

**ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS**

**AERONAUTICAL
ENGINEERING**

FOR

B.TECH FOURYEAR DEGREE COURSE
(Applicable for the batches admitted from 2002-2003)



**JAWAHARLAL NEHRU
TECHNOLOGICAL UNIVERSITY
KUKATPALLY, HYDERABAD - 500072.**



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. (Regular) Four Year Degree Course (Revised) Academic Regulations

(Effective for the students studying 1 year from the
Academic Year 2002-2003 and onwards)

1. Award of B.Tech.Degree:

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

- i. He has pursued a course of study for not less than four academic years and not more than eight academic years.
- ii. He has registered for and studied all the subjects for a total of 212 credits and secured all the 212 credits.
2. Students, who fail to fulfill all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in the course and their seat shall stand cancelled.

3 Courses of Study:

The following courses of study are offered at present for specialization for the B.Tech. Degree:

1. Aeronautical Engineering ✓
2. Bio-Medical Engineering ✓
3. Bio-Technology ✓
4. Chemical Engineering ✓
5. Civil Engineering ✓
6. Computer Science and Engineering ✓
7. Computer Science and Systems Engineering ✓
8. Electrical and Electronics Engineering ✓
9. Electronics and Communication Engineering ✓
10. Electronics and Computer Engineering ✓
11. Electronics and Control Engineering ✓
12. Electronics and Instrumentation Engineering ✓
13. Electronics and Telematics Engineering ✓

14. Information Technology ✓
 15. Instrumentation and Control Engineering ✓
 16. Mechanical (Mechatronics) Engineering ✓
 17. Mechanical (Production) Engineering ✓
 18. Mechanical Engineering
 19. Metallurgical Engineering ✓
 20. Metallurgy and Material Technology ✓

and any other courses as approved by the authorities of the University from time to time.

4. Credits:

	Semester Pattern		Yearly Pattern	
	Periods/week	Credits	Periods/weeks	Credits
Theory	04	04	03	06
Practicals	03	02	03	04
Practicals	06	04	06	08
Project	08	08	-	-

5. Distribution and Weightage of Marks:

- The Performance of a student in each semester / 1 year shall be evaluated subject-wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition, project shall be evaluated for 200 marks.
- For theory subjects the distribution shall be 20 marks for internal Evaluation and 80 marks for the end-examination.
- For theory subjects, there shall be 5 objective type tests for a duration of 20 minutes each during the semester. Each test shall contain 20 objective type questions for 20 marks. The best 4 tests will be considered for awarding 20 sessionals marks. For the 1 year class which shall be on yearly basis, there shall be 6 tests of the same duration and weightage as mentioned above. However, the performance in the best 4 tests will be considered for awarding 20 sessional marks.
- For Practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 50 End Examination marks. Of the 25 marks for internal, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting internal lab test(s). The end examination shall be conducted by the teacher concerned and another member of the staff of the same department of the same institution.
- For the subject having design and / or drawing, and estimation, the distribution shall be 20 marks for internal evaluation (10 marks for day-to-day work and 10 marks for internal tests). There shall be two internal tests in a semester and the better of the two will be taken into consideration. However in the 1 year class, there shall be three tests and the best two will

be taken into consideration for a maximum of 20 marks. The End Examination shall be for a total of 80 marks.

- The Engineering Drawing Practice Course wherever offered is to be treated as a practical course. Evaluation method adopted for practicals shall be followed here also.
- Out of a total of 200 marks for the project work, 40 marks shall be for Internal Evaluation and 160 marks for the End Semester Examination. The End Semester Examination (viva-voce) shall be conducted by a board of examiners consisting of Guide, Head of the Department and an external examiner. The evaluation of project work shall be conducted at the end of the IV year. The internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project.
- Laboratory marks and the sessional marks awarded by the college are not final. They are subject to scrutiny and scaling by the University wherever felt desirable. The uniform distribution of awarding of sessional marks and Laboratory marks will be referred to a Committee. The Committee will arrive at a scaling factor and the marks will be scaled as per the scaling factor. The recommendations of the committee are the final and binding. The laboratory records and internal test papers shall be preserved in the respective departments as per the University norms and shall be produced to the Committees of the University as and when they visit the college.

6. Attendance:

- A student has to put in a minimum of 75% of attendance in aggregate of all the subjects for acquiring credits in the 1 year and / or each semester thereafter.
- Condonation of shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each semester or 1 year may be granted by the college Academic Committee.
- A student will not be promoted to the next semester unless he satisfies the attendance requirement of the present semester / 1 year.
- Shortage of Attendance below 65% in aggregate shall in no case be condoned.
- Students whose shortage of attendance is not condoned in any semester / 1 year are not eligible to take their end examination of that class and their registration shall stand cancelled. They may seek re-admission for that semester / 1 year when offered next.
- Condonation of shortage of attendance as stipulated in 6(ii) above shall be granted on genuine and valid grounds with supporting evidence.
- A stipulated fee shall be payable towards condonation of shortage of attendance

7. Minimum Academic Requirements:

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

- i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or practical design or drawing subject or project if he secures not less than 35% of marks in the end examination and minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together.
- ii. A student shall successfully complete all the 1 year subjects from 3 regular consecutive examinations and 3 supplementary consecutive examinations of 1 year from the date of admission. If he has failed to do so he shall forfeit the seat in course and his seat shall stand cancelled.
- iii. A student shall be promoted from II to III year only if he fulfils the academic requirements of 56 credits from the consecutive regular and supplementary examinations of 1 year and from the regular examination of II year I semester irrespective of whether the candidate takes the examination or not.
- iv. A student shall be promoted from third year to fourth year only if he passes all the subjects of 1 year and fulfils the academic requirements of total 100 credits (including 56 credits of I year) from the following examinations,
 - a. Two regular and two supplementary examinations of I year
 - b. Two regular and I Supplementary examinations of II year I Semester
 - c. One regular and One Supplementary examinations of II year II Semester
 - d. One regular III year I semester examinations.
- v. A Student shall earn all the 212 credits offered as indicated in the course structure.
- vi. Students who fail to earn all the 212 credits offered as indicated in the course structure within 8 academic years from the year of their admission shall forfeit their seat in the course and their seat shall stand cancelled.

8. Withholding of Results:

The result of a student shall be withheld if:

- i. He has not cleared any dues to the Institution / Hostel;
- ii. A case of disciplinary action against him is pending disposal;

9. Course pattern:

- i. The entire course of study is of four academic years. The first year shall be on yearly pattern and the second, third and fourth years on semester pattern.
- ii. A student eligible to appear for the end examination in a subject, but absent at it or has failed in the examination may appear for that subject at the supplementary examination.

10. Award of Class:

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

First Class with Distinction	70% and above	From the aggregate marks secured for 212 credits.
First class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

11. Minimum Instruction Days:

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

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

13. There shall be no place transfer within the Constituent Colleges of Jawaharlal Nehru Technological University for B.Tech. Regular / FDH/CCC and P.G. Programmes.

General:

14. Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
15. The academic regulation should be read as a whole for the purpose of any interpretation.
16. In the case of any doubt or ambiguity in the interpretation of above rules, the decision of the Vice-Chancellor is final.
17. The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

**Academic Regulations for
B.Tech. (Lateral Entry Scheme)**

(Effective for the students getting admitted into II year from the Academic Year 2003-2004 and onwards)

1. The students have to acquire 156 credits from II to IV year of B.Tech. Programme (Regular) for the award of the degree.
2. Students who fail to fulfill the requirements for the award of the degree in 6 consecutive academic years from the year of admission shall forfeit their seat.
3. The same attendance regulations are to be adopted as that of B.Tech. (Regular).
4. Promotion Rule:
A student shall be promoted from third year to fourth year only if he fulfills the academic requirements of 44 credits from the following examinations.
 - a. Two regular and one supplementary examinations of II year I Semester.
 - b. One regular and one supplementary examinations of II Year II Semester.
 - c. One regular III year I Semester examination.
5. Award of Class:

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

First Class with Distinction	70% and above	From the aggregate marks secured for 156 credits. (i.e. II year to IV year)
First class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

6. All other regulations as applicable for B.Tech Four-year degree course (Regular) will hold good for B.Tech. (LES)

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

I Year B. Tech. AE

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

Notation: AE = Aeronautical Engineering

CODE	SUBJECT	T	P	D	C
AE 1021	ENGLISH	3	0	0	6
AE 1022	MATHEMATICS – I	3 + 1*	0	0	6
AE 1023	ENGINEERING PHYSICS	2 + 1*	0	0	4
AE 1024	ENGINEERING CHEMISTRY	2	0	0	4
AE 1025	ENGINEERING MECHANICS	2 + 1*	0	0	6
AE 1026	INTRODUCTION TO COMPUTERS	3	0	0	6
AE 1027	ENGINEERING GRAPHICS	0	0	6	8
AE 1028	ENGINEERING PHYSICS LAB.	0	3/2	0	2
AE 1029	FUELS AND LUBRICANTS LAB.	0	3/2	0	2
AE 1030	COMPUTER LAB.	0	6	0	8
AE 1031	WORKSHOP	0	3	0	4
	TOTAL	15 + 3*	12	6	56

(* = Tutorial)

T = Theory periods per week
P = Practical/Drawing periods per week
C = Total Credits for the subject

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II Year B. Tech. AE - 1 Semester

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

CODE	SUBJECT	T	P	D	C
AE2121	MATHEMATICS - II	4	0	0	4
AE2122	DATA STRUCTURES THROUGH C	4	0	0	4
AE2123	MECHANICS OF SOLIDS	4	0	0	4
AE2124	MECHANICS OF FLUIDS	4	0	0	4
AE2125	MACHINE DRAWING	0	0	6	4
AE2126	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	4	0	0	4
AE2127	DATA STRUCTURES LAB.	0	3	0	2
AE2128	MECHANICS OF SOLIDS AND FLUID MECHANICS LAB.	0	3	0	2
	TOTAL	20	6	6	28

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II Year B. Tech. AE - 11 Semester

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

CODE	SUBJECT	T	P	D	C
AE2221	MATHEMATICS - III	4	0	0	4
AE2222	AERODYNAMICS - I	4	0	0	4
AE2223	ENGINEERING THERMODYNAMICS	4	0	0	4
AE2224	ELECTRICAL AND ELECTRONICS ENGINEERING	4	0	0	4
AE2225	AEROSPACE MATERIALS	4	0	0	4
AE2226	KINEMATICS OF MACHINES	4	0	0	4
AE2227	CAD LAB.	0	3	0	2
AE2228	ELECTRICAL AND ELECTRONICS LAB.	0	3	0	2
	TOTAL	24	6	0	28

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

III Year B. Tech. AE - 1 Semester

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

CODE	SUBJECT	T	P	D	C
AE3121	AIRCRAFT PRODUCTION TECHNOLOGY	4	0	0	4
AE3122	AIRCRAFT PERFORMANCE	4	0	0	4
AE3123	AERODYNAMICS - II	4	0	0	4
AE3124	WIND TUNNEL TECHNIQUES	4	0	0	4
AE3125	AIRCRAFT STRUCTURES - I	4	0	0	4
AE3126	AEROSPACE PROPULSION - I	4	0	0	4
AE3127	AIRCRAFT PRODUCTION LAB.	0	3	0	2
AE3128	AERODYNAMICS LAB.	0	3	0	2
	TOTAL	24	6	0	28

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

III Year B. Tech. AE - II Semester

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

CODE	SUBJECT	T	P	D	C
AE3221	AIRCRAFT STABILITY AND CONTROL	4	0	0	4
AE3222	AIRCRAFT STRUCTURES - II	4	0	0	4
AE3223	AEROSPACE PROPULSION - II	4	0	0	4
AE3224	COMPUTATIONAL AERODYNAMICS - I	4	0	0	4
AE3225	HIGH SPEED AERODYNAMICS	4	0	0	4
AE3226	ROCKETS AND MISSILES	4	0	0	4
AE3227	AIRCRAFT STRUCTURES LAB.	0	3	0	2
AE3228	AERO ENGINE REPAIR AND MAINTENANCE LAB.	0	3	0	2
	TOTAL	24	6	0	28

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE - 1 Semester

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

CODE	SUBJECT	T	P	D	C
AE4121	THEORY OF VIBRATIONS AND AEROELASTICITY	4	0	0	4
AE4122	AIRCRAFT DESIGN PRACTICE	4	0	0	4
AE4123	COMPUTATIONAL AERODYNAMICS - II	4	0	0	4
AE4124	AIRCRAFT SYSTEMS AND INSTRUMENTS	4	0	0	4
	ELECTIVE - I				
AE 4125	EXPERIMENTAL STRESS ANALYSIS	4	0	0	4
AE 4126	AVIONICS	4	0	0	4
AE 4127	SPACE TECHNOLOGY	4	0	0	4
AE 4128	COMPOSITE MATERIALS AND STRUCTURES	4	0	0	4
AE 4129	INDUSTRIAL AERODYNAMICS	4	0	0	4
	ELECTIVE - II				
AE 4130	DESIGN AND DRAFTING	4	0	0	4
AE 4131	APPROXIMATE METHODS FOR STRUCTURAL MECHANICS	4	0	0	4
AE 4132	PROPELLANT TECHNOLOGY	4	0	0	4
AE 4133	FLIGHT TRAINING AT IIT, KANPUR	0	4	0	4
AE 4134	COMPUTER INTEGRATED MANUFACTURING	4	0	0	4
	AIRCRAFT SYSTEMS LABORATORY	0	3	0	2
AE4135	COMPUTATIONAL AERODYNAMICS LABORATORY	0	3	0	2
	TOTAL	24	6	0	28

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE - II Semester

**AERONAUTICAL ENGINEERING
COURSE STRUCTURE**

CODE	SUBJECT	T	P	D	C
	ELECTIVE – III				
AE 4221	FINITE ELEMENT METHODS	4	0	0	4
AE 4222	CRYOGENICS	4	0	0	4
AE 4223	AIRCRAFT DESIGN	4	0	0	4
AE 4224	CREATIVE, INNOVATION AND NEW PRODUCT DEVELOPMENT	4	0	0	4
AE 4225	SPACE MECHANICS	4	0	0	4
	ELECTIVE – IV				
AE 4226	FATIGUE AND FRACTURE MECHANICS	4	0	0	4
AE 4227	VISCOUS FLOW THEORY	4	0	0	4
AE 4228	HELICOPTER AERODYNAMICS	4	0	0	4
AE 4229	HEAT TRANSFER	4	0	0	4
AE 4230	AEROELASTICITY	4	0	0	4
AE4231	PROJECT & SEMINAR	0	0	0	8
	TOTAL	8	0	0	16

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

I Year B. Tech. AE

3-0-6

AE1021

ENGLISH
(Common to all branches)

The following text books of English are prescribed for I B.Tech class of all branches in the Colleges of Engineering and Technology affiliated to JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD. The exercises given are expected to be covered by the teacher in the classroom, the objective of the course being the development of linguistic skills of the learners.

1. A textbook of English for Engineers and Technologies, OL.
2. Masterminds, OL.

UNIT – I

1. Energy, Unit 3: Alternative Sources (from a textbook of English for Engineers and Technologists, OL).
2. Jagadish Chandra Bose, (a profile from the Trail Blazers in Masterminds, OL).

UNIT – II

1. Computers, Unit 2: New Frontiers (from a textbook of English for Engineers and Technologists, OL).
2. Chandrasekhara Venkata Raman (a profile from the World of Figures and Physics in Masterminds, OL).

UNIT – III

1. Technology, Unit 3: Evaluating Technology (from a Text Book of English for Engineers and Technologists, OL).
2. S.S. Bhatnagar (a profile from the Institution Builders in Masterminds, OL).

UNIT – IV

1. Environment, Unit I: Pollution (from a text book of English for Engineers and Technologists, OL).
2. Homi Jehangir Bhabha (a profile from the New Age in Masterminds, OL).

UNIT – V

1. Industry, Unit 2: Safety and Training (from a Text Book of English for Engineers and Technologists, OL).
2. Salim Ali (a profile from The Living World in Masterminds, OL).

UNIT – VI

Common Errors, Sentence Completion, Synonyms and Antonyms, Analogy, Report Writing, Comprehension, General Essay, Situational Dialogues.

Note: The Establishment of an English Language Laboratory in each Affiliated College of Engineering and Technology is recommended with effect from the Academic year 2002-03 for the following reasons:

1. To expose the students to TOEFL and GRE model of training and practice.
2. To help the students learn correct pronunciation, accent and intonation.
3. To enable the students to improve and strengthen their communicative skills.
4. To expose the students to different variations in English expression.

It is also recommended that the English Language Laboratory training and practice is treated as a non-examination item of the curriculum.

TEXT BOOKS:

1. Strengthen Your Writing, V.R. Narayana Swami (OL).
2. Success with Grammar and Composition, K.R. Narayanaswamy (OL).
3. Examine Your English, Margaret Maison (OL).
4. English for Professional Students, S.S.Prabhakara Rao.
5. TOEFL (ARCO & BARRONS, USA) & CLIFFS TOEFL.
6. GRE (ARCO & BARRONS ,USA) & CLIFFS GRE.
7. Communication skills for Technical Students, T.M. Farhathulla (OL).
8. Strategies for Engineering Communication, Susan Stevenson & Steve Whitmore (John Wiley & Sons)
9. Basic Communication Skills for Technology, 2nd edition, Andrea J. Rutherford, (Pearson Education Asia).

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

I Year B. Tech. AE

4-0-6

AE1022

MATHEMATICS - 1
(Common with Mechanical, Production Engg – and Mechatronics)

UNIT – I

Sequences – Series – Convergence and divergence – Ratio test – Comparison test – Integral test – Cauchy's root test – Raabe's test – Absolute and conditional convergence.

Rolle's theorem – Lagrange's Mean Value theorem – Cauchy's Mean Value Theorem – generalized Mean value theorem (Taylor's Theorem)

UNIT – II

Functions of several variables – Limit and continuity – Partial differentiation – Chain rule – Total derivative – Euler's theorem, Jacobian–Functional dependence, Maxima and Minima of functions of two variables with and without constraints, Radius, Centre and circle of curvature – Evolutes and Envelopes.

UNIT – III

Curve tracing – Cartesian, polar and Parametric curves. Applications of integration to lengths, volumes and surface areas in Cartesian and polar coordinates.

UNIT – IV

Differential equations of first order and first degree – Formation, Exact, linear and Bernoulli. Applications to Newton's Law of Cooling, Law of natural growth and decay, Orthogonal trajectories. Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type e^{ax} , $\sin ax$, $\cos ax$, polynomial in x , $e^{ax} V(x)$, $xV(x)$, method of variation of parameters.

UNIT – V

Laplace transform of standard functions – Inverse transform – Linearity – First shifting Theorem. Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Differentiation and integration of transforms. Multiple integrals: Double and triple integrals – Change of variables – Change of order of integration.

UNIT – VI

Vector Differential Calculus: Gradient, Divergence, Curl and their related properties of sums, products, Laplacian and second order operators.

Vector integral calculus: Vector integration – Line integral – Work done – Potential function – area, surface and volume integrals. Green's theorem, Stokes's and Gauss Divergence theorem. Verification of Green's, Stoke's and Gauss Theorems, Curvilinear Coordinates – Cylindrical, Spherical coordinates – Expressions of Grad, div, curl in Spherical, Cylindrical and Curvilinear coordinates.

TEXT BOOKS

1. A Text Book of Engineering Mathematics Volume – I, 2002, T.K.V.Iyengar, B.Krishna Gandhi, and others, S.Chand and company
2. Engineering Mathematics, B.V.Ramana, Tata McGraw Hill 2002
3. Engineering Mathematics –I, C.Sanakraiah, Vijaya publications –2002
4. Engineering Mathematics –I, P.Nageswara Rao, Y.Narsimhulu, Prabhakar Rao, 2002

REFERENCE BOOKS

1. Engineering Mathematics –I, S.K.V.S. Sri Rama Chary, M.Bhujanga Rao, Shankar, B.S.Publications, 2000
2. Advanced Engineering Mathematics (Eighth edition), Erwin Kreyszig, John Wiley & Sons (ASIA) Pvt. Ltd., 2001
3. Advanced Engineering Mathematics (Second edition), Michael D. Green Berg, Prentice Hall, Upper saddle River, New Jersey 1998
4. Engineering Mathematics, Sarveswara Rao Koneru, Orient Longman Pvt. Ltd., 2002
5. Engineering Mathematics –I, N.P.Bali, Laxmi Publications (P) Ltd., New Delhi.

ENGINEERING PHYSICS
(Common with Mechanical, Production Engg – and Mechatronics)

UNIT – I (A)

Interference of light: Introduction – Superposition of waves - Young's double slit experiment – Coherence – Types of interference – Interference in thin films- Colour of thin films – Newton's rings.

UNIT – I (B)

Diffraction of light: Introduction – Fraunhofer diffraction at a single slit, Fraunhofer diffraction due to two parallel slits - Fraunhofer diffraction due to n-parallel slits – Diffraction - a qualitative description – diffraction grating – Grating Spectrum -Fraunhofer diffraction at a circular aperture – Rayleigh's criterion for resolving power –electron microscope.

UNIT – II (A)

Polarization of light: Introduction - Representation of polarized and unpolarized light – Production of polarized light – Circular and elliptical Polarization – Calculation of the phase difference when a linearly polarized light passes through a double refracting crystal.

UNIT – II (B)

Non-destructive Testing: Introduction – Theory and practice of ultrasonic testing – Ultrasonic testing systems – Ultrasonic testing methods – Applications of ultrasonics.

UNIT – III (A)

Laser: Introduction – Characteristics of laser light – Basic concepts of laser – Types of lasers - Ruby laser, He-Ne laser – Applications of lasers.

UNIT – III (B)

Fibre Optics: Introduction – Basic principles – Light wave communication using optical fibres – Numerical aperture – Acceptance angle – Fibre optics in medicine & industry.

UNIT – IV (A)

Thermal properties: Specific heat of solids – Einstein model, Photons – Thermal conductivity – Thermal expansion – Thermoelectric effect - Thermo-analyzer – Thermo-gravimetry - Thermo-mechanical analysis.

UNIT – IV (B)

Dielectric materials: Introduction – Dielectric constant or relative permittivity – Loss tangent or dielectric loss – Polarization – Dielectric strength – Classification of dielectrics – Porcelain – Glass

UNIT – V (A)

Magnetic materials: Introduction – Magnetic moment of electrons and atoms – Basic definitions – Classification of Magnetic materials – Diamagnetic materials – Paramagnetic materials – Ferromagnetic materials – Anti-ferromagnetic and Ferri-magnetic materials – Soft and Hard magnetic materials.

UNIT – V (B)

Superconductivity: Introduction – Properties of superconductors – BCS theory of superconductivity – Applications of superconductors.

UNIT – VI (A)

Deformation & Creep in materials: Plastic deformation – Stress strain curve – deformation by slip – Strength of crystals – Dislocations – Multiplication of dislocations – Mechanism of creep – Creep resistant materials.

UNIT – VI (B)

Materials for Space Applications: Space programme – Structural materials and their properties - High temperature materials – Materials for thermal protection.

TEXT BOOKS

1. Physics for engineers by M.R.Srinivasan, (New Age International, New Delhi)
2. Material Science & Engineering, V Raghavan,(Prentice Hall India) New Delhi.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

I Year B. Tech. AE

2-0-4

AE1024

ENGINEERING CHEMISTRY
(Common with Mechanical, Production Engg – and Mechatronics)

UNIT – I

SCIENCE OF CORROSION AND CONTROL AGAINST CORROSION

Definition – Electrochemical Theory of Corrosion- Corrosion Reactions – Factors Effecting Corrosion – Protection.

a. Cathodic Protection

1. Sacrificial Anode
2. Impressed Current

b. Metallic Coatings

1. Anodic Coating
2. Cathodic Coating
3. Surface Conversion Coatings

c. Inorganic Coatings

d. Organic Coatings

1. Paints – Definition – Constituents and their Functions
2. Varnishes and Lacquers.

UNIT – II

POLYMER SCIENCE AND TECHNOLOGY

Polymerisation – Definition, Types of Polymerisation ; Basic Concepts ; Plastics – Definition and Classification; Thermosetting and Thermoplastics; Compounding and Fabrication of Plastics; Composition, Properties and Engineering uses of the following: Polyethylene, PVC, Teflon, Bakelite, Nylon, Polymethyl Methacrylate, Urea-Formaldehyde and silicon Resins. Rubber – Processing of Natural Rubber, Vulcanisation and Compounding. Elastomers – Buna S, Buna N, Thiokol, Polyurethane Rubber, Silicon Rubber.

UNIT – III
WATER TECHNOLOGY

Sources, Impurities in Water, Water Quality; Hardness of water; Units – Its Determination; Boiler Troubles, Water Treatment, Lime-Soda Process, Zeolite Process, Ion-Exchange Process; problems.

Water for drinking purposes and its treatment; Analysis of Water; Alkalinity; Chlorides and Dissolved Oxygen.

UNIT – IV
FUELS AND COMBUSTION:

Definition and Classification:

1. Solid Fuels – Coal and its Formation – Roxn and Ultimate Analysis of coal and significance of the constituents – Metallurgical Coke.
2. Liquid Fuels – Petroleum – Origin – Extraction-Refining and Cracking-Knocking – Octane and Cetane Numbers – Synthetics of Petrol – Bergius Process – Fischer Tropsch Process.
3. Gaseous Fuels – Analysis of the Gas by Orsats Apparatus – Calorific Value of Fuels – Bomb Calorimeter – Junker's Gas Calorimeter.
4. Combustion –Problems

UNIT – V
REFRACTORIES AND INSULATORS

Refractories – Definition, Classification with Examples; Criteria of a good Refractory Material; Causes for the failure of a Refractory Material; Insulators – Definition and Classification with Examples; Characteristics of Insulating Materials; Thermal Insulators, Electrical Insulators, Their Characteristics and Engineering applications.

UNIT – VI
LUBRICANTS

Definition - Classification – Theories of Lubrication – Properties of Lubricants.

TEXT BOOKS

1. Textbook of Engineering Chemistry By Jain & Jain.
2. Chemistry of Engineering Materials by C.V.Agarwal
3. Textbook of engineering Chemistry by P.C.Jain
4. Textbook of Engineering Chemistry by M.S.N.Raju.
5. Engineering Chemistry By Dara, Published by Pearson Education, Asia.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

I Year B. Tech. AE

3-0-6

AE1025

ENGINEERING MECHANICS
(Common with Mechanical, Production Engg – and Mechatronics)

UNIT – I

Introduction to Engg. Mechanics – Basic Concepts

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its application – Couples and Resultant of Force Systems.

Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

UNIT – II

Friction: Types of Friction – Limiting Friction – Laws of Friction – Static and Dynamic Frictions – Motion of Bodies: Wedge, Screw, Screw-jack, and Differential Screw-jack.

Transmission of Power: Belt Drives - Open, Crossed and Compound – Length of Belt, Tensions, Tight side, Slack Side, Initial and Centrifugal Power Transmitted and Condition for maximum power.

UNIT – III

Centroid and Centre of Gravity: Centroids – Theorem of Pappus – Centroids of Composite Figures – Centre of Gravity of Bodies.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

UNIT – IV

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

Kinematics: Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion.

UNIT – V

Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion- Equations of Plane Motion – Fixed Axis Rotation- Rolling Bodies.

Work – Energy Method: Equations for Translation, Work-energy applications to particle motion, Connected System - Fixed Axis Rotation and Plane Motion. Impulse momentum method.

UNIT – VI

Mechanical Vibrations: Definitions, Concepts – Simple Harmonic Motion – Free vibrations, Simple and Compound Pendulums.

TEXT BOOKS

- Engineering Mechanics, Ferdinand L.Singer, Harper – Collins.

REFERENCE BOOKS

- Engineering Mechanics, Irving H.Shames, Prentice-Hall.
- Engineering Mechanics, Timoshenko & Young.
- Engineering Mechanics, Umesh Regl, Tayal
- Engineering Mechanics, R.V. Kulkarni & R.D. Askhevkar
- Engineering Mechanics, S.S. Bharikati & J.G. Rajasekarappa
- Strength of Materials & Applied Mechanics, IB Prasad
- Text Book in Applied Mechanics, Malhotra, Subramanian,Gahlot and Rathore, New Age.
- Engineering Mechanics, KL Kumar, Tata McGraw Hill.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

I Year B. Tech. AE

3-0-6

AE1026

INTRODUCTION TO COMPUTERS
(Common with Mechanical, Production Engg – and Mechatronics)

UNIT - I

(COMPUTER AWARENESS – QUALITATIVE TREATMENT ONLY)

Computers, capabilities, types of computers, application areas, computer anatomy, functional block diagram, central processing unit, functions of ALU and control unit in CPU, purpose of Registers in CPU, micro-processors CIRC / RISC processors, memory functions, address, word, RAM, ROM, Cache memory, Associate memory, magnetic disk, tape, floppy, optical disk, address, address bus, data bus, control bus, functions of I-O devices, key board, mouse, light pen, dot matrix printer, line printer, laser printer, ink jet printer, CRT monitor, Color monitor, CGA, Screen resolution, Flat panel display unit, machine language, compiler, Operating System, Types of operating systems, Number Systems, Binary, Hex, Octal, BCD Code, Character Codes, 3 methods of binary representation of integers, floating point numbers.

UNIT - II

COMPUTER PROGRAMMING I

Algorithm, flow chart program development steps, Basic Structures of C Language; C tokens, Data types, declaration of variables, assigning values, arithmetic, relational and logical operators, increment and decrement operators, control operator, bit-wise operators, expressions, evaluation, input-output operations, IF and SWITCH statements, WHILE, DO-WHILE, and FOR Statement, C programs covering all the above aspects.

UNIT - III

COMPUTER PROGRAMMING II

String Variables in C declaration, reading, writing, string handling functions, user-defined functions, variables and storage classes, structures, unions, pointers, file management in C, opening, closing and I-O operations on files. C programs covering the above aspects.

UNIT - IV

NUMERICAL METHODS – I

Iterative methods, bisection, false position, Newton-Raphson, Successive approximation methods, algorithms, comparsion of iterative methods, solution of linear simultaneous algebraic equations, Gauss Jordan and Gauss Siedel's methods, algorithms.

UNIT - V

NUMERICAL METHODS – II

Interpolation, Lagranges interpolation, forward difference, backward difference and central difference interpolation methods, algorithms, errors in interpolation, least square approximation of functions, linear regression, polynomial regression, algorithms.

UNIT - VI

NUMERICAL METHODS – III

Numerical integration by trapezoidal and Simpson's rules, algorithms, Numerical solution of differential equations, Euler Method, Runge-Kutta fourth order methods, Milne predictor corrector method, algorithms, comparsion of Runge – Kutta and predictor – Corrector methods.

TEXT BOOKS

1. Computer and Commonsense, Shelly and Hunt, 4th Edn., PHI.
2. Programming in ANSI C, E. Balaguruswamy.
3. Computer Oriented Numerical Methods, V. Rajaraman
4. Programming in C/D, Ravichandra, New Age.

2002-2003

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I Year B. Tech. AE

0-6-8

AE1027

ENGINEERING GRAPHICS
(Common with Mechanical, Production Engg – and Mechatronics)

UNIT -I

INTRODUCTION TO ENGINEERING DRAWING

Principles of Engineering Graphics and their Significance, Engineering Drawing –Drawing Instruments and their Use – Conventions in Drawing – Lettering – BIS Conventions. Scales used in Engineering Practice and Representative Fraction –Construction of Plain, Diagonal and Vernier Scales.

PLANE GEOMETRIC DRAWING

Construction of Polygons – Inscription and Superscription of Polygon given the diameter of the Circles.

Curves used in Engineering Practice and their Constructions.

- a) Conic Sections including the Rectangular Hyperbola – General method only.
- b) Cycloid, Epicycloid and Hypocycloid
- c) Involute.

UNIT -II

DRAWING OF PROJECTIONS OR VIEWS

ORTHOGRAPHIC PROJECTION IN FIRST ANGLE PROJECTION ONLY

Principles of Orthographic Projections – Conventions - First and Third Angle Projections - Projections of Points and Lines.

Projections of Plane regular geometric figures – Auxiliary Planes.

UNIT - III

Projections of Regular Solids – Auxiliary views.

Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone -Auxiliary views – Sections of Sphere.

UNIT - IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone.

Interpenetration of Right Regular Solids – Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone.

UNIT - V
ISOMETRIC PROJECTIONS

Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids - Isometric Projection of objects having non-isometric lines. Isometric Projection of Spherical Parts.

TRANSFORMATION OF PROJECTIONS

Conversion of Isometric Views to Orthographic Views and Vice-Versa – Conventions.

UNIT - VI
PERSPECTIVE PROJECTIONS

Perspective View: Points, Lines, Plane figures and Simple Solids, Vanishing Point Methods (General Method only)

TEXT BOOKS

1. Engineering Drawing, Narayana and Kannaiah, Scitech Publishers.
2. Engineering Drawing, N.D.Bhat, Charotar
3. Engineering Drawing and Graphics, Venugopal, New age.

2002-2003

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HYDERABAD

I Year B. Tech. AE

0-3/2-2

AE1028

ENGINEERING PHYSICS LAB

(Common with Mechanical, Production Engg – and Mechatronics)

Any ten of the following experiments are to be performed during the academic year.

1. Determination of Rigidity Modulus of the material of a wire (Torsional Pendulum)
2. Study of normal modes in a string using forced vibrations in rods (Meilde's experiment)
3. Study of Resonance – Using audio generator
4. Coupled Oscillator.
5. Diffraction grating
6. Dispersion of Light (Prism – Spectrometer method)
7. Determination of thickness of a thin object by optical method Parallel Fringes
8. Newton's Rings.
9. Lasers – Single slit and double slit experiments
10. Study of electrical resonance – LCR circuit.
11. Time constant of an R-C Circuit
12. Sonometer – Verification of laws of stretched strings.
13. Frequency of A.C. Supply
14. Magnetic field along the axis of current carrying coil – Stewart and Gee's Method.
15. Optical Fibres – Numerical aperture measurement.
16. Optical Fibres – Study of Losses

2002-2003

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HYDERABAD

I Year B. Tech. AE

0-3/2-2

AE1029

FUELS AND LUBRICANTS LAB

(Common with Mechanical, Production Engg – and Mechatronics)

1. Determination of Flash and Fire points of Liquid Fuels / Lubricants
2. Carbon Residue Test: Liquid Fuels
3. Determination of Viscosity: Liquid Lubricants
4. Determination of Calorific Value: Solid/Liquid/Gaseous Fuels
5. Grease Penetration Test.

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HYDERABAD**

I Year B. Tech. AE

0-6-8

AE1030

COMPUTER LAB
(Common with, Mechanical, Production Engg. - Mechatronics)

1. Write a C program that evaluates the following algebraic expressions after reading necessary values from the user
 - a) $ax + b/ax - b$
 - b) $2.5\log x + \cos 32^\circ + 1x^2 - y^2/1 + v^2xy$
 - c) $1/av^2 e^{- (x-m)/v^2s^2}$
2. Write a C program for the following
 - a) Printing three given integers in ascending order
 - b) Sum of $1 + 2 + 3 + \dots + n$
 - c) $1 + x^2/2! + x^4/4! + \dots$ up to ten terms
 - d) $x + x^3/3! + x^5/5! + \dots$ upto 7th digit accuracy
 - e) Read x and compute Y = 1 for $x > 0$
 $Y = 0$ for $x = 0$
 $Y = -1$ for $x < 0$
3. Write C program using FOR statement to find the following from a given set of 20 integers.
 - i) Total number of even integers.
 - ii) Total number of odd integers.
 - iii) Sum of all even integers.
 - iv) Sum of all odd integers.
4. Write a C program to obtain the product of two matrices A of size (3X3) and B of size (3X2). The resultant matrix C is to be printed out along with A and B. Assume suitable values for A & B.
5. Using switch-case statement, write a C program that takes two operands and one operator from the user, performs the operation and then prints the answer.
(Consider operators +, -, *, / and %)
6. Write C procedures to add, subtract, multiply and divide two complex numbers ($x+iy$) and ($a+ib$). Also write the main program that uses these procedures.
7. The total distance traveled by vehicle in 't' seconds is given by distance = $ut + 1/2at^2$ where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec²). Write C program to find the distance traveled at regular intervals of time given the values of u and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for

different values of 'u' and 'a'.

8. A cloth show room has announced the following seasonal discounts on purchase of items.

Purchase Amount	Discount (Percentage)	Mill Cloth	Handloom items
1-100		5.0	
101-200	5.0		7.5
201-300	7.5		10.0
Above 300	10.0		15.0

Write a C program using switch and If statements to complete the net amount to be paid by a customer.

9. Given a number, write C program using while loop to reverse the digits of the number.
Example 1234 to be written as 4321.
10. The Fibonacci sequence of numbers is 1,1,2,3,5,8... based on the recurrence relation $f(n) = f(n-1) + f(n-2)$ for $n > 2$.

Write C programs using do-while to calculate and print the first m Fibonacci numbers.

11. Write C programs to print the following outputs using for loop.

1	1
2 2	2 2
3 3 3	3 3 3
4 4 4 4	4 4 4 4
5 5 5 5 5	5 5 5 5 5

12. Write a C program to extract a portion of a character string and print the extracted string.
Assume that m characters are extracted starting with the nth character.
13. A Maruthi Car dealer maintains a record of sales of various vehicles in the following form:

Vehicle type	Month of sales	Price (Rs)
Maruthi - 800	02/87	75,000
Maruthi - DX	07/87	95,000
Gypsy	04/88	1,10,000
Maruthi Van	08/88	85,000

Write a C program to read this data into a table of strings and output the details of a particular vehicle sold during a specified period. The program should request the user to

- input the vehicle type and the period (Starting month & ending month).
14. Write a function that will scan a character string passed as an argument and convert all lowercase characters into their upper case equivalents.
 15. $f(x) = x\sin x + \cos x = 0$ using bisection method. Write a program & Evaluate the root of the equation.
 16. $f(x) = x\sin x + \cos x = 0$ using false position method. Write a program & Evaluate the root of the equation.
 17. $f(x) = x\sin x + \cos x = 0$ using Newton Raphson method. Write a program & Evaluate the root of the equation.
 18. $f(x) = x\sin x + \cos x = 0$ using Successive approximation method. Write a program & Evaluate the root of the equation.
 19. Solve
 $9X_1 + 2X_2 + 4X_3 = 0 \quad (1)$
 $X_1 + 10X_2 + 4X_3 = 6 \quad (2)$
 $2X_1 - 4X_2 - 4X_3 = -15 \quad (3)$ using Gauss-Jordan method.
 20. Solve
 $9X_1 + 2X_2 + 4X_3 = 0 \quad (1)$
 $X_1 + 10X_2 + 4X_3 = 6 \quad (2)$
 $2X_1 - 4X_2 - 4X_3 = -15 \quad (3)$ using Gauss-Seidel method.
 21. Write a computer program to implement LaGrange interpolation technique. Check the working of the Program with suitable example.
 22. Write a computer program to implement Newton - Gregory forward interpolation. Check the working of the program with suitable example.
 23. Write a program to implement Trapezoidal method. Check the working of the program with suitable example.
 24. Write a program to implement Simpson method. Check the working of the program with suitable example.
 25. Implement, in C, the linear regression algorithm. Check the working of the program with suitable example.

W O R K S H O P

(Common with Mechanical, Production Engg – and Mechatronics)

I. Trades for Exercises

(Minimum of THREE exercises in each Trade)

- 1. Carpentry & Pattern Making
- 2. Fitting
- 3. Tin – Smithy
- 4. Black Smithy
- 5. House – wiring
- 6. Foundry

II. Trades for Demonstration & Exposure

1. Plumbing
2. Welding
3. Machine Shop

MATHEMATICS II
(Common to all branches)

UNIT - I

Matrices — brief review — Inverse of a matrix by adjoint elementary row transformations — Rank- Normal form — echelon form. Augmented matrix — Consistency — solution of system of simultaneous linear homogeneous and non-homogeneous equations.

UNIT — II

Eigen values, Eigen vectors — Properties — Cayley — Hamilton Theorem (Inverse and powers of a matrix by Cayley — Hamilton theorem). Quadratic forms — positive, negative definite — Diagnolization of matrix. Calculation of powers of matrix — Modal and spectral matrices Real matrices — Symmetric, skew-symmetric, orthogonal. Linear Transformation — Orthogonal Transformation. Quadratic forms — Reduction of quadratic form to canonical form — index — signature.

Complex matrices: Hermitian, Skew-Hermitian and Unitary —Eigen values and eigen vectors of complex matrices and their properties.

UNIT — III

Fourier Series: Determination of Fourier coefficients — Fourier series — even and odd functions — Fourier series in an arbitrary interval — even and odd periodic continuation — Half — range Fourier sine and cosine expansions.

UNIT-IV

Formation of Partial differential equations by elimination of arbitrary constants and arbitrary functions — solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations. Method of separation of variables — Classification of second order linear Partial Differential Equations, solutions of one dimensional heat equation wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

UNIT-V

Fourier integral theorem — Fourier sine and cosine integrals. Fourier transform — Fourier sine and cosine transforms. — properties — Inverse transforms — Finite Fourier transforms. Solution of one dimensional wave, heat equations and two dimensional Laplace's equation by Fourier transforms. Z-transform — Inverse z — transform — properties — Damping rule — shifting rule — Initial and final value theorems.
 Convolution theorem — Solution of difference equations by Z — transforms.

TEXT BOOKS

1. A Text Book of Engineering Mathematics Volume : II-2002
T.K.V.Iyengar, B. Krishna Gandhi and others, S. Chand & Company
2. Engineering Mathematics
B.V. Ramana, Tata McGraw-Hill- 2002
3. Engineering Mathematics -II-2002
C.Sankaraiah, Vijaya Publications
4. Engineering Mathematics — II-2002.
P.Nageswara Rao, Y. Narsimhulu, Prabhakar Rao

REFERENCE BOOKS

1. Engineering Mathematics
S.K.V.S.Sri Rama Chary, N. Bhujanga Rao, P.Bhaskara Rao, B.S.Publications 2000
2. Advanced Engineering Mathematics (Eighth edition) Erwin Kreyszig John Wiley & Sons (ASIA) Pvt Ltd.-2001
3. Advanced Engineering Mathematics (Second edition) Michael D. Green Berg, Prentice Hall,Upper Saddal River ,New Jersey-1998
4. Sarveswara Rao Koneru
Engineering Mathematics Orient Longman (Pvt.) Ltd. 2002
5. Engineering Mathematics - II
N.P.Bali, Laxmi Publications (P) Ltd., New Delhi.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
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II Year B. Tech. AE – I Semester

4-0-4

AE2122

DATA STRUCTURES
(Common with Mech.Engg-Production and Mech.Engg.-Mechatronics)

UNIT-I

One-dimensional and multi-dimensional arrays, initialization, application & applications program examples.

UNIT-II

Single linked list, double linked list, header, and circular list and applications program examples.

UNIT-III

Stacks, representation, infix, postfix and prefix programs, recursion in C, application of stacks queues, representations queues, circular queues applications, programs examples.

UNIT-IV

Binary tree, representation, trees traversals, graph, representations, graph traversals and spanning trees.

UNIT-V

Searching techniques, linear and binary search methods, sorting method exchange sort, selection sort, quick sort & tree sort program.

TEXT BOOKS

1. Data structures through "C", A.M. Tanenbaum and others, PHI.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II Year B. Tech. AE – I Semester

4-0-4

AE2123

MECHANICS OF SOILDS

(Common with Mech.Engg-Production and Mech.Engg.-Mechatronics)

UNIT-I

SIMPLE STRESSES AND STRAINS

Elasticity, plasticity, ductility, malleability, Hardness and brittleness of materials - Definition of stress - types of stresses compressive, tensile and shear - definition of strain, types of strains - factor of safety.

Elastic limit, Hooke's Law-Young's modulus and shear modulus. Tensile test on mild steel specimen-bars of varying section -Extension of a tapering rod - Stresses in bars of composite section - Temperature stresses - Lateral strain poisson's ratio and volumetric strain-element in a state of simple shear -Stresses on oblique sections. Definition of Bulk modulus, Relation between the three elastic constants - Bars of uniform strength.

UNIT-II

SHEAR FORCES AND BENDING MOMENTS

Definition of a Beam, Types of beams - Cantilever, Freely supported overhanging, fixed and continuous beams - Concept of shear force and bending moment - Shear force and bending moment diagrams for cantilevers, freely supported and overhanging beams due to point loads, uniformly distributed load, uniformly varying load and combination of the above loads - Point of contra-flexure, relation between shear force and bending moment.

UNIT-III

FLEXURAL STRESSES

Theory of simple bending - Derivation of the equation $M/I=F/Y=E/R$ - Neutral axis - Assumptions in the theory of pure bending -Determination of bending Stresses - Section modulus of solid and hollow rectangular and circular sections I, T, Channel and Angle sections. Design of simple beam sections.

SHEAR STRESSES

Derivation of governing equation - Shear stress distribution over a cross section - rectangular, circular and structural sections.

UNIT -IV

DEFLECTION OF BEAMS

Members bending into a circular arc - Slope deflection and radius of curvature- differential equation for the elastic line of a loaded beam - Deflections in the case of cantilevers, Freely supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying load - Macaulay's method - Determination of slope and deflection of cantilevers, simply supported beams, overhanging beams. Macaulay's theorems and moment - area method - applications to simple cases

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II Year B. Tech. AE – I Semester

4-0-4

AE2124

THIN CYLINDERS

Thin seamless cylindrical shells - Derivation of the formula for hoop stress and longitudinal stress- Hoop strain and longitudinal strain. Wire wound thin cylinders.

**UNIT -V
PRINCIPAL STRESSES AND STRAINS**

Introduction - Stress Components on inclined planes- Two perpendicular normal stresses accompanied with state of Simple shear- Mohrs circle - Determination of principal stresses and principal planes analytically and graphically- Principal strains.

TORSION

Theory of pure torsion - Torsional moment of Resistance- Assumptions in theory of pure torsion - Polar modulus - Power transmitted by shaft keys and couplings - Shear and torsional resistance - Shafts of circular cross sections - Combined bending and torsion and end thrust - Design of shafts based on theories of failure. Closely coiled and open coiled springs.

TEXT BOOKS

1. Strength of materials and mechanics of solids - Vol. I, BC Punmia
2. Strength of materials, S. Ramanrutham

REFERENCE BOOKS

1. Solid Mechanics, Papov
2. Elementary strength of Materials, Timoshenko & Young

MECHANICS OF FLUIDS

(Common with Mechanical Engineering)

UNIT- 1

FLUID PROPERTIES AND FLUID STATICS:

Density, specific weight, specific gravity, viscosity, Newtonian and Non-Newtonian Fluids, Vapor pressure, compressibility, capillarity, Forces on plane surfaces - total pressure and centre of pressure.

FLUID KINEMATICS:

Streamline, path line, streakline, stream tube, classification of flows, steady unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, one, two and three dimensional flows - Continuity equation, stream function, velocity potential function.

UNIT 2

FLUID DYNAMICS

Surface and Body forces - Euler's and Bernoulli's equation for flow along a streamline. Momentum equation, applications, vortex - Free and Forced, Forced vortex with free surface.

BOUNDARY LAYER FLOW

Development of boundary layer along a thin flat plate, Laminar boundary layer and turbulent boundary layer, Laminar sub layer, boundary layer separation, Drag and lift forces – Aerofoil, pressure and form Drags.

UNIT 3

FLOW OF COMPRESSIBLE FLUIDS

Equation of state, gas laws, Equation of motion, equation of continuity and equation of energy, compressible flow regimes, mach number, Mach cone, Shock Wave, Stagnation point, flow of compressible fluid through Venturi meter.

UNIT 4

LAMINAR FLOW THOUGH CONDUITS

Flow through closed conduit, Reynolds's number, laminar flow through circular tube -horizontal and tubes having slopes. Flow between parallel plates - distribution of shear stress and velocity across the section.

ANALYSIS OF PIPE FLOW

Darcy - Weibach equation, Hydraulic gradient and total energy lines, loss of Head due to sudden

enlargement and contraction, Syphon pipes, parallel pipes, pipes in series, power transmission through pipes.

UNIT 5 MEASUREMENT OF PRESSURES AND FLOWS

Piezometer, manometers, pressure gauges, venturimeters and orificemeters, flow through notches and weirs, viscometers, Hot wire Anemometers

TEXT BOOKS

1. P.H. Modi & S.M. Seth-Fluid Mechanics
2. A.K. Jain-Fluid Mechanics
3. K.L. Kumar-Fluid Mechanics

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

II Year B. Tech. AE - I Semester

0-6-4

AE2125

MACHINE DRAWING

(Common with Mech.Engg – Mechatronics and Mech.Engg. - Production)

UNIT - I MACHINE DRAWING CONVENTIONS

Need for drawing Conventions – introduction to ISI conventions

- a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
- b) Types of Sections – selections of sections planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
- c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
- d) Title boxes, their size, location and details –common abbreviations and their liberal usage
- e) Types of drawing –working drawings for machine parts.

UNIT - II DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS

Selection of views, additional views for the following machine elements and parts with every drawing proportions

- a) Popular forms of screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
- b) Keys, cottered joints and knuckle joint.
- c) Riveted joints for plates
- d) Shaft coupling, spigot and socket pipe joint.
- e) Journal, pivot and collar and foot step bearings.

UNIT - III ASSEMBLY DRAWING

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions

- a) Steam engine parts-stuffing boxes, cross heads and eccentrics
- b) Other machine parts-Screws jacks, Machine vices, petrol engine connecting rod and Plummer block
- c) Simple design of stem stop valve, spring-loaded safety valve, feed check valve and air cock.

Note: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOK

- Machine Drawing, K.L Narayana, P.Kannaiah & K.VenkataReddy, New Age Publishers

REFERENCE BOOKS

- Machine Drawing, P.S. Gill
- Machine Drawing, Luzzader
- Machine Drawing, Rajput

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

II Year B. Tech. AE – I Semester

4-0-4

AE2126

FUNDAMENTAL OF AERONAUTICAL ENGINEERING

UNIT-I

HISTORICAL EVALUATION

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

UNIT-II

AIRCRAFT CONFIGURATIONS

Components of an airplane and their functions. Different types of flight vehicles and classifications. Conventional Control and Powered controls, Basic instruments for flying-Typical systems for control actuation.

UNIT-III

INTRODUCTION TO PRINCIPLES OF FLIGHT

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

UNIT-IV

INTRODUCTION TO AIRPLANE STRUCTURES

General types of construction, Monocoque, semi-monocoque and geodesic construction, typical wing and fuselage structure.

UNIT-V

POWER PLANTS USED IN AIRPLANES

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TEXT BOOKS

- Anderson, J.D., " Introduction to Flight ", McGraw Hill, 1995.
- Kermode, A.C., " Flight without Formulae ", McGraw Hill, 1987.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
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II Year B. Tech. AE – I Semester

0-3-2

AE2127

DATA STRUCTURES LAB.

(Common with Mech.Engg –Mechatronics and Mech.Engg.-Prod.)

1. Implement the following data structures using Arrays
 - a) Stacks
 - b) Linear queues.
 - c) Circular queues
 - d) De queue
2. Implement polynomial addition and multiplication with linked list spare matrix.
3. Implement binary search tree using linked list and perform the following operations.
 - a) Insertion
 - b) Deletion
 - c) In order Traversal
 - d) Pre order Traversal
 - e) Post Order Traversal
4. Single Linked list and double linked lists
 - a) Insertion
 - b) Deletion
 - c) Loop up
5.
 - a) Implement stack using singly linked list
 - b) Implement queue using singly linked list
 - c) Implement the following sorting techniques
 - i) Bubble sort
 - ii) Insertion sort
 - iii) Quick sort
 - iv) A cap sort
6. Implement the following searching methods.
 - a) Sequential Search.
 - b) Binary Search
 - c) Fibonacci Search
7.
 - a) Conversion of Infix expression to post fix notation
 - b) Simple expression evaluation that can handle : +, -, / and *

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II Year B. Tech. AE – I Semester

0-3-2

AE2128

MECHANICS OF SOILS AND FLUID MECHANICS LAB

SECTION A
SOLID MECHANICS

1. Tension Test
2. Torsion Test
3. Hardness Test
4. Spring Test
5. Impact Test
6. Deflection Test on Simple beam.

SECTION B
FLUID MECHANICS

1. Calibration of venturi meter
2. Calibration of orifice meter
3. Determination of friction factor for a given pipe line
4. Calibration of a contracted Rectangular notch
5. Verification of Bernoulli's equation
6. Reynold's experiment

2002-2003
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II Year B. Tech. AE - II Semester

4-0-4

AE2221

MATHEMATICS III
(Common to all branches except CSE, Mech., and Civil Engineering)

UNIT—I

Special functions: Gamma and Beta functions and their properties — Evaluation of improper integrals - Bessel functions - Properties - Recurrence relations — Orthogonality. Legendre polynomials — properties — Rodrigue's formula — Recurrence relations — Orthogonality.

UNIT—II

Functions of a Complex variable — Continuity — Differentiability — Analyticity — Properties — Cauchy Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions - Milne - Thompson method.
Elementary functions: Exponential, trigonometric, hyperbolic functions and their properties - General power z^c (C is complex) Principal value.

UNIT—III

Complex integration: Line integral -evaluation along a path and by indefinite integration - Cauchy's integral theorem - Cauchy's integral formula - Generalized integral formula. Zero - singular point — Isolated singular point - pole of order m - essential singularity.

Complex Power series: Radius of convergence expansion in Taylor's series, Maclaurin's series and Laurent series.

UNIT—IV

Residue - Evaluation of residue by formula and by Laurent series Residue theorem. Evaluation of integrals of the type

- a) Improper real integral

Argument principle — Rouche's theorem — determination of number of zeros of complex polynomials. Fundamental theorem of Algebra, Liouville's Theorem.

UNIT—V

Conformal mapping : Transformation by $e^z, \ln z, z^2, z^n, z + n/z$.

Translation, rotation, inversion and bilinear transformation - Fixed point - cross ratio - properties - invariance of circles and cross ratio — Determination of bilinear transformation mapping 3 given points.

TEXT BOOKS

1. A Text Book of Engineering Mathematics Volume— II 2002
T.K.V.Iyengar, B. Krishna Gandhi and others, S. Chand and Company
2. Engineering Mathematics - B.V. Ramana, Tata McGraw-Hill, 2002
3. Engineering Mathematics — By, G.Sankaraiah, Vijaya Publications
4. Engineering Mathematics — By, P.Nageswara Rao, Y. Narsimulu, Prabhakar Rao

REFERENCE BOOKS

1. Advanced Engineering Mathematics (Eighth edition) Erwin KreysZig, John Wiley & Sons (ASIA) Pvt. Ltd. 2001
2. Advanced Engineering Mathematics (Second edition), Michael D. Green Berg, Prentice Hall, Upper Saddal River, New Jersey, 1998
3. SarvesWara Rao KonerU.
Engineering Mathematics Orient Longman (Pvt.) Ltd. 2002
4. Engineering Mathematics — III.
N.P.Bali, Laxmi PublicatiOnS (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

II Year B. Tech. AE – II Semester

4-0-4

AE2222

2002-2003

AERODYNAMICS – I

UNIT-I

WING AND AIRFOIL SECTION GEOMETRY

Planform geometry, Airfoil section geometry, Dihedral angle, Incidence, Twist, Wash-out and Wash-in.

UNIT-II

AERODYNAMIC FORCES

Force and moment components and coefficients, Pressure distribution on an airfoil, Relation between pitching moment at various points along the chord, Types of drag, Estimation of lift, Drag and pitching moment coefficient from the pressure distribution, Drag Polar.

UNIT-III

CONFORMAL TRANSFORMATION

The complex potential function and conformal transformation, The Kutta-Zhukovsky transformation, Lift of the Zhukovsky airfoil section.

UNIT-IV

PROPELLERS

Froude Momentum and blade element theories, Propeller coefficients, Performance of fixed and variable pitch propellers.

UNIT-V

INTRODUCTION TO HELICOPTERS

Introduction, Helicopter rotor theory: Hovering performance, Induced and profile and parasite power requirements in forward flight – Performance curves with effect of altitude, and Auto-gyro.

TEXT BOOKS

1. Anderson, J. D., Fundamental of Aerodynamics, Mc Graw-Hill International Edition
2. Houghton, E.L., and Carruthers, N.B., Aerodynamics for Engineering Students, Edward Arnold Publishers Ltd., London, 1989
3. Gupta, L., Helicopter Engineering, Himalayan Books, 1996

REFERENCE BOOKS

1. Clancy, L.J., Aerodynamics, Pitman, 1986
2. Mc Cormic, B.W., Aerodynamics, Aeronautics & Flight Mechanics, John Wiley 1995
3. Gessow, A., and Myers, G.C., Aerodynamics of Helicopter, Macmillan & Co., N.Y.1987

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II Year B. Tech. AE – II Semester

4-0-4

AE2223

ENGINEERING THERMODYNAMICS
(Common with Mech.Engg –Mechatronics and Mech.Engg. –Prod.n.)

UNIT - I

Introduction – Basic concepts: System of control volume, Surroundings, Boundaries of Universe, Types of Systems, Macroscopic and microscopic views. Concepts of Continuum, Pure substance, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi-static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in transition, Types, Work and Heat, Point and Path function. Zeroth Law of thermodynamics – Concept of quality of temperature – Principles of thermometry – Reference Points – Constant volume gas thermometer – Scales of Temperature, Ideal Gas scale, Joule's experiments – First law of thermodynamics – Corollaries – First law applied to a process and applied to a flow system – Steady flow energy equation.

UNIT - II

Limitations of the first law – Thermal Reservoir, Heat Engine, Heat Pump, Parameters of performance. Second law of thermodynamics, Kelvin/Planck and Clausius statements and their equivalence/corollaries, PMM of second kind, Carnot's principle, Carnot's cycle and its specialties, Thermodynamic scale of temperature, Clausius inequality, Entropy, Principle of entropy increase – Energy equation, Availability and irreversibility – Thermodynamic potentials, Gibb's and Helmholtz's functions, Maxwell Relations – Elementary treatment of the third law of thermodynamics.

UNIT - III

Perfect Gas laws – Equation of state, specific and universal Gas constants – various Non-flow processes, properties, end states, Heat and work transfer, Changes in Internal energy – Throttling and free expansion processes – Flow processes – Deviations from perfect Gas Model – Vanderwalls equation of state – Compressibility charts – Variable specific heats – Gas tables, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clasius-Clapeyron equation, Property tables, Mollier charts – Various Thermodynamic processes and energy transfer – Steam Calorimetry.

UNIT - IV

Mixtures of perfect gases – Mole fraction, Mass fraction, Gravimetric and volumetric analysis – Dalton's law of partial pressure, Avagadro's law of additive volumes – Mole fraction, volume fraction and partial pressure, Equivalent Gas constant and molecular internal energy, Enthalpy specific heats and entropy of mixture of perfect Gases and vapour. Atmospheric air-Psychrometric properties – Dry bulb temperature, Wet bulb temperature and Dew point temperature, Thermodynamic Wet bulb temperature, Specific humidity, Relative humidity, Saturated air, Vapour pressure, degree of saturation – Adiabatic saturation, Carrier's equation - Psychrometric chart.

UNIT - V
THERMODYNAMIC CYCLE

Power cycles: Otto, Diesel, Dual combustion cycles, Brayton cycle, Stirling Cycle, Atkinson cycle, Ericsson cycle, Lenoir cycle – Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air Standard basis – Comparison of Cycles.

Joule and Rankine cycles – Performance Evaluation – Combined cycles.
Refrigeration cycles: Bell-Coleman cycle, vapour compression cycle – Performance evaluation.

TEXT BOOKS

1. An Introduction to Thermodynamics, YVC Rao/New Age Publishers
2. Engineering Thermodynamics, PK Nag/TMH

REFERENCE BOOKS

1. Thermodynamics and Heat Engines, Yadv/Central Book Depot, Allahabad
2. Basic Engineering Thermodynamics, Roy Choudhury/TMH
3. Engineering Thermodynamics with Applications, Burghardt/Hooper & Row
4. Thermal Engineering, RK Rajput/Lakshmi Publications
5. Engineering Thermodynamics, Rogers and Mattheu/Addision Wesly (Work and Heat Transfer)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II Year B. Tech. AE – II Semester 4-0-4

2002-200

AE2224

ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT-I

Series and parallel circuits, Kirchoffs law – Magnetic circuits, Generation of an alternating emf – Average and rms values of alternating quantity – Representation of alternating quantities as phasors – Single phase circuits – Resonance – Three phase balance systems – Single and three phase power calculations.

UNIT-II

Principles and operation of DC machines – emf equation – Types of generators – Magnetization and load characteristics of DC generators – Types and characteristics of DC motors – Torque equation - DC motor starters (three points) – Efficiency calculation and swinburnes test – Speed control.

UNIT-III

Construction and principles of operation of single phase transformer – emf equation O.C and S.C tests – Efficiency and regulation – Principle and operation of three phase induction motors – Types – Slip torque characteristics – Principle and operation of alternator – O.C and S.C tests – Regulation by synchronous impedance method.

UNIT-IV

Conductors, Insulators, Semiconductors, Energy band theory, Intrinsic and Extrinsic semiconductors - PN junction – Potential barrier - Depletion region – Forward bias – Reverse bias.
Construction, principle of operation, V-I characteristics, symbol, equivalent circuit, parameter calculation, and applications and limitations of PN junction diode, Zener diode, Varactor diode, Tunnel diode and photo diode. Diffusion and transition capacitance of PN junction diode.

UNIT-V

Construction, Principle operation, V-I characteristics, Symbol, Parameter calculations and applications and limitations of BJT, FET, UJT and MOSFETS (Different configurations of transistors are to be considered).

Principles of CRT, Deflection sensitivity (Electrostatic and magnetic deflection). Application of CRO: Voltage, current and frequency measurements.

TEXT BOOKS

1. Mittal, V.N., Basic Electrical Engineering, TMH Edition, New- Delhi, 1990.
2. Del Taro, Electrical Engineering Fundamentals, Prentice Hall of India Pvt. Ltd., New Delhi, Second Edition
3. Milman & Halkias, Integrated Electronics, Mc Graw Hill, 1979
4. Bhattacharya, S.K., Electrical Machines, TMH Publication

REFERENCE BOOKS

1. Jimmie J. Cathey and Nasar S.A., Basic Electrical Engineering, Schaum Outline series in Engineering, McGraw Hill Co, 1987.
2. Deshpande, N.V., Electrical Machines, A.A. Wheeler and Co. Ltd., New Delhi 1994.
3. Mehta, V.K., Principles of Electronics, S.Chand and Company Ltd., 1994.
4. Malvino & Leach, Digital Principles and Applications, Mc Graw Hill, 1986.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

II Year B. Tech. AE – II Semester

4-0-4

AE2225

AEROSPACE MATERIALS

UNIT - I

ELEMENTS OF MATERIAL SCIENCE

Structure of solid materials – Atomic structure and crystal structure – Imperfections in crystals.

UNIT - II

MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS

Linear and non-linear elastic properties – Mechanism of elastic and inelastic action – Yielding, Strain hardening, and fracture, Elastic after effect Bauchinger's effect – Notch effect, Testing and flaw detection of material and components.

UNIT - III

HEAT TREATMENT OF METALS, ALLOYS AND CORROSION

Heat treatment of carbon steel, Aluminum alloys, Magnesium alloys and titanium alloys used in aircraft. Types of corosions – Effect of corrosion on mechanical properties – Protection against corrosion – Corrosion resistant materials used in aircraft.

UNIT - IV

ALUMINIUM ALLOYS AND COMPOSITES

Introduction – Physical Metallurgy – Wrought aluminum alloys – Cast aluminum alloys – Production of semi-fabricated forms – Aerospace applications – Plastics and Rubber – Introduction to FRP Glass and Carbon composites – Fibers and Resins – Characteristics and applications.

UNIT - V

SELECTION OF MATERIALS FOR AIRCRAFT AND ROCKETS

Classification of aircraft materials – Materials used for aircraft components – Application of composite materials – Supper alloys, indigenised alloys, emerging trends in aerospace materials.

TEXT BOOKS

1. Krishnadas Nair, C.G., Handbook of Aircraft Materials, Inerline publishing, 1993.
2. Balram Gupta, Aerospace Materials Vol. I, Vol. II & Vol.III, S.Chand & Company Ltd., New Delhi – 1996.

REFERENCES BOOKS

1. Martin, J.W. Engineering Materials, Their Properties and Applications, Wykedham Publications (London) Ltd., 1987.
2. Titterton, G., Aircraft Materials and Processes, V Edition, Pitman Publishing Co., 1995.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II Year B. Tech. AE - II Semester

4-0-4

AE2226

KINEMATICS OF MACHINES

(Common with Mech. Engg. - Mechatronics and Mech. Engg. - Prodn.)

**UNIT - I
MECHANISMS**

Elements of links – Classification – Rigid link, flexible and fluid link – Types of kinematic pairs – Sliding, turning, rolling, screw and spherical pairs – Lower and higher pairs – Closed and open pairs – Constrained motion – Completely, partially or successfully constrained and incompletely constrained.

MACHINES

Mechanism and machines – Classification of machines – Kinematic chain – Inversion of mechanism – Inversion of quadratic cycle, Chain – single and double slider crank chains.

STRAIGHT LINE MOTION MECHANISMS

Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russell, Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph.

**UNIT - II
KINEMATICS**

Velocity and acceleration – Motion of link in machine – Determination of velocity and acceleration diagrams – Graphical method – Application of relative velocity method for chain.

ANALYSIS OF MECHANISMS

Analysis of slider crank chain for displacement, Velocity and acceleration of slider – Acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, Determination of Coriolis component of acceleration.

PLANE MOTION OF BODY

Instantaneous center of rotation, centroids and axodes – Relative motion between two bodies – Three centers in line theorem – Graphical determination of instantaneous center, diagrams for simple mechanisms and determination of angular velocity of points and links.

**UNIT - III
STEERING GEARS**

Conditions for correct steering – Davis Steering gear, Ackermans steering gear – Velocity ratio

HOOK'S JOINT

Single and double Hook's joint – Universal coupling – Application – Problems

CAMS

Definition of cam and followers – Their uses – Types of followers and cams – Terminology – Types of follower motion – Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and Maximum acceleration during outward and return strokes in all the above three cases.

ANALYSIS OF MOTION OF FOLLOWERS

Roller follower – Circular cam with straight, concave and convex flanks.

UNIT - IV

Higher pairs, friction wheels and toothed gears – Types – Law of gearing, condition for constant velocity ratio for transmission of motion – Form of teeth, cycloidal and involute profiles. Velocity of sliding – phenomenon of interference – methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to helical – Bevel and worm gearing.

**UNIT - V
GEAR TRAINS**

Introduction – train value – Types – Simple and reverted wheel train – Epicyclic gear train. Methods of finding train value or velocity ratio – epicyclic gear trains. Selection of gear box – differential gear for an automobile.

TEXT BOOKS

1. Theory of Machines, Dr Jagdish Lal, JM Shaw.

REFERENCE BOOKS

1. Theory of Machines, Thomas Beven
2. Theory of Machines, Abdulla Sharif
3. Theory of Machines, PL Ballaney
4. Mechanism and Machine Theory, JS Rao and RV Dukkipati / New Age
5. Theory of Machines Through Solve Problems, JS Rao / New Age

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II Year B. Tech. AE – II Semester

0-3-2

AE2227

CAD LABORATORY

1. Fundamentals of CAD and Design process
2. Geometric Modelling
 - 2D Drawings: points, lines, curves, and planes
 - 3D Drawings: Solids
 - Part Drawings and Dimensioning
 - Part Modelling through 2D, 3D modelling techniques.
3. Solid and Surface Modelling
 - 2D Drawing:
 - 3D Drawing:
 - Part Drawing and Dimensioning from Aircraft Drawing
 - Part modelling from Aircraft Components
 - Solid and surface modelling.

TEXT BOOKS

1. Mikell, P., Groover, "Automation Systems and CIM"; Prentice Hall of India
2. Ibrahim Zeid, "CAD/CAM Theory and Practice"; Prentice Hall of India
3. Stephen J. Kochen & Patrick H. Wood, "Exploring the UNIX System"; Techmedia, 1999.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II Year B. Tech. AE – II Semester

0-3-2

AE2228

ELECTRICAL AND ELECTRONICS LAB

1. Speed control of D.C shunt motor by
 - a) Armature voltage control
 - b) Field flux control
2. Swinburne's test on DC shunt machine (Predetermination of efficiency of a given D.C shunt machine working as motor or generator)
3. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factor)
4. Brake test on 3-phase Induction motor (Determination of performance characteristics)
5. Regulation of alternator by synchronous impedance method.
6. PN junction diode, Zener diode characteristics
 - a) Forward bias
 - b) Reverse bias
7. Transistor CE characteristics (Input and Output)
8. Transistor CB Characteristics (Input and Output)
9. Rectifiers with and without filters
10. Study of CRO

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

III Year B. Tech. AE – I Semester

4-0-4

AE3121

AIRCRAFT PRODUCTION TECHNOLOGY

UNIT – I
CASTING

Classification and comparison (merits and limitations) of manufacturing processes – Criteria for selection of a process for manufacturing a product. Sand casting – Types – Procedure to make sand moulds – Cores – Types – Uses – Moulding tools – Pouring of metal – Principles of die casting. Centrifugal casting, investment casting, shell moulding and CO₂ process.

UNIT – II
WELDING

Classification of welding processes – Principles and equipment used in the following processes – Arc welding – GTAW and GMAW – Gas welding – Resistance welding – Thermit welding – Soldering and Brazing.

UNIT – III
CONVENTIONAL MACHINING

General principles (with schematic diagrams only) of working, Types and commonly performed operations in the following machines; Lathe, Shaper, Planer, Milling machine, Drilling machine and gear cutting grinding machine – Concept of NC machines.

UNIT – IV
UNCONVENTIONAL MACHINING PROCESSES

Need for unconventional machining processes - Classifications – Principles (with schematic diagrams only) and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electrochemical machining, Electro-chemical machining, Electro-chemical grinding, Chemical machining, Laser beam machining, Electron beam machining, Plasma Arc machining.

UNIT – V
METAL FORMING AND POWDER METALLURGY

Basic concepts and classification of forming processes – Principles, equipment used and application of following processes; forging, rolling, extrusion, wire drawing, deep drawing, spinning – Powder Metallurgy – Procedural steps involved, merits and limitations, applications.

TEXT BOOKS:

1. H. Choudhury, Elements of Workshop Technology, Vols. 1 and 2., Kahnna Publishers, 1988
2. P.C. Pandey and HS Shan, Modern Machining Processes, Tata McGraw Hill Publication, New Delhi, 1980.
3. R. Gosh and AK Malik, Manufacturing Science, Affiliated East West Press, 1985.
4. HW Yankee, Manufacturing Processes, Prentice Hall Inc., 1979.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

III Year B. Tech. AE – I Semester

4-0-4

AE3122

AIRCRAFT PERFORMANCE

UNIT-I

REVIEW OF BASIC AERODYNAMICS

Types of drag, Effects of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Induced drag, Chord wise and span wise pressure distributions, Aspect ratio, Camber and Planform characteristics, and drag polar.

UNIT-II

STEADY FLIGHT

Steady level flight, Thrust/Power, available and required with altitude – Estimation of maximum level flight speed, Condition for minimum drag and minimum power required.

UNIT-III

GLIDING AND CLIMBING FLIGHT

Maximum rate of climb and steepest angle of climb, Time to climb and ceilings, Minimum rate of sink and shallowest angle of glide and glide hodograph.

UNIT-IV

SPECIAL PERFORMANCE PROBLEM

Range and endurance of jet and propeller type of airplanes, Estimation of take-off and landing distances. High lift devices. Use of thrust augmentation and reverse thrust.

UNIT-V

TURNING PERFORMANCE

Bank angle and load factor, Limitations on turn, Pull-up and push over, and the v-n diagram.

TEXT BOOKS

1. Anderson, J. D., Aircraft Performance and Design, Mc Graw-Hill International Edition 1999
2. Clancy, L.J., Aerodynamics, Pitman, 1986

REFERENCE BOOKS

1. Houghton, E.L., and Carruthers, N.B., Aerodynamics for Engineering Students, Edward Arnold Publishers Ltd., London, 1989
2. Perkins, C.D., and Hage, R.E., Airplane Performance and Stability and Control, Wiley Toppan 1974

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

III Year B. Tech. AE – I Semester

4-0-4

AE3123

AERODYNAMICS – II

UNIT-I

FUNDAMENTAL PRINCIPLES AND EQUATIONS

Importance of Aerodynamics, Review of vector relations, Models of fluid: Control Volumes and fluid elements, Continuity, momentum and energy equation. Drag of a two-dimensional body, path lines and streamlines of a flow, angular velocity vorticity and strain, circulation, stream function, velocity potential.

UNIT-II

FUNDAMENTALS OF INVISCID INCOMPRESSIBLE FLOW

Introduction, Bernoulli's equation, Incompressible flow in a duct: the venturi and low speed wind tunnel, Pitot tube, Pressure Coefficient, Incompressible flow condition, Governing equation for irrotational, incompressible flow: laplace equation

UNIT-III

TWO-DIMENSIONAL FLOWS

Uniform flow, Point Source and Sink, Combination of a uniform flow with a Source and Sink, Doublet flow, Non lifting flow over a circular cylinder, Vortex flow, lifting flow over a cylinder, Kutta-joukowski theorem.

UNIT-IV

INCOMPRESSIBLE FLOW AIRFOILS

Introduction, Airfoil nomenclature, Airfoil characteristics, the vortex sheet, Kutta condition, Kelvin circulation theorem and starting vortex, classical thin airfoil theory, symmetric and cambered airfoil.

UNIT-V

INCOMPRESSIBLE FLOW OVER A FINITE WING

Introduction: downwash and induced drag, vortex filament, Biot-Savart law and Helmholtz's theorems, Prandtl's classical lifting line theory: elliptical lift distribution and General lift distribution, Effect of Aspect ratio.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

III Year B. Tech. AE – I Semester 4-0-4

AE3124

TEXT BOOKS

1. Anderson, J.D., Fundamental of Aerodynamics, Mc Graw-Hill International Edition
2. Houghton, E.L., and Carruthers, N.B., Aerodynamics for Engineering Students, Edward Arnold Publishers Ltd, London, 1989

REFERENCE BOOKS

3. Clancy, L.J., Aerodynamics, Pitman, 1986
1. Milne Thomson, Theoretical Aerodynamics, Macmillan, 1985

WIND TUNNEL TECHNIQUES

UNIT – I

PRINCIPLES OF MODEL TESTING

Buckingham Π Theorem – Non-dimensional Numbers – Scale effect 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 TUNNEL

Test Section Speed – Horizontal buoyancy – Flow angularities – Turbulence Measurements – Associated instrumentation – Calibration of supersonic tunnel.

UNIT – IV

WIND TUNNEL MEASUREMENTS

Pressure, Velocity measurements – Force measurements – Three component and six component balance- Internal balances.

UNIT – V

FLOW VISUALIZATION

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization, Hotwire and Laser – Doppler anemometer.

TEXT BOOKS

2. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
2. Rae, W.H., and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication.

AIRCRAFT STRUCTURES - I**UNIT I****STATICALLY DETERMINATE BEAMS**

Double integration and moment area methods, Conjugate beam method, Principle of superposition, Beams of constant strength, Composite beams.

UNIT II**STATICALLY INDETERMINATE BEAMS AND FRAMES**

Clapeyron's three-moment equation method, Moment distribution method.

UNIT III**ENERGY METHODS**

Castigliano's theorem, Maxwell's reciprocal theorem, Unit load method, Application to beams, trusses, frame, rings, etc.

UNIT IV**COLUMNS**

Columns with various end conditions, column curves, columns with initial curvature, with eccentric loading, Southwell plot, short column formulae like Rankine's, Johnson's, etc, Energy method.

UNIT V**BEAMS COLUMNS**

Various loadings and end conditions.

TEXT BOOKS

1. Timoshenko, S., "Strength of materials", Vols. I & II, Princeton, D. Von Nostrand Co., 1988.
2. Donaldson, B.K, "Analysis of Aircraft Structures - An Introduction", McGraw Hill, 1993.

AEROSPACE PROPULSION - I**UNIT I****FUNDAMENTALS OF GAS TURBINE ENGINES**

Illustration of working of gas turbine engine - The thrust equation - Factors effecting thrust - Effect of pressure, velocity and temperature changes of air entering compressors - Method of thrust augmentation - Characteristics of turboprop, turbojet - Performance characteristics.

UNIT II**SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES**

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

UNIT III**COMBUSTION CHAMBERS**

Classification of combustion chambers - Important factors effecting combustion chamber design - Combustion process - Combustion chamber performance - Effect of operating variables on performance - Flame tube cooling - Flame stabilization - Use of flame holders - Numerical problems.

UNIT IV**NOZZLES**

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

UNIT V**COMPRESSORS**

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

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

III Year B. Tech. AE – I Semester 0-3-2

AE3127

TEXT BOOKS

1. Mathur, M.L., and Sharma, R.P. Gas Turbine, Jet and Rocket Propulsion, Standard Publishers and Distributors, Delhi, 1988.
2. Oates, G.C. Aerothermodynamics of Aircraft Engine Components, AIAA Education Series, Newyork, 1985.

REFERENCE BOOKS

3. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. Gas Turbine Theory, Longman, 1989.
4. Rolls- Royce, Jet Engine, 3rd edition, 1983.

AIRCRAFT PRODUCTION LAB

Exercises in Lathe, Shaper, Milling, Slotting, EDM and Grinding machines comprising the following.

1. Plain Turning
2. Taper Turning
3. Facing
4. Thread Cutting
5. Drilling, boring, counter boring, counter sinking
6. Knurling
7. Shaping and planning of square blocks, V-ways and Dovetail ways
8. Plain Milling
9. Gear Milling
10. Cylindrical Grinding / Surface Grinding
11. Simple exercises in EDM
12. Sheet metal joining by rivets, Soldering and brazing.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

III Year B. Tech. AE – I Semester

0-3-2

AE3128

AERODYNAMICS LABORATORY

1. Fluid flow studies using blower
2. Calibration of subsonic wind tunnel
3. Drag of different bodies
4. Pressure distribution studies on two-dimensional models
5. Pressure distribution over an airfoil at different angles of attack
6. Measurements in wind tunnel, such as boundary layer measurements, wake survey etc.
7. Calibration of supersonic wind tunnel
8. Supersonic flow visualisation with Schlieren system

2002-2003

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HYDERABAD**

III Year B. Tech. AE – II Semester

4-0-4

AE3221

AIRCRAFT STABILITY AND CONTROL

UNIT - I

GENERAL

Degree of freedom of a system - Static and dynamic stability - Need for stability in an airplanes - Purpose of controls - Inherently and marginally stable airplanes.

UNIT - II

STATIC LONGITUDINAL STABILITY

Stick Fixed: Basic equilibrium equation - Stability criterion - Wing and tail moments - Effect of fuselage and nacelles - Effects of center of gravity location - Power effects - Stabiliser setting and center of gravity location - Elevator effects - Stick fixed neutral point.

Stick free: Hinge moment coefficients - Stick free neutral point - Stick force gradients - Stick force per 'g' - Aerodynamic balancing of control surfaces.

UNIT - III

STATIC LATERAL STABILITY

Dihedral effect - Coupling between rolling and yawing moment - Adverse yaw - Aileron power - Aileron reversal.

UNIT - IV

STATIC DIRECTIONAL STABILITY

Weather cocking effects - Rudder requirements - One engine inoperative conditions - Rudder lock.

UNIT - V

Dynamic longitudinal - Lateral and Directional stability.
Equation of motion - Stability derivatives - Routh's discriminant solving the stability quadratic, Phugoid motion - Factor affecting the period and damping.
Dutch roll and spiral instability - Auto rotation and spin.

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HYDERABAD**

III Year B. Tech. AE – II Semester 4-0-4

AE3222

TEXT BOOKS

1. Perkins C.D., & Hage, R.E., Airplane Performance, Stability and Control, Wiley Toppan 1974.
2. Nelson, R.C., Flight Stability and Automatic Control, Mc Graw Hill 1989

REFERENCE BOOKS

1. Houghton, E.L., and Carruthers, N.B., Aerodynamics for Engineering Students, Edward Arnold Publishers Ltd., London, 1989
2. Mc.Cormic, B.W., Aerodynamics, Aeronautics & Flight Mechanics, John Wiley 1995

AIRCRAFT STRUCTURES – II

UNIT - I

UNSYMMETRICAL BENDING

Stresses in beams of unsymmetrical sections.

UNIT - II:

SHEAR FLOW IN OPEN SECTIONS

Thin walled beams - Concept of shear flow - Shear centre - Elastic axis with one axis of symmetry, with wall effect and ineffective in bending - Unsymmetrical beam sections.

UNIT - III

SHEAR FLOW IN CLOSED SECTIONS

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

UNIT - IV

BUCKLING OF PLATES

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

UNIT - V

STRESS ANALYSIS OF WING AND FUSELAGE

Procedure - Shear and bending moment distribution for semi cantilever and other types of wings and fuselage - Thin webbed beam with parallel and non-parallel flanges - Shear resistant web beams - Tension field web beams (Wagner's).

TEXT BOOKS

1. Peery, D.J, and Azar, J.J., Aircraft Structures, 2nd edition, Mc Graw-Hill, N.Y., 1993.
2. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.

REFERENCE BOOKS

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

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

III Year B. Tech. AE – II Semester

4-0-4

AE3223

AEROSPACE PROPULSION - II

UNIT - I

AIRCRAFT GAS TURBINES

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

UNIT - II

RAMJET PROPULSION

Operating principle- Subcritical, critical and supercritical operation - Combustion in ramjet engine - Ramjet performance - Sample ramjet design calculations - Introduction to SCRAMJET - Preliminary concepts in supersonic combustion - Integral ram - Rocket - Numerical problems.

UNIT - III

FUNDAMENTALS OF ROCKET PROPULSION

Operating principle - Specific impulse of a rocket - Internal ballistics - Rocket nozzle classifications - Rocket performance considerations - Numerical problems.

UNIT - IV

CHEMICAL ROCKETS

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

UNIT - V

ADVANCED PROPULSION TECHNIQUES

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

TEXT BOOKS

1. Mathur, M., and Sharma, R.P., Gas Turbines and Jet and Rocket Propulsion, Standard Publishers, New Delhi, 1988.
2. Gorden, C.V., Aerothermodynamics of gas turbine and Rocket Propulsion, AIAA Education Series, New York, 1986.

REFERENCE BOOKS

1. Sutton, G.P., Rocket Propulsion Elements, John Wiley & Sons Inc., New York, 5th Ed., 1993.
2. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., Gas turbine theory, Longman Co., ELBS Ed., 1989.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

III Year B. Tech. AE - II Semester

4-0-4

AE3224

COMPUTATIONAL AERODYNAMICS – I

UNIT-I
BASICS

Introduction to computational fluid dynamics – Research tool – Design Tool, Finite control volume, infinitesimal fluid element, substantial derivatives, divergence of Velocity.

UNIT-II
GOVERNING EQUATIONS OF FLUID DYNAMICS

The continuity equation, the momentum equation, the energy equation, physical boundary conditions, Form of Governing equation suited for CFD - Conservation form - shock fitting and shock capturing.

UNIT-III
IMPACT OF PARTIAL DIFFERENTIAL EQUATIONS ON CFD

Introduction, Classification of Quasi-Linear Partial differential equation, The Eigen value method, General behavior of different classes of Partial differential equation – elliptic, parabolic and hyperbolic.

UNIT-IV
DISCRETIZATION

Introduction, Finite differences, difference equations, Explicit and implicit approaches, Errors and an analysis of stability.

UNIT-V
GRID GENERATIONS

Introduction, transformation of the governing partial differential equations, Matrices and the Jacobian of transformation, Grid Generation techniques, Elliptic Grid Generator – Simply connected domain – doubly connected domain, Coordinate system control – Grid Point clustering, Introduction to Hyperbolic Grid Generation techniques and parabolic grid generator.

TEXT BOOKS

1. John D. Anderson " Computational Fluid Dynamics", McGraw Hill
2. Anderson, Dale A., John C. Tanhill and Richard H. Pletcher, "Computational Fluid Mechanics and Heat Transfer", McGraw Hill, New York 1984, Volumes I & II

REFERENCE BOOKS

1. Hoffmann, K.A: Computational Fluid Dynamics for Engineers, Engineering Education System, Austin, Tex., 1989
2. Kreyszig, E., Advanced Engineering Mathematics, Wiley, New York
3. Introduction to Computational Fluid Dynamics, Chow CY, John Wiley, 1979

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

III Year B. Tech. AE – II Semester

4-0-4

AE3225

HIGH SPEED AERODYNAMICS

UNIT-I
INTRODUCTION

Basic concepts of Entropy, Enthalpy, and Isentropic flow - Compressibility - Governing equation for inviscid-compressible flow - Stagnation conditions - Basics of supersonic flow.

UNIT-II
NORMAL SHOCK WAVES

Introduction - Basic normal shock equations - Speed of sound - Energy equation - Normal shock wave properties - Measurement of velocity in compressible flow.

UNIT-III
OBLIQUE SHOCK AND EXPANSION WAVES

Introduction - Oblique shock wave relations - Supersonic flow over wedges and cones - Shock interactions and reflections - Detached shock wave in front of a blunt body - Prandtl-Meyer expansion waves - Shock Expansion theory - Ackert's theory

UNIT-IV
NOZZLE, DIFFUSER AND SUPERSONIC WIND TUNNEL

Introduction - Governing equation for quasi-one-dimensional flow, Nozzle flows, Diffusers, Supersonic wind tunnels.

UNIT-V
SUBSONIC COMPRESSIBLE FLOW OVER AIRFOIL

Introduction - Velocity potential equation - Transonic small perturbation equation - Prandtl-Glauert compressibility corrections - Critical Mach number - Drag divergence Mach number - Area rule - Supercritical airfoil.

TEXT BOOKS

1. Anderson, J.D., Modern Compressible Fluid Flow, Mc Graw-Hill International Edition
2. Radhakrishnan, E. E., Gas Dynamics, Prentice Hall of India, 1995
3. Hodge B.K & Koenig K Compressible Fluid Dynamics with Computer Application, Prentice Hall, 1995
4. Clancy, L.J., Aerodynamics, Pitman, 1986, Macmillan, 1985

REFERENCE BOOKS

1. Anderson, J.D., Fundamental of Aerodynamics, Mc Graw-Hill International Edition

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

III Year B. Tech. AE – II Semester

4-0-4

AE3226

ROCKETS AND MISSILES

UNIT - I
ROCKET SYSTEMS

Ignition system in rockets - Types of igniters - Igniter design considerations - Design consideration of liquid rocket combustion chamber, Injector propellant feed lines, Valves, Propellant tank outlet and helium pressurized and turbine feed systems - Propellant slosh and propellant hammer - Elimination of geysering effect in missiles - Combustion system of solid rockets.

UNIT - II
AERODYNAMICS OF ROCKETS AND MISSILES

Airframe components of rockets and missiles - Forces acting on a missile while passing through atmosphere - Classification of missiles - Method of describing aerodynamic forces and moments - Lateral aerodynamic moment - Lateral damping moment and longitudinal moment of a rocket - Lift and drag forces - Drag estimation - Body upwash and downwash in missiles - Rocket dispersion - Numerical problems.

UNIT - III
ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD

One-dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields - Description of vertical, inclined and gravity turn trajectories - Determination of range and altitude simple approximations to burn out velocity.

UNIT - IV
STAGING AND CONTROL OF ROCKETS AND MISSILES

Rocket thrust vector control - Methods - Thrust termination - SITVC- Multi staging of rockets - Vehicle optimization - Stage separation dynamics - Separation techniques.

UNIT - V
MATERIALS FOR ROCKETS AND MISSILES

Selection of materials - Special requirements of materials to perform under adverse conditions.

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HYDERABAD**

III Year B. Tech. AE – II Semester 0-3-2

AE3227

TEXT BOOKS

1. Mathur, M., and Sharma, R.P., Gas Turbines and Jet and Rocket Propulsion, Standard Publishers, New Delhi, 1998.
2. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, J.W. freemn & Co., Ltd., London, 1982
3. Parket, E.R, Materials for Missiles and Space Craft, McGraw Hill Book Co., Inc., 1982.

REFERENCE BOOKS

1. Sutton, G.P, et al, Rocket Propulsion Elements, John Wiley & Sons Inc., New York, 1993.

AIRCRAFT STRUCTURES LABORATORY

1. Tensile testing using universal Testing Machine - Mechanical and optical Extensometers - Stress - strain curves and strength tests for various engineering materials.
2. Bending tests - Stress and deflection of beams for various end conditions - Verification of Maxwell's and Castiglianios theorems - Influence coefficients.
3. Compression tests on load and short column - Critical buckling loads - South well plot.
4. Test on riveted and bolted joints.
5. Test using NDT inspection method.
6. Strain gauge techniques - Measurement of strain in beams, thin and thick walled cylinders subjected to internal pressure - Shaft subjected to combined loading.
7. Shear centre in open and closed sections beams - Test on semi-tension field beams.
8. Elastic constants for composite materials - Flexural test on composites.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

III Year B. Tech. AE – II Semester 0-3-2

AE3228

AERO ENGINE REPAIR AND MAINTENANCE LABORATORY

1. Stripping of a piston engine, visual inspection and reasoning
2. Disassembly of turbojet, inspection and assembly
3. Engine balancing
4. Propeller pitch setting
5. Engine starting procedures
6. Trouble shooting practices

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV Year B. Tech. AE – I Semester 4-0-4

AE4121

THEORY OF VIBRATIONS AND AEROELASTICITY

UNIT - I

INTRODUCTION

Simple Harmonic Motion, Terminology, Newton's Law, D'Alembert's Principle, Energy Methods.

UNIT - II

SINGLE DEGREE OF FREEDOM SYSTEMS

Free vibrations, Free damped vibrations, Forced vibration with and without damping, Support excitation, Vibration - measuring instruments.

UNIT - III

MULTI-DEGREE OF FREEDOM SYSTEMS

Two degree of freedom systems, Static and dynamic couplings, Vibration absorber, Principal coordinates, Principal modes, orthogonality conditions. Hamilton's principle, Lagrangean equation and applications. Vibrations of elastic bodies, Strings or stretched cord, Longitudinal vibration, Lateral vibration, Torsional vibration.

UNIT - IV

Approximate method to determine the natural frequencies.

UNIT - V

Introduction to Aero-elasticity, Couplings, Aeroelastic instabilities and their prevention - Collar's Triangle, Wing divergence, Control reversal and Control flutter speed, Flutter prevention.

TEXT BOOKS

1. Bisplinghoff, R.L., Ashley, H. and Hogman, R.L., Aero elasticity, Addison Wesley Publication, New York, 1983
2. Rao, J.S and Gupta K., Theory and practice of Mechanical vibrations, Wiley Eastern Ltd., New Delhi, 1999
3. Scanlon, R.H., & Rosenbaum, R., "Introduction to the Study of Aircraft Vibration & Flutter." John Wiley and Sons, New York, 1982

REFERENCE BOOKS

1. Timoshenko, S., Vibration Problems in Engineering, John Wiley and Sons, New York, 1987.
2. Fug, Y.C., An Introduction to Theory of Aeroelasticity, John Wiley & Sons, New York, 1984

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

IV Year B. Tech. AE – I Semester

4-0-4

AE4122

AIRCRAFT DESIGN PRACTICE

UNIT - I

Introduction to systematic approach to design preliminary weight estimation, size from a conceptual sketch, airfoil and geometry, selection, thrust loading and wing loading.

UNIT - II

Initial sizing, configuration layout, special considerations in configuration design.

UNIT - III

Design of wing, fuselage, control surfaces, and landing gear and subsystems, surface control. Preliminary cost analysis.

UNIT - IV

Preliminary aerodynamic design of an airplane of given set of specifications. Three view Drawing and layout and estimation of its performance and stability characteristics.

UNIT - V

Detailed structural design of the major components of an airplane including load calculations.

TEXT BOOKS

1. Torenbeek, E., Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986
2. Kuechemann, D., Aerodynamic Design of Aircraft, Pergamon Pres, 1978.

REFERENCE BOOKS

1. Raymer, D.P., Aircraft Conceptual Design, AIAA Education Series

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

IV Year B. Tech. AE – I Semester

4-0-4

AE4123

COMPUTATIONAL AERODYNAMICS – II

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 McCormack'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 METHOD

Stability of Solution, Explicit time dependent methods - Euler, Backward Euler, One step trapezoidal, Backward differencing, methods, Leap Frog method.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE – I Semester

4-0-4

AE4124

Description of Lax-Wendroff Scheme and Mac Cormack's two-step predictor – Corrector method. Description of time split methods and Approximate factorization schemes

TEXT BOOKS

1. John D. Anderson "Computational Fluid Dynamics", McGraw Hill
2. Anderson, Dale A., John C. Tanhill and Richard H.P. Letcher, "Computational Fluid Mechanics and Heat transfer", McGraw Hill, New York 1984, Volumes I & II.

REFERENCE BOOKS

1. Hoffmann, K.A: Computational Fluid Dynamics for Engineers, Engineering Education System, Austin, Tex., 1989
2. Kreyszig, E., Advanced Engineering Mathematics, Wiley, New York
3. Introduction to Computational Fluid Dynamics, Chow CY, John Wiley, 1979

AIRCRAFT SYSTEMS AND INSTRUMENTS

**UNIT - I
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 – Retractive mechanism.

**UNIT - II
AIRPLANE CONTROL SYSTEMS**

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

**UNIT - III
ENGINE SYSTEMS**

Fuel system for piston and jet engines - Components of multi engines – Lubricating systems for piston and jet engines – Starting and Ignition systems – Typical examples for piston and jet engines.

**UNIT - IV
AIR CONDITIONING AND PRESSURIZING SYSTEMS**

Basic air cycle systems – Vapor cycle systems, Boost – strap air cycle system – Evaporative vapor cycle systems – Evaporative air cycle systems – Oxygen systems – Fire protection systems, De-icing and anti-icing systems.

**UNIT - V
AIRCRAFT INSTRUMENTS**

Flight instruments and Navigation instruments – Accelerometers, Air speed indicators – Mach meters – Altimeters – Principles and operation – Study of various types of engine instruments – Tachometers – Temperature gauges – Pressure gauges – Operation and principles.

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV Year B. Tech. AE - I Semester

4-0-4

AE4125

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., Aircraft Maintenance & Repair, McGraw Hill, 1993.
2. General Handbooks of Airframe and Power Plant Mechanics, U.S. Dept. of Transportation, Federal Aviation Administration The English Book Store, New Delhi, 1995

REFERENCE BOOKS

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

EXPERIMENTAL STRESS ANALYSIS
(ELECTIVE – I)

UNIT – I
MEASUREMENTS

Basic principles, Accuracy, Sensitivity, Range Measurements, Errors.

UNIT – II
EXTENSOMETERS

Mechanical, Optical, Acoustical and Electrical extensometers and their use – Advantage and disadvantage.

UNIT – III
STRAIN GAUGE

Principles and operation of electrical strain gauge- Requirement - Type and their uses, Material for strain gauge, Calibration, Cross sensitivity, Rosette Analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, Strain indicator.

UNIT - IV
PHOTOELASTICITY

Two dimensional Photoelasticity, Concept of Light – Photo-elastic effects, Stress and optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photoelastic material.

UNIT – V
NON-DESTRUCTIVE TESTING

Fundamentals of Non Destructive Testing, Radiography, Ultrasonic magnetic particles Inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique, Fundamentals of brittle coating methods, Introduction to Moiré Techniques, Holography, Ultrasonic C-Scan, Thermography, Fiber-optic sensors.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE - I Semester

4-0-4

AE4126

TEXT BOOKS

1. Daily, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1978

REFERENCE BOOKS

1. Hetenyi, M., Hand Book of Experimental Stress Analysis, John Wiley and Sons INC., New York, 1972
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Gargesh, G. Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.

AVIONICS

(ELECTIVE - I)

UNIT - I

INTRODUCTION TO AVIONICS

Use of Avionics in Civil and Military Aircraft and Space Systems – Typical Avionics sub-system – Design and Technologies.

UNIT - II

PRINCIPLES OF DIGITAL SYSTEMS

Digital Computer – Microprocessors – Memories

UNIT - III

FLIGHT DECK AND COCKPITS

Control and display technologies, CRT, LED, LCD, EL and Plasma Panel – Touch Screen – Direct Voice Input (DVI) – Civil Cockpit.

UNIT - IV

INTRODUCTION TO AVIONIC SYSTEM

Communication systems - Navigation systems - Flight control systems - Radar electronic warfare - Utility systems - Reliability and maintainability – Certification.

UNIT - V

ELECTRONIC NAVIGATION

Classification - Dead Reckoning - Celestial and Radio Direction Finding at Medium, high and very high frequencies. Radio compass and Automatic Direction Finder - Radio Ranges - Medium Frequency - VHF Omni Directional Ranges - Hyperbolic Navigation System - LORAN AND DECCA/TACAN aids to approach and landing - Standard ILS and Ground Control - Approach systems - Dead Reckoning Navigation System - Doppler Navigation - Inertial Navigation system - Navigational Instruments.

Analog and Digital computers for Aeronautical applications – Head up display.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE – I Semester 4-0-4

AE4127

TEXT BOOKS

1. Goanekar R.S – Micro Processors Architecture Programming and Applications Wiley and Sons, 10th Reprint, 1989
2. Stitzer C.R, Digital Avionics Systems – Prentice Hall

REFERENCE BOOKS

1. Kaylon M and Fried W - Avionic Navigation System, Wiley and Sons
2. Middleton D.W - Avionics Systems Longman Group

SPACE TECHNOLOGY

(ELECTIVE – I)

UNIT-1

Historical development of rockets – Solid and liquid propellant rockets – Specific impulses – Principle of operation of rocket motor – Assumption of ideal rocket theory – Rocket's thrust equation – Performance of rocket nozzles.

UNIT –2

Governing equation of rocket flight – Simple equation to burn out velocity – Determination of range, trajectory and maximum altitude – Law of mass ratios – Multistage rocket and their final velocity.

UNIT – 3

Aerodynamic considerations – Types of design and control – Drag estimation, wave, skin friction and base pressure drags – Free flight dispersion.

UNIT – 4

Kepler's law of planetary motion – Brief discussion of solar system – Two-body problem – Newton's law of gravitation, Orbit and least energy liberation point.

UNIT – 5

Orbital and escape velocities – The surface potential estimation of orbital size, shape and velocities – Geo synchronous orbits.

TEXT BOOKS

1. "Rocket Propulsion Elements", Sutton GP, John Wiley and Sons, NY, 1993
2. "Rocket Propulsion and Space Dynamics", Cornelisse JW, WH Freeman & Co., 1984
3. "Missiles Configuration Design", Chin SS, McGraw Hill, NY, 1961

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

IV Year B. Tech. AE – I Semester

4-0-4

AE4128

COMPOSITE MATERIALS AND STRUCTURES (ELECTIVE - I)

UNIT - I

INTRODUCTION

Classification of composites; Advantages and applications of composite materials reinforcements and matrices.

UNIT - II

STRESS STRAIN RELATION

Isotropic, Orthographic and an-isotropic material transformation of material properties for arbitrary fiber orientation.

UNIT - III

METHODS OF ANALYSIS

Micro-mechanics - Mechanics of materials approach to determine Young's modulus, Shear modulus and Poisson's ratio; Brief mention of elasticity approach. Macro mechanics of laminates - Anisotropic Elasticity - Stress-strain relations in material coordinates - Transformation to geometric axes - Strength concepts - Biaxial Strength theories - maximum stress, maximum strain.

UNIT - IV

LAMINATED PLATES

Laminate analysis - Classical plate theory - Classical lamination theory - Special cases of single-layer - Symmetric, anti-symmetric and unsymmetric configurations with cross-ply and angle-ply lay-ups - Deflection analysis of laminated plates - Analysis of laminated beams and columns - Shear deformation theories for composite laminates.

UNIT - V

FABRICATION PROCESSES

Fabrication Process: Open and closed mould processes - Filament winding and on-line production method – Manufacture of fibers and properties.

TEXT BOOKS

1. "Analysis and Performance of fibre Composites", Agarwal BD and Broutman LJ., John Wiley and Sons., NY, 1980
2. "Handbook on Advanced Plastics and Fibre Glass", Lubin G., Von Nostrand Reinhold Co., NY, 1989.
3. "Advanced Composite Materials", Lalit Gupta, Himalayan Books, New Delhi, 1998.

REFERENCE BOOKS

1. "Mechanics of Composite Materials", Jones RM., McGraw Hill, Kogakusha Ltd., Tokyo, 1985.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE – I Semester

4-0-4

AE4129

**INDUSTRIAL AERODYNAMICS
(ELECTIVE – I)**

**UNIT - I
ATMOSPHERE**

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 requirements and drag coefficients of automobiles, Effects of cut back angle, and 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**

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

TEXT BOOKS

1. Blevins, R.D., *Flow Induced Vibrations*, Van Nostard, 1990.
2. Calvert, N.G., *Wind Power Principles*, Charles Griffin & Co., London, 1979.

REFERENCE BOOKS

1. Scorer, R.S., *Environmental Aerodynamics*, Ellis Harwood Ltd, England, 1978.
2. Sovran, M., *Aerodynamics Drag Mechanisms of Bluff Bodies and Road Vehicles*, Plenum Press, N.Y., 1978.
3. Sachs, P., *Wind Forces in Engineering*, Pergamon Press, 1988.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY**HYDERABAD****IV Year B. Tech. AE – I Semester****4-0-4****2002-2003****AE4130****DESIGN AND DRAFTING****(ELECTIVE - II)****UNIT - I****ANALYSIS AD DESIGN OF TRUSSES**

Statically determinate plane and space trusses, estimation of forces and design members

UNIT - II**LANDING GEAR DESIGN**

Basic elements of landing gear system.

UNIT - III**DESIGN OF JOINTS**

Bolted, riveted, bonded and welded joints, Standard specifications.

UNIT - IV**LAYOUT OF TYPICAL WING AND FUSELAGE**

Drafting of typical wing structural elements, Types of wing structures. Drafting of typical fuselage structural elements, Types of fuselage structures.

UNIT - V**MODELLING AND DRAFTING**

Computer aided modelling and drafting of aircraft components using software packages.

TEXT BOOKS

1. Bruhn E.H. Analyses and Design of Flight Vehicle Structures, Tri State Off Set Company, USA 1965
2. Meeta Gandhi, Tilak Shetty & Rajiv Shah, The 'C' Odyssey ++ & Graphics – The Future of C, BPB Publications, New Delhi 1992

REFERENCE BOOKS

1. Peery, D.J., and Azar, J.J., Aircraft Structures, McGraw Hill, 1993
2. Dowty, G.H., Structural Principles and Data, The New Era Publishing Co., 1980

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD****IV Year B. Tech. AE – I Semester****4-0-4****AE4131****APPROXIMATE METHODS IN STRUCTURAL MECHANICS
(ELECTIVE - II)****UNIT - I****INTRODUCTION**

Exact method versus approximate method – Need for approximate methods

UNIT - II**ENERGY METHODS**

Review of basic energy principles – Applications to statically determinate and indeterminate structures. Free vibration analysis – Beams and columns – Variation principle.

UNIT - III**METHOD OF WEIGHTED RESIDUALS**

Application of Galerkin, Collocation, Least square methods to analysis of beams

UNIT - IV**FINITE DIFFERENCE**

Application of static, dynamic and stability analysis of beams and plates.

UNIT - V**FINITE ELEMENT METHOD**

Application of truss, bar, beam and two-dimensional elements

TEXT BOOKS

1. Tauchert, T.R., Energy Principles in Structural Mechanics, McGraw Hill, International student Edition
2. Bathe, K.J and Wilson, E.L., Numerical Methods in Finite Element Method, Prentice Hall (India) Ltd, 1985.

REFERENCE BOOKS

1. Szilard, R., Theory and Analysis of Plates – Classical and Numerical Methods, Prentice Hall, 1984
2. Chajes, A., Principles of structural stability Theory, Prentie Hall, Inc., 1987

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE – I Semester

4-0-4

AE4132

PROPELLANT TECHNOLOGY**(ELECTIVE – II)****UNIT - I****LIQUID FUELS**

Properties and tests for petroleum products - Motor gasoline - Aviation gasoline - Aviation turbine fuels - Requirements of aviation fuels of kerosene type and high flash point type - Requirements for fuel oils.

UNIT - II**SOLID PROPELLANTS**

Single base propellants - Double base propellants - Composite propellants - CMBD propellants - Metallized composite propellants - Introduction to different fuels and oxidizers of composite propellants - Brief introduction to composite theory of composite and double base propellants.

UNIT - III**LIQUID PROPELLANTS**

Various liquid propellants and their properties - Monopropellants and bipropellant system - concept of ullage - Ignition studies of liquid propellants - Propellant loading tolerances - inventory - Volume versus mass loading - Loading measurement and control - Outage control.

UNIT - IV**CRYOGENIC PROPELLANTS**

Introduction to cryogenic propellants - Liquid hydrogen, liquid oxygen, liquid nitrogen and liquid nitrogen and liquid helium - Theory behind the production of low temperature - Expansion engine - Cascade process - Joule Thompson effect - Magnetic effect - Ortho and para H₂ - Helium 4 and Helium 3 - Ideal cycles and efficiency of cryo systems - Storing of cryogenic propellants - Cryogenic loading problems.

UNIT - V**PROPELLANT TESTING**

Laboratory testing - Arc Image Furnace - Ignitability studies - Differential Thermal Analysis - Thermo-gravimetric analysis - Particle size measurement Micro-merograph - Strand burner tests impulse bomb - Performance estimation.

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IV Year B. Tech. AE - I Semester

0-4-4

AE4133

FLIGHT TRAINING AT I.I.T KANPUR

(ELECTIVE - II)

1. Weight and C.G Determination
2. Calibration of ASI and Altimeter
3. Calibration of Special Instrument
4. Cruise and Climb performance
5. Determination of Stick free and fixed neutral points
6. Determination of Stick free and fixed maneuver points
7. Verification of lateral-directional equations of motion for a steady state side slip maneuver.
8. Verification of Lateral-directional equations of motion for a steady state coordinate turn
9. Flight determination of drag polar of a glider

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IV Year B. Tech. AE – I Semester 4-0-4

AE4134

**COMPUTER INTEGRATED MANUFACTURING
(ELECTIVE – II)**

UNIT – I

CIM as a concept of a technology – CASA/SME model of CIM – CIM II – Benefits of CIM – Communication matrix in CIM – Fundamentals of computer communications in CIM – CIM data transmission methods – Serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex – Types of communication in CIM – Point to point (PIP) – Star and multiplexing – Computer networking in CIM – the seven layer OSI model – LAN Map model – Network topologies – Starr, ring and bus, advantages of networks in CIM.

UNIT – II

Concept of CAD as drafting and design facility – Desirable features of CAD package – Drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, zoom, redraw and regenerate, surface modelling and solid modelling (concepts only) in relation to popular CAD packages.

UNIT – III

Manufacturing industries as basic producer – Converter and fabricator, types of production, Functions in manufacturing, Production concepts – Manufacturing lead time (MLT), Production rate, Components of operation times – Plant capacity – Plant/machine utilization – Work in process (WIP) – Simple problems, automation definition, types of automation.

UNIT – IV

Group technology – Areas of applications – Benefits – Part families - Part classification and coding systems – Optiz multi class – Production flow analysis (PFA) – Machine cell design – Determining the best machine layout – To/from ratio method, simple problems. Flexible manufacturing system – Introduction – Components – Types – Applications and benefits – Work station – Material handling and storage system – Layout configuration – Data files – System reports and planning.

UNIT – V

Characteristics of manufacturing process data – Continuous analogue – Discrete binary and pulse data – Types of interface for input and output of process data – Analog to digital converter (ADC) – Digital to analog converter (DAC) – Multiplexer – Process monitoring through computer – Types of computer process control – Preplanned, direct digital control (DDC), Regulator control and feed forward control – Requirements of control programming – Interrupt, real time clock interrupt.

TEXT BOOKS

1. "Automation, production systems and CIM", 2nd Edn., Mikell P. Groover, Prentice Hall of India (PHI), 1999
2. "Computer Aided Design and Manufacturing", Faird ML., PHI 1993
3. "CAD/CAM/CIM", 1st Edn., Radhakrishnan P., New Central Book Agency, 1992
4. "Computer Integrated Manufacturing from Concepts of Raeization", 1st Edn., Addison Wesley, 1997
5. "Computer Aided Design and Manufacturing", David Vallicre, PHI, 1990 "CAD/CAM", Sadhu Singh, Kahnna Publications

REFERENCE BOOK

1. "Principles of Computer – Integrated Manufacturing", 1st Edn. Kant Vajpayee S, PHI, 1995

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV Year B. Tech. AE - I Semester 0-3-2

AE4135

AIRCRAFT SYSTEMS LABORATORY

1. Aircraft Hydraulic System
2. Aircraft Pneumatic System
3. Aircraft Oxygen System
4. Aircraft Landing Gear System
5. Aircraft Pressurisation System
6. Aircraft de-icing and anti-icing system
7. Aircraft electrical system
8. Aircraft control system
9. Aircraft fuel system

2002-2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV Year B. Tech. AE - I Semester 0-3-2

AE4136

COMPUTATIONAL AERODYNAMICS LAB

UNIT - I

Numerical solutions for any one of the following, using Finite difference method.

- a) Elliptic Equations
- b) Parabolic Equations
- c) Hyperbolic Equations

UNIT - II

Grid Generations for any one of the following

- a) Algebraically stretched Cartesian grids.
- b) Elliptic grids

UNIT - III

Numerical solutions for any one of the following

- a) Vortex panel method
- b) Source panel method
- c) Incompressible coutte flow
- d) Supersonic flow over a flat plate

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD****IV Year B. Tech. AE – II Semester****4-0-4****AE4221****FINITE ELEMENT METHODS
(ELECTIVE - III)****UNIT - I
INTRODUCTION**

Review of basics, stiffness and flexibility matrices for simple case, Governing equation and outline for convergence of finite element method.

**UNIT - II
DISCRETE ELEMENT**

Bars, Frames and beam element, Application to static, dynamic and stability analysis.

**UNIT - III
CONTINUUM ELEMENT**

Types of 2-d elements, Application to plane stress, Plane strain problematic symmetric case, Consistent and lumped formulation.

**UNIT - IV
ISOPARAMETRIC ELEMENTS**

Application to two and three-dimensional problems, Numerical integration.

**UNIT - V
COMPUTER IMPLEMENTATION AND FIELD PROBLEM**

Computer implementation for assembly of elements matrices and solution procedure. Application to other field problems like heat transfer and fluid flow.

TEXT BOOKS

1. Seaglind, L.J., Applied Finite Element Analysis, John Wiley and Sons, Inc., New York, 1991.
2. Desai, C.S and Abel, J.F., An introduction to the Finite Element Method, Affiliated East-West Press Pvt., Ltd., New Delhi, 1987.
3. Bathe, K.J. And Wilson, E.L., Numerical Methods in Finite Element Analysis, Prentice Hall of India, 1985.

REFERENCE BOOK

1. Krishnamurthy, C.S., C.S., Finite Element Analysis, Tata McGraw Hill, 1987.

2002-2003

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HYDERABAD**

IV Year B. Tech. AE – II Semester 4-0-4

AE4222

CRYOGENICS

(ELECTIVE – III)

**UNIT – I
INTRODUCTION**

Historical background – Introduction to cryogenic problems – Liquid hydrogen, Liquid helium, Liquid nitrogen and Liquid oxygen and their properties.

**UNIT – II
PRODUCTION OF LOW TEMPERATURE**

Theory behind the production of low temperature – Expansion engine heat exchangers – Cascade process Joule Thomson effect – Magnetic effect - Ortho and para H₂ – Helium 4 and Helium 3.

**UNIT – III
EFFICIENCY OF CRYOGENIC SYSTEMS**

Types of losses and efficiency of cycles – Specific amount of cooling – The fraction liquefied – Cooling coefficient of performance – Thermodynamic efficiency – The energy balance method.

**UNIT – IV
CYCLES OF CRYOGENIC PLANTS**

Classification of cryogenic cycles – The structure of cycles – Throttle expansion cycles – Expander cycles – Mixed throttle expansion and expander cycles – Thermodynamic analysis – Numerical problems.

**UNIT – V
CRYOGENICS IN AEROSPACE APPLICATIONS**

Cryogenic liquids in missile launching and space simulation of cryogenic liquids – Effect of cryogenic liquids on properties of Aerospace materials – Cryogenic loading problems – Zero gravity problems associated with cryogenic propellants – Phenomenon of tank collapse – Elimination of geysering effect in missiles.

TEXT BOOKS

1. "Cryogenic Systems", Barron RF, Oxford Univ., 1985
2. "Propellant Chemistry", Sarner SF, Reinhold Pub. Corp., NY, 1985

REFERENCE BOOK

1. "Cryogenic Fundamentals", Haseldorf G, Academic Press, 1971

AIRCRAFT DESIGN

(ELECTIVE – III)

UNIT-I

INTRODUCTION

State of art in the airplane design. Classification of airplanes based on purpose and configuration, Factor affecting configuration, Merits of different airplane layouts.

UNIT-II

SHAPING THE AIRPLANE

Principal features, Aerodynamics configuration, Lift, drag and interference effects, Weight and strength considerations, Peculiarities in layout, Designing for manufacturability, Maintenance, Operational Costs, Interactive Design.

UNIT-III

PRELIMINARY DESIGN PROCEDURE

Data collection and 3- view drawings, their purpose, Weight estimation, Choice of wing loading and thrust loading.

UNIT-IV

POWER PLANT SELECTION

Choices available, Comparative merits, Location power plants, Function dictating the locations.

UNIT-V

DESIGN OF MAJOR AIRPLANE COMPONENTS

- a) Wing Design
Airworthiness requirements, V-n diagram Loads, Elements of Wing design, Structural features.
- b) Fuselage Design
Loads on fuselage, Elements of fuselage design, Determination of tail surface areas, Structural features.

c) Landing Gear Design

Loads on landing gear, Preliminary landing gear design

TEXT BOOKS

1. Raymer, D.P., Aircraft Conceptual Design, AIAA Education Series

REFERENCE BOOKS

1. Torenbeek, E., Synthesis of subsonic Airplane Design, Delft University Press, U.K. 1986
2. Kuechemann, D., Aerodynamic Design of Aircraft, Pergamon Pres, 1978.

2002-2003

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HYDERABAD**

IV Year B. Tech. AE – II Semester

4-0-4

AE4224

**CREATIVE, INNOVATION AND NEW PRODUCT DEVELOPMENT
(ELECTIVE – III)**

**UNIT - I
CREATIVITY**

Questioning mind – Novel ideas – The need for creativity and innovation – Creativity and problem solving – Brain storming techniques, Process of technological invention – Factors contributing to successful innovation and design.

**UNIT - II
IDEA GENERATION AND SCREENING**

Process of generating original ideas and products/services – Group brain storming – Project selection and evaluation – Problem solving techniques.

**UNIT - III
NEW PRODUCT DEVELOPMENT**

Selection criteria – Goal definition – Successful methods of invention and design, Invention note book

UNIT - IV

NEW PRODUCT PLANNING

Prototype design – Use of CAD (basics) – Fabrication – Testing – Quality standards – Market survey – Introducing new survey.

**UNIT - V
PATENTS AND INTELLECTUAL PROPERTY RIGHTS (IPR)**

Patents – Patent laws – Patent cooperation treaty (PCT) – International patents, Patent search – IPR related issues.

TEXT BOOKS

1. Harry B. Watton, New Product Planning – Prentice Hall Inc (1992)
2. IPR – Bulletins, TIFAC, New Delhi.

REFERENCE BOOKS

1. William C. Miller – The Creative Edge, Addison-Wesley Pub. Co., New York (1997)
2. Khandwalla – Forth eye – Excellence Through Creativity, Wheeler Publications, Allahabad (1992)

WEB SITES

1. <http://www.c11.wayne.edu/isp/drbowen/crtvw99>
2. <http://www.virginia.edu/tcc315>
3. <http://www.Wipo.int>
4. <http://www.Uspto.gov>

2002-2003

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HYDERABAD

IV Year B. Tech. AE - II Semester 4-0-4

AE4225

SPACE MECHANICS
(ELECTIVE – III)

UNIT - I
BASIC CONCEPTS

The solar system – Reference frames and coordinate systems – The celestial sphere – The ecliptic – Motion of vernal equinox – Sidereal time – Solar time – Standard Time - The earth's atmosphere.

UNIT - II
THE GENERAL N-BODY PROBLEM

The many body problem – Lagrange – Jacobi identity - The Circular restricted three body problem – Libration points – Relative Motion in the N- body problem – Two body problem – Satellite orbits – Relations between position and time – Orbital elements.

UNIT - III
SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS

General aspects of satellite injections – satellite orbit transfer – Various cases – Orbit deviations due to injection errors – Special and general perturbations – Cowell's Method – Encke's method – Method of variations of orbital elements – General perturbations approach.

UNIT - IV
INTERPLANETARY TRAJECTORIES

Two-dimensional interplanetary trajectories – Fast interplanetary trajectories – Three-dimensional interplanetary trajectories – Launch of interplanetary spacecraft – Trajectory about target planet.

UNIT - V
BALLISTIC MISSILE TRAJECTORIES

The boost phase – The ballistic phase – Trajectory geometry – Optimal flights – Time of flight – Re-entry phase – The position of the impact point – Influence of coefficients.
Materials for Spacecraft: Space environment – Peculiarities – Effect of space environment on the selection of materials of spacecraft.

TEXT BOOKS

1. "Rocket Propulsion Elements", Sutton GP, John Wiley, 1993
2. "Elements of Astrodynamics", Van de Kamp P, Pitman 1979.
3. "Materials for Missiles and Spacecraft", Parker ER, McGraw Hill Book Co., Inc., 1982.

REFERENCE BOOK

1. "Rocket Propulsion and Space Dynamics", Cornelisse JW, WH Freeman & Co., 1984

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IV Year B. Tech. AE – II Semester 4-0-4

AE4226

2002-2003

**FATIGUE AND FRACTURE MECHANICS
(ELECTIVE – IV)**

UNIT - I
FATIGUE OF STRUCTURES

S-N Curves - Endurance limit - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factor - 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 TESTING

Safe life and fail-safe design philosophies – Importance of fracture mechanics in aerospace structure - Application to composite materials structures.

TEXT BOOKS

1. Knott, J.F., Fundamentals of Fracture Mechanics, Butter Worth & Co., (Publishers) Ltd., London, 1983

REFERENCE BOOKS

1. Barrois, W., and Ripley, E.L., Fatigue of Aircraft Structures, Pergamon Pres., Oxford, 1983.
2. Sih, C.G., Mechanics of Fracture, Vol. I, Sijhoff and Noordhoff International Publishing Co., Netherlands, 1989.

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HYDERABAD**

IV Year B. Tech. AE – II Semester 4-0-4

AE4227

**VISCOUS FLOW THEORY
(ELECTIVE – IV)**

**UNIT - I
BASICS**

Basic laws of fluid flow – Continuity, momentum and energy equations as applied to system and control volume – Concept of flow fields – Viscous fluid flow – Boundary conditions – Development of boundary layer – Estimation of boundary layer thickness – Displacement thickness, momentum and energy thickness for two-dimensional flows.

**UNIT - II
NAVIER STOKES EQUATION**

General stress system in a deformable body – General strain system – 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 - Stokes Equation (N-S) – General properties of Navier - Stokes Equation.

**UNIT- III
EXACT SOLUTIONS**

Exact solution of N-S 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 - IV
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 layer temperature profiles for constant plate temperature – Falkner Skan Wedge flows – Integral equation of Boundary layer – Pohlhausen method – Thermal boundary calculations – One parameter and two parameter integral methods.

**UNIT – V
TURBULENT BOUNDARY LAYER**

Two-dimensional turbulent boundary layer equations – Integral relations – Eddy-viscosity theories – Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary on a 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
3. "Fundamentals of Aerodynamics", Anderson JD, McGraw Hill Book Co., Inc., NY, 1985
4. "Boundary Layer Theory", Schlichting H, McGraw Hill

REFERENCE BOOKS

1. "Boundary Layer Theory", Schlichting H, McGraw Hill
2. "Viscous fluid Flow", White FM, McGraw Hill Co. Inc., NY, 1985

2002-2003

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IV Year B. Tech. AE – II Semester

4-0-4

AE4228

**HELICOPTER AERODYNAMICS
(ELECTIVE – IV)**

UNIT - I

ELEMENTS OF HELICOPTER AERODYNAMICS

Configurations based on torque reaction - Jet rotors and compound helicopters - Methods of control - Collective and cyclic pitch changes - Lead-lag and flapping hinges.

UNIT - II

IDEAL ROTOR THEORY

Hovering performances - Momentum and simple blade element theories - Figures of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

UNIT - III

POWER ESTIMATES

Induced, Profile and Parasite power requirements in forward flight - Performances curves with effects of altitude - Preliminary ideas on helicopter stability.

UNIT - IV

LIFT AND CONTROL OF V/STOL AIRCRAFT

Various configuration - Propeller, Rotor ducted fan and jet lift - Tilt wing and vectored thrust - Performances of VTOL and STOL aircraft in hover, Transition and Forward motion.

UNIT - V

GROUND EFFECT MACHINES

Types - Hover height, Lift augmentation and power calculations for plenum chamber and peripheral jet machines - Drag of hovercraft on land and water. Applications of hovercraft.

TEXT BOOKS

1. Johnson, W., Helicopter Theory, Princeton University Pres, 1980.
2. McCormick, B.W., Aerodynamics, Aeronautics & Flight Mechanics John Wiley, 1995
3. Gupta, L Helicopter Engineering, Himalayan books, 1996.

REFERENCE BOOKS

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

HEAT TRANSFER
(ELECTIVE – IV)

UNIT - I
FUNDAMENTALS

Different modes of heat transfer and general principles.

UNIT - II
HEAT CONDUCTION

Steady and unsteady state heat conduction in solids - Effect of variation of thermal conductivity on heat transfer in solids - Heat transfer problems in infinite and semi-infinite solids - Extended surfaces - Application of numerical techniques.

UNIT - III
CONVECTIVE HEAT TRANSFER

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

UNIT – IV
RADIATIVE HEAT TRANSFER

Introduction to physical mechanism - Radiation properties - Radiation shape factors - Heat exchange between non-black bodies - Radiation shields.

UNIT - V
HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING

Heat transfer problems in gas turbine combustion chambers - Rocket Thrust Chambers - Aerodynamic heating - Ablative heat transfer.

TEXT BOOKS

1. Sachdeva, S.C., Fundamentals of Engineering Heat & Mass Transfer, Wiley Eastern Ltd., New Delhi, 1981.
2. Sutton, G.P., Rocket Propulsion, John Wiley & Sons, 5th edn., 1986.
3. Mathur, M. and Sharma, R.P. Gas Turbine and Jet and Rocket Propulsion, Standard Publishers, New Delhi 1988.

REFERENCE BOOKS

1. Lienhard, J.H., A Heat Transfer Text Book, Prentice Hall Inc., 198.
2. Holman, J.P., Heat Transfer, McGraw Hill Book Co., Inc., New York, 6th edn., 1991.

2002-2003

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B. Tech. AE – II Semester

4-0-4

AE4230

**AEROELASTICITY
(ELECTIVE – IV)**

UNIT - I

AEROELASTICITY PHENOMENA

Stability versus response problems – The aero-elastic triangle of forces - Aeroelasticity in Aircraft design – Prevention of Aeroelastic instability.

UNIT - II

DIVERGENCE OF LIFTING SURFACE

Simple two-dimensional idealization – Strip theory – Fredholm integral equation of the second kind –Exact solutions for simple rectangular wings – Semigrid assumptions and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.

UNIT - III

STEADY STATE AEROELASTIC PROBLEM

Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semigrid theory and successive approximations – Lift distribution – Rigid and elastic wings

UNIT - IV

FLUTTER PHENOMON

Non-dimensional Parameters – Stiffness criteria – Dynamic mass balancing – Model experiments – Dimensional similarity – Flutter analysis - Two dimensional thin airfoils in steady incompressible flow – Quasi-steady aerodynamic derivatives – Galerkin method for critical speed – Stability of distributed motion –Torsion flexure flutter – Solution of the flutter determinant – Methods of determining the critical flutter speeds – Flutter prevention and control.

UNIT - V

EXAMPLES OF AEROELASTIC PROBLEMS

Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges.

TEXT BOOKS

1. Fung, Y.C., An introduction to the theory of Aeroelasticity, John Wiley and Sons Inc., New York, 1985.
2. Scanlan, R.H. and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, McGraw Co., N.Y., 1991

REFERENCE BOOKS

1. Bisplinghoff, R.L., Ashley, H., and Halfmann, R.L., Aeroelasticity, Addison Wesley Publishing Co., Inc., II ed, 1987
2. Broadbent, E.G., Elementary theory of Aeroelasticity, BunHill Publication Ltd., 1986

2002-2003

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HYDERABAD

IV Year B. Tech. AE – II Semester

0-0-8

AE4231

PROJECT WORK & SEMINAR