJECTIVE:

To develop drawing skills for communicating concepts, ideas and designs of engineering products.

UNIT-I

Importance, Significance and scope of engineering drawing, Lettering, Dimensioning. **GEOMETRICAL CONSTRUCTIONS:** Introduction, bisecting a line, perpendiculars lines, parallel lines, divide a line, circle, bisect an angle, trisect an angle, center of an arc, construction of squares, regular polygons, regular polygons inscribed in circles, inscribed circles.

ENGINEERING CURVES: Introduction, Conic sections, ellipse, parabola, hyperbola, cycloid curves, epicycloids and hypocycloid.

UNIT-II

ORTHOGRAPHIC PROJECTIONS: Introduction, principle of projection, methods of projection, orthographic projection, planes of projection, first angle projection and third angle projection.

Projections of Points: Introduction, projections of points in different quadrants

UNIT-III

PROJECTIONS OF STRAIGHT LINES: Introduction, line parallel to one or both the planes, line
contained by one or both the planes, line perpendicular to one of the planes, line inclined to one plane and parallel to the other, line inclined to both the planes, traces, inclinations, and true lengths of the lines.

UNIT-IV

PROJECTIONS OF PLANES: Introduction, types of planes, perpendicular planes, perpendicular to one pane and parallel to other plane, perpendicular to one plane and inclined to other plane, oblique planes.

PROJECTIONS ON AUXILIARY PLANES: types of auxiliary planes, perpendicular to one pane and parallel to other plane, perpendicular to one plane and inclined to other plane, oblique planes.

UNIT-V

PROJECTIONS OF SOLIDS: Introduction, types of solids, polyhedral tetrahedron- prism, pyramid and solids of revolution- cylinder, cone. Projections of solids, simple positions, and axis inclined to on plane and parallel to other, axis inclined to both the planes.

TEXT BOOKS:

1. *Engineering Drawing* by N.D. Bhatt and V. M .Panchal, Charotar publishing house Pvt. Ltd, 49th edition, 2008.
2. *Engineering Drawing* by M.B Shah and B.C Rana, Pearson Edn, 2nd edition, 2009

REFERENCES:

1. *Geometrical Drawing*- A generalized approach by Arunvikram, Ch.Ratnam and P.Vasudevarao, IK International Pvt.Ltd., New Delhi.

3. *A text book on Engineering Drawing* by K.L .Narayana and P. Kanniah (Scitec publications (India) Pvt. Ltd.

B.Tech. (Aeronautical Engineering) - I Semester
EURME111: WORKSHOP PRACTICE

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BE	---	3	--	-	100	2

OBJECTIVE:

The main aim of Workshop Practice is to acquaint the student with the basic tools used in Workshop Practice and to develop skills in using these tools to perform simple tasks. The students should be able to work with these tools to prepare simple jobs in Wood Work PRACTICE, Sheet Metal Working, Forging and Fitting.

An illustrative list of tasks to be performed by the student is given below:

I. WOOD WORKING - Familiarity with different types of woods used and tools used in wood Working technology.

Tasks to be performed:

1) To make Half – Lap joint
2) To make Mortise and Tenon joint
3) To make Corner Dovetail joint
4) To make Briddle joint.

II. SHEET METAL WORKING – Familiarity with different types of tools used in sheet metal working, developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering.

Tasks to be performed:

1) To make Square Tray
2) To make Taper side Tray
3) To make Conical Funnel
4) To make Elbow Pipe.

III. FORGING – Familiarity with different types of tools used in forging technology. Knowledge of different types of furnaces like coal fired, electrical furnaces etc...

Tasks to be performed:

1) To make round M.S rod to square
2) To make L bend in given M.S. Rod.
3) To make S bend in given M.S. Rod.
4) To perform heat treatment tests like annealing, normalizing etc..

IV. FITTING – Familiarity with different types of tools used in fitting technology. Tasks to be performed:

1) To make "V" – fitting
2) To make Rectangular fitting
3) To make Dovetail fitting
4) To make Semi circular fitting
5) To make Hexagon fitting

Student is required to work individually and complete at least three jobs in each technology.

DRESS CODE:

FOR BOYS : Blue Colour Long Apron, Khaki Trousers, Half Sleeve Shirt (Tucked-in), Black Leather Shoes.

FOR GIRLS : Blue Colour Long Apron, Salwar Suit, Black Shoes.

REFERENCE BOOK:

1. *Workshop Technology*, *Part 1,* W.A.J. Chapman, Viva Low Priced Student Edition.
2. *Elements of Workshop Technology,* Volume 1, S.K.Hajra Choudhury, S.K.Bose.
3. A.K.Hajra Choudhury and Nirjhar Roy, Media Promoters and Publishers Pvt. Ltd.

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B.Tech. (Aeronautical Engineering) - I Semester
EURCS113: PROGRAMMING WITH C LAB

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BE	---	3	--	-	100	2

OBJECTIVE:

To provide an awareness to develop the programming skills using computer languages.

1. a) Write a C program to ask the user to enter one char (Upper-Case letter) check whether user entered a Upper-case letter or not(by using relational and logical operators) and then if user has entered a Upper-case letter convert into a Lower-case letter? (hint: Upper-case means capital letters, use ASCII information to check for Upper-case and convert)

b) Write a C program to ask the user to enter two integers and apply all arithmetic operations on those print the corresponding values?(hint : +,-,*,/,%)

c) Write a C program to Determine the ranges of char, short, int and long int variables both signed and unsigned

i) By using sizeof operator (ii) By printing appropriate values from standard header (limits.h)

2. a) Write a Program to Find the Roots of a Quadratic Equation using if else and Switch statements.

b) Write a Program which Generates One Hundred Random Integers in the Range of 1 To 100, store them in an array and then prints the average. Write three versions of the program using Different Loop Constructs.

3. a) Write a C program to find the sum of individual digits of a positive integer.

b) A Fibonacci Sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

c) Write a C program to calculate the following

Sum=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!

4. a) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

b)Write C programs that use both recursive and non-recursive functions

i) To find the factorial of a given integer.

ii) To find the GCD (greatest common divisor) of two given integers.

iii) To solve Towers of Hanoi problem.

5. a) Write a C program to find both the largest and smallest number in a list of integers.

b) Write a program to read set of elements in the array and sort them in ascending order.

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

i) Addition of Two Matrices

ii) Multiplication of Two Matrices

iii) Transpose of a given Matrix

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

i) To insert a sub-string in to given main string from a given position.

ii) To delete n Characters from a given position in a given string.

b) Write a C program to determine if the given string is a palindrome or not

c) Given an Array of Strings Write a Program to Sort the String in Dictionary Order.

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

i) Reading a complex number

ii) Writing a complex number

iii) Addition of two complex numbers

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

a) Count number of characters, words in a file.

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

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

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

B.Tech. (Aeronautical Engineering)- I Semester
EURCH114 – ENGINEERING CHEMISTRY LAB

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem End Exam	Con. Eval	
BS	--	3	--	--	100	2

The objective of the Laboratory Practical's is to make the student to acquire the basic concepts in Engineering Chemistry.

1. Calibration of Volumetric Apparatus.
2. Determination of sodium carbonate in soda ash.
3. Estimation of Iron as Ferrous Iron in an Ore Sample.
4. Estimation of Calcium in Portland cement.
5. Estimation of Volume Strength of Hydrogen Peroxide.
6. a) Estimation of Active Chlorine Content in Bleaching Powder.
   b) Determination of Hardness of a Ground Water Sample.
7. Determination of Chromium (VI) in Potassium Dichromate.
8. Determination of Copper in a Copper Ore.
9. a) Determination of Viscosity of a Liquid
   b) Determination of Surface Tension of a Liquid.
10. a) Determination of Mohr's Salt by Potentiometric Method.
    b) Determination of Strength of an Acid by pH metric Method

II SEMESTER

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EUREG 201	Engineering English - II	HS	3		---	3	40	60	100	3
2	EURMT202	Engg. Mathematics –II	MT	3		---	3	40	60	100	3
3	EURAE203	Engineering Mechanics	BE	3			3	40	60	100	3
4	EURPH204	Engg. Physics-II	BS	3		---	3	40	60	100	3
5	EURCH205	Engg. Chemistry –II	BS	3		---	3	40	60	100	3
6	EURAE 206	Introduction to Aeronautics	CE	3		--	3	40	60	100	3
7	EURPH 212	Engineering Physics Lab	BS			4	4	100	--	100	2
8	EURAE 213	Aeronautical Engineering Workshop	CE			3	3	100	--	100	2
9	EURME 215	Engineering graphics Lab	BE			3	3	100	--	100	2
		TOTAL									**24**

B.Tech (Aeronautical Engineering) - II Semester
EUREG201: ENGINEERING ENGLISH – II

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
HS	3	---	3	60	40	3

OBJECTIVE:
This course is specially designed to teach the elements of effective writing and communicative methods, while imparting the essential skills that help personality development.

UNIT – I
INTERPERSONAL COMMUNICATION: Introduction to interpersonal communication, Models of interpersonal relationship development, Team work, Persuasion techniques

UNIT – II
SPOKEN COMMUNICATION: Importance of spoken communication, Basics of spoken English, Situational dialogues
Speech making: formal and informal

UNIT – III
DEVELOPING VOCABULARY AND CORRECTING COMMON ERRORS: Homonyms, homophones and homographs
Synonyms and antonyms
Oral and written

UNIT – IV
INFORMATION TRANSFER: Using charts, Figures, Tables, Pictograms, Maps
Note making, Note taking

UNIT – V
READING FOR ENRICHMENT: Sir Mokshagundam Visvesvaraya
Steve Jobs: The Early Years

TEXT BOOK PRESCRIBED:
1. E. Suresh Kumar et al., Communication for Professional Success, Orient Blackswan, 2012.

REFERENCE BOOKS:

1. E. Suresh Kumar et al., *Communication Skills and Soft Skills*, Pearson, 2010.
2. Jayashree Mohanraj et al., *Speak Well,* Orient Black Swan, 2011.
3. *Oxford Advanced Learners'* Dictionary, 2010 Edition.

B.Tech. (Aeronautical Engineering) II Semester
EURMT202: ENGINEERING MATHEMATICS – II

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
MT	3	---	3	60	40	3

OBJECTIVE:
The course is to impart knowledge in Basic concepts of Mathematics relevant to Engineering applications.

UNIT – I
PARTIAL DIFFERENTIATION: Introduction to Partial differentiation, Total derivative, Differentiation of implicit functions, Geometrical interpretation, Tangent plane and normal to a surface, Change of variables, Jacobians, Taylor's theorem for functions of two variables.

UNIT –II
APPLICATIONS OF PARTIAL DIFFERENTIATION: Total differential, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers, Differentiation under the integral sign, Leibnitz's Rule.

UNIT-III
PARTIAL DIFFERENTIAL EQUATIONS : Introduction, Formation of partial differential equations, Solutions of a partial differential equation, Equations solvable by direct integration, Linear equations of the first order, Non-linear equations of the first order, Homogeneous linear equations with constant coefficients, Rules for finding the complementary function, Rules for finding the particular integral.

UNIT-IV
LINEAR ALGEBRA-1: Rank of Matrix, Elementary transformations, Elementary matrices, Inverse, Normal form, Consistency of linear system of equations, Linear transformations.

UNIT-V
LINEAR ALGEBRA – 2: Eigen value and eigen vectors of a matrix, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic forms and canonical forms, Hermitian and Skew Hermitian matrix, Unitary matrix.

TEXT BOOKS PRESCRIBED :

1. *Higher Engineering Mathematics,* Dr.B.S Grewal, Khanna Publishers.

REFERENCES :

1. *Advanced Engineering Mathematics,* Erwin Kreyszig, Wiley Eastern Pvt. Ltd.
2. *Textbook of Engineering Mathematics,* N.P.Bali, Laxmi Publications (P) Ltd.
3. *Higher Engineering Mathematics,* Dr. M.K.Venkata Raman, National Pub. Co.

B.Tech. (Aeronautical Engineering) II Semester
EURAE203: ENGINEERING MECHANICS

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BE	3	---	3	60	40	3

OBJECTIVE:

The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios.

UNIT – I

BASIC CONCEPTS& EQUILIBRIUM: Introduction to Engineering Mechanics – Resolution of a Force, Moment of a Force and its applications, Varignon's theorem. Couples, Resultant of Force Systems. Free Body Diagram, equilibrium of coplanar force systems.

UNIT – II

FRICTION: Nature of Friction, Laws of Dry Friction, Coefficient of Friction, Angle of Friction, Static Friction, Dynamic Friction, Rolling Friction, Belt Friction, Screw Friction, Ladder Friction and Wedge Friction, Equilibrium of coplanar force systems involving Frictional Forces.

UNIT- III:

TRUSSES: Analysis of Trusses by Method of Joints and Method of Sections.

Center of Gravity: First moment of area and the Centroid of sections, Centroid of Composite Areas, Centroid of an Area Bounded by two Curves. Centre of Gravity of a Body, Centre of Gravity of Composite Bodies.

UNIT - IV

PROPERTIES OF SURFACES AND SOLIDS: Moment of Inertia and Product of Inertia of Plane Areas by Integration,– 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 Masses like Disc, Cylinder, Sphere and Thin Rod.

UNIT – V

KINETICS: Force, Mass and Acceleration: Introduction, Newton's Laws of Motion, Equations of Motion of a Particle in Rectilinear and Curvilinear Motion, Motion of Mass centre of a System of Particles, Kinematics of Plane Motion, Equations of Motion of a Rigid Body in Rotation and Plane Motion, D' Alembert's Principle.

WORK AND ENERGY –IMPULSE AND MOMENTUM: Concept of Virtual Work, Work Done by a Force and a System of Forces, Work done by a Varying force, Energy, Potential Energy, Kinetic Energy of a Particle, Kinetic Energy of a Rigid Body in Rotation and in Plane Motion, Work and Energy Principle, Law of Conservation of Energy. Linear Impulse, Linear Momentum, Principle of Linear Impulse and Linear Momentum, Conservation of Linear Momentum, Direct Central Impact, Coefficient of Restitution.

TEXT BOOKS:

1. *Engineering Mechanics* by S. Timoshenko and D.H.Young, McGraw-Hill International Edition – SI Version

REFERENCE BOOKS:

1. *Engineering Mechanics* – Statics and Dynamics by Ferdinand L. Singer, Harper
2. International Edition
3. *Engineering Mechanics* – Statics and Dynamics by Irving Shames, Prentice Hall of India
4. *Engineering Mechanics* – Volume I Statics by J. L. Meriam and L. G. Kraige, John Wiley and Sons
5. *Engineering Mechanics* – Statics and Dynamics by McLean and Nelson(Schaum's Outline Series), McGraw-Hill Book Co.

B.Tech. (Aeronautical Engineering) - II Semester
EURPH204: ENGINEERING PHYSICS-II

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BS	3	---	3	60	40	3

OBJECTIVE:
The aim of the course is to impart knowledge in basic concepts of physics relevant to engineering applications.

UNIT - I
INTERFERENCE:- Introduction – Interference in Thin Films – Wedge Shaped Film – Newton's Rings – Michelson's Interferometer and Applications.
DIFFRACTION:- Introduction - Differences between Fresnel and Fraunhofer Diffractions - Single Slit Diffraction (Qualitative and Quantitative Treatment)– Differences between Interference and Diffraction. Gratings and Spectra-Multiple Slits; Diffraction Grating; X-ray Diffraction; Bragg's Law.

UNIT – II
POLARISATION:- Introduction – Double Refraction –Negative Crystals and Positive Crystals - Nicol's Prism – Quarter Wave Plate and Half Wave Plate – Production and Detection of Circularly and Elliptically Polarised Lights.
LASERS : Introduction - Spontaneous and Stimulated Emissions – Population Inversion – Ruby Laser – He-Ne Laser – Semiconductor Laser – Applications

UNIT – III
MODERN PHYSICS (QUANTUM PHYSICS): Matter Waves – Heisenberg's Uncertainty Principle - Schrodinger's Time Independent Wave Equation – Physical Significance of Wave Function (ψ) – Application to a Particle in a one Dimensional Box (Infinite Potential Well) –Free Electron Theory of Metals – Band Theory of Solids (qualitative) – Distinction between Metals, Insulators and Semiconductors – Elementary Concepts of Maxwell - Boltzmann, Bose - Einstein and Fermi – Dirac Statistics (No Derivation)

UNIT – IV
SEMICONDUCTORS: Introduction - Intrinsic and Extrinsic Semiconductors - Carrier Concentration in Intrinsic Semiconductors - Carrier Concentration in n-Type Semiconductors - Carrier Concentration in p-Type Semiconductors - Hall Effect and Applications -Variation of Carrier Concentration with Temperature - Conductivity of

Extrinsic Semiconductor - PN Junction - Forward Bias - Reverse Bias -VI Characteristics of a PN Junction - Fundamentals of LED, LCD - Photovoltaic Cell (Solar Cell).

UNIT – V

FIBRE OPTICS: Introduction - Optical Paths in Fibre - Optical Fibre and Total Internal Reflection - Acceptance Angle and Cone of a Fibre - Fibre Optics in Communications - Applications.

NANOSCIENCE: History – Definition - Size Dependent Properties (Qualitative): Mechanical and Electrical - Growth Techniques: Top Down (PVD, Ball Milling) - Bottom Up (Sol-Gel and Co-Precipitation) - Applications.

PRESCRIBED BOOKS :

1. *Physics part I & II*, Robert Resnick and David Halliday, Wiley- Eastern Limited.
2. *Engineering Physics*, P.K. Palanisamy, Scitech Publications (India) Pvt. Ltd, Chennai.

REFERENCE BOOKS:

1. *Heat, Thermodynamics, and Statistical Physics,* Agarwal, Singhal, Satya Prakash. Pragati Prakashan, Meerut.
2. *Solid State physics*, S.O.Pillai. New Age International (P)Limited, New Delhi.
3. *Materials Science*, M. Arumugam. Anuradha Agencies, Kumbhakonam.
4. *A Text Book of Engg. Physics*, Kshirsagar & Avadhanulu. S.Chand and Co.The Feynman Lectures on Physics, Addison-Wesley.

B.Tech. (Aeronautical Engineering) - II Semester
EURCH205: ENGINEERING CHEMISTRY – II

Category	Scheme of instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BS	3	---	3	60	40	3

OBJECTIVE:
The syllabus is to provide knowledge in the basic concepts of the Chemistry of Engineering materials.

UNIT-I
NON-CONVENTIONAL ENERGY SOURCES AND APPLICATIONS:
Chemical: Electrode Potential –Determination of Single Electrode Potential-Reference Electrodes – Hydrogen and Calomel Electrodes. Electrochemical Series and its Applications. Primary Cell–Dry or Leclanche Cell. Secondary Cell – Lead acid storage cell - Fuel Cell:Hydrogen-Oxygen Fuel Cell.
Solar : Photoelectric cells –Applications of Solar Cells

UNIT-II
CORROSION ENGINEERING: Definition of Corrosion. Theories of Corrosion –Dry Corrosion and Electro Chemical Corrosion. Factors Affecting Corrosion- Nature of the Metal and Nature of the Environment. Prevention of Corrosion: Cathodic Protection, Inhibitors, Metallic Coatings – Anodic and cathodic coatings -Galvanising and Tinning, Anodized Coatings. Organic Coatings-Paints –Characteristics, Constituents and their functions, Varnishes.

UNIT-III
FUEL TECHNOLOGY: **Calorific Value and Solid Fuels**: Classifications of Fuels – Characterstics of Fuels- Calorific Value - Units. Determination – Bomb Calorimetric Method- Dulong's formula. Solid Fuels–Coal, Classification of Coal by Rank-Analysis of Coal –Proximate and Ultimate Analysis. Coke : Manufacture of Coke- Beehive oven and Otto Hoffmann's by product oven processes.

UNIT-IV
FUEL TECHNOLOGY : Liquid Fuels: Refining of Petroleum - Petroleum products used as Fuels - Gasoline - Knocking and Octane Number of Gasoline. Diesel - Cetane Number High speed and low speed Diesel oil. Synthetic Petrol –Bergius and Fishcher - Tropsch methods. Power Alcohol - Manufacture, Advantages and Disadvantages - LPG.

UNIT-V

LUBRICANTS : Classification-Properties- Viscosity ,Oiliness, Flash and Fire - Points, Cloud and Pour - Points. Aniline point, Saponification number ,Carbon residue, Emulsification number volatility, precipitation number, specific gravity and neutralization number. Principles and Mechanism of Lubrication - Fluid Film, Boundary and Extreme - Pressure Lubrications.

TEXT BOOKS PRESCRIBED :

1. *Engineering Chemistry*, P.C. Jain and M. Jain. Dhanapat Rai & Sons, Delhi.
2. *Engineering Chemistry,* B.K.Sharma.Krishna Prakashan,Meerut.
3. *A Textbook of Engineering Chemistry*, Sashi Chawla, Dhanapath Rai & Sons, Delhi.

REFERENCE BOOKS :

1. *A Textbook of Engineering Chemistry,* S.S.Dara, S.Chand & Co. New Delhi.
2. *Material Science and Engineering*, V.Raghavan, Prentice-Hall India Ltd.

B.Tech. (Aeronautical Engineering) II Semester
EURAE206: INTRODUCTION TO AERONAUTICS

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
CE	3	---	3	60	40	3

OBJECTIVE:

To make basic understanding of airplanes, helicopters, spacecraft, aero engines, satellites and their functions.

UNIT- I

INTRODUCTION: Evolution of Planes: Pre Wright brother era to present plane. Progress in Structure airplane design and applications ; Classification of aircraft and space vehicles. Functions of major Components of an airplane. Conventional Control and Power controls, Role of DGCA in air safety and regulatory authority, accident investigation. Human factors in flight safety.

UNIT -II

FLIGHT CONTROL SURFACES

Aircraft principle axes, Main control surfaces –Ailerons, types of ailerons, Elevators, rudders, spoilers, spoileron, flaps, use of flaps during takeoff, landing, maneuvering. Types of flaps- slotted, fowler, junkers, gouge, Slats and slots. Airbrakes

UNIT -III

AIRPLANE STRUCTURES: Structural arrangement of Monocoque, Semi-monocoque and geodesic construction. Details of the structural layout of wing, fuselage and tail planes. Aircraft joints.

Types of wings – monoplanes – biplanes - triplanes and multiplanes.

Wing geometry – straight wing – swept wing – variable geometry –delta wing -

Airframe Configuration – Tandem wing – Flying wing – Blended Wing Body – Lifting Body.

UNIT -IV

AIRPLANE PROPULSION:

piston engines and jet engines,Various means of thrust production, Comparative merits.

Ramjet, Pulse Jet, Scramjet.

Rockets- Principle of operation, types and application. Hypersonic Vehicle Propulsion

SATELLITE SYSTEM- Elements, operation, Structures, Mechanisms and Materials, Power Systems, Communication and Telemetry. Indian satellites and their purpose.

Indian satellite Launch Vehicles.

UNIT- V

HELICOPTERS :

Rotorcraft, Types of rotorcraft- Autogyro, gyrodyne, helicopter- Main rotor system- fully articulated, semi rigid and rigid rotor system. Transmission system- Main rotor drive, tail rotor drive. Helicopter control- collective pitch control, cyclic pitch control, anti torque mechanism, throttle control. Basics of helicopter aerodynamics

TEXT BOOKS:

1. *Introduction to Aeronautics,* Gregg Angels, Random Exports, New Delhi
2. *Fundamentals of Flight,* Richard S. Shevel, Prentice Hall
3. *Helicopter Engineering,* Lalit Gupta Himalayan Books New Delhi 1996 edition

REFERENCES:

1. *Introduction to Flilght,* Anderson, J.D., , McGraw Hill, 1995.
2. *Flight without Formulae*, Kermode, A.C., McGraw Hill, 1987.

B.Tech. (Aeronautical Engineering) II Semester
EURPH212: ENGINEERING PHYSICS LAB

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BS	---	4	-	-	100	2

OBJECTIVE:
The course is to acquaint the students with basic concepts in Engineering Physics using the following illustrative list of experiments.

1. J – by Callender and Barne's Method.
2. Thermal Conductivity of a Bad Conductor – Lee's Method.
3. Magnetic Field Along the Axis of a Circular Coil Carrying Current – Stewart and Gee's Galvanometer.
4. Hall Effect- Measurement of Hall Coefficient.
5. Carey Foster's Bridge – Laws of Resistance and Specific Resistance.
6. Calibration of Low Range Voltmeter – Potentiometer Bridge Circuit.
7. Thickness of a Paper Strip- Wedge Method.
8. Newton's Rings – Radius of Curvature of a Plano Convex Lens.
9. Diffraction Grating – Normal Incidence.
10. Determination of Refractive Indices (o and e) of a Bi-Refringent Material (Prism).
11. Cauchy's Constants – Using a Spectrometer.
12. Dispersive Power of a Prism – Using a Spectrometer.
13. Determination of Rydberg Constant.
14. LASER – Diffraction.
15. Determination of Band Gap in a Semiconductor.
16. Optical Fibres – Numerical Aperture and Loss of Signal.
17. VI Characteristics of a pn-junction diode
18. Response of a series RLC Circuit

B.Tech. (Aeronautical Engineering) -II Semester
EURAE213: AERONAUTICAL ENGINEERING WORKSHOP

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
CE	-	3	-	-	100	2

OBJECTIVE:
To develop basic manufacturing skills and concepts of Aeronautical components.

The illustrated list of experiments using hand tools is as follows:

1. Making of a NACA 0012 or 0015 Airfoil (Symmetric).
2. Making of a NACA 2412 or 2415 Airfoil (Cambered).
3. Making of a Wing using sheet metal.
4. Making of a Lap Joints using sheet metal and rivets.
5. Making of a Butt Joints using sheet metal and rivets.
6. Making of Winglets of different Shapes.
7. Making of Helicopter Rotor Blade.
8. Making of Propeller.
9. Making of Pitot Tube.
10. Making of a Chart /Board of Civil Aircrafts.
11. Making of a Chart /Board of Military Aircrafts.
12. Making of a Chart /Board of Indian Launch Vehicles.
13. Aircraft wood gluing practice

Note: Any 10 experiments can be performed out of the above 12 experiments.

B.Tech. (Aeronautical Engineering) -II Semester
EURME215: ENGINEERING GRAPHICS LAB

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
BE	---	3	-	--	100	2

OBJECTIVE:

To develop graphic skills for communicating concepts, ideas and designs of engineering products.

INTRODUCTION TO AUTOCAD: Beginning a new drawing, exploring and interacting with the Drawing window, saving and opening a file, coordinate systems, draw commands, modify commands, dimensioning and object properties.

SECTIONS OF SOLIDS: Introduction, section planes, sections and true shape of a section. Sections and sectional views of solids- prism, pyramid, cylinder and cone.

DEVELOPMENTS OF SURFACES: Introduction, Developments of lateral surfaces of right solids cube, prisms, cylinders, pyramids and cones.

INTERSECTION OF SURFACES: Introduction, line of intersection, different methods, intersection of two prisms, intersection of two cylinders, intersection of cylinder and prism, intersection of cone and cylinder, intersection of cone and prism, intersection of cone and cone.

ISOMETRIC PROJECTIONS: Introduction, isometric axes, lines and planes. Isometric scale,
isometric view and projections of solids in simple position- prism, pyramid, Cylinder, cone and sphere.

TEXT BOOKS:

1. *Engineering Drawing* by N.D. Bhatt and V. M .Panchal, Charotar publishing house Pvt. Ltd, 49th edition, 2008.
2. *Engineering Graphics* with AutoCAD 2011 by James D. Bethune, Prentice Hall of India 2010, 1st edition.

REFERENCES:

1. *Geometrical Drawing*- A generalized approach by Arunvikram, Ch.Ratnam and P.Vasudevarao, IK International Pvt.Ltd., New Delhi.
2. *Engineering Drawing,* by K.L .Narayana and P. Kanniah (Scitec publications (India) Pvt Ltd.

III Semester:

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE301	Engineering Mathematics-III	MT	3			3	40	60	100	3
2	EURAE302	Fluid Mechanics	BE	3			3	40	60	100	3
3	EURAE303	Thermodynamics	BE	3			3	40	60	100	3
4	EURAE304	Production Technology	BE	3			3	40	60	100	3
5	EURAE305	Mechanics of solids	BE	3			3	40	60	100	3
6	EURAE306	Basic Electrical and Electronics Engg.	BE	3			3	40	60	100	3
7	EURAE311	Fluid Mechanics and Mechanics of Solids Lab	BE			3	3	100	--	100	2
8	EURAE312	Electrical and Electronics Lab	BE			3	3	100	--	100	2
9	EURAE313	Computer Aided Aircraft Drawing Lab	CE			3	3	100	--	100	2
10	EURAE314	Industrial Tour	IT					--	--		NA
		TOTAL									**24**

B.Tech. (Aeronautical Engineering) -III Semester
EURAE301: ENGINEERING MATHEMATICS – III

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
MT	3	---	3	60	40	3

OBJECTIVE:

To impart analytical skills to the students in the areas of core Aeronautical Engineering streams.

UNIT-I

FOURIER SERIES: Euler's formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even functions, Expansions of odd or even periodic functions, Half range series and practical Harmonic Analysis.

UNIT-II

VECTOR CALCULUS (DIFFERENTIATION) : Scalar and vector fields, Gradient, Divergence, Curl, Directional derivative, Identities, Irrotational and Solenoidal fields.

UNIT-III

VECTOR CALCULUS (INTEGRATION) : Line integral, Surface integral, Volume integral, Green's theorem in the plane, Stoke's and Gauss divergence theorems with proofs, Introduction of orthogonal curvilinear co-ordinates, Cylindrical co-ordinates, Spherical polar co-ordinates (without proof)

UNIT-IV

FUNCTIONS OF A COMPLEX VARIABLE & APPLICATIONS: Functions of a complex variable –analytical functions – Cauchy-Riemann equations – elementary functions of z – conformal mappings – bilinear transformation. Special conformal transformation ($w = z^2$, $w= z+1/z$, $w = e^z$, $w= \cosh z$).

UNIT-V

COMPLEX INTEGRATION: Cauchy's theorem , Cauchy's integral formula – series of complex functions – Taylor's series – Laurent's series – residue theorem – evaluation of real definite integrals.

TEXT PRESCRIBED :

1. *Higher Engineering Mathematics,* Dr.B.S Grewal. Khanna Publishers.

REFERENCES :

1. *Advanced Engineering Mathematics,* Erwin Kreyszig. Wiley Eastern Pvt. Ltd.
2. *Textbook of Engineering Mathematics,* N.P.Bali. Laxmi Publications (P) Ltd.
3. *Higher Engineering Mathematics,* Dr.M.K.Venkata Raman. National Pub. Co.

B.Tech. (Aeronautical Engineering) - III Semester
EURAE302: FLUID MECHANICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam Marks	Total	
BE	3	-	-	3	40	60	100	3

OBJECTIVE:

To introduce the behaviour of fluids, kinematics and dynamics of fluids.

UNIT-I

FLUID PROPERTIES AND FLUID STATICS: Mass Density, Viscosity, Vapor Pressure, Compressibility, Surface Tension and Capillarity. Pascal's law, Hydrostatic law. Measurement of Pressure: Piezometer, Simple and Differential manometers. Total pressure and Center of pressure – horizontal, vertical and inclined plane surfaces.

UNIT-II

FLUID KINEMATICS: Classification of flows, Steady, Unsteady, Uniform, Non-uniform, Laminar, Turbulent, Rotational, Irrotational flows, Stream line, Path line, Streak line, Stream tube, One, Two and Three dimensional flows. Velocity and Acceleration - Stream function- Velocity Potential function –Equipotential line –Flow Net –Types of Motion – Vorticity and Circulation – Free Vortex flow and Forced Vortex flow.

FLUID DYNAMICS: Three dimensional Continuity equation, Cylindrical and Polar Coordinates - Surface and Body Forces – Euler's and Bernoulli's Equation of Motion – Applications of Bernoulli's Equation – Momentum Equation- applications.

UNIT-III

CLOSED CONDUIT FLOW: Characteristics of real fluids – Reynolds Experiment – Darcy's Equation – Minor Energy losses in pipes – Total Energy **Line** and Hydraulic gradient Line – Flow Through Syphon - Pipes in Series – Equivalent Pipe - Pipes in parallel –Flow Through Branched Pipes.

UNIT-IV

VISCOUS FLOW: Viscous Flow Through Circular Pipe – Hagen-Poiseuille Law- Flow Through Annulus - Flow between Two Parallel Plates –Flow Through Porous Media – Flow around a sphere- Stokes law**.**

UNIT-V

BOUNDARY LAYER FLOW: Definition - Thickness of Boundary Layer – Boundary layer along a long thin plate and its characteristics –Boundary Layer Equations – Momentum Integral Equation of the Boundary layer – Laminar Boundary Layer- Turbulent Boundary Layer – laminar Sub layer –Separation of boundary layer – Methods of controlling the Boundary layer.

DIMENSIONAL ANALYSIS: Dimensional Homogeneity – Methods of Dimensional Analysis - Rayleigh Method -Buckingham π- Method- Use of Dimensional Analysis in Presenting Experimental Data- Model Testing- Types of Similarity- Geometric, Kinematic and Dynamic Similarities- Force Ratios – Dimensionless Numbers.

TEXT BOOKS:

1. *Fluid Mechanics and Hydraulic Machines*, by R.K.Bansal, Laxmi publications.
2. *Hydraulics and Fluid Mechanics* by Modi and Seth, Standard book house

REFERENCES:

1. *Fluid Mechanics* by F. M. White , Mc Graw Hill Series.
2. *Fluid Mechanics*, by A.K.Mohanty, Prentice Hall of India Pvt.Ltd.
3. *Fluid Mechanics* , by Douglas and swasfield , Pearson Asia
4. *Foundations of Fluid Mechanics,* by Yuan, Prentice Hall of India.
5. *Fluid Mechanics and its Applications*, by S.K.Gupta and A.K.Gupta, Tata McGraw Hill, New Delhi.

B.Tech. (Aeronautical Engineering)- III Semester
EURAE303 : THERMODYNAMICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing / Practical		Con. Eval	End Exam	Total	
BE	3	-	-	3	40	60	100	3

OBJECTIVE:

Thermodynamics is a branch of natural science concerned with heat and its relation to energy and work.

UNIT - I

BASIC CONCEPTS- Introduction- Basic Concepts - Thermodynamic Systems, Perfect Gas laws- Equation of State- Universal Gas Constant Vander Waal's Equation of State. Thermodynamic Systems, Micro & Macro Systems- Homogeneous and Heterogeneous Systems - Concept of Continuum- Pure Substance - Thermodynamic Equilibrium, State Property, Path, Process- Reversible and Irreversible Cycles. Specific Heats at Constant Volume and Pressure. Energy as a Property of the Systems- Energy in state and Transition, Work, Heat, Point Function, Path Function.

UNIT - II

FIRST LAW OF THERMODYNAMICS: Joule's Experiments- First law of Thermodynamics- Corollaries- First law of Thermodynamics Applied to Various Non-Flow Processes- Properties of end States- Heat Transfer and Work Transfer- Change in Internal Energy. Systems Undergoing a Cycle and Change of State - Throttling and free Expansion-. First law Applied to Flow Systems- Steady Flow Energy Equation - First law Applied to Steady Flow Processes. First law Applied to Isolated Systems - Limitations of First law of Thermodynamics. Problems Related Application of First law of Thermodynamics for Flow and Non-Flow Processes.

UNIT - III

SECOND LAW OF THERMODYNAMICS- Kelvin Plank Statement and Clausius Statement and their Equivalence, Corollaries- Perpetual Motion Machines of first kind and second kind- Reversibility and Irreversibility- Cause of Irreversibility- Carnot Cycle- Heat Engines and Heat Pumps- Carnot Efficiency- Clausius Theorem- Clausius Inequality- Concept of Entropy- Principles of Increase of Entropy- Entropy and Disorder. Problems Related

AVAILABILITY AND IRREVERSIBILITY- Definitions and Expression for Availability and Irreversibility, Energy and Available Energy. Availability in chemical reactions. Helmholtz Function and Gibbs Function- Availability in Steady Flow- and Non-Flow Processes. Entropy Equation for Flow Process- Irreversibility and Change of Entropy.

UNIT – IV :
PROPERTIES
PURE SUBSTANCES- P-V, P-T, T-S and H-S Diagrams, Quality, Dryness fraction, Measurement of Dryness Fraction. Problems Related.

GAS MIXTURES: Properties of Gas Mixtures, Internal energy, Enthalpy and Specific heats of gas mixtures, entropy and Gibbs function of mixtures of Ideal gases.

UNIT - V:
POWER CYCLES
VAPOUR POWER CYCLES: Vapor Power Cycle-Rankine Cycle- Thermodynamic Variables Effecting Efficiency and output of Rankine Cycle- Improvements of Efficiency. Problems related to Rankine Cycle.

GAS POWER CYCLES: I.C engines, Classification, Comparison of two Stroke and Four Stroke Engines, Comparison of SI and CI Engines. Air Cycles- Otto, Diesel, Dual, their Analysis. Efficiencies- Air Standard Efficiency, Brayton cycle.

TEXT BOOKS:
1. *Engineering Thermodynamics*, by P.K.Nag, Tata McGraw-Hill Publications company.
2. *Thermal Engineering*, by M.L.Mathur and F.S.Mehta, Jain Brothers.

REFERENCES:
1. *Thermal Engineering* by P.L.Ballaney Khanna Publishers.
2. *Thermodynamics*, by Spolding and Cole.
3. *Thermal Engineering* by R.K. Rajput, S.Chand & Co.
4. *Introduction to thermodynamics* – J.B.Jones and G.A.Hawkins-John wiley &sons
5. *Thermodynamics*-Van wylen and Sunntagg

B.Tech. (Aeronautical Engineering) III Semester
EURAE304: PRODUCTION TECHNOLOGY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam Marks	Total	
BE	3	-	-	3	40	60	100	3

OBJECTIVE:
To study different production and machining techniques used for manufacturing of aircraft and its materials.

UNIT I
INTRODUCTION TO PRODUCTION TECHNOLOGY
Classification and comparison of different manufacturing process, criterion for selection of apt process, casting techniques, die casting, plaster and shell casting, permanent mold casting, evaporative pattern casting, casting heat treatment, sand casting, Investment casting (SC, DC and polycrystalline), Molding techniques, extrusion, injection molding, special molding for PMC.

UNIT II
METAL FABRICATION TECHNIQUES
Rolling: Cold and hot rolling, Roll bending, roll forming and flat rolling.
Forming: Blanking and piercing, Brake forming, deep forming, stretch forming rubberpad and superplastic forming.
Forging: Drop forging, press forging, upset forging, hot and roll forging.
Extrusion: Hot extrusion, Cold extrusion and warm extrusion.
Tubedrawing, wire drawing and deep drawing process.

UNIT III
MACHING TECHNIQUES
Conventional: Lathe, Milling, Grinding, Drilling, Broaching, Planner, Lapping and Honing techniques.
Non-Conventional: EDM, ECM, DSM, LBM and water jet machining.

UNIT IV
SURFACE TREATMENT TECHNIQUES
Grinding, polishing, Types of coating (metal and non metal), coating techniques (diffusion, overlay and thermal barrier coating), heat treatment, corrosion protection treatments, chemical treatments etc.

UNIT V

AIRCRAFT ASSEMBLY

Fixtures used in aircraft production, Riveting, Welding (Gas metal, tungsten arc, plasma arc, laser, resistance and friction stir), soldering, brazing and joining techniques (types and equipment for riveted joints, bolted joints (only)).

TEXT BOOKS:

1. *Manufacturing Technology for aerospace structural materials by* Campbell F C, Elsevier Publications, 2006.
2. *Air craft production techniques* by Keshu S.C, Ganapathy K.K., Interline Publishing House, Banglore-1993.
3. *Manufacturing Engineering and Technology* by Kalpakajam – Addison Wesley.
4. *Production Technology: Manufacturing Processes* by Technology and Automation 17th Edition", Jain R K, Khanna Publications – New Delhi, 2011.

REFERENCES:

1. *Production Technology: Manufacturing Processes* 7th Edition by Sharma P C, S Chand publishers, 2008.
2. *A Textbook of Manufacturing Technology: Manufacturing Processes* byR K Rajput, Laksmi Publications, 2007.
3. *Production technology* by R.K. Jain – Khanna Publishers – 2002.
4. *Production technology* by O.P.Khanna and lal. M.Dhanpat rai publications-New Delhi-1997.

B.Tech. (Aeronautical Engineering) -III Semester
EURAE305: MECHANICS OF SOLIDS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
BE	3	-	-	3	40	60	100	3

OBJECTIVE:

To understand the behaviour of solid material under the application of different types of loads.

UNIT-I:

SIMPLE STRESSES AND STRAINS: Classification of Loads, Stress, Strain, Stress-Strain Curve for ductile and brittle materials, Stress and Elongation Produced in a Bar due to its self weight, Tie Bar of uniform strength, Stress in a Bar due to Rotation, Elongation in case of a Taper Rod, Poisson's Ratio, Relation Between the types of Modulii, Stresses Induced in Compound Bars, Thermal Stress and Strain, Hoop Stress-Problems.

UNIT-II:

SHEAR FORCE AND BENDING MOMENT: Basic Definitions, Classification of Beams, Types of Loads, Types of Supports, S.F. and B.M. Diagrams for Cantilever, Simply Supported and Overhanging Beams for different types of Loadings, The Point of Contra flexure, General Relation between the Load, the Shearing Force and the Bending Moment-Problems.

UNIT-III:

BENDING AND SHEAR STRESSES IN BEAMS: Theory of Simple Bending (Bending equation/ Flexural Formula), Position of Neutral Axis, Section Modulus, Practical Application of Bending Equation, Shear Stresses in Beams, Variation of Shear Stress Distribution for Rectangular, Circular and I-Sections-Problems.

TORSION OF CIRCULAR SHAFTS: Shafts, Torsion of Shafts, Torsion equation, Hollow Circular Shafts, Torsional Rigidity, Power Transmitted by the Shaft, Importance of Angle of Twist and Shear Stresses in Shafts, Shafts in Series, Shafts in Parallel, comparison of Solid and Hollow Shafts, Combined Bending and Torsion.

UNIT-IV:

ANALYSIS OF DETERMINATE BEAMS: Beam Deflection, Relation between Slope, Deflection and Radius of Curvature, Slope and Deflection at a Section, Double Integration Method, Macaulay's Method, Moment Area Method, Energy Method (Castigliano's

theorem and Unit load Method), Maxwell's Reciprocal theorem and Conjugate Beam Method for Cantilever and Simply Supported Beams-Problems.

UNIT-V:

COMPLEX AND PRINCIPAL STRESSES: Introduction, Stresses on an oblique plane under Uniaxial loading, Stresses on an oblique plane under Biaxial, Complementary Shear Stress, Simple Shear, Pure Shear, Biaxial stresses combined with Shear stresses, Principal stresses and principal planes, Mohr's circle for Complex stresses.

Failure Theories: Maximum Stress theory, Maximum Strain Theory, Maximum Shear Stress Theory Distortion Theory, Maximum Strain energy theory, Application to aircraft Structural problems.

TEXT BOOK:

1. *Strength of Materials* by Dr. Sadhu Singh, Khanna Publishers, New Delhi.
2. *Strength of Materials* by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company (P) Limited, New Delhi.

REFERENCES:

1. *Strength of Materials* by Timoshenko, Part-I & II, 3rd edition, CBS Publishers & Distributors, New Delhi.
2. *Mechanics of Solids* by Popov, 2nd Edition, Pearson Education, 2003, New Delhi.
3. *Mechanics of Materials* by F.P.Beer, E.R. Johnston, Jr & John.T.. Dewolf, 3rd edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. *Strength of Materials* by Dr.R.K.Rajput, First multi colour Revised Edition 2006, S.Chand & Company Limited, New Delhi.
5. *Mechanics of solids* by Crandal, Dahl and Lardner.

B.Tech. (Aeronautical Engineering) -III Semester
EURAE 306 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam Marks	Total	
BE	3	-	-	3	40	60	100	3

OBJECTIVES:
At the end of this course the student should be able to understand all the basic laws of electrical and electronics engineering.

UNIT-I
ELECTROMAGNETIC INDUCTION: Faraday's laws of Electromagnetic Induction, Induced E.M.F., Dynamically Induced E.M.F., Statically Induced E.M.F., Self Inductance, Mutual Inductance.

D.C. MACHINES: Principle of operation as Generator and as a Motor, Types of D.C.Generators and D.C.Motors. E.M.F Equation of D.C Generator, Torque Equation of D.C. Motor. Speed Control, Characteristics of Dc Machines, Losses and Efficiency, Simple Tests.

UNIT-II
A.C. CIRCUITS: Introduction of Steady State Analysis of A.C. Circuits, Single and balanced
3-phase Circuits.

TRANSFORMERS: Transformer principle, EMF equation of transformer, Transformer on load, Equivalent circuit of transformer, Voltage regulation of transformer, Losses in a transformer, Calculation of efficiency and regulation by open circuit and short circuit tests.

UNIT-III
Three Phase Induction Motor: Induction motor working principle, Construction of 3-phase induction motor, Principle of operation, Types of 3-phase induction motor, Torque equation of induction motor, Slip-torque characteristics, Starting torque, Torque under running condition, Maximum torque equation, Power stages of induction motor, Efficiency calculation of induction motor by direct loading.

UNIT-IV
Devices: Semi-conductor diode, Zener diode - Transistor - Silicon control rectifier.
Rectifiers, Amplifiers, Oscillators, Cathode ray oscilloscope.(Elementary treatment only)

UNIT-V

INTRODUCTION TO DIGITAL ELECTRONICS AND MICROPROCESSORS: Fundamentals of digital electronics, Number system and codes, Logic gates, Boolean algebra, Arithmetic-logic units, The Intel-8085 microprocessor; Architecture, Instruction set, Execution of instructions, Addressing structures.

TEXT BOOKS:

1. *Principles of Electrical Engineering & Electronics* by V.K.Mehta (S.Chand & Company LTD) first edition 1996.
2. *Degital logic & Computer Design* by M.Morris Mano (Prontice, Hall of India Private Limited)
3. *Micro Processor Architecture* of *Applications with 8085/8080A* by Goankan. (H.S.Poplaj, WILEY ESTERN LTD)

REFERENCES:

1. *Engineering Electronics* by Ryder-McGraw Hill.
2. *Micro Processors* by Leventhal.
3. *Industrial Electronics* by Bhatacharya, Tata Mc-Graw Hill.
4. A First Course in Electrical Engineering by Kothari.

B.Tech. (Aeronautical Engineering) -III Semester
EURAE311: FLUID MECHANICS and MECHANICS OF SOLIDS LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
BE	-	-	3	-	100	--	100	2

FLUID MECHANICS LAB

OBJECTIVE: **To study experimentally the methods of fluid flow measurement and fluid properties.**

1. Calibration of Flow Nozzle.
2. Calibration of Orifice meter
3. Calibration of Venturimeter.
4. To study the Calibration procedure of the given Triangular notch (V - Notch)
5. Determine the coefficient of discharge of a small orifice
6. Determine the coefficient of discharge of a mouth piece
7. Determination of head loss in flow through pipes..
8. Verification of Bernoulli's Theorem.

MECHANICS OF SOLIDS LAB

OBJECTIVE: **To study experimentally the material behaviours and their properties**.

1. To study the Stress - Strain Characteristics (Tension & Compression) of Metals by using UTM.
2. Determination of Compressive Strength of wood
3. Determination of hardness using different hardness testing Machines- Brinnels, Vickers, and Rockwell's.
4. Impact Test by using Izod and Charpy Methods.
5. Deflection test on Beams using UTM.
6. Tension Shear Test on MS Rods.
7. To find Stiffness and Modulus of Rigidity by Conducting Compression Test on Springs.
8. Torsion Test on Circular Shafts.

B.Tech. (Aeronautical Engineering)- III Semester
EURAE312: ELECTRICAL AND ELECTRONICS LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
BE	-	-	3	-	100	--	100	2

OBJECTIVE:

To train students on fundamental conceptual principles of Electrical Engineering and Technology.

LIST OF EXPERIMENTS

1. Study and Calibration of Wattmeter and Energy Meter.
2. Measurement of Armature Resistance, Field Resistance and Filament Resistance.
3. Verification of KCL and KVL.
4. Superposition Theorem.
5. OC and SC Tests on Transformer.
6. Load test on D.C. Shunt Machine.
7. O.C. Test on D.C. separately Excited Machine.
8. Swinburnes Test.
9. 3 Phase Induction Motorload Tests.
10. OC and SC Tests on Transformer.
11. Load Test on D.C. Shunt Machine.
12. O.C. Test on D.C. separately Excited Machine.
13. Swinburnes Test.
14. 3 Phase Induction Motorload Tests.

B.Tech. (Aeronautical Engineering)- III Semester
EURAE313: COMPUTER AIDED ARICRAFT DRAWING LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE		-	3	-	100	-	100	2

OBJECTIVE:
To understand 2D & 3D drafting and designing concept of Aircraft, Aero engines and its components.

SCREW THREADS: Definitions, V-Threads, Square Thread, Conventional Representation of Threads, Right Hand and Left Hand Threads.

SCREW FASTENINGS: Introduction, Hexagonal Nut, Square Nut, Flanged Nut, Dome Nut, Ring Nut, Washer, Types of Bolts, Lock Nut, Castle Nut, Eye Foundation Bolt,. Rivets of different types and riveting joints.

KEYS AND COTTER JOINTS: Introduction, Taper Key, Sunk Taper Key, Round Key, Saddle Key, Feather Key, Splined Shaft, Woodruff Key, Socket and Spigot Joint, Knuckle Joint.

AIRFOIL DRAWINGS: Drawings of different Symmetrical and Cambered Airfoils like NACA 4-digits and 5- digits airfoils. Drawing of Wings of Different NACA (3D).

AIRCRAFT ASSEMBLY DRAWINGS:

1. Different types of trusses used in wings fuselage including ribs, stringers, skin, brackets
2. Different elements of fuselage structures, bulk head, and rings (frame) longirons
3. Different types of fuselage.
4. Landing gear basic elements, structural brackets, wheel, shock absorber and Hydraulic cylinder
5. Connecting rod for aero piston engine

Note:
1. The above Components can be drawn using Mechanical Drafting packages like AutoCAD/MDT/CATIA.
2. Drawings as per IS.
3. All Drawings are in 2-D in which one chapter should be drawn in 3-D.

B.Tech. (Aeronautical Engineering) -III Semester
EURAE314: INDUSTRIAL TOUR

Category	Periods per week				Maximum Marks			Credits
	L	T	P	Total hours	C	S	T	
IT	-	-	-	7-10 days	--	-	--	NA

The student will visit core Industries like HAL, NAL, DRDL, ISRO, ADA etc.
The Industries to be visited should be from the Approved list by the Department / TPC.
At least 4 Industries are to be visited by the student

The duration of the Industrial tour would be week to ten days.
The tour will be organized by the Department in the break between two Semesters of their second year of study.

Each student will have to submit an individual report on the tour for assessment within ten days of return from the tour.

Grade will be Awarded (for 1 credit) to the student based on the student's report and Viva-Voce Examination to be conducted by the Department by appointing examiners like Laboratory examination.
The amount of Tour expenditure is restricted as per College rules.
Staff member(s) will accompany students for the entire tour. College will reimburse the Tour-expenses to the staff member(s) as per the College rules

IV Semester:

S.no	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE401	Engineering Mathematics-IV	MT	3			3	40	60	100	3
2	EURAE402	Aerodynamics-I	CE	3	1		3	40	60	100	4
3	EURAE403	Aircraft Materials and Processes	CE	3			3	40	60	100	3
4	EURAE404	Aircraft Propulsion	CE	3	1		4	40	60	100	4
5	EURAE405	Aircraft Structures-I	CE	3	1		4	40	60	100	4
6	EURAE406	Numerical Methods	MT	3			3	40	60	100	3
7	EURAE411	Numerical Simulation Lab	MT			3	3	100	--	100	2
8	EURAE412	Aircraft Materials and Processing Lab	CE			3	3	100	--	100	2
9	EURAE413	English Communication Skills Lab	HS			3	3	100	--	100	2
TOTAL											27

B.Tech. (Aeronautical Engineering)- IV Semester
EURAE401: ENGINEERING MATHEMATICS –IV

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Tot al	
MT	3	-	-	3	40	60	100	3

OBJECTIVE:

To impart analytical skills to the students in the areas of core Aeronautical Engineering streams.

UNIT-I

DIFFERENCE EQUATIONS: Introduction – definition – order and solution of difference equations – linear difference equations – rules for finding complementary function-rules for finding Particular Integral – Difference equations reducible to linear form – simultaneous difference equations with constant coefficient.

UNIT -II

Z-TRANSFORMS: z-transform – definition , some standard z-transforms – linearity property – damping rule – some standard results – shifting rules – initial and final value theorems – convolution theorem – evaluation of inverse of transform- application to difference equations.

UNIT-III

FOURIER TRANSFORMATION: Fourier Integral Theorem, Fourier Sine and Cosine Integrals, Complex form of Fourier Integral, Inverse Formulae for Fourier Transformations, Fourier Transforms of the Derivatives of a Functions, Application of Fourier Transforms to Boundary Value Problems.

UNIT-IV

LAPLACE TRANSFORMS: Transforms of elementary functions, Properties of Laplace transforms, Existence conditions, Inverse transforms, Transforms of derivatives, Transforms of integrals, Multiplication by t^n, Division by t, Convolution theorem.

UNIT-V

APPLICATIONS OF LAPLACE TRANSFORMS: Applications to ordinary differential equations and simultaneous linear equations with constant coefficients, Unit step function, Unit impulse function, Periodic functions (without proofs).

TEXT BOOKS :

1. *Higher Engineering Mathematics* by Dr. B.S.Grewal, Khanna publishers.

REFERENCE BOOKS :

1. *Advanced Engineering Mathematics*, Kreyszig E, Wiley Eastern.
2. *Engineering Mathematics* by N.P.Bali et.al, Laxmipublications (P) Ltd., New Delhi-110 002.
3. *Higher Engineering Mathematics* by Dr.M.K.Venkata Raman, National Pub.Co.,Madras-1.

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE402: AERODYNAMICS-I

Category	Scheme of Instruction		Scheme of Examination			Credits to be awarded
	Hours per week		Sem. End Exam Duration in Hrs.	Maximum Marks (100)		
	L/T	D/P		Sem. End Exam	Con. Eval	
CE	3	---	3	60	40	4

OBJECTIVE:
To study aerodynamic concepts and understanding motion of air around an object enables the calculation of forces and moments acting on the object.

UNIT I
GOVERNING EQUATIONS OF INVISCID FLOW:
Flow Regimes, Isentropic relations, governing equations of Inviscid Incompressible and Compressible flow, Stagnation Conditions.

UNIT II
INTRODUCTION:
Wing and Airfoil geometry, Aerodynamic force and moments. Pressure distribution on an airfoil, Pitching Moment, Aerodynamic Center, Center of Pressure, Types of drag, Estimation of lift, Drag and pitching moment coefficient from the pressure distribution, Airfoil characteristics, Experimental methods, wake survey.

UNIT III
INVISCID-INCOMPRESSIBLE FLOW:
Condition on velocity for Incompressible flow, Laplace's equations. : Boundary conditions. Basic elementary flows: Uniform flow, Source flow, Doublet flow and Vortex flow. Superimposition of elementary flows, Non lifting and lifting flow over a circular cylinder. Kutta - Joukowski theorem and the generation of lift, Numerical Source Panel Method. Comparison with real flow over circular cylinder, D'Alembert's Paradox.

UNIT IV
INCOMPRESSIBLE FLOW OVER AIRFOILS:
Complex Potential and Conformal Transformation, The Joukowski Transformation – Flow past a Flat Plate, Joukowski Airfoils, Modified Joukowski Transformation.
The Vortex Sheet, Kutta-Condition, Kelvin's Circulation Theorem and the starting vortex. Classical Thin Airfoil Theory: Symmetric and Cambered airfoil. Vortex Panel Numerical Method, Experimental characteristics of airfoils and Comparison with theoretical results. Limitations.

UNIT V

INCOMPRESSIBLE FLOW OVER FINITE WINGS:

Introduction: Downwash and Induced Drag. The Vortex Filament, Biot-Savart law and Helmholtz theorem. Prandtl's classical lifting-line theory, A Numerical Non-linear lifting-line method. The lifting surface theory and Vortex lattice Numerical Method. Flow past swept and delta wings.

TEXT BOOKS:

1. *Fundamentals of Aerodynamics*, John D. Anderson (Jr.) Fifth Edition, McGraw Hill Series.
2. *Aerodynamics for Engineering Students, sixth Edition*, Houghton, E.L., P. W. Carpenter, Steven H. Collicott, Daniel T. Valentine Elseveir Publishers Ltd.,

REFERENCES:

1. *Aerodynamics*, Clancy, L.J., Indian Edition 2006, Sterling Book House Mumbai.
2. *Theoretical Aerodynamics*, Milne Thomson, Macmillan, 1985
3. *Aerodynamics for Engineers*, fourth Edition, Bertin J J., Pearson Education 2002.
4. *Foundations of Aerodynamics*, Kuethe. A. M., and Chow. C., 5thEdition, Wiley 1998.
5. *The Aerodynamic Design of Aircraft*, Kuchemann. D., Peragamon, 1978.
6. *Aerodynamics, Aeronautics &Flight Mechanics, second edition,* McCormick, B.W., John Wiley, 1995.

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE403: AIRCRAFT MATERIALS AND PROCESSES

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To introduce various materials used in Aerospace industry, their behavior and testing methods.

UNIT I
INTRODUCTIN TO ENGINEERING MATERIALS:
Crystallography: Classification of solids – Amorphous and Crystalline solids. Space Lattice and unit Cells, Crystal Systems.
Structure of Materials: Microstructure **–** Grains, Grain boundaries, grain size, effect of grain size on properties of materials**,** Stress-strain Diagrams, Yielding, strain Hardening, Precipitation Hardening, toughness, Modules of resilience, Bauschinger's effect – Effect of notches, Fatigue – Temperature Dependence.

UNIT II
FERROUS ALLOYS IN AIRCRAFT
Iron: Iron Carbide Diagram, Differences between Iron and Steel**.**
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
Super Alloys: Uses, Nickel based, Cobalt based, Iron based, Forging and Casting of Super alloys, Welding, Heat treatment.

UNIT III
NON-FERROUS ALLOYS IN AIRCRAFT
Aluminum and its alloys: Types and identification, Properties, fabrication, 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.
Copper Alloys: Properties and Applications

UNIT IV

TESTING OF MATERIALS

Destructive Type: Hardness Testing: Different types, Tensile test, torsion test, deflection tests, Impact tests.

Non-Destructive Type: Introduction, Types of NDT (Ultrasonic, dye penetrate, Magnetic penetrate, Eddy current, Acoustic Emission, X-ray)

UNIT V

HEAT TREATMENT AND SURFACE FINISHING

Heat treatment of Aluminium alloys, titanium alloys, steels, case hardening, Initial stresses and the stress alleviation procedures. Corrosion prevention, protective treatments.

TEXT BOOKS:

1. *Aircraft materials and processes* by George Francis Titterton, English Book Store, 1968.
2. *Manufacturing Technology for aerospace structural materials* Campbell F C, Elsevier Publications, 2006.
3. *Mechanical Metallurgy* by George E Dieter, McGraw-Hill publications, 1976.

REFERENCES:

1. *Introduction to Physical Metallurgy- Second Edition* by Rodney H Avner, TATA McGraw-Hill Publications, 1997.
2. *Material Science and Engineering*: An Introduction by William D Callister, David G Rethwisch, John-Wiley and Sons, 2010.

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE404: AIRCRAFT PROPULSION

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam Marks	Total	
CE	3	1	-	3	40	60	100	4

OBJECTIVE:
To train learners on fundamentals of Aircraft power plant components

UNIT – I
THERMODYNAMICS OF GAS TURBINE ENGINES:
Introduction: Nomenclature and Air breathing engines, Principle of gas turbine engine, thrust equation and related factors
Aerothermodynamics of Engines: Turboprop engine, Turbojet Engine, Turbo fan engine, Turbo shaft engine, Ramjet engine, and their performance characteristics-Thermodynamic Cycles, thrust, efficiencies, specific fuel consumption(thrust),specific thrust -Numericals Augmentation.

UNIT – II
AXIAL FLOW COMPRESSORS:
Introduction: Geometry structure of stage and related terminology, Cascade Aerodynamics-Nomenclature, Analysis of cascade forces, Energy losses
Flow Analysis: Coordinate system, Velocity triangles, Flow behavior, Thermodynamic cycle, single and multistage, Degree of reaction, stage pressure ratio and other performance characteristics, compressor pressure curve. Losses- Causes, Primary and secondary losses, stall, surge. Efficiencies - Polytrophic, stage and Adiabatic – Numericals and study of performance charts.

UNIT III
COMBUSTION SYSTEM:
Combustors: System - desirable properties. Combustion process- reaction rate, flammability characteristics, stability- effects of fuel-air mixture ratio, mass flow rate, combustor volume, pressure. Combustion loading parameter, sizing of combustor. Combustion system total pressure ratio. Burners - types, components- function, schematic diagram, airflow distribution, cooling- types, cooling effectiveness. Combustor performance parameters- combustion efficiency, overall total pressure loss, exit temperature profile. Fuel injection, atomization, vaporization, recirculation- flame stabilization, flame holders**,** Afterburners.

UNIT - IV

AXIAL FLOW TURBINES

Analysis: Comparative differences between Turbines and compressors, Velocity diagrams for rotors and stators, Performance parameters computations, Degree of reaction, Impulse and Reaction Turbines, Flow losses and causes, Efficiencies-Total to Total and Total to static, Blade spacing, Blade and Disk stress - Centrifugal, bending and thermal. Typical blade profiles, Study of performance charts **Limitations**: Materials used for Blades and Disks, Cooling-Internal, External cooling. Limitations on pressure ratio - single, multi stage.

UNIT V

SUBSONIC 1-D FLOW AND MATCHING

Inlets: Introduction, Geometry structure, Subsonic inlets- Capture area , low subsonic and high subsonic diffusers, Internal flow , external flow decelerations and their implications, area ratio and design criteria. **Nozzles**: Introduction, Types, Governing equations of flow though Nozzles, Effects of compressibility, Area-velocity relationship and its parameter analysis.

TEXT BOOKS

1. *Mechanics and Thermodynamics of Propulsion*, P. Hill and C.Peterson, Addison-Wesley Publishing Company
2. *Elements of Gas Turbine Propulsion,* Mattingly, J.D., McGraw-Hill
3. *Aerothermodynamics of Aircraft Engine Components*, Oates, G.C., ed., AIAA.
4. *Fundamentals of Jet Propulsion with Applications*, Flack, R.D., Cambridge University Press

REFERENCES

1. *Jet Propulsion*, Cumpsty, N., Cambridge University Press.
2. *Aircraft Propulsion and Gas Turbine Engines*, El-Sayed, A.F., CRC Press, 2008.
3. *Aircraft Engines and Gas Turbines,* Kerrebrock, J.L., MIT Press.

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE405: AIRCRAFT STRUCTURES-I

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing / Practical		Con. Eval	End Exam Marks	Total	
CE	3	1	-	3	40	60	100	4

OBJECTIVE

To understand the basic concepts of different structural members of Aircraft.

UNIT-I

THEORY OF ELASTICITY: Equilibrium and Compatibility conditions for elastic solids. 2D elasticity equations for plane stress, plane strain and generalized plane strain cases, Stress Functions –Airy's Stress Function, Bending of end-loaded cantilever beams.

UNIT-II

STATICALLY INDETERMINATE STRUCTURES: Introduction, Methods for Indeterminate Beams- Superposition Method, Double Integration Method, Singularity Method and Clapeyron's Three Moment Equation Method. Matrix Methods for Indeterminate Trusses and Frames.

UNIT-III

COLUMNS AND STRUTS: Columns with one end free and the other fixed, Both ends fixed, One end fixed and other hinged, Limitation of Euler's formula, Column with initial curvature, Column carrying eccentric load, Laterally loaded columns, Empirical formulae, Rankine and Jhonson's formulae, Effect of intermediate supports, Concept of beam column for different end conditions.

UNIT-IV

THICK CYLINDRICAL SHELLS: Stresses in thick cylindrical shells, Stresses in compound cylinders, Initial difference in radii at the junction of a compound cylinders for shrinkage.

TORSION OF NON-CIRCULAR SHAFTS: Prandtl stress function solution, St. Venant warping function solution, Membrane Analogy and Torsion of a narrow rectangular strip. Beam torsion approximate solution – Open cross section beam torsion, closed section beam torsion, accuracy of the uniform torsion theory and Beams subjected to a variable torque.

UNIT-V

BENDING AND BUCKLING OF THIN PLATES: Pure bending of thin plates, plates subjected to bending, twisting and distributed lateral load, Elastic buckling of Isotropic Flat plates in compression, Elastic buckling of plates due to shear and bending stresses, Elastic buckling of curved rectangular plates, Stiffened Panels, Columns subjected to local

crippling failure – Needham method, Gerard method. Pure or complete tension field beams (Wagner's Theory), Incomplete diagonal tension field beam and tapered tension filed beam.

TEXT BOOKS:

1. *Analysis of Aircraft Structues-An introduction* by Donaldson, B. K. McGraw Hill.
2. *Energy and finite element methods structural analysis* by Shames I. H. and Dym C. L. McGraw
3. *Aircraft Structures for Engineering Students* T.H.G.Megson Edward Arnold,UK

REFERENCES:

1. *Analysis of Structures*, Vol. 1, 1993 edition, by Vazirani and Ratwani.
2. *Mechanics of solids by Crandal,* Dahl and Lardner.
3. *Strength of materials* by Dr. Sadhu Singh.

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE406: NUMERICAL METHODS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
MT	3	-	-	3	40	60	100	3

OBJECTIVE:
This course emphasises different Numerical Methods which are very much essential for Computational Programming and Numerical Analysis.

UNIT I
SOLUTION OF EQUATIONS: Linear interpolation methods - Bisection method, Method of false position, Secant method, Newton-Raphson method, Newton's method for multiple roots. Solution of linear simultaneous equations- Gaussian elimination, Gauss-Jordan methods, Iterative methods - Gauss Jacobi and Gauss – Seidel methods.

UNIT II
INTERPOLATION AND APPROXIMATION: Finite Differences- Forward, Backward and Central Differences, Differences of polynomial. Newton's formulae for Interpolation, Gauss central difference Interpolation formula, Lagrangian Interpolation formula – Divided difference – Newton's general interpolation formula, Interpolation with a cubic spline.

UNIT III
NUMERICAL DIFFERENTIATION AND INTEGRATION: Derivatives from difference table – Divided difference and finite difference – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson's rules.

UNIT IV
INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS: Single step Methods : Taylor Series and methods - Euler and Modified Euler methods – Fourth order Runge-Kutta method for solving first and second order equations - Multistep methods – Milne's and Adam's predictor and corrector methods.

UNIT V
BOUNDARY VALUE PROBLEMS: Finite difference solution for the second order ordinary differential equations. Finite difference solution for one dimensional heat equation by implicit and explicit methods – one dimensional wave equation and two dimensional Laplace and Poisson equations.

TEXT BOOKS:

1. *Introductory Methods Of Numerical Analysis* by S. S. Sastry,
2. *Numerical Methods for Engineers* by S. Arumugam, "
3. *Numerical Methods*, M.K. Venkataraman, Natiuonal Publishing Company, Latest Edition.

REFERENCES:

1. *Numerical Methods* by A. Singaravelu, Meenakshi Publications, Latest Edition
2. *Numerical Methods* by Kandasamy, , S. Chand & Co., New Delhi.
3. *Numerical Methods in Engineering and Science*, B.S. Grewal, Khanna Publishers, Delhi.

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE411: NUMERICAL SIMULATION LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
MT	-	-	3	-	100	--	100	2

OBJECTIVE:
The aim of the Lab is for students to get acquainted with complete procedure for solving numerically different kinds of problems in engineering using MATLAB and C-language. The illustrated list of experiments is as follows.

1. Bisection and Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss Elimination Method
4. Gauss-Jordan Method
5. Gauss-Seidial Iteration Method
6. Power Method
7. Newton's Forward Interpolation Method
8. Lagrange's Interpolation Method
9. Trapezoidal Rule
10. Simpson's Rule
11. Runge-Kutta Method
12. Solution of Heat and Wave Equation

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE412: AIRCRAFT MATERIALS AND PROCESSING LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	-	100	--	100	2

OBJECTIVE:
To impart practical knowledge on different materials in space of their micro structure, hardness and machining aspects.

1. Lathe-Step turning, Chamfering, Knurling. Taper turning, Thread cutting
2. Milling- Round to Hexagonal nut cutting using direct indexing method.
3. Planning practice and slotting practice.
4. Grinding: Grinding a single point cutting tool as per given signature.
5. Sheet metal joining by Rivets, Soldering and brazing.
6. Simple exercises on CNC machines and Program generation.
7. Simple exercises in Solid State Welding, Gas Welding and Arc Welding.
8. Study of Micro Structures of Ferrous alloys
9. Study of Micro Structures of Non ferrous alloys
10. Study of effect of temperature on hardness of material
11. Non Destructive Testing of Aircraft materials
12. Experiment on Autoclave for different geometrical structures

REFERENCE:

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

B.Tech. (Aeronautical Engineering) -IV Semester
EURAE413: ADVANCED COMMUNICATION SKILLS LABORATORY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
HS	-	-	3	-	100	-	100	2

UNIT - I
REPORT WRITING: Types of reports, Writing technical reports and scientific papers
Writing a Statement of Purpose

UNIT - II
PRESENTATION SKILLS: Make effective presentations, expressions which can be used in presentations, use of non-verbal communication, coping with stage fright, handling question and answer session, Audio-visual aids, PowerPoint presentations.
Seminar Skills

UNIT - III
INTERVIEW SKILLS: planning and preparing for interviews, facing interviews confidently, use of suitable expressions during interviews.

UNIT - IV
GROUP DISCUSSION: objectives of a GD; Types of GDs; Initiating, continuing and concluding a GD.

UNIT - V
DEBATE: difference between debate and group discussion, essentials of a debate, conducting a debate.
Telephone Etiquette

V Semester:

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE501	Environmental Studies	HS	3	1		4	40	60	100	4
2	EURAE502	Aerodynamics-II	CE	3			3	40	60	100	3
3	EURAE503	Flight Mechanics	CE	3			3	40	60	100	3
4	EURAE504	Aircraft Systems & Instruments	CE	3			3	40	60	100	3
5	EURAE505	Aircraft Structures-II	CE	3			3	40	60	100	3
6	EURAE506	Theory of Vibrations	CE	3			3	40	60	100	3
7	EURAE511	Aerodynamics Lab	CE			3	3	100	--	100	2
8	EURAE512	Aircraft Systems Lab	CE			3	3	100	--	100	2
9	EURAE513	Aircraft Structures Lab	CE			3	3	100	--	100	2
		TOTAL									25

B.Tech. (Aeronautical Engineering) -V Semester
EURAE501: ENVIRONMENTAL STUDIES

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
HS	3	1	-	3	40	60	100	4

OBJECTIVE:

To understand the various environmental components, natural resources, understand their interactions, create awareness over the various issues of pollution and remediation, instigate interests over the social issues of the environment thereby evoking environmental consciousness in day today life. This course stands as a mandatory subject to all UG Engineers of all disciplines. This compulsory course was introduced by UGC under the direction of Supreme Court since 2004.

UNIT-I

THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES: Definition, Scope and Importance; Need for Awareness.

ECOSYSTEMS, BIO DIVERSITY& CONSERVATION: Concept of an Ecosystem – Structure (Components of an Ecosystem and Ecological Pyramids) and Functional (Food chain, Food web, Productivity, Ecological energetic); Types of Ecosystems – Forest, Grassland, Desert and Aquatic; Biodiversity: Introduction – Definition: Genetic, Species and Ecosystem Diversity; Value of Biodiveersity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option Values; Biodiversity at Alobal, National and local levels, Hot Spots of Biodiversity; Endangered and Endemic Species of India; Conservation of Biodiversity: In situ and Ex-situ Conservation of Biodiversity.

UNIT-II

ENVIRONMENTAL POLLUTION: Definition, Causes, Effects and Control Measures of Air Pollution, Water Pollution, Soil Pollution and Noise Pollution; Solid Waste Management: Causes, Effects and Control Measures of Urban and Industrial Wastes.

UNIT-III

NATURAL RESOURCES: Renewable Non-Renewable Resources; Natural Resources and Associated Problems; Forest Resources; Use and Over-Exploitation, Deforestation, case Studies, Mining, Dams and Their Effects on Forests and Tribal People; Water Resources: India's water Resources, Rain Fall Distribution, Use and over Utilization of Surface and ground Water. Case Studies on Cleaning the Ganga; Mineral Resources: Use and Exploitation, Environmental Effects of Extracing and using Mineral Resources. Case Studies; Energy Resources: Growing Energy Needs, Renewable and Non Renewable Energy Sources, use of Alternate Energy Sources. Case Studies; Land Resources: Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification.

UNIT-IV

ENVIRONMENTAL PROBLEM OF INDIA: Forests – Importance of Forests and their Conservation, Chipko Movement; Dam – Miner and Medium Projects for Irrigation, Case Studies of Teheri and Salient Valley Project, Atmosphere – Domestic Pollution – automobile and Industrial Pollution, Impact of Pollution on Public Health; Case Studies on Pollution from Cement, Pesticides and Chemical Plants; Health – Poverty, Public Health & Sanitation, Vital Statistics, Water Borne Diseases, Malaria, Filarial and other Mosquito control Relevant Diseases and their Control. Occupational Hazards, Bhopal Disaster.

UNIT-V

SOCIAL ISSUES AND THE ENVIRONMENTAL LAWS: From Unsustainable to Sustainable Development; Water Conservation, Rain Water Harvesting. Watershed Management; Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Stuedies; Wasteland Reclamation; Consumerism and Waste Products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Public Awareness.

TEXT BOOKS:

1. *Fundamentals of Ecology, 3rd ed*,Odum, E.P.1971,. W.B.Saunders, & Co., Philadelphia.
2. *Ecology and Environment* by R.D.Sharma, 1996, Rev.ed.Rastogi Publications.
3. *Environmental Science, 8th edition*, RICHARD T.WRIGHT and BERNARD J.NEBEL, 2002 2002, Pretice Hall of India Pvt.Limited.
4. *Introduction to Environmental Engineering and science, 2nd edition*, 2004, EILBERT M.MASTERS, 2004, Pearson Education.
5. *Elements of Air Pollution and its control*, Shivaji Rao, T. 1988, Lavanya Publications, Visakhapatnam.

B.Tech. (Aeronautical Engineering) - V Semester
EURAE502: AERODYNAMICS-II

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To understand the behavior of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows

UNIT I
ONE-DIMENSIONAL FLOWS:
One Dimensional Flow Equations, Speed of Sound and Mach Number, Special Forms of Energy equation, Normal Shock Relations, Hugoniot Equation, Measurement of Velocity in compressible flows.

UNIT II
OBLIQUE SHOCK AND EXPANSION WAVES:
Source of Oblique Waves, Oblique Shock Relations, Supersonic Flow over Wedges and Cones, Shock Polar, Regular Reflections from a Solid Boundary, Pressure-Deflection Diagrams, Intersection of Shocks, Mach reflection, Detached Shock Wave in Front of a Blunt Body, Three Dimensional Shock Waves, Prandtl's-Meyer Expansion Waves, Shock Expansion theory- Applications to Supersonic Airfoils. Viscous boundary layer - Effects of compressibility, Shock-Boundary Layer Interactions.

UNIT III:
SUPERSONIC INLETS AND NOZZLES:
Inlets: Introduction, Starting problem, Convergent divergent diffuser, Divergent inlet. Shock boundary layer problem, External deceleration and performance, flow stability problem with movable spikes. Numericals
Nozzles: Isentropic flow past through CD nozzle- Subsonic, supersonic. Area Mach number relation, chocking, and critical parameters. Effect of different pressure ratio across nozzle, under and over expanded nozzles- Numericals. Concept of supersonic diffusers

UNIT IV
COMPRESSIBLE SUBSONIC FLOWS AND TRANSONIC FLOWS :
The Velocity Potential, Linearized Velocity Potential equation, Prandtl-Glauert Compressibility Correction, Improved Compressibility Corrections, Critical Mach Number, D**rag-D**ivergence Mach Number: The sound barrier. Transonic Flow Past Unswept Airfoils, Supercritical Airfoils, Swept Wings. Wing-body Interactions, Area Rule, Forward Swept Wing, Transonic Aircraft.

UNIT V

LINEARISED SUPERSONIC FLOWS:

Linearized Supersonic Flow, Linearized Supersonic Pressure coefficient, Application to supersonic airfoils - Governing Equations, Boundary Conditions. Viscous Flow: Supersonic Airfoil Drag.

TEXTBOOKS

1. *Aerodynamics for Engineers* : Bertin and Smith,Prentice Hall,1989
2. *Modern Compressible Fluid Flow* by Anderson, J .D., Mc Graw-Hill International Edition

RFFERENCES

1. *Fundamental of Aerodynamics,* Anderson, J DMc Graw-Hill International Fifth Edition Singapore-2001.
2. *Gas Dynamics,* Radhakrishnan, E, E., Prentice Hall of India, 1995
3. *Mechanics and Thermodynamics of Propulsion,* P. Hill and C.Peterson, Addison-Wesley Publishing Company
4. *Aerothermodynamics of Aircraft Engine Components,* Oates, G.C., ed., AIAA
5. *Compressible Fluid Dynamics with Computer Application,* Hodge B.K & Koenig K Prentice Hall, 1995
6. *Elements of Gas Dynamics*,Liepmann, H.W., and Roshko, A., John Wiley, 1957.
7. *Aeronautics & Flight Mechanics*, 2nd edn.,McCormick, B.W., Aerodynamics, John Wiley, 1995, ISBN: 0-471-57506-2.
8. *The Dynamics and Thermodynamics of Compressible Fluid Flow,* Vols. I and II, Shapiro, A.H., John Wiley,1953.

B.Tech. (Aeronautical Engineering) -V Semester
EURAE503: FLIGHT MECHANICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To introduce basic concepts of aeronautics and related flight mechanics knowledge.

UNIT I
INTRODUCTION TO AEROSPACE:
Introduction to Atmosphere: Layers of atmosphere, Temperature, pressure, density dependence on Altitude, Hydrostatic pressure, Geo-potential and geometric altitudes, Numericals.
Introduction to Anatomy: Aircraft anatomy, engine anatomy, Trajectory Analysis, Nomenclature of Aerofoil, wings and bodies, NACA - 4,5 and 6 series.

UNIT II
AERODYNAMIC PERFORMANCE: Effect of geometry, Reynolds number, Mach number on aerodynamic characteristics, Measures of aerodynamic performance, Critical Mach number and pressure co-efficient, Drag divergence Mach number, wave drag. Drag of aerospace vehicle components, Total drag estimation, Methods of drag reduction, Propellers, Performance, design features and Performance characteristics.

UNIT III
AIRCRAFT PERFORMANCE: Equations of motion, thrust and power for level cruising flight, available and maximum thrust and power, altitude effects on power, climb rate, gliding, ceilings, time to climb, range & endurance for propeller driven and jet aircrafts, take-off & landing performance, v-n diagram, turning flight, pull-up & pull-down, accelerated rate of climb.

UNIT IV
PERFORMANCE OF POWERPLANTS: Introduction, propeller, performance of reciprocating engines and jet propulsion systems, turbojet engine, turboprop engine, turbofan engine, turboshaft engine, ramjet engine, rocket engine and its equation of motion.

UNIT V

PERFORMANCE ENHANCEMENT AND PLANNING: High lift devices and performance variation, Modern low speed aerofoils and their characteristics, flight path planning, estimation of take off distances, effect of take off distance wrt weight, wind, runway conditions, ground effect. Take off performance safety factors. Estimation of landing distance, the discontinued landing, baulked landing, air safety procedures and requirements on performance.

Fuel Planning, fuel requirement, trip fuel, reserve and tankering.

TEXT BOOKS:

1. *Introduction to Flight*, John D Anderson Jr, McGraw Hill publications – New Delhi, 2011.
2. *Fundamentals of Airplane Flight Mechanics*, David G. Hull, Springer publications, 2010.

REFERENCES:

1. *Flight Theory and Aerodynamics*, Charles E Dole, James E Lewis, Wiley India edition, 2010.
2. *Airplane Performance – Stability and control*, Courtland D Perkins, Robert E Hage, Wiley India Edition, 2011.

B.Tech. (Aeronautical Engineering) -V Semester
EURAE504 : AIRCRAFT SYSTEMS & INSTRUMENTS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:

To have sound knowledge on principles, functions and operations of all aircraft system and its instruments.

UNIT I

AIRCRAFT SYSTEMS: 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 -Retraction mechanism- Aircraft applications, examples.

UNIT II

ENGINE SYSTEMS: Fuel systems - For Piston and jet engines, - Components of multi engines. Lubricating systems for aircraft piston and jet/propeller engines - Starting and Ignition systems - Typical examples for piston, jet and propeller engines.

UNIT III

AIRPLANE CONTROL SYSTEMS: Principles of flight control, flight control surfaces, control surface actuation, flight control linkage systems, trim and feel. Power control, mechanical, direct drive, electromechanical, electro-hydrostatic actuation, multiple redundancy.The fly by wire system. Airbus and Boeing implementations. Inter-relationship of flight control, guidance and vehicle management systems.

Use of pneumatic power in aircraft. Sources of pneumatic power, the engine bleed air, engine bleed air control. Users of pneumatic power, wing and engine anti-ice, engine start, thrust reversers, hydraulic system, pitot static systems.

UNIT IV

AIRCONDITIONING AND PRESSURIZING SYSTEM: Vapor Cycle systems, Boost-Strap air cycle system - Evaporative vapour cycle systems - Evaporative air cycle systems - Oxygen systems - Fire protection systems, Deicing and anti icing systems- Humidity control. Air distribution systems. Cabin pressurization, tolerance, rain dispersal, anti-misting and demisting.

UNIT V

AIRCRAFT INSTRUMENTS: 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.

TEXT BOOKS

1. *Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration*, Moir, I. and Seabridge, A., AIAA (American Institute of Aeronautics & Astronautics) 2001
2. *Civil Avionics Systems*,Moir, I. and Seabridge, A., AIAA (American Institute of Aeronautics & Astronautics) 2002
3. *Aircraft Instruments & Principles* , Pallet, E.H.J., Pitman & Co., 1993.

REFERENCES

1. *Ground Studies for Pilots: Flight Instruments and Automatic Flight Control Systems*, Harris, D., Blackwell Science, ISBN 0-632-05951-6 sixth edition 2004.
2. *Aircraft Maintenance & Repair*, McKinley, J.L., and Bent, R.D., McGraw Hill, 1993.

B.Tech. (Aeronautical Engineering) -V Semester
EURAE505: AIRCRAFT STRUCTURES-II

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To understand and analyse the behaviour of various Aircraft Structural components.

UNIT I
BENDING AND SHEAR OF OPEN AND CLOSED THIN-WALLED BEAMS: Unsymmetrical bending- resolution of bending moments, direct stress distribution, position of neutral axis. Deflections due to bending - approximations for thin walled sections. General stress, strain and displacement relationships for open and single-cell closed section thin-walled beams, shear of open and closed section beams.

UNIT-II
TORSION OF BEAMS: Torsion of closed section- displacements associated with Bredt-Batho shear flow. Torsion of open section beams. Warping of cross section- conditions for zero warping.
Structural Idealization: Idealization of panel, Effect of idealization on the analysis of open and closed section beams. Deflection of open and closed section beams.

UNIT III
STRESS ANALYSIS OF WING AND FUSELAGE: Tapered beams of single web, open and closed section beams and Beams having variable stinger areas.
Bending, shear and torsion of wings and fuselage. Shear center, tapered wings, deflection. Fuselage frames and Wing Ribs - principles of stiffener/ web construction, fuselage frames, wing ribs.

UNIT IV
STRUCTURAL AND LOADING DISCONTINUITIES IN THIN WALLED BEAMS:
Closed section beams- shear stress distribution of a closed section beam built in at one end under bending, shear and torsion loads – Semi monocoque.
Open section beams- I section beam subjected to torsion, torsion of beam of arbitrary section, torsion bending constant, Shear lag.

UNIT-V
JOINTS AND FITTINGS: Introduction to Bolted and Riveted Joints, Standard Parts, Accuracy Fitting Analysis, Eccentrically loaded connections, Welded joints.

TEXT BOOKS

1. *Aircraft Structures for Engineering Students*,Megson, T.M.G.,Edward Arnold, 1985.
2. *Mechanics of Elastic Structures*, J.T. Oden, McGraw-Hill. 1967
3. *Airplane Structural Analysis and Design*, Scheler.E.E and Dunn L.G, John Wiley & Sons.1963

REFERENCES

1. *Aircraft Structures, 2nd edition,* Peery, D.J, and Azar, J.J., , Mc Graw-Hill, N.Y., 1993.
2. *Theory and Analysis of Flight Structures*, Rivello, R.M., , McGraw Hill, 1993.
3. *Analysis and Design of Flight Vehicles Structures,* Bruhn. E.H, tri -state off set company, USA, 1965.
4. *Stresses in Aircraft and Shell Structure*, Kuhn.P, McGraw-Hill.
5. *An Introduction to the Theory of Aircraft Structures*, William.D, Edward Arnold

B.Tech. (Aeronautical Engineering) -V Semester
EURAE506: THEORY OF VIBRATIONS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To gain fundamental knowledge on vibration and related systems in the context of Aircraft Structures

UNIT-I
FUNDAMENTALS OF VIBRATION: Brief history of vibration, Importance of the study of vibration, basic concepts of vibration, classification of vibrations, vibration analysis procedure, spring elements, mass or inertia elements, damping elements, harmonic analysis.
FREE VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, Free vibration of an undamped translational system, free vibration of an undamped torsional system, stability conditions, Raleigh's energy method, free vibration with viscous damping, free vibration with coulomb damping, free vibration with hysteretic damping.

UNIT-II
HARMONICALLY EXITED VIBRATIONS: Introduction, Equation of motion, response of an undamped system under harmonic force, Response of a damped system under harmonic force, Response of a damped system under harmonic motion of the base, Response of a damped system under rotating unbalance, forced vibration with coulomb damping, forced vibration with hysteresis damping.

UNIT-III
VIBRATION UNDER GENERAL FORCING CONDITIONS: Introduction, Response under a general periodic force, Response under a periodic force of irregular form, Response under a non periodic force, convolution integral.
Two Degree of Freedom Systems: Introduction, Equation of motion for forced vibration, free vibration analysis of an undamped system, Torsional system, Coordinate coupling and principal coordinates, forced vibration analysis.

UNIT-IV
MULTIDEGREE OF FREEDOM SYSTEMS: Introduction, Modeling of Continuous systems as multi degree of freedom systems, Using Newton‟s second law to derive equations of motion, Influence coefficients, Free and Forced vibration of undamped systems, Forced vibration of viscously damped systems.
Determination Of Natural Frequencies and Mode Shapes: Introduction, Dunkerley‟s formula, Rayleigh‟s method, Holzers method, Matrix iteration method, Jacobi;s method.

UNIT-V

CONTINUOUS SYSTEMS: Transverse vibration of a spring or a cable, longitudinal vibration of bar or rod, Torsional vibration of a bar or rod, Lateral vibration of beams, critical speed of rotors.

TEXT BOOK:

1. *Mechanical Vibrations* by S.S.Rao.

REFERENCES:

1. *Mechanical Vibrations* by G.K. Grover
2. *Mechanical Vibrations* by W.T. Thomson
3. *Mechanical vibrations: theory and application to structural dynamics*, Michel Géradin, Daniel Rixen, John Wiley, 1997

B.Tech. (Aeronautical Engineering)- V Semester
EURAE511: AERODYNAMICS LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	-	100	-	100	2

OBJECTIVE:
To study experimentally the aerodynamic forces on different bodies at all flow regimes.

LIST OF EXPERIMENTS

1. Study of the pressure distribution over smooth and rough cylinder.
2. Study of the Pressure distribution over symmetric airfoil.
3. Study of the Pressure distribution over cambered airfoil& thin airfoils
4. Study of the characteristics of three dimensional airfoils involving measurement of lift, drag, pitching moment.
5. Performance of an aerofoil with flap, influence of flap angle on lift, drag and stall
6. Flow visualization studies in low speed flow over airfoil with different angle of incidence
7. Pressure distribution around a two- dimensional model in supersonic flow conditions, at different angles of attack.
8. Lift coefficient for aerodynamic models in supersonic flow.
9. Shock waves and expansion patterns around a two - dimensional model in supersonic flow conditions. (Flow visualization with Schlieren Apparatus.)
10. Measurement of the Velocity profile in laminar and turbulent boundary layers
11. Measurement of the Velocity profile in the boundary layer at on rough and smooth plates
12. Measurement of the Velocity profile in the boundary layer at various distances from the leading edge of the plate

B.Tech. (Aeronautical Engineering) -V Semester
EURAE512: AIRCRAFT SYSTEMS LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	-	100	-	100	2

OBJECTIVE:
To describe the principle and working of different aircraft systems (Hydraulic, Pneumatic and Fly by wire systems)

1. Aircraft Hydraulic System.
2. Aircraft Pneumatic System.
3. Aircraft Oxygen System.
4. Aircraft Landing Gear System.
5. Aircraft Pressurization System.
6. Aircraft De-icing and anti-icing System.
7. Aircraft Electrical System.
8. Aircraft Fuel System.
9. Helicopters transmission system.
10. Aircraft instruments like Gyro, Altimeter, Pitot System etc
11. Airplane Control Systems (Elevator, Ailerons, Rudders) "Rigging Check" procedure
12. Aircraft "Jacking Up" procedure
13. Aircraft "Levelling" procedure

B.Tech. (Aeronautical Engineering) V Semester
EURAE513: AIRCRAFT STRUCTURES LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	-	100	-	100	2

OBJECTIVE:
To impart practical knowledge by conducting different tests on various sections of the Aircraft Structures.

1. Tensile testing using Mechanical and optical extensometers, Stress Strain curves and strength tests for various engineering materials.
2. Bending tests, Stress and deflections of beams for various end conditions, verification of Maxwell's and Castiglianos theorems, Influence coefficients.
3. Compression tests on long and short columns, Critical buckling loads, South well plot.
4. Tests on Riveted and Bolted joints.
5. Strain gauge techniques - Measurement of strain in beams, thin and thick walled cylinders subjected to internal pressure - Shaft subjected to combined loading.
6. Shear centre in open and closed sections beams - Test on semi-tension field beams.
7. Elastic constants for composite materials - Flexural test on composites.
8. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
9. Study and use of a Seismic pickup for the measurement of vibration amplitude.
10. Critical Fracture toughness of Aerospace material

REFERENCE BOOKS

1. *Aircraft Structures for Engineering Students*, Megson, T.M.G., Edward Arnold, 1985.
2. *Analysis and Design of Flight Vehicles Structures,* Bruhn. E.H, tri -state off set company, USA, 1965

VI Semester:

S.no	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE601	Finite Element Analysis	CE	3			3	40	60	100	3
2	EURAE602	Aircraft Stability and Control	CE	3			3	40	60	100	3
3	EURAE603	Control Systems and Instrumentation	BE	3			3	40	60	100	3
4	EURAE604	Aerospace Propulsion	CE	3			3	40	60	100	3
5	EURAE605	Computational Aerodynamics	CE	3			3	40	60	100	3
6	EURAE606	Composite Materials and Mechanics	CE	3			3	40	60	100	3
7	EURAE611	Computational Structural Analysis Lab	CE			3	3	100	--	100	2
8	EURAE612	Aircraft Propulsion Lab	CE			3	3	100	--	100	2
9	EURAE613	Computational Aerodynamics Lab	CE			3	3	100	--	100	2
	TOTAL										24

B.Tech. (Aeronautical Engineering) -VI Semester
EURAE601: FINITE ELEMENT ANALYSIS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To introduce the concept of numerical analysis of structural components.

UNIT-I
BASIC CONCEPTS: Introduction, Comparison of Finite element and Exact solutions and Finite Difference Methods. Historical background, Basic concept of FEM, Weak formulation of boundary value problems – Weighted-integral and weak formulations, Variational methods of approximation- Rayleigh-Ritz method, Weighted residual methods.

UNIT-II
ONE-DIMENSIONAL PROBLEMS: Introduction, Finite element modeling, coordinates and Shape functions. The potential energy approach. The Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects.
Trusses: Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.

UNIT-III
TWO-DIMENSIONAL PROBLEMS USING CONSTANT STRAIN TRIANGLES: Introduction, Finite element modeling, Constant strain triangle, in plane and Bending, problem modeling and boundary conditions.
AXISYMMETRIC SOLIDS SUBJECTED TO AXISYMMETRIC LOADING: Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions.

UNIT-IV
TWO-DIMENSIONAL ISOPARAMETRIC ELEMENTS AND NUMERICAL INTEGRATION: Introduction, The four-node quadrilateral, Numerical integration, Higher-order elements.
BEAMS AND FRAMES: Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames.

UNIT-V

SCALAR FIELD PROBLEMS: 1-D Heat conduction – 1D fin elements – 2D heat conduction - analysis of thin plates – Composite slabs - problems.

Dynamic Analysis: Dynamic equations – Lumped and consistent mass matrices – Eigen Values and Eigen Vectors – mode shapes – modal analysis for bars and beams.

TEXT BOOK:

1. *An Intoduction to the Finite Element Method,* Reddy J.N., McGraw Hill, International Edition,1993.
2. *Introduction to Finite Elements in Engineering,* Tirupathi R. Chandrupatla, Ashok D.Belegundu, , Pearson education.
3. *Fundamentals of Finite Element Analysis*, David V Hutton, Tata McGraw-Hill Eddition.

REFERENCES:

1. *The Finite element method in engineering* by S S Rao, Butterworth-Heinemann, 2005.
2. *Applied Finite Element Analysis* by Segerlind L.J . , John Wiley,1984.
3. *Finite Element Method*, by O.C. Zienkiewicz.
4. *Concept and Applications of Finite Element Analysis* by Cook,Robert Davis etal Wiley , John and Sons,1999
5. *Schaum's Outline of Finite Element Analysis* by George R Buchaman, McGraw Hill Company,1994.

B.Tech. (Aeronautical Engineering) -VI Semester
EURAE602: AIRCRAFT STABILITY AND CONTROL

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To study the performance of airplanes under various operating conditions

UNIT I
STICK FIXED STATIC LONGITUDINAL STABILITY*:* Introduction to stability of airplane, stick fixed longitudinal stability, effect of power, Neutral point, Centre of gravity limits. In flight measurement of stick fixed neutral point.

UNIT II
CONTROL SURFACES AND AERODYNAMIC BALANCING: Control surface hinge moments, floating and restoring tendencies, different types of tabs used on airplanes. Frise Aileron, Spoiler Controls.

UNIT III
STICK FREE STATIC LONGITUDINAL STABILITY: Effect of free elevator on airplane stability, Elevator Control force, stick force gradients, Neutral point, Controls free center of gravity limit. In flight measurement of stick free neutral point.

UNIT IV
MANEUVERING FLIGHT, DIRECTIONAL, LATERAL STABILITY AND CONTROLS : Effect of acceleration on airplane balancing, Elevator angle per g, and stick force per g, Maneuver margins. Asymmetric flight, Weather cock stability, contribution of different parts of Airplane, Rudder Fixed and Rudder free static directional stability, rudder lock. Dihedral Effect. Contribution of different. Parts of airplane controls in Roll, Aileron control power, cross coupling of lateral and directional effects.

UNIT V
DYNAMIC STABILITY *:* Introduction to dynamics, spring-mass system. Equations of motion without derivation, stability derivatives (a) Longitudinal Dynamic Stability: Approximate analysis of short period and phugoid modes, stick-fixed and stick-free. (b) Lateral and Directional Dynamic Stability: approximate analysis of roll subsdience spiral mode and dutchroll.

TEXT BOOKS:

1. *Airplane Performance Stability and Control* by Perkins And Hage, John Wiley, 1949

REFERENCES:

1. *Dynamics of flight* by Bernard Etkin, John Wiley 1989

B.Tech. (Aeronautical Engineering) - VI Semester
EURAE603: CONTROL SYSTEMS AND INSTRUMENTATION

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam Marks	Total	
BE	3	-	-	3	40	60	100	3

OBJECTIVE:
To train seekers of the course, on control and related loop design of engineering systems

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

OPEN AND CLOSED LOOP SYSTEMS
Feedback control systems - Block diagram representation of control systems, Reduction of block diagrams, Output to input ratios, Signal flow graph, Mason's Gain Formula.

UNIT II
CHARACTERISTIC EQUATION AND FUNCTIONS: 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 III
CONCEPT OF STABILITY: Necessary and sufficient conditions, Routh - Hurwitz criteria of stability, Root locus, Concept and construction, frequency response – Polar Plot, Bode Plot, Nyquist's Stability Criteria.
Introduction to digital control system, Digital Controllers and Digital PID Controllers.

UNIT IV
INTRODUCTION TO INSTRUMENTATIONS – Process of measurement, Static performance characteristics, Dynamic performance characteristics, Transducer elements, Intermediate elements, and Indicating and recording elements. Recording instruments for Strain Gages.
MOTION MEASUREMENTS: Relative motion measurement, absolute motion measurement, calibration of motion measuring devices.
VELOCITY MEASUREMENTS: Particle image velocimetry (PIV), Laser Doppler velocimetry (LDV), Doppler Global Velocimetry (DGV), Hot Wire Anemometer.

UNIT-V

FORCE MEASUREMENTS: Hydraulic load cell, Pneumatic load cell, Elastic force devices, calibration. Liquid crystals, Piezofoil arrays, Surface hotfilms, Temperature and pressure sensitive paints.

PRESSURE MEASUREMENTS: Pressure transducers, Dynamic pressure gauges.
TEMPERATURE MEASUREMENTS: Non-electrical methods, electrical methods, Radiation methods.
VIBRATION MEASUREMENTS: velocity & acceleration measurement. Vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers.
SKIN FRICTION MEASUREMENTS: Oil film interferometer, Global interferometer.

TEXT BOOKS

1. *Modern Control Engineering* by OGATA, "Prentice - Hall of India Pvt. Ltd. New Delhi, 1991.
2. *Control Systems & Engineering*, I.J. Nagrath and M. Gopal, Wiley Eastern Ltd.
3. *Mechanical Measurements* by Sirohi and Radha Krishnan,

REFERENCES

1. *Automatic control systems* by Kuo, B.C., Prentice - Hall of India Pvt. Ltd., New Delhi, 1998.
2. *Digital Control Systems* by Houpis, C.H. and Lamont, G.B., McGraw-Hill Book Co. New York, USA 1995.
3. *Control Systems*, Naresh K. Sinha, New Age International Publishers, New Delhi.
4. *Feedback and Control Systems* by Schaum's Outlines, Tata McGraw-Hill Publication, New Delhi, 2000.
5. *Instrumentation, Measurements, and Exxperiments in Fluids* by E. Rathakrishnan, CRC Press, Taylor & Francis Group.

B.Tech. (Aeronautical Engineering) -VI Semester
EURAE604: AEROSPACE PROPULSION

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To train learners on fundaments concepts related to aerospace propulsion.

UNIT – I
ELEMENTS OF ROCKET PROPULSION
Evolution, basic principles, different types, applications. The rocket equation. Vehicle velocity, jet exit Velocity, mass ratio, effect of atmosphere. Nozzle - expansion, performance, design parameters, analysis- non-equilibrium expansion- frozen equilibrium, shifting equilibrium. Performance measures of chemical rocket engines- thrust coefficient, specific impulse; engine parameters, thrust chamber pressure, temperature, characteristic velocity, exhaust velocity, effective velocity.

UNIT – II
SOLID PROPELLANT ROCKET MOTOR
Structure, propellant composition, Solid propellant motor components. Applications, performance analysis. Examples of solid propellant boosters combustion chambers, ignition, surface recession rate, gas generation rate, effect of propellant temperature, combustion pressure, charge design- thrust profile, burning stability, erosive burning, thermal protection.

UNIT – III
LIQUID PROPELLANT ROCKET ENGINE
Liquid propellant rocket engines- structure- principal components, basic parameters- propellant combinations, chamber pressure, Injection, feed system, thrust level. Propellants – properties- considerations for selection- storage, feed, control, injection, ignition. Combustion chamber and nozzle, shape, size, materials, cooling- thrust vector control.

UNIT – IV
COMBUSTION INSTABILITIES
Instabilities of combustion, types, mechanism, low frequency instability in liquid engines, high frequency instability, solutions to high frequency instabilities, intermediate frequency instability, stability rating, Pogo instability, High frequency in solid rocket motor

UNIT – V

ELECTRIC AND ADVANCED PROPULSION

Electric propulsion: Electromagnetic thrusters- magneto plasma dynamic (MPD), pulsed plasma (PPT), Hall effect and variable Current technology of electric propulsion engines, applications.

Nuclear propulsion - Principles, fuel elements, exhaust velocity, operating temperature. Fission fragment propulsion, radioisotope nuclear rocket, fusion propulsion, inertial, electrostatic and magnetic confinement fusion.

Propellantless Propulsion - Photon rocket, beamed energy propulsion, solar, magnetic sails.

TEXT BOOKS

1. *Rocket Propulsion Elements*, G. P. Sutton and D. M. Ross
2. *Rocket and Spacecraft Propulsion, M*. J. L. Turner, Springer Praxis Publishing.
3. *Rocket Propulsion,* Barrere, M., Elsevier Publishing Company, Amsterdam, 1960
4. *Understanding Aerospace Chemical Propulsion*, Mukunda H. S., Interline Publishing, Bangalore

REFERENCES:

1. *Propulsion Techniques,* P. J. Turchi, Ed., AIAA Book Series.
2. *Aerothermodynamics of Gas Turbine and Rocket Propulsion,* Oates, G.C., AIAA, 1988
3. *Mechanics and Thermodynamics of Propulsion*, P. Hill and C.Peterson, Addison-Wesley Publishing Company.
4. *Fundamentals of Jet Propulsion with Applications*, Flack, R.D., Cambridge University Press
5. *Jet Propulsion*, Cumpsty, N., Cambridge University Press.

B.Tech. (Aeronautical Engineering)- VI Semester
EURAE605: COMPUTATIONAL AERODYNAMICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:

To make the students to understand the basic concepts of CFD and to get a clear picture of the numerical techniques.

UNIT- I

BASIC ASPECTS OF COMPUTATIONAL AERODYNAMICS: Why Computational Fluid Dynamics? What is CFD? - CFD as a research tool- as a design tool. Applications in various branches of engineering - Models of fluid flow- Finite Control Volume, Infinitesimal Fluid Element. Substantial derivative- physical meaning of Divergence of velocity.

GOVERNING EQUATIONS AND PHYSICAL BOUNDARY CONDITIONS : Derivation of continuity, momentum and energy equations- physical boundary conditions- significance of conservation and non-conservation forms and their implication on CFD applications- strong and weak conservation forms- shock capturing and shock fitting approaches.

UNIT- II

MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS AND THEIR IMPACT ON COMPUTATIONAL AERODYNAMICS: Classification of quasi-linear partial differential equations by Cramer's rule and eigen value method. General behavior of different classes of partial differential equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations- domain of dependence and range of influence for hyperbolic equations. Well-posed problems.

UNIT- III

BASIC ASPECTS OF DISCRETIZATION: Introduction to finite differences- finite difference approximation for first order, second order and mixed derivatives. Pros and cons of higher order difference schemes. Difference equations- explicit and implicit approaches- truncation and round-off errors, consistency, stability, accuracy, convergence, efficiency of numerical solutions-Von Neumann stability analysis. Physical significance of CFL stability condition.

FINITE VOLUME METHODS: Basis of finite volume method- conditions on the finite volume selections- cell-centered and cell-vertex approaches. Definition of finite volume discretization -general formulation of a numerical scheme- two dimensional finite volume methods with example.

UNIT- IV

GRID TYPES AND CHARACTERISTICS: Need for grid generation. Structured grids- Cartesian grids, stretched (compressed) grids, body fitted structured grids, H-mesh, C-mesh, O-mesh, I-mesh, Multi-block grids, C-H mesh, H-O-H mesh, overset grids, adaptive grids. Unstructured grids- triangular/ tetrahedral cells, hybrid grids, quadrilateral/ hexahedra cells.

UNIT- V

CFD TECHNIQUES: Lax-Wendroff technique, MacCormack's technique-Crank Nicholson technique-Relaxation technique - aspects of numerical dissipation and dispersion. Alternating-Direction-Implicit (ADI) Technique. Pressure correction technique- application to incompressible viscous flow- need for staggered grid. Philosophy of pressure correction method- pressure correction formula. Numerical procedures- SIMPLE, SIMPLER, SIMPLEC and PISO algorithms. Boundary conditions for pressure correction method.

TEXT BOOKS

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

REFERENCES

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

B.Tech. (Aeronautical Engineering) VI Semester
EURAE606: COMPOSITE MATERIALS AND MECHANICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To understand and study about composite materials, their mechanisms and failure criteria.

UNIT I
INTRODUCTION TO COMPOSITE MATERIALS
Classification, advantages and disadvantages of composites, Different lay-Up configuration, Applications of composites in aerospace industries viz., Fuselage, Wings, empennage, Primary, secondary control surfaces and auxiliary skeleton members.

FABRICATION OF FIBERS: Glass fibers, Carbon/Graphite fibers, Aramid fibers, Boron Fibers and other fibers.

FABRICATION OF COMPOSITES: Fabrication of Thermosetting Resin matrix composites, Fabrication of Thermoplastic Resin matrix composites, fabrication of MMCs, fabrication of CMCs.

UNIT II
MACROMECHANICAL BEHAVIOR OF LAMINA
Hooke's Law, stiffness and Compliance matrix for generally anisotropic materials, orthotropic materials, transversely isotropic materials and isotropic materials. Relations between engineering constants and elements of stiffness and compliance matrix. Stress strain relations for plane stress in a uni- directional orthotropic material and arbitrary oriented orthotropic material. Problems on orthotropic composite materials.

UNIT III
MICROMECHANICAL BEHAVIOR OF LAMINA
Introduction, Mechanics of materials approach to stiffness to determine young's modulus, Poisson's ratio and rigidity modulus. Elasticity approach to stiffness by bounding techniques of elasticity and Halpin-Tsai equations.

UNIT IV

MACROMECHANICAL BEHAVIOR OF LAMINATE

Classical Lamination Theory: Lamina stress-strain behavior, stress and strain variation in a laminate, resultant laminate forces and moments.

Special cases of laminate stiffnesses: Single-layered, symmetrical laminates, anti-symmetrical laminates, unsymmetrical laminates.

UNIT V

PERFORMANCE OF COMPOSITE MATERIALS

Strength criteria of orthotropic lamina: Maximum Stress failure criterion, Maximum strain failure criterion, Tsai-Hill failure criterion, Hoffman Failure criterion and Tsai-Wu tensor failure criterion.

Fatigue: Damage/Crack initiation, crack arrest and branching, final fracture, schematic representation, damage characterization and its influence on properties.

Impact: Introduction and fracture process, energy absorbing mechanisms and failure models.

Environmental Interaction effects.

TEXT BOOKS:

1. *Analysis and performance of fiber composites* by Agarwal. B. D, Broutman. L. J, Chandrasekhara K, John Wiley and sons – New York, 1980.
2. *Mechanics of Composite Materials* by R M Jones, Taylor and Francis – New York, 1999.
3. *Advanced Composite Materials* by lalith Gupta, Himalayan Book- New Delhi, 1998.

REFERENCES:

1. *Mechanics of composite Materials – Second edition* by Autar K Kaw, Taylor and Francis, 2009.

B.Tech. (Aeronautical Engineering) VI Semester
EURAE611: COMPUTATIONAL STRUCTURAL ANALYSIS LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	3	100	-	100	2

OBJECTIVE:
To train students on Finite Element Analysis of 2D and 3D models using different CAE softwares.

Introduction to finite element packages like Ansys, Nastran/Patran

1. Static Analysis of 2D and 3D models
2. Thermal analysis of 2D and 3D models
3. Bending of uniform cantilever beam.
4. Compressive strength of rectangular stiffened panels of uniform cross-section.
5. Statically indeterminate trusses.
6. Free vibrations of uniform cantilever beams, determination of natural frequencies and mode shapes.

Modeling and analysis of simple Aircraft components using professional software

7. 3D landing gear trusses
8. Tapered wing box beams
9. Fuselage bulkheads
10. Grid Generation of Aerofoil NACA 0012

B.Tech. (Aeronautical Engineering) -VI Semester
EURAE612: AIRCRAFT PROPULSION LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	3	100	-	100	2

OBJECTIVE:

To train students on conceptual working principles and performance of Aircraft Power plant related components

1. Axial flow compressors
2. Centrifugal Compressors
3. Aerodynamics(Pressure distribution, under and over expanded) Nozzles
4. Performance(Jet reaction, efficiency and chocking) of Nozzles
5. Reaction Turbine
6. Impulse Turbine
7. Performance of Gas Turbine
8. Wall jet and wake study
9. Combustion Process
10. Flame propagation and stability
11. Convection
12. Thermal Conductivity of fuel

B.Tech. (Aeronautical Engineering) -VI Semester
EURAE613: COMPUTATIONAL AERODYNAMICS LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	3	100	-	100	2

1. Introduction to anyone one of the suitable software employed in modeling and simulation of aerodynamic problems

2. Numerical Solution for the following equations using finite difference method (Code development).
   a) 1-D and 2-D Linear Convection Equation e using Lax – Fredrich's and Lax Wendroff Techniques
   b) 1-D and 2-D Burger's Equation Lax-Fredrich's and Lax Wendroff Techniques
   c) Vortex panel method
   d) Source panel method
   e) One dimensional heat conduction equation using explicit method.

3. Generation of the following grids(Code development)
   a) Algebraically Stretched Cartesian Grids
   b) Elliptic Grids

4. Numerical Simulation of the following flow problems using commercial packages:
   a. Supersonic flow over a flat plate
   b. Supersonic flow over a wedge
   c. Flat plate boundary layer
   d. Grid Generation of Aerofoil NACA 0012
   e. Laminar Pipe flow
   f. Flow past a cylinder

Suggested Software:

1. FLUENT/GAMBIT
2. CFX
3. MATLAB

VII Semester:

S. No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE701	Introduction to Space Technology	CE	3			3	40	60	100	3
2	EURAE702	Aircraft Design	CE	3			3	40	60	100	3
3	EURAE703	Airport and Airline Management System	CE	3			3	40	60	100	3
4	EURAE721-725	Department Elective-I	DE	3	1		4	40	60	100	4
5	EURAE731-735	Inter Departmental Elective-I	IE	3	1		4	40	60	100	4
6	EURAE711	Personality Development	HS			3	3	100	--	100	
7	EURAE712	Aircraft Maintenance and Design Lab	CE			3	3	100	--	100	2
8	EURAE713	Industrial Training	IT			6	6	100		100	2
9	EURAE714	Project Phase-I	PW								3
TOTAL											24

B.Tech. (Aeronautical Engineering)- VII Semester
EURAE701: INTRODUCTION TO SPACE TECHNOLOGY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To train learners on fundamentals of Satellite launch, operation and Technology

UNIT - I
PERFORMANCE OF ROCKETS INTRODUCTION-Rocket equation, Burning time, Single stage Rocket, Multi stage Rockets, Two multistage Rockets, Trade-off ratios, single stage to orbit, optimal multistage, Sounding rocket, Gravity –Turn, **Thrust**: Rocket thrust, Ideal thrust equation, Optimum Ideal Thrust, Vacuum Ideal Thrust, Thrust variation with altitude, Effective exhaust velocity and specific Impulse

UNIT - II
TWO BODY ORBITAL MECHANICS: Introduction, Two body Problem, Equations and constants of Motion, Equation of conic sections, Properties of conic sections, Physical significance of tow body trajectories-Circular, Parabolic and Hyperbolic trajectories. Elevation angle, Different types of orbits and their characterizes.

UNIT - III
ORBIT CHANGES: Introduction, Circular and Elliptical orbits. Orbital transfers-orbit shaping and impulse thrusting, Hohmann transfer from inner to outer circle, inner ellipse to outer circle, Bielliptic transfer, Plane change.
Time of Flight: Basic features, Parabolic, Ellipse and Hyperbolic time, Lamberts theorem.

UNIT - IV
RE-ENTRY AND INTERPLANETARY TRANSFERS

RE-ENTRY: Introduction, Entry Problem, Ballistic entry, Aerobraking, Lifting entry, Heating Problem.

INTERPLANETARY TRANSFERS: Solar system, Sphere of Influence and Impact parameter, Launch windows and Mission duration, Patched conic, planetary capture, planetary passage and Gravity Assist, Intercept problem, fast transfers, Canonical units

UNIT - V

SPACE ENVIRONMENT: Space characteristics, Atmosphere, Light and Space craft Temperature, Charged Particle Motion, Magnetic mirrors, Van Allen belts, radiation effects, Meteors and Impact, Local Neighborhood.

TEXT BOOKS

1. *Introduction to space flight* by Francis J Hale, Prentice hall
2. *Space Flight dynamics* by Wiesel,W.E., McGraw hill

REFERENCES

1. *Fundamentals of space Astrodynamics* by Bate, R.R., Mueller, D.D and White, J.E., Dover Publications
2. *Rocket Propulsion and Spaceflight Dynamics* by Cornelisse, j.w., Pitman Publishing
3. *Spacecraft Mission Design* by Brown, C.D., AIAA Education series, 1998
4. *Orbital Mechanics* by Chobotov, V.A.M, AIAI Education series 2002

B.Tech. (Aeronautical Engineering)- VII Semester
EURAE702: AIRCRAFT DESIGN

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To understand the conceptual design and detailed design of Aircrafts.

UNIT I
OVERVIEW OF DESIGN PROCESS: Introduction, Phases of Aircraft design, Aircraft conceptual design process. Introduction to Weight estimations - Takeoff weight buildup, Empty-Weight estimation, Fuel-Fraction estimation, Take-off weight calculation.

UNIT II
WING LAYOUTS AND THEIR CHARACTERISTICS: Type of Wings, Wing Geometry, Wing Loading, Selection of Thrust to Weight and Wing Loading, Airfoil Selection.
Introduction to Tail Geometry and Arrangements, Wing/Tail Layout and Loft.

UNIT III
FUSELAGE LAYOUT AND LOFT: Introduction, Conic Lofting, Conic Fuselage Development, Flat-Wrap Fuselage Lofting, Circle to Square Adapter, Fuselage Loft Verification, Aircraft Layout Procedures, Wetted Area Determination, Volume Determination.

UNIT IV
PROPULSION AND LANDING GEAR SYSTEMS: Propulsion Systems- Propulsion selection, Jet engine Integration, Propeller Engine Integration, Thrust Considerations, Performance of Piston Engine and Turboprop Engine, Fuel Systems.
LANDING GEAR – Landing Gear Arrangements, Tire Sizing, Shock Absorbers, Castoring-Wheel Geometry, Gear-Retraction Geometry, Seaplanes, Subsystems.

UNIT-V
INTRODUCTION TO FATIGUE: Safe life and fail-safe structures, Designing against fatigue, Fatigue strength of components, Prediction of aircraft fatigue life and crack propagation.

TEXT BOOKS

1. *Airplane Design- A Conceptual Approach* by Daniel P Raymer. AIAA Education Series USA, 1999.
2. *Fatigue of aircraft structure* by Barrois W, Ripely, E.L., Pergamon press. Oxford, 1913.

REFERENCES:

1. *The Design of Airplane* by D.Stinton GRANADA,UK,2000
2. *Fundamentals of Aircraft Design* by L.M.Nikolai,Univ. of Dayton Ohio,1975
3. *Aerodynamics for Engineers* by Bertin and Smith,Prentice Hall,198
4. *Airplane Structural Analysis and Design* by Scheler.E.E and Dunn L.G, John Wiley & sons.1963

B.Tech. (Aeronautical Engineering) -VII Semester
EURAE703: AIRPORT AND AIRLINE MANAGEMENT

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:

To understand and acquire a sound understanding on basic management aspect of airport and airlines system such as airports layout, air traffic control, landing procedure, scheduling, flight planning and other economic and commercial activities.

UNIT I

AIRPORTS AND AIRPORT SYSTEMS: Airports and airport systems: An introduction, Airports and airport systems: Organization and administration.
Airports and airport systems: A historical and legislative perspective.

UNIT II

AIRPORT OPERATIONS MANAGEMENT: The airfield, Airspace and air traffic management, Airport operations management under FAR Part 139, Airport terminals and ground access, Airport security.

UNIT III

AIRPORT ADMINISTRATIVE MANAGEMENT: Airport financial management, The economic, political, and social role of airports, Airport planning, Airport capacity and delay, The future of airport management.

UNIT IV

NTRODUCTION TO AIRLINE PLANNING: Structure of Airline Industry (Domestic & International)-Growth and Regulation-Deregulation-Major and National Carriers-Regional Carriers-Economic characteristics of the Airlines Airline Planning Process-Airline Terminology and Measures: airline demand, airline supply, average load factor, unit revenue, Airline Planning Decisions: Fleet Planning, Route Evaluation, Schedule Development, Pricing, Revenue Management

UNIT-V

FLEET PLANNING AND ROUTE EVALUATION: Factors in Fleet Planning-Hub-and-Spoke System-Technical Aspects-Fleet Rationalization-Fleet Commonality-Long Range Aircraft-Noise Restrictions-Factors in Design and Development-Fleet Planning Process; Route Evaluation in Hub Networks-Route profitability estimation issues-Demand Driven Dispatch.

TEXT BOOKS

1. *Airport Planning and Management 6/E 0006 Edition* by Young Seth, Mc GRAW Hills.
2. *Airport Management* by Ravindran P.C.K, Asian Law House.
3. *Air Transportation:A Management Perspective* (Fifth Edition) by Alexander T.Wells and John G.Wensveen, Brooks Cole,2003
4. *Airline Management* by Charles Banfe, Prentice-Hall, 1991,

REFERENCE

1. *Airport Systems :Planning ,Design and Management* by Rechard De Neufville Tata Mc Graw Hills.
2. *Straight and Level:Practical Airline Economics* by Stephen Holloway, Ashgate Publishing, 2003
3. *Airline Marketing and Management* by Stephen Shaw, Ashgate Publishing, 2004
4. *An Introduction to Airline Economics (Sixth Edition),* William O' Connor, Praeger Publishers,2000
5. *Airline Management*, by Peter P BelobabaMIT Open Courseware Lecture Notes, 2006
6. *Airline Operations and Scheduling* by Massoud Bazargan, Ashgate Publishing, 2004

B.Tech. (Aeronautical Engineering) VII Semester

DEPARTMENT ELECTIVE-I

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE 721	Helicopter Engineering	DE	4
2	EURAE 722	Boundary Layer Theory	DE	4
3	EURAE 723	Automatic Flight Control	DE	4
4	EURAE 724	Theory of Elasticity	DE	4
5	EURAE 725	Introduction to Combustion	DE	4

B.Tech. (Aeronautical Engineering)- VII Semester
DEPARTMENT ELECTIVE-I
EURAE 721: HELICOPTER ENGINEERING

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:

To understand and acquire a good understanding on vertical flight vehicles, its principles, aerodynamics, performance and basic design aspects of helicopter.

UNIT-I

INTRODUCTION AND ELMENTS OF HELICOPTER AERODYNAMICS: Brief History of Helicopters- Early Years, first word war era, Inter-war years, second world war era, Post world war Years. The Helicopter from an Engineering viewpoint. Configurations based on torque reaction-Jet rotors and compound helicopters- Methods of control – Collective and cyclic pitches changes - Lead - Lag and flapping hinges, lift dissymmetry, Helicopters-contra rotating, tandem and tail rotor configuration and their advantages and disadvantages. Auto rotation of helicopter. Rotor wake model, Ground effect on lifting rotors.

UNIT-II

ROTOR IN VERTICAL FLIGHT:

MOMENTUM THEORY AND WAKE ANALYSIS: Momentum theory for hover , Non-dimensionalization, Figure of Merit, Axial Flight, Momentum theory of Vertical climb, Modeling the streamtube, Descent, Wind tunnel Test Results, Complete Induced Velocity curve.

Blade Element Theory: Basic Method, Thrust Approximation, Non Uniform Flow, Ideal Twist, Blade Mean lift Coefficient, Power Approximations, Tip Loss,(All topics in Hovering condition) Examples of Hover Characteristics.

UNIT-III

ROTOR IN FORWARD FLIGHT:

ROTOR MECHANISM: The Edgewise rotor, Flapping Motion, Rotor Control, Equivalence of Flapping and Feathering (Blade Sailing, Lagging motion, Coriolis Acceleration, Lag frequency, Blade Flexibility, Ground Resonance).

ROTOR AERODYNAMICS : Momentum Theory, Descending Forward Flight, Wake Analysis, Blade Element Theory (Factors involved, Thrust, In- Plane H – Force, Torque and power, Flapping Coefficients).

UNIT-IV

CONFIGURATION AND POWER ESTIMATES: Various configuration - Propeller, rotor, ducted fan and jet lift - Tilt wing and vectored thrust - Performance of VTOL and STOL aircraft in hover, transition and forward motion.

POWER ESTIMATES: Induced, profile and parasite power requirements in hover and forward flight-Performance curves with effects of altitude, in ground and out of ground effects of helicopter-Preliminary ideas on helicopter's longitudinal, lateral and yaw stability and control (No Derivation).

UNIT-V

ROTOR AERODYNAMIC DESIGN:

Blade Section design, Blade Tip Shapes (Rectangular, Swept, Advance Planforms), Tail Rotors (Propeller Moment , Precession-Yaw Agility, Calculation of Downwash, Yaw Acceleration), Parasite Drag, Rear Fuselage Upsweep, Aerodynamic Design process.

TEXT BOOKS

1. *Basic Helicopter Aerodynamics* IIIrd Edition by John Seddon and Simon Newman, John Wiley & Sons Ltd ,Publication U.K
2. *Helicopter Theory* by Johnson, WPrinceton University Press, 1980.
3. *Helicopter Engineering* by Gupta, LHimalayan books, 1996

REFERENCES

1. *Aerodynamics of Helicopter*, by Gessow, A., and Myers, G.C., Macmillan & Co., N.Y.1987.
2. Aerodynamics of V/STOL Flight by McCormick, B.W., Academics Press, 1987

B.Tech. (Aeronautical Engineering) VII Semester
DEPARTMENT ELECTIVE-I
EURAE 722: BOUNDARY LAYER THEORY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To make the students to understand the basic concepts of Boundary layer and its applications

UNIT - I
BASIC LAWS: Basic laws of fluid flow – Continuity, momentum and energy equations as applied to system and control volume –Concept of flow fields.
FUNDAMENTALS OF BOUNDARY LAYER THEORY
Viscous fluid flow – Boundary conditions – Development of boundary layer – Estimation of boundary layer thickness –Displacement thickness, momentum and energy thickness for two-dimensional flows. General stress system in a deformable body – General strain system.

UNIT - II
NAVIER STOKES EQUATION
Relation between stress and strain system in a solid body (Hooke's Law) – Relation between stress and strain rate system in liquids and gases (Stroke's Law) – The Navier - Strokes Equation (N-S) – General properties of Navier -Stokes Equation.
EXACT SOLUTION OF NAVIER-STOKES EQUATION
Two dimensional flow through a straight channel, Hagen –Poiseulle flow – Suddenly accelerated plane wall – Flow near a rotating disk – Very slow motion: Parallel flow past a sphere.

UNIT -III
LAMINAR BOUNDARY LAYER
Analysis of flow past a flat plate and a cylinder – Integral relation of Karman – Integral analysis of energy equation –Laminar boundary layer equations – Flow separation – Blasius solution for flat–plate flow – Boundary layertemperature profiles for constant plate temperature.

UNIT – IV

BOUNDARY LAYER METHODS

Falkner Skan Wedge flows – Integral equation of Boundary layer – Pohlhausen method – Thermal boundary calculations – One parameter and two parameter integral methods.

UNIT – V

INCOMPRESSIBLE TURBULENT MEAN FLOW

Two-dimensional turbulent boundary layer equations – Integral relations – Eddy viscosity theories – Velocity profiles.

COMPRESSIBLE – BOUNDARY LAYER FLOW

The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary on flat plate– Boundary layers with pressure gradient.

TEXT BOOKS

1. *Turbulent Flows in Engineering*, Reynolds AJ, John Wiley & Sons, 1980
2. *Incompressible Flow,* Panton RL, John Wiley & Sons, 1984

REFERENCES

1. *Boundary Layer Theory*, Schlichting H, McGraw Hill, New York, 1979
2. *Viscous fluid Flow*, White FM, McGraw Hill Co. Inc., NY, 1991, 2nd Edition
3. *Fundamentals of Aerodynamics*, Anderson JD, McGraw Hill Book

B.Tech. (Aeronautical Engineering) VII Semester
DEPARTMENT ELECTIVE-I
EURAE 723: AUTOMATIC FLIGHT CONTROL

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To understand the working concept of Autopilot, different feedback system of Aircraft and their stability and controls.

UNIT I:
FEED BACK CONTROL SYSTEM: Transfer function of linear systems. Impulse response of linear systems, Block diagrams of feedback control systems, Multivariable systems, Block diagram algebra.

UNIT II:
ANALYSIS OF FEEDBACK CONTROL SYSTEMS: Typical test input signals, Time domain performance characteristics of feedback control systems. Effects of derivative and integral control. Steady State response of feedback control system-steady State error, Frequency response.

UNIT III:
SYSTEM STABILITY: Routh-Hurwitz Criterion, the Root Locus Method.

UNIT IV:
LONGITUDINAL AUTO PILOT: Longitudinal Auto Pilots: Brief description through Block diagrams and Root Locus of Displacement Auto Pilot, Pitch Orientational Control System. Acceleration control system. Fly-By-Wire control system, Instrument Landing System.

UNIT V:
LATERAL AUTO PILOT: Introduction, Damping of the Dutch Roll, Methods of Obtaining coordination, Yaw orientation control system

TEXT BOOK:

1. *Automatic Control of aircraft and Missiles* by John H.Blackelock, John Wiley & Sons,2nd Ed.1990

REFERENCES

1. *Airplane Performance Stability and Control* by C.D.Perkins And R.E.Hage,John Wiley & Sons
2. *Dynamics of Flight :Stability and Control* by Bernard Etkins,John Wiley & sons,2nd Ed 1989
3. *Flight Stability And Automatic Control* by Robert C. Nelson,McGraw Hill Book Comp,1989
4. *Automatic Flight Control* by EHJ Pallet , B.S.Professionals Books,Oxford,3rd Ed,1987
5. *Automatic Control Systems* by Benjamin C.Kuo

B.Tech. (Aeronautical Engineering) VII Semester
DEPARTMENT ELECTIVE-I
EURAE 724: THEORY OF ELASTICITY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE

To understand the theoretical concepts of material behaviour with particular emphasis on their elastic property.

UNIT-I

DEFORMATION: Displacements and Strains - General Deformation, Geometric Construction of small Deformation Theory, Strain Transformation, Principal Strains, Spherical and Deviatoric Strains, Strain Compatibility, Curvilinear Cylindrical and Spherical Coordinates.

UNIT-II

MATERIAL BEHAVIOR- LINEAR ELASTIC SOLIDS: Material Characterization, Linear Elastic Materials-Hooke's Law, Physical Meaning of Elastic Moduli, Thermoelastic Constitutive Relations

FORMULATION AND SOLUTION STRATEGIES: Review of Field Equations, Boundary Conditions and Fundamental Problem Classifications, Stress Formulation, Displacement Formulation, Principle of Superposition, Saint-Venant's Principle, General Solution Strategies

UNIT-III

STRAIN ENERGY AND RELATED PRINCIPLES: Strain Energy, Uniqueness of the Elasticity Boundary-Value Problem, Bounds on the Elastic Constants, Related Integral Theorems, Principle of Virtual Work, Principles of Minimum Potential and Complementary Energy, Rayleigh-Ritz Method.

TWO-DIMENSIONAL FORMULATION: Plane Strain, Plane Stress, Generalized Plane Stress, Antiplane Strain, Airy's Stress Function, Polar Coordinate Formulation.

UNIT-IV

TWO-DIMENSIONAL PROBLEM SOLUTION: Cartesian Coordinate Solutions Using Polynomials, Cartesian Coordinate Solutions Using Fourier Methods, General Solutions in Polar Coordinates, Polar Coordinate Solutions.

UNIT-V

EXTENSION, TORSION, AND FLEXURE OF ELASTIC CYLINDERS: General Formulation, Extension Formulation, Torsion Formulation, Torsion Solutions Derived from Boundary Equation, Torsion Solutions Using Fourier Methods, Torsion of Cylinders With Hollow Sections, Torsion of Circular Shafts of Variable Diameter, Flexure Formulation, Flexure Problem Without Twist.

TEXT BOOKS:

1. *Elasticity: Theory, Applications, and Numerics* by Martin H Sadd, Elsevier Academic Press.
2. *Theory of Elasticity* by S. Timoshenko and J.N. Goodier, McGraw - Hill Book Company.

REFERENCES

1. *Advanced Strength of Materials*, Enrico Volterra & J.H. Caines, Prentice Hall New Jersey, 1991.
2. *Applied Elasticity*, Wng, C.T., McGraw‑Hill Co., New York, 1993.
3. *Mathematical Theory of Elasticity,* Sokolnikoff, I.S., McGraw‑Hill New York, 1971.

B.Tech. (Aeronautical Engineering) VII Semester
DEPARTMENT ELECTIVE-I
EURAE725: INTRODUCTION TO COMBUSTION

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
Understanding fundamentals of different combustion processes and its chemistry

UNIT - I
INTRODUCTION: Combustion, Applications of combustion, types of fuels and oxidizers, types of combustion modes and their domain of application, Ideal gas mixtures, partial pressure law, latent heats, Reactant and product mixtures, Enthalpy of formation.

UNIT – II
THERMO CHEMISTRY AND KINETICS
THERMODYNAMICS: Stoichiometry, Heat of combustion, adiabatic flame temperature, chemical equilibrium, Equilibrium products of combustion. Kinetics of Reaction, collision theory, Arrhenius law elementary reactions, chain reaction, Multi step reactions, Global reactions

UNIT - III
COMBUSTION CONSERVATION ANALYSIS: Mass conservation, momentum conservation, energy conservation, concept of conserved scalar, Transport properties, Transport in turbulent flows

UNIT - IV
LAMINAR FLAMES
PREMIXED FLAMES: Physical description Detailed analysis, Factors Influencing flame velocity and thickness, Quenching, Flammability and Ignition Flame stabilization.
Diffusion flames: jet flame physical descriptions, flame lengths for circular port and slot burners, Soot formation and destruction

UNIT - V
COMBUSTION AND EMISSIONS OF POLLUTANTS
DROPLET COMBUSTION: Introduction, applications, Droplet evaporation and combustion
Solids burning: Heterogeneous reactions, burning of carbon, particle burning time, coal combustion.

EMISSIONS: Effects of pollutants, Quantification of emissions, emission from premixed combustion, Emissions from non premixed combustion

TEXT BOOKS

1. *An Introduction to Combustion* by Stephen R.Turns, McGraw Hill
2. *Fuels and Combustion* by Samir Sarkar, Universities Press
3. *Fundamentals of Combustion* by D.P Mishra, Prentice Hall of India
4. *Fundamentals of Combustion* by Strehlow R A., McGraw Hill

REFERENCES

1. *Principles of Combustion* by Kuo K.K., John Wiley and Sons
2. *Introduction to Combustion Phenomena* by Kanury A Murty, Gordon & Breach
3. *Introduction to Physics and Chemistry of Combustion* by Michael A Liberman, Srpinger

B.Tech. (Aeronautical Engineering) VII Semester
INTER DEPARTMENTAL ELECTIVE-I

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE731	Nano Science and Technology	IE	4
2	EURAE732	Theory of Plates and Shells	IE	4
3	EURAE733	Heat and Mass Transfer	IE	4
4	EURAE734	CNC	IE	4
5	EURAE735	Object Oriented Programming with Java	IE	4

B.Tech. (Aeronautical Engineering)- VII Semester
INTER DEPARTMENTAL ELECTIVE-I
EURAE731: NANO SCIENCE AND TECHNOLOGY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To introduce concepts of Nano material fabrication and their properties for aerospace applications.

UNIT I
INTRODUCTION TO NANOMATERIALS: Nano definition, Why Nano, Merits and demerits of Nanomaterials over conventional materials.
Quantum Mechanics: Differential equations of wave mechanics, Matter waves, Heisenberg's Uncertainty principle, Schrodinger equation, electron confinement, tunneling of a particle through potential barrier.

UNIT II
SYNTHESIS OF NANOMATERIALS AND NANOSTRUCTURES:
PHYSICAL METHODS: Mechanical Methods, Methods based on Evaporation, Sputter deposition, chemical vapor deposition, electric arc deposition and ion beam techniques, Lithography using Photons and Particle beams
Chemical Methods: Langmuir-Blodgett method, Sol-Gel methods, hydrothermal methods, Sonochemical synthesis, Microwave synthesis.
Biological Methods: Synthesis using Micro-organisms, plant extracts and DNA

UNIT III
CHARACTERIZATION AND PROPERTIES OF NANOMATERIALS:
CHARACTERIZATION TECHNIQUES: Electron microscopes, scanning probe Microscopes, Diffraction techniques, spectroscopies.
PROPERTIES OF NANOMATERIALS: Mechanical properties, structural properties, melting of nanoparticles, optical properties and magnetic properties.

UNIT IV

SPECIAL NANOMATERIALS: Carbaneous nanomaterials, porous silicon, aerogels, zeolites, ordered porous materials using micelle as templates, core-shell particles and metamaterials.

UNIT V

APPLICATIONS OF NANOMATERIALS: Space and defense applications, electronics, energy, automobile, textiles, cosmetics, domestic, biotechnology and medical fields. Environmental effects due to nanomaterials.

TEXT BOOKS:

1. *Textbook of Nanoscience and Nanotechnology* by B.S. Murty, P. Shankar, B BRath, James Murday, University Press, New Delhi, 2012.
2. *Nanotechnology: Principles and Practices* by Sulabha K Kulkarni, Capital Publishing company, New Delhi, 2011.

REFERENCES:

1. *Nano Materials* by A K Bandyopadhyay, New Age International Publishers, New Delhi, 2011.
2. *Nanotechnology* by A Gentle Introduction to the next big idea", Mark Ratner, Daniel Ratner, Pearson publications inc., 2003.

B.Tech. (Aeronautical Engineering) -VII Semester
INTER DEPARTMENTAL ELECTIVE-I
EURAE732: THEORY OF PLATES AND SHELLS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To study the behaviour of the plates and shells with different geometry under various types of loads.

UNIT I
CLASSICAL PLATE THEORY: Classical Plate Theory - Assumptions - Differential Equation - Boundary Conditions.

UNIT II
BENDING OF ISOTROPIC RECTANGULAR PLATES: Navier's Method of Solution for Simply Supported Rectangular Plates - Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions, Bending analysis of continuous rectangular plates.

UNIT III
PLATES OF VARIOUS SHAPES: Equations of bending of plates in polar coordinates, Circular plates under different load conditions, Elliptical plates, Triangular plates, Skewed plates, stress distribution around holes.

UNIT IV
APPROXIMATE METHODS: Rayleigh - Ritz, Galerkin Methods - Finite Difference Method - Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT V
SHELLS: Basic Concepts of Shell Type of Structures - Membrane and Bending Theories for Circular Cylindrical Shells.

TEXT BOOK

1. *Theory of Plates and Shells* by Timoshenko, S.P. Winowsky. S., and Kreger, McGraw – Hill Book Co. 1990.
2. *Theory of Plates* by K Chandrasekhara, Universities Press

REFERENCES

1. *Stresses in Shells* by Flugge, W. Springer - Verlag, 1915.
2. *Theory of Elastic Stability* by Timoshenko, S.P. and Gere, J.M., McGraw-Hill Book Co. 1961.

B.Tech. (Aeronautical Engineering) VII Semester
INTER DEPARTMENTAL ELECTIVE- I
EURAE733: HEAT AND MASS TRANSFER

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To give a brief background of application of various laws of thermodynamics and its application in heat transfer.

UNIT-I
INTRODUCTION: Basic modes of heat transfer- Rate equations- Generalized heat conduction equation in Cartesian, Cylindrical and Spherical coordinate systems. Steady state heat conduction solution for plain and composite slabs, cylinders and spheres- Critical thickness of insulation- Heat conduction through fins of uniform and variable cross section- Fin effectiveness and efficiency.
UNSTEADY STATE HEAT TRANSFER CONDUCTION- Transient heat conduction- Lumped system analysis, and use of Heisler charts.

UNIT-II
CONVECTION: Continuity, momentum and energy equations- Dimensional analysis- Boundary layer theory concepts- Free, and Forced convection- Approximate solution of the boundary layer equations- Laminar and turbulent heat transfer correlation- Momentum equation and velocity profiles in turbulent boundary layers- Application of dimensional analysis to free and forced convection problems- Empirical correlation.

UNIT-III
RADIATION: Black body radiation- radiation field, Kirchoff's laws- shape factor- Stefan Boltzman equation- Heat radiation through absorbing media- Radiant heat exchange, parallel and perpendicular surfaces- Radiation shields.

UNIT-IV
HEAT EXCHANGERS: Types of heat exchangers- Parallel flow- Counter flow- Cross flow heat exchangers- Overall heat transfer coefficient- LMTD and NTU methods- Fouling in heat exchangers- Heat exchangers with phase change. **Boiling and Condensation**: Different regimes of boiling- Nucleate, Transition and Film boiling. Condensation: Laminar film condensation- Nusselt's theory- Condensation on vertical flat plate and horizontal tubes- Drop wise condensation.

UNIT-V

MASS TRANSFER: Conservation laws and constitutive equations- Isothermal equimass, Equimolal diffusion- Fick's law of diffusion- diffusion of gases, Liquids- Mass transfer coefficient.

TEXT BOOKS:

1. *Heat Transfer*, by J.P.Holman, Int.Student edition, McGraw Hill Book Company.
2. *Fundamentals of Heat and Mass Transfer*- Incropera and Dewitt

REFERENCES:

1. *Heat and Mass Transfer*- Arora and Domkundwar
2. *Analysis of Heat Transfer* by Eckert and Drake, Intl student edition Mcgraw hill.
3. *Essential of Heat Transfer* by Christopher A. Long
4. *Heat transfer* by Sukhatme
5. *Heat transfer* by Yunus A Cengel

B.Tech. (Aeronautical Engineering) -VII Semester
INTER DEPARTMENTAL ELECTIVE-I
EURAE734: CNC

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:

To understand the process of the manufacturing or production by using computer numerical controls and programs.

UNIT-I

INTRODUCTION: NC, CNC, DNC, Programmed Automations, Machine Control Unit, Part program, NC tooling.

NC Machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changers (ATC), Turning centers.

UNIT-II

MACHINE CONTROL UNIT & TOOLING: Functions of MCU, NC actuation systems(NCAS), Part program to command signal, MCU Organization, Computerized Numerical Control, Transducers for NC machine tools, Tooling for NC machining centers and NC turning machines, Tool presetting.

UNIT-III

MANUAL PART PROGRAMMING: Part program instruction formats, information codes: preparatory function, miscellaneous functions, tool code and tool length offset, interpolations, canned cycles. Manual part programming for milling operations, turning operations, parametric sub routines.

UNIT-IV

COMPUTER AIDED PART PROGRAMMING: NC languages: APT, NELAPT, EXAPT, GNC, VNC, pre-processor, post- processor.

UNIT-V

APT PROGRAMMING: APT language structure, APT geometry: Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: set-up commands, point-to-point motion commands, continuous path motion commands. Post-processor commands, complication and control commands. Macro sub routines. Part programming preparation for typical examples.

TEXT BOOKS:

1. *Automation, Production systems & Computer integrated manufacturing* by M.P.Groover, PHI Publications,
2. *Numerical Control and Computer aided Manufacturing* by T.K. Kundra, P.N.Rao & N.K.Tiwari, Tata.Mc Graw Hill Ltd.

REFERENCES:

1. *Manufacturing systems Engineering* by Katsundo Hitomi , Second Edition, Viva Low Priced Student Edition
2. *Numerical control of Machines Tools* by Yoram Koren and Joseph BenUri, Khanna publications.
3. *Manufacturing Engineering and Technology* by Serope Kalpakjian, Steven & Schmid, 4th edition-Pearson Education Publications 4. CAD/CAM principles & applications" by P. N. Rao, Ist edition, Tata McGraw Hill publications.

B.Tech. (Aeronautical Engineering) -VII Semester
INTER DEPARTMENTAL ELECTIVE-I
EURAE735: OBJECT ORIENTED PROGRAMMING WITH JAVA

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To learn the object oriented programming concepts using Java

UNIT-I
BASICS: Software Evolution, Object Oriented Programming Paradigm, Basic Concepts of OOP, Benefits of OOP, Object Oriented Languages, Features of OOP. How OOP Differ from POP. Applications of OOP.
Java Evolution and Overview of Java Language, Java History, Features of Java, How Java differ from C and C++, Java and World Wide Web, Web Browser. Java Environment: Java Development kit (JDK), Application Programming Interface (API).
Java Programming Structure, Java Tokens, Constants, Variables, Expressions, Decision Making Statements and Looping, Java Statements, Overview of arrays and strings, Machine Neutral, Java Virtual Machine (JVM), Command Line Arguments
Arrays And Strings
Arrays : One-Dimensional arrays, creating an array, declaration of arrays, initialization of arrays. Two-Dimensional arrays, String arrays, String methods, String Buffer class, Vectors, Wrapper classes. Basic I/O Streams : Scanner, Buffered Reader.

UNIT-II
CLASSES, OBJECTS AND METHODS: Introduction, Defining a class, Creating objects, Accessing class members, Constructors, Methods overloading, Static members.
Inheritance Defining a sub class, Sub class constructor, Multilevel variables, Final classes, and Finalize methods, Abstract methods and classes, Visibility control.
Managing Errors and Exceptions
Introduction, Types of Errors: Compile time and Run time errors, Exceptions, Types of Exceptions, Syntax of Exception handling code, multiple catch statements, Using finally statement, Throwing our own exceptions.

UNIT – III

INTERFACES, PACKAGE & MULTITHREADED PROGRAMMING: Introduction, Defining interfaces, Extending Interfaces, Implementing interfaces. Package :Creation , Importing a package.

Introduction to Threads, Creating Threads, Extending the Thread Class, Implementing the Runnable' Interface, Life cycle of a Thread, Priority of a Thread, Synchronization, and Deadlock.

UNIT – IV

APPLET PROGRAMMING : Introduction, How Applet differ from Applications, Building Applet code, Applet life cycle, About HTML, Designing a Web page, Passing Parameters to Applets, Getting input from the User.

UNIT –V

GRAPHICS PROGRAMMING: Introduction, Abstract window toolkit (AWT), frames, Event-driven programming, Layout managers, Panels, Canvasses, Drawing Geometric figures.

Creating User Interface Introduction, Describe various User interface Components: Button, Label, Textfield, Textarea, Choicelist, Check box, Check box group. Introduction to Networking-Inet address, Socket address, URL.

TEXT BOOK:

1. *Thinking in Java* by Bruce Eckel 4th Edition, Pearson Education, Inc

REFERENCE BOOKS:

1. *Java programming language* – James Gosling, Bill joy.
2. *An Introduction to JAVA Programming* by Y.DanielLiang , TMH
3. *JAVA in a Nut Shell* by David Flanagan, OReilly Publications.
4. *Programming with JAVA* (2nd Edition) by Balagurusamy , TMH
5. *Head First Java* Second Edition,Kathy Sierra,Shroff Publishers

B.Tech. (Aeronautical Engineering) VII Semester
EURAE711: PERSONALITY DEVELOPMENT

Category	Periods per week				Maximum Marks			Credits
	L	T	P	Total hours	C	s	T	
HS					--	--	--	NA

B.Tech. (Aeronautical Engineering) -VII Semester

EURAE712: AIRCRAFT MAINTENANCE AND DESIGN LAB

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	-	-	3	-	100	-	100	2

A. AIRCRAFT MAINTENANCE:-

1. Stripping of Aircraft piston engine (Head, cylinder, inlet- exhaust valves, starter, generator etc), Identification and function of each parts, visual inspection and reasoning.
2. Disassembly of turbojet engine, identification of each parts, inspection & assembly.
3. Disassembly of turboprop engine, identification of each parts, inspection & assembly.
4. Disassembly of turbo shaft engine, identification of each parts, inspection & assembly.
5. Engine mass balancing.
6. Propeller Pitch setting.
7. Engine starting procedures.
8. Trouble shooting practices.
9. Engine Run Down Time (RDT) checks.
10. Turbine Centering Checks of Turbo Prop, Turbo jets and Turbo shaft Engines.

B. DESIGN:-

1. Design an aircraft that will transport 80 business class passengers and their associated baggage over a design range of 7000nm at a cruise speed equal or better than existing competitive services.
2. Design as electric powered racing aircraft
3. Design a dual mode (road/air) vehicle
4. Design an advanced deep interdiction aircraft
5. Design a general aviation amphibian aircraft

TEXT BOOK:

1. *Aircraft design Projects for Engineering Students* by Lloyd R Jenkinson and James F Marchman, Butterworth & Heinemann.

B.Tech. (Aeronautical Engineering)- VII Semester

EURAE713: INDUSTRIAL TRAINING

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			Duration in hr.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		S Con. Eval.	End Exam	Total	
IT	-	-	3	-	100	-	100	2

B.Tech. (Aeronautical Engineering) -VII Semester

EURAE714: PROJECT PHASE-I

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
PW	-	-	6	-	100	-	100	3

Fabrication of prototypes based on new ideas, robots and machines based on hitech systems. Experimental set ups, energy audit/ conservation studies of a departmental or a section in an organization/plant. Fabrication of testing equipment, renovation of machines, etc. Above work to be taken up individually or in groups. The group shall not be more than 4 students. A detail report on the work done shall include project specifications, design procedure, drawings, process sheets, assembly procedure, test results, costing etc.

GUIDELINES FOR PROJECT REPORT:

a) Report shall be typed or printed
b) Figures and tables shall be on separate pages and attached at respective positions.
c) Project title and approval sheet shall be attached at the beginning of the report followed by index and synopsis of the project.
d) Reference shall be mentioned at the end of the followed by appendices (if any)
e) When a group of students is doing a project, names of all the students shall be included on every certified report copy.
f) Each group of students shall submit two copies of reports to the institute and one copy for each individual students.
g) In case of sponsored projects, the students shall obtain certificate from sponsor and attach it to the report.

OR

2. Computer based design/analysis or modeling/simulation of products (s) mechanism (s) or system (s) and its validation or comparison with available bench marks/results. Oral shall be based on the project done by the students, jointly conducted by an internal and an external examiners appointed, at the end of Part II.

VIII semester:

S.No	Course Code	Name of the Course	Category	Instruction hours per week				Maximum Marks			Credits
				L	T	P	Total hours	C	S	T	
1	EURAE801	Avionics	CE	3	-		3	40	60	100	3
2	EURAE821-825	Department Elective –II	DE	3	1		4	40	60	100	4
3	EURAE831-835	Department Elective-III	DE	3	1		4	40	60	100	4
	EURAE841-845	Inter Departmental Elective –II	IE	3	1		4	40	60	100	4
4	EURAE811	Seminar	CE			3	3	100	-	100	2
5	EURAE812	Project Phase-II	PW			9	9	100	-	100	6
6	EURAE813	Comprehensive Viva-Voce	PW					100	-	100	2
	Total										25

B.Tech. (Aeronautical Engineering) -VIII Semester
EURAE801: AVIONICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
CE	3	-	-	3	40	60	100	3

OBJECTIVE:
To introduce the basic concepts of navigation & communication systems of aircraft.

UNIT-I
INTRODUCTION TO AVIONICS: Importance and role of Avionics, Basic principles of Avionics – Typical avionics sub system in civil/ military aircraft and space vehicles Need for avionics in civil and military aircraft and space systems - Integrated avionics and weapon systems-, design, technologies.

UNIT-II
FLIGHT DECK AND DISPLAY TECHNOLOGY
FLIGHT DECKS AND COCKPITS: Control and display technologies: CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) - Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS

UNIT-III
AUDIO AND COMMUNICATION SYSTEMS: Aircraft audio systems basic – audio transmitter and receiver principles – VHF communication system – UHF, communication systems.
RANGING AND LANDING SYSTEMS:VHF Omnirange – VOR receiver principles – distance maturity equipment – principles of operation – Instrument landing system – localizer and glideslope..

UNIT-IV
FLY –BY- WIRE FLIGHT CONTROL: FBW Flight control Features, Basic concept, Advantages of FBW control, control laws, Redundancy and Failure Survival,
Navigation Systems: Inertial Navigation, GPS (Basic principle, Integration of GPS and INS, Differential GPS),

UNIT-V
AUTOPILOTS AND FLIGHT MANAGEMENT SYSTEMS:
AUTOPILOTS: basic principles, Height control, Heading Control, ILS/MLS coupled control, Automatic Landing, Satellite Landing Guidance System, Speed Control and Auto-throttle control System

FLIGHT MANAGEMENT SYSTEM: Introduction, Radio Navigation Tuning, Navigation, Flight Planning, Performance prediction and Flight Path optimization, Control of Vertical Flight Path Profile. Integrated DATATRANSFER methodology by use of MILS – STD – 1553/ ARINC – 429

TEXT BOOK

1. *Introduction to Avionics System* IIIrd Edition by Collinson R.P.G " Springers
2. *Civil Avionics Systems*, Ian Moir, Allan G. Seabridge Professional Engineering Publishing Limited, London and Bury St Edmunds, UK.

REFERENCES:

1. *Avionics systems* by Middleton, D.H., EdLongman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. *Digital Avionics systems* by Spitzer, C.R., Prentice-Hall, Englewood Cliffs, N.J., U.S.A., 1987.
3. *Digital Principles and Application* by Malvino, A.P. and Leach, D.P., Tata McGraw Hill, 1990.

B.Tech. (Aeronautical Engineering) VIII Semester
DEPARTMENTAL ELECTIVE –II

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE821	High Temperature Materials	DE	4
2	EURAE822	Fatigue and Fracture Mechanics	DE	4
3	EURAE823	Rockets and Missiles	DE	4
4	EURAE824	Advanced CFD	DE	4
5	ERUAE825	Hypersonic Aerodynamics	DE	4

B.Tech. (Aeronautical Engineering) -VIII Semester
DEPARTMENT ELECTIVE –II
EURAE821: HIGH TEMPERATURE MATERIALS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To gain fundamental inputs related to *high temperature resisting materials*, mechanisms and methodologies.

UNIT-I
CREEP: factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

UNIT-II
DESIGN FOR CREEP RESISTANCE : Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT-III
FRACTURE : Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT-IV
OXIDATION AND HOT CORROSION: Oxidation, Pilling, Bed-worth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT-V
SUPERALLOYS AND OTHER MATERIALS: Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

TEXT BOOKS: .

1. *Flow and Fracture at Elevated Temperatures* by Raj. R., American Society for Metals, USA, 1985.
2. *Deformation and Fracture Mechanics of Engineering materials* 4th Edition by Hertzberg R. W., John Wiley, USA, 1996.
3. *Mechanical Behavior of Materials* by Courtney T.H, McGraw-Hill, USA, 1990.

REFERENCES:

1. *Stress Analysis for Creep* by Boyle J.T, Spencer J, Butterworths, UK, 1983.
2. *Creep and Fatigue in High Temperature Alloys by* Bressers. J., Applied Science, 1981.
3. *Directionally Solidified Materials for High Temperature Service by* McLean D., The Metals Society, USA, 1985.

B.Tech. (Aeronautical Engineering)-VIII Semester
DEPARTMENT ELECTIVE –II
EURAE822: FATIGUE AND FRACTURE MECHANICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:

To study the concepts of estimation of the endurance and failure mechanism of components

UNIT I

FATIGUE OF STRUCTURES: S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT II

STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR: Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques –Cumulative damage - Miner's theory - Other theories.

UNIT III

PHYSICAL ASPECTS OF FATIGUE: Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations – fatigue fracture surfaces.

UNIT IV

FRACTURE MECHANICS: Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - stress analysis of cracked bodies – Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT V

FATIGUE DESIGN AND TESTINIG: Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Applica¬tion to composite materials and structures.

TEXT BOOKS

1. *Elements of fracture mechanics* by Prasanth Kumar -- Wheeter publication, 1999.
2. *Fatigue of aircraft structure* by Barrois W, Ripely, E.L., Pergamon press. Oxford, 1913.

REFERENCES

1. *Mechanics of fracture Vol. I* by Sin, C.G., Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1919.
2. *Fundamentals of Fracture Mechanics* by Knott, J.F., Buterworth & Co., Ltd., London, 1913

B.Tech. (Aeronautical Engineering) -VIII Semester
DEPARTMENT ELECTIVE –II
EURAE823: ROCKETS AND MISSILES

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To equip students with basic knowledge on principles of Rockets and missile, study of their performance, stability.

UNIT – I
INTRODUCTORY NOTES: Introduction, Classification, mission profile, propulsion system and types, thrust profile, payload, staging, performance measures, requirements of design, control and guidance, construction, operation, case study of few launch vehicles and missiles

UNIT – II
AERODYNAMICS OF COMPONENTS: Forces acting on missile, methods for forces and moments, Bodies of revolution, conical, ogival, hemispherical and other fore body shapes, aspect ratio, wing area & planforms, subsonic characteristics of airfoils, aerodynamics of controls-wing, canard, trail, lateral controls

UNIT – III
PERFORMANCE STUDY: Drag and types, estimation of lift and drag, Boost glide trajectory, boost sustain trajectory, long range cruise trajectory- max speed, rate and time of climb, stall speed, max range, Long range ballistic trajectory- powered flight, unpowered flight

UNIT – IV
STABILITY AND CONTROL: Static longitudinal: Tow degree of freedom analysis, static stability margin and load factor capability for forward control. Lateral: Directional: Cruciform configuration, body, wing, tail contribution and directional control. Induced roll and lateral control for cruciform

UNIT – V
LAUNCHING AND TESTING OF ROCKET: Rocket equation, vertical motion in gravitational field, range without gravity field, constant pitch trajectory, gravity turn.Earth launch trajectories- gravity turn, trajectory of constant pitch, orbital launch

Testing: Types of tests, test facilities, safeguard, instrumentation and data management, flight testing, trajectory monitoring. Case study of typical launch vehicle procedures

TEXT BOOKS:

1. *Missile configuration design* by S.S Chin, McGraw hill book company
2. *Rocket propulsion and space craft dynamics* by J.W Cornelisse, H.FR Schoyer and K.F.Wakker, Pitman

REFERENCES:

1. *Rocket propulsion elements* by George P. Sutton and Oscar Biblarz, Wiley
2. *Gas Turbines and Jet and Rocket propulsion* by Mathur, M and Sharma, R.P.
3. *Rocket Propulsion and space dynamics* by Cornelisse, J.W.

B.Tech. (Aeronautical Engineering) VII Semester
DEPARTMENT ELECTIVE-II
EURAE 824: ADVANCED COMPUTATIONAL FLUID DYNAMICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To make the students to understand the advanced numerical techniques.

UNIT - I
PANEL METHODS: Introduction to panel method, Basic aspects of uniform source and vortex flows, Source panel method – Non-lifting flows over arbitrary two-dimensional bodies. Vortex panel method – Lifting flows over arbitrary two-dimensional bodies.

UNIT – II
METHOD OF CHARACTERISTICS: Introduction to numerical techniques for steady supersonic flows, Philosophy of method of characteristics. Determination of characteristic lines – Two-dimensional irrotational flow. Determination of the compatibility equation and unit processes. Regions of influence and Domains of dependence. Supersonic nozzle design using method of characteristics - Description of Mc Cormack's predictors – Corrector techniques.

UNIT – III
TRANSONIC RELAXATION METHOD: Theoretical aspects of transonic flows, Small Perturbation flows - Transonic small perturbation equations – Central and Backward difference schemes, Shock capturing vs. shock fitting techniques: Conservation vs. non conservation forms of governing equations, Line relaxation techniques.

UNIT - IV
BOUNDARY LAYER EQUATION: Introduction to boundary layer equations and their solutions. Description of the boundary layer equations. Transformation of boundary layer equations and the numerical solution method. Choice of discretization model and the generalized Crank- Nicholson Scheme. Discretization of boundary layer equations and illustration of solutions of a tridiagonal system of linear algebraic equations.

UNIT - V

TIME DEPENDENT METHODS – I: Stability of Solution, Explicit time dependent methods - Euler, Backward Euler, One step trapezoidal, Backward differencing, methods, Leap Frog method.

TIME DEPENDENT METHODS – II : Description of Lax-Wendroff Scheme and Mac Cormack's two-step predictor – Corrector method. Description of time split methods and Approximate factorization schemes

TEXT BOOK

1. *Computational Fluid Dynamics* by John .D. Anderson McGraw Hill
2. *Computational Fluid Mechanics & Heat transfer* by Anderson, Dale A., John C. Tanhill and Richard H.P Letcher, McGraw Hill, NewYork 1984, Volumes I & II.

REFERENCES

1. *Computational Fluid Dynamics for Engineers, Engineering Education System by* Hoffmann, K.A Austin, Tex., 1989
2. *Advanced Engineering Mathematics* by Kreyszig, E., , Wiley, New York
3. *Introduction to Computational Fluid Dynamics* by Chow CY, John Wiley, 1979
4. *Computation Fluid Dynamics* by Bose, T.K., Wiley Eastern Ltd., 1988.
5. *Introduction to Computational Fluid Dynamics* by Chow, C.Y., John Wiley, 1979.
6. *Introduction to Computational Fluid dynamics* by Hirsch, A.A., Mcgraw Hill, 1989.
7. *Computational Fluid Dynamics*, Vol I & II, by Fletcher, Springer Verlag, 1993.
8. *Numerical heat Transfer and Fluid Flow* by S.V., Patankar, Hemispher Publishing Corporation, 1992

B.Tech. (Aeronautical Engineering)- VII Semester
Department Elective-II
EURAE 825: HYPERSONIC AERODYNAMICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To make the students to understand the basic concepts of Hypersonic Flow and its applications.

UNIT – I
INTRODUCTION: History of hypersonic flight- a logical progression in the light of advancing technical findings. Hypersonic flow – definition, importance, physical aspects. Brief descriptive introductory preview of various phenomena such as Thin Shock layer, Entropy layer, Viscous Interaction, Effects of high Temperature and communication black out. Low density flow, free molecular flow.

UNIT – II
HYPERSONIC SHOCK AND EXPANSION WAVE RELATIONS: Oblique shock relations for high Mach numbers, Expansion wave relations for high Mach numbers. Theoretical basis of Mach number independence principle – corroboration by experimental results. Importance of experiments.
LOCAL SURFACE INCLINATION METHODS: Newtonian flow and the hypersonic double limit of M&1, Modified Newtonian flow, Centrifugal force correction to Newtonian flow, wedge and tangent cone methods.

UNIT – III
HYPERSONIC INVISCID FLOWS – I: Hypersonic small disturbance theory, Equivalence principle and hypersonic similarity parameter; Hypersonic shock relations in terms of similarity parameter.
HYPERSONIC INVISCID FLOWS – II: Application of small disturbance theory and equivalence of 1-dimensional piston motion with 2-dimensional hypersonic flow, Flat plate at an angle of attack by piston theory and comparison with exact shock expansion method, Bi-convex airfoil at zero angle of attack: comparison of piston theory and exact shock expansion method. Phenomenological aspects of hypersonic blunt body problem. Importance of blunt body problem and brief outline of Computational time-marching finite difference method and its advantage over other methods.

UNIT – IV

VISCOUS FLOWS: Derivation of compressible boundary layer equations, Brief Introduction to the flatpalte case and Some Important results and conclusions for high Mach number flows, Special characteristics of hypersonic boundary layers, Introduction to hypersonic interaction parameters – weak & strong.

UNIT –V

SHOCK TUBE BASED EXPERIMENTAL FACILITIES: Shock Tunnel, Gun Tunnel, Free Piston Wind Tunnel, Ludweig tube, Measurement techniques, Samples of comparison of experimental and theoretical results.

HYPERSONIC FACILITIES: Continuous hypersonic tunnel free flight experiments in tunnels and ballistic ranges – Measurement techniques. Role of experiments in computer code validation and Calibration.

TEXT BOOKS:

1. *Hypersonic and High Temperature Gas Dynamics,* Anderson J D, 2nd Edition, AIAA Education series, 2000.
2. *Hypersonic Flow Theory,* Hayes and Probstein,
3. *Hypersonic Aerothermodynamics,* Bertin J J, AIAA Education series, 1994.
4. *Fluid Mechanics,* Spurk J, Springer, Heidelberg 1997.

REFERNCES:

1. *European Hypersonic Wind Tunnels,* Wendt J F, AGARD Conference Proceedings No 428, Nov 1987, Paper 2.
2. Canning T N, Seiff A and James C S, Ballistic Range Technology AGARDOGRAPH report AD07 13915, Aug1970.
3. *Introduction to Reactive Gas Dynamics,* Brun, Raymond. Oxford University Press, 2009, Chapter 11: Facilties and Experimental Method
4. *Shock Tube Techniques and Instrumentation,* Harry J Davies and Churchack H D, 1969, US Army Material Command, Harry Diamond Lab, Washington DC
5. Burtschell Y, Brun R, and Zeitoun D, Shock Waves, Springer Verlag, Berlin, 1992.
6. Curtis P, Shock tubes, Pegasus Eliot Mackenzie Publishers, October 2004

B.Tech. (Aeronautical Engineering) -VIII Semester

DEPARTMENTAL ELECTIVE-III

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE831	Experimental Stress Analysis	DE	4
2	EURAE832	Industrial Aerodynamics	DE	4
3	EURAE833	Wind Tunnel Techniques	DE	4
4	EURAE834	Air Transportation Systems	DE	4
5	EURAE835	Aerodynamics of Turbo Machinery	DE	4

B.Tech. (Aeronautical Engineering) -VIII Semester
DEPARTMENT ELECTIVE –III
EURAE831: EXPERIMENTAL STRESS ANALYSIS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To bring awareness on experimental method of finding the response of the structure to different types of load.

UNIT I
MEASUREMENTS : Principles of measurements, Accuracy, Sensitivity and range of measurements.

UNIT II
EXTENSOMETERS: Mechanical, Optical, Acoustical and Electrical extensometers and their uses. Advantages and disadvantages.

UNIT III
ELECTRICAL RESISTANCE STRAIN GAUGES: Principle of operation and requirements of electrical strain gauges. Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis. Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT IV
PHOTOELASTICITY: Two dimensional photo elasticity, Concept of light – photoelastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photoelastic materials. Introduction to three dimensional photo elasticity.

UNIT V
NON–DESTRUCTIVE TESTING: Fundamentals of NDT. Radiography, ultrasonic, magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique, Fundamentals of brittle coating methods, Introduction to Moiré techniques, Holography, ultrasonic C- Scan, Thermograph, Fiber – optic Sensors.

TEXT BOOKS

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

REFERENCES

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

B.Tech. (Aeronautical Engineering) - VIII Semester
DEPARTMENT ELECTIVE –III
EURAE832: INDUSTRIAL AERODYNAMICS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To introduce fundamental principles related to Aerodynamics of movable and immovable objects.

UNIT I
ATMOSPHER: Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height.

UNIT II
WIND ENERGY COLLECTORS: Horizontal axis and vertical axis machines, Power Coefficient, Betz coefficient by momentum theory.

UNIT III
VEHICLE AERODYNAMICS: Power requirement and drag coefficients of automobiles, Effects of cut back angle Aerodynamics of trains and Hovercraft.

UNIT IV
BUILDING AERODYNAMICS: Pressure distribution on low rise buildings, Wind forces on buildings, Environmental winds in city blocks, Special problems of tall buildings, building codes, building ventilation and architectural aerodynamics.

UNIT V
FLOW INDUCED VIBRATIONS: Effect of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.
FLOW MACHINERY: Special features of industrial and stationary gas turbines as compared to aircraft gas turbines.

TEXT BOOKS

1. *Flow Induced Vibration* by Blevins, R.D., Vam Nostard, 1990
2. *Wind Power Principles by* Calvert, N.G., , Charles Griffin & Co., London, 1979.

References:

1. *Environmental aerodynamics* by Scorer, R.S. Ellis Harwood Ltd., England, 1978.
2. *Aerodynamic Drag Mechanisms of Bluff Bodies and Road Vehicles* by Sovran, M., Plenum Press, N.Y., 1978.
3. *Wind Forces in Engineering* by Sachs. P Pergamon Press, 1988.

B.Tech. (Aeronautical Engineering) -VIII Semester
DEPARTMENTAL ELECTIVE –III
EURAE833: WIND TUNNEL TECHNIQUES

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:
To study physics and operating mechanism and different method of experimentation using wind tunnel.

UNIT - I
Principles of Model Testing: Buckingham Theorem - Non dimensional numbers - Scale effect Types of similarities.

UNIT - II
Wind Tunnels: Classification - special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions -Layouts - sizing and design parameters.

UNIT - III
Calibration of Wind Tunnels: Test section speed - Horizontal buoyancy - Flow angularities - Turbulence measurements – Associated instrumentation - Calibration of supersonic tunnels.

UNIT - IV
Wind Tunnel Measurements: Pressure, and velocity measurements – Force measurements - Three component and six component balances -Internal balances.

UNIT - V
Flow Visualization: Smoke and Tuft grid techniques-Dye injection special techniques - Optical methods of flow visualization.

TEXT BOOKS:

1. *High Speed wind Tunnel Testing* by Pope, A., and Goin, L., John Wiley, 1985.
2. *Low Speed wind Tunnel Testing* by Rae, W.H. and Pope, AJohn Wiley Publication , 1984.

B.Tech. (Aeronautical Engineering) -VIII Semester
DEPARTMENT ELECTIVE –III
EURAE834: AIR TRANSPORTATION SYSTEMS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
DE	3	1	-	3	40	60	100	4

OBJECTIVE:

To impart operational / management knowledge on air transportation which includes aircrafts, airports, airspace and airlines.

AIM: The subject will introduce the air transportation systems in detail.

OUTCOME: The student with acquire the operational knowledge of air transport.

UNIT- I

AVIATION INDUSTRY & ITS REGULATORY AUTHORITIES: Introduction, history of aviation- evolution, development, growth, challenges. Aerospace industry, air transportation industry- economic impact- types and causes. Airline Industry- structure and economic characteristics.

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

UNIT-II

AIRSPACE: Categories of airspace- separation minima, airspace sectors- capacity, demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses.

Communication, navigation and surveillance systems (CNSS). Radio communications- VHF, HF, ACARS, SSR, ADS. Navigation- NDB, VOR, DME, area-navigation systems(R-Nav), ILS, MLS, GPS, INS.

UNIT- III

AIRCRAFT: Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness- payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance. typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.

UNIT- IV

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

UNIT-V

AIRLINES: Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft- buy or lease. Revenue generation, Computerized reservation systems, yield management. Integrating service quality into the revenue-generation process. Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

TEXT BOOK

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

REFERENCES

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

B.Tech. (Aeronautical Engineering) VIII Semester
DEPARTMENT ELECTIVE –III
EURAE835: AERODYNAMICS OF TURBO MACHINERY

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
DE	3	1	-	3	40	60	100	3

OBJECTIVE:
To train learners on fundamentals of Turbomachinery

UNIT – I Axial Flow compressors
Basic terminology of Turbomachinery, Axial flow compressor: Geometry structure of stage and related terminology, Cascade Aerodynamics-Nomenclature, Analysis of cascade forces, Energy losses
Flow Analysis: Coordinate system, Velocity triangles, Flow behavior, Thermodynamic cycle, single and multistage, Degree of reaction, stage pressure ratio and other performance characteristics, compressor pressure curve. Losses- Causes, Primary and secondary losses, stall, surge. Efficiencies - Polytrophic, stage and Adiabatic – Numericals and study of performance charts

UNIT II
Centrifugal Flow compressors
Introduction: Geometry structure and related terminology, Flow physics across inducer, impeller, and diffuser
Analysis: Velocity triangles, inlet velocity limitations, slip factor, radially straight, forward and backward leading configurations, Inlet guide vanes computation of pressure ratio, temperature and other parameters – Numericals.
Inducer and Diffuser: Limitations of inlet flow properties, pressure coefficient, maximum turning angle, tip velocity at inlet to inducer, inlet tip diameter. Vane and vaneless diffuser aerodynamic analysis-Numericals and performance chart analysis

UNIT - III
Axial Flow Turbines
Analysis: Comparative differences between Turbines and compressors, Velocity diagrams for rotors and stators, Performance parameters computations, Degree of reaction, Impulse and Reaction Turbines, Flow losses and causes, Efficiencies-Total to Total and Total to static, Blade spacing, Blade and Disk stress - Centrifugal, bending and thermal. Typical blade profiles, Study of performance charts
Limitations: Materials used for Blades and Disks, Cooling-Internal, External cooling. Limitations on pressure ratio - single, multi stage.

UNIT – IV

Radial Turbine and Compressor flow Instabilities

Radial Turbine: Thermodynamics and Aerodynamics of radial turbines, Radial Turbine Characteristics, Losses and efficiency

Flow Instabilities: Instabilities in Compressors, Rotating Stall and Surge, Modal and spike disturbance, Inlet Distortion and Rotating Stall, Compressor Instability and control, Noise problem in Compressors

UNIT - V

Design of Compressors

Axial Compressor: Radial equilibrium free vortex, forced vortex, Design of compressor blades 2-D blade section design: subsonic, transonic and supersonic blades, Advanced 3-D Blade profiles of Rotors and Stators

Centrifugal Compressor: Design of impellers, subsonic and supersonic vaned diffusers, vaneless volutes

Axial Turbine: Free-vortex and 3-D flow theories, Turbine Blade Cooling, Blade design, Airfoil Data, Three dimensional blade profiles

TEXT BOOKS

1. *Mechanics and Thermodynamics of Propulsion*, P. Hill and C.Peterson, Addison-Wesley Publishing Company
2. *Aerothermodynamics of Aircraft Engine Components*, Oates, G.C., ed., AIAA.
3. *The design of GasTurbine Engines:Thermodynamics and Aerodynamics* IGTI/ASME (chapter 8 and10), 2005

REFERENCES

1. *Jet Propulsion,* Cumpsty, N., Cambridge University Press.
2. *Aircraft Propulsion and Gas Turbine Engines*, El-Sayed, A.F., CRC Press, 2008.
3. *Aircraft Engines and Gas Turbines*, Kerrebrock, J.L., MIT Press.
4. *Fundamentals of Jet Propulsion with Applications*, Flack, R.D., Cambridge University Press

B.Tech. (Aeronautical Engineering) VIII Semester

INTER DEPARTMENTAL ELECTIVE-II

S.no	Course Code	Name of the Course	Category	Credits
1	EURAE841	Microprocessors and Applications	IE	4
2	EURAE842	Neural Networks & Fuzzy Logic	IE	4
3	EURAE843	CAD/CAM and CIM	IE	4
4	EURAE844	Robotics & Automation	IE	4
5	EURAE845	Data Base Management System	IE	4

B.Tech. (Aeronautical Engineering) -VIII Semester
INTER DEPARTMENTAL ELECTIVE –II
EURAE841: MICROPROCESSORS AND APPLICATIONS

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To understand the concept of RAM, Microcontroller and Data file transfer.

UNIT- I
SEMICONDUCTOR MEMORIES: Introduction to semiconductor memories RAM- Static and Dynamic /ROM/PROM/EPROM/EEPROM.

UNIT-II
MICROCONTROLLER: comparing Microprocessors & Microcontrollers, 8051 architecture, pin diagram, Input/output ports, SFRs - Counters & Timers, Serial Data Input/ Output, Interrupts.

UNIT- III
Addressing Modes of 8051, Bit manipulation Instructions. Interfacing of switches, LEDs, ADC & DAC.

UNIT-IV
PLC data acquisition: Study of PC based data acquisition cards. Multiplexing of i/p of A/D, Scanning rates.
STUDY OF PLC APPLICATION: Ladder diagram development. Application of PLC to CNC machine, cooling equipment as case studies. Applications in aeronautical engineering.

UNIT-V
Case study of microprocessor based smart instruments, smart control valves and control systems. Explanation of smart features for two or three types of equipment like weighing machine, pH transmitter, differential pressure transmitter.

REFERENCES:

1. *Digital Principles & Applications* by Malvino A.P. Leach, D.P., Tata McGraw-Hill, 1990.
2. *The 8051 Microcontroller: Architecture, programming and application* by K.J. Ayala, Penram International Published, India.
3. S. Y. Boyer, "*SCADA*", ISA Publications John Webb,"*PLC*", Otter.
4. *Instrumentation's Reference Book* by B.E. Noltingk, Butterworth International Edition.
5. *Electrical & Electronic Measurements and Instrumentation* by A.K. sawhney. 2002 edition.

B.Tech. (Aeronautical Engineering)- VIII Semester
INTER DEPARTMENTAL ELECTIVE –II
EURAE842: NEURAL NETWROKS & FUZZY LOGIC

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To understand the different communication network systems and data base management systems using human interface and part programming.

UNIT-I
FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS: Biological neurons and their artificial models, Neural processing, learning and Adaptation, Neural Network Learning Rules – Hebbian, perceptron, delta, widrow – hoff, correlation, winner – take –all, outstar learning rules.

UNIT-II
SINGLE LAYER PERCEPTIONS: Multi player Feed forward Networks – Error back propagation training algorithm, problems with back propagation, Boltzmann training, Cauchy training, Combined back propagation/Cauchy training.

UNIT-III
HOPFIELD NETWORKS: Recurrent and Bi-directional Associative Memories, Counter Propagation Network, Artificial Resonance Theory (art).

UNIT-IV:
APPLICATIONS OF NEURAL NETWORKS: Handwritten digit and character recognition, Traveling salesman problem, Neuro controller – inverted pendulum controller, cerebellar model articulation controller, Robot kinematics, Expert systems for Medical Diagnosis.

UNIT-V:
INTRODUCTION TO FUZZY SET THEORY: classical set Vs fuzzy set, properties of fuzzy sets, operations on fuzzy sets – union, intersection, complement, T-norm and co T-norm.
FUZZY RELATIONS: Operations on fuzzy relations, cylindrical extensions Inference rules, compositional rule of inference.

TEXT BOOKS:

1. *Introduction to artificial Neural System* by S.M.Zurada, Jaico Publishing House,(1992)
2. *Neural Computing – Theory and Practice* by Philip D.Wesserman, Van Nostrand Rein hold, New York (1989)
3. *Neural Networks and Fuzzy Systems* by Bart Kosko, Prentice Hall, NJ, (1992)
4. *Fuzzy sets, Uncertainty, and Information* by G.J.Klir, T.A.Folger, Prentice Hall of India, New Delhi 1988
5. *An Introduction to Fuzzy Control* by D.Driankov, H.Hellen Doorn, M.Reinfrank,Narosa Publishing House New Delhi 1993.
6. *Essential of Fuzzy Modeling and Control* by R.K.Yager, D.P.Filev, John Wiley & Sons, Inc, NY 1994.

B.Tech. (Aeronautical Engineering) -VIII Semester
INTER DEPARTMENTAL ELECTIVE –II
EURAE843: CAD/CAM AND CIM

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
IE	3	1	-	3	40	60	100	4

The main objective of this subject is to learn the criteria of design and manufacturing of any machine parts or component using computer aided design or programs using various surfaces and curves. Hence can be integrated by various part programming and coding.

UNIT – I

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.

COMPUTER GRAPHICS: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT – II

GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

UNIT – III

DRAFTING AND MODELING SYSTEMS : Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling.

Numerical control : NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming : fundamentals, manual part programming methods, Computer Aided Part Programming.

UNIT – IV

GROUP TECH: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

UNIT – VII

Material requirement planning, manufacturing resources planning, DNC, AGV, ASRS, Flexible manufacturing systems– FMS equipment, system layouts, FMS control.

CIM : Integration, CIM implementation, major functions in CIM, Benefits of CIM, Lean manufacturing, Just-in-time.

TEXT BOOKS :

1. *CAD / CAM Principles and Applications* – 2nd edition, P.N. Rao, Tata Mc. Graw Hill

REFERENCES :

1. *CAD / CAM Theory and Practice* by Ibrahim Zeid / TMH
2. *CAD / CAM / CIM by* Radhakrishnan and Subramanian / New Age
3. *Principles of Computer Aided Design and Manufacturing* by Farid Amirouche / Pearson
4. *Computer Numerical Control Concepts and programming* by Warren S Seames / Thomson.
5. CAD / CAM by CSP Rao – Hi-Tech Publishers.

B.Tech. (Aeronautical Engineering) -VIII Semester
INTER DEPARTMENTAL ELECTIVE –II
EURAE844: ROBOTICS & AUTOMATION

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To learn and understand of automatic control of manually designed robots or manufacturing machine by using Robotics arm and various kinematics and dynamic performance of the numerically controlled machine.

UNIT I:
INTRODUCTION TO ROBOTICS: History of Robots – Classifications – Various fields of Robotics – Actuators – Sensors – Manipulators – End effectors – Application areas – Robot programming languages.

UNIT II:
ROBOT KINEMATICS : Matrix representation – Homogeneous transformation – DH representation of standard robots – Inverse kinematics.

UNIT III:
ROBOT DYNAMICS: Velocity kinematics – Jacobian and inverse Jacobian – Lagrangian formulation – Eulers Lagrangian formulation – Robot equation of motion.

UNIT IV:
TRAJECTORY PLANNING: Introduction – Path Vs trajectory – Joint-space Vs Cartesian-space descriptions – Basics of trajectory planning – Joint-space trajectory planning – Cartesian-space trajectories.

UNIT V:
CONTROL AND APPLICATION OF ROBOTICS : Linear control of robot manipulation – Second-order systems – trajectory following control – Modeling and control of single joint – Architecture of industrial robotic controllers – Robot applications.

TEXT BOOKS

1. *Introduction to Robotics Analysis, Systems, Applications* by Saced B. Niku, Prentice Hall of India/Pearson Education, Asia, 2001.
2. *Introduction to Robotics Mechanics and Control* by Craig, 'Second edition, Pearson Education, Asia, 2004.

REFERENCE BOOKS

1. *Robotics Control, Sensing, Vision and Intelligence* by K.S. Fu & Co., , McGraw Hill International Editions, Industrial Engineering Series, 1991.
2. *Robotic Engineering – An integrated Approach* by R.D.Klafter, T.A. Chimielewski and M.Negin, ', Prentice Hall of India, New Delhi, 1994.
3. *Industrial Robotics Technology Programming and Application* by Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, 'McGraw Hill book company, 1986.

B.Tech. (Aeronautical Engineering) VIII Semester
INTER DEPARTMENTAL ELECTIVE –II
EURAE845: DATA BASE MANAGEMENT SYSTEM

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval	End Exam	Total	
IE	3	1	-	3	40	60	100	4

OBJECTIVE:
To understand the basic concepts of Data base management systems.

UNIT-I
INTRODUCTION TO DBMS: Overview, File system vs DBMS, Advantages of DBMS, Storage data, queries, Transaction Management, DBMS structure
E-R model: Entities, Attributes and Entity sets, Relationship and Relationship sets,
Features of ER model, Conceptual database design with ER model

UNIT-II
RELATIONAL MODEL: Integrity constraints over relations and enforcement, Querying relation data, Logical database design, views, destroying/altering tables and views
Relational algebra and calculus: Relational algebra and calculus

UNIT-III
SQL: Basic SQL, Query, union, interest, except, Nested Queries, Aggregated Operation, Null values, Embedded SQL, cursors, ODBC and JDBC, Triggers and Active database, designing active databases

UNIT-IV
SCHEMA REFINEMENT AND NORMAL FORMS: Schema refinement, fds, fds reasoning normal forms, decomposition, normalization.

UNIT-V
Transaction management, concurrency control & crash recovery
Transaction concept, transactions and schedules, concurrent execution of transactions ,lock – based concurrency control, crash recovery.
Concurrency control - lock management, specialized locking techniques, concurrency control without locking.
Crash Recovery- Aries, recovering from a system crash, media recovery

TEXT BOOKS:

1. *Database Management Systems*, by Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill
2. *Database System Concepts*, H.F.Korth and A.silberschatz McGraw-Hill

REFERENCE BOOKS:

1. *Fundamentals of Database Systems*, by Ramez Elmasri, Shamkant B. Navathe
2. *Fundamentals of Database Systems,* Elmasri, Navathe, Somayajulu, Gupta, Pearson Education,

B.Tech. (Aeronautical Engineering) VIII Semester

EURAE811: SEMINAR

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
CE	-	-	3	3	100	-	100	2

OBJECTIVE:
To improve the technical investigation, report writing and presentation skills.

Upon the interest of the student, he/she is supposed to choose any one of the core investigation/research areas for taking up technical investigation and analysis through latest published literature consisting national and international publications, journals.

B.Tech. (Aeronautical Engineering)- VIII Semester

EURAE812: PROJECT PHASE-II

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
PW	-	-	9	3	100	-	100	6

Fabrication of prototypes based on new ideas, robots and machines based on hitech systems. Experimental set ups, energy audit/ conservation studies of a departmental or a section in an organization/plant. Fabrication of testing equipment, renovation of machines, etc. Above work to be taken up individually or in groups. The group shall not be more than 4 students. A detail report on the work done shall include project specifications, design procedure, drawings, process sheets, assembly procedure, test results, costing etc.

GUIDELINES FOR PROJECT REPORT:

a) Report shall be typed or printed
b) Figures and tables shall be on separate pages and attached at respective positions.
c) Project title and approval sheet shall be attached at the beginning of the report followed by index and synopsis of the project.
d) Reference shall be mentioned at the end of the followed by appendices (if any)
e) When a group of students is doing a project, names of all the students shall be included on every certified report copy.
f) Each group of students shall submit two copies of reports to the institute and one copy for each individual students.
g) In case of sponsored projects, the students shall obtain certificate from sponsor and attach it to the report.

OR

2. Computer based design/analysis or modeling/simulation of products (s) mechanism (s) or system (s) and its validation or comparison with available bench marks/results. Oral shall be based on the project done by the students, jointly conducted by an internal and an external examiners appointed, at the end of Part II.

B.Tech. (Aeronautical Engineering) VIII Semester

EURAE813: COMPREHENSIVE VIVA-VOCE

Category	Scheme of Instruction			Scheme of Examination				Credits
	Periods per week			End Exam Duration in hours.	Maximum Marks			
	Lectures	Tutorials	Drawing/ Practical		Con. Eval.	End Exam	Total	
PW	-	-	-	-	100	-	100	2

A viva voce examination is to be conducted by an external examiner at the end of the total course work. The examination should be comprehensive covering all the topics learnt by the candidate in his four year course duration of study.