



HINDUSTAN

INSTITUTE OF TECHNOLOGY & SCIENCE

SCHOOL OF AERONAUTICAL SCIENCES

CURRICULUM

(Applicable for Students admitted from Academic Year 2015-16)

CHOICE BASED CREDIT SYSTEM (CBCS)

B. Tech.

AERONAUTICAL ENGINEERING /

AERONAUTICAL ENGINEERING

(WITH SPECIALIZATION IN AVIONICS)

VISION

To make every man a success and no man a failure.

MISSION

- To provide every individual with a good quality of education and to show the way to achieve advancement his/her career goals.
- To impart skills to every individual to acquire knowledge on all spheres of Aeronautical engineering, technology, applied sciences and management as well as ethics.

The **Program outcome** should enable the students to:

1. Acquire an in-depth knowledge required to apply and analyze real life problems.
2. Execute critical thinking, including the ability to develop innovative ideas and come up with practical solutions.
3. Communicate effectively, including the ability to listen, write and interpret.
4. Work collectively and participate effectively in teams.
5. Prepare to engage in lifelong learning and demonstrate proficiency in use of current technologies.
6. Practice personal and professional ethics in all aspects.
7. Demonstrate social, cultural & global competence.

Programme Educational Objectives (PEOs)

The main objectives are to enable students to:

1. Adapt to new technologies in Aeronautical Engineering and cater the needs of the society.
2. Gain knowledge from modern design tools and apply to current technical issues.
3. Encourage an attitude of independent learning and communication skills.
4. Execute multi-disciplinary engineering projects in team.
5. Inculcate lifelong learning to be able to cope with changing technologies.
6. Have high degree of professional ethics and standards.
7. Develop ability to critically analyze and carry out innovative and independent research.

STRUCTURE OF THE B.TECH PROGRAMME

The programme will consist of the following categories of courses:

- General Core Foundation (**CF**) courses
- Compulsory Courses (**CC**)
- Engineering Electives(**EE**)
- Open Electives(**OE**)
- Non-CGPA courses

General Core Foundation (**CF**) courses comprising of:

- English;
- Basic Sciences (BS) including Physics, Chemistry, Mathematics;
- Engineering Sciences (ES), including Basic Engineering courses such as Material Science, Basic Workshop, Engineering Drawing, Engineering

Graphics Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation; etc.

Compulsory Courses (CC) consisting of:

- Professional Core (**PC**), courses introducing the students to the foundation of engineering topics related to the chosen programme of study comprising of theory and Practical/ field work/ Mini project/ Project.
- Professional Electives (**PE**)-are elective programmes enabling the students to take up a group of courses for specialisation/ interest to him/her in his/her programme of study.

Engineering Electives (EE) - Engineering electives are offered by other engineering departments (across disciplines).

Open Electives (OE) - Courses offered by non-Engineering departments (Science & Humanities, Management School) other than communication skills and personality development credit courses etc.).

Non-CGPA courses shall be offered in certain semesters which are compulsory, but not calculated for GPA and CGPA. However, the credits will be mentioned in the grade card.

CURRICULUM STRUCTURE FOR B. TECH. DEGREE PROGRAMMES

Sl. No.	Course Classification	Range of Total Credit (%)	Suggested (out of 180)	
			% of Total Credit	Credit
1	Core Foundation (CF)	20-30	25	45
2	Core Courses (CC)	55-65	60	108
	i) Professional Core (PC)#, Theory	40-60 (30-40)	50 (35)	90 (63)
	Lab/project work	(10-20)	(15)	(27)
	ii) Professional Electives (PE)	8-12	10	18
3	Engineering Electives (EE)	5-10	8	15
4	Open Electives (OE)	5-10	7	12
	Total		100	180

**SEMESTER WISE CREDIT FOR
AERONAUTICAL ENGINEERING /
AERONAUTICAL ENGINEERING (WITH SPECIALIZATION IN
AVIONICS)**

Course Category		I	II	III	IV	V	VI	VII	VIII	Total	Grand Total
CF	English	4	0	1	1	1	-	-	-	7	51
	BS	8	11	4	4	-	1	-	-	28	
	ES	8	5	-	-	-	-	3	-	16	
CC	PC (Theory)	-	7	14	14	15	11	6	-	67	108
	PC (Practical)	-	1	3	3	3	2	5	6 [#]	23	
	PE	-	-	-	-	3	6	9	-	18	
EE		-	-	3	3	3	3	3	-	15	15
OE		-	-	-	3	3	3	3	-	12	12
Total		20	24	25	28	28	26	29	6	186	186

AERONAUTICAL ENGINEERING (WITH SPECIALIZATION IN AVIONICS)

Semester I

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	ELA101	CF	Technical English	3	0	0	3	3
2	MAA101	CF(BS)	Engineering Mathematics– I	3	1	0	4	4
3	PHA101 / CYA101	CF(BS)	Engineering Physics / Engineering Chemistry	3	0	0	3	3
4	CSA101	CF(ES)	Computer Programming	3	0	0	3	4
Practical								
5	MEA101	CF(ES)	Computer Aided Engineering Drawing	1	1	3	3	5
6	PHA131/ CYA131	CF(BS)	Physics LAB/Chemistry LAB	0	0	3	1	3
7	CSA131	CF(ES)	Computer Programming LAB	0	0	3	1	3
8	ELA131	CF	Communication Skills LAB-I	0	0	3	1	3
9	GEA131	CF(ES)	Engineering Practices LAB-I	0	0	3	1	3
Total							20	31

CF: 20 (BS: 8, English: 4, ES: 8); CC: 0; EE: 0; OE: 0; Total: 20

Semester II

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	MAA102	CF(BS)	Engineering Mathematics – II	3	1	0	4	4
2	PHA101/ CYA101	CF(BS)	Engineering Chemistry / Engineering Physics*	3	0	0	3	3
3	EEB122	CF(ES)	Basic Electrical & Electronics Engineering	3	1	0	4	4
4	MEA102	CC(PC)	Engineering Mechanics	3	1	0	4	4
5	AEB101	CC(PC)	Element of Aeronautics	3	0	0	3	3
6	ELA102	CF(BS)	Personality development & Soft skills	3	0	0	3	3
Practical								
7	PHA131/ CYA131	CF(BS)	Physics Lab/Chemistry Lab*	0	0	3	1	3
8	GEA132	CF(ES)	Engineering Practices Lab-II#	0	0	3	1	3
9	EIB146	CC(PC)	Electrical & Electronics Laboratory	0	0	3	1	3
Total							24	28

CF: 16 (BS: 8, English: 4, ES: 5); CC: 8 (PC: 8, PE: 0); EE: 0; OE: 0; Total: 24

Semester III

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	MAA202	CF(BS)	Engineering Mathematics – III	3	1	0	4	4
2	AEB202	CC(PC)	Solid mechanics	3	1	0	4	4
3	AEB203	CC(PC)	Aero Engineering Thermodynamics	3	1	0	4	4
4	AEB204	CC(PC)	Fluid Mechanics and Machinery	3	0	0	3	3
5	AEB205	CC(PC)	Aircraft Materials	3	0	0	3	3
6		EE	Engineering Elective I	3	0	0	3	3
7	SSA231		Aptitude – I	1	0	1	1	2
Practical								
7	AEB211	CC(PC)	Strength of materials lab	0	0	3	1	3
8	AEB212	CC(PC)	Fluid mechanics and machinery lab	0	0	3	1	3
9	AEB213	CC(PC)	Thermodynamics lab	0	0	3	1	3
Total							25	31

CF: 4 (BS: 4, ES: 0); CC: 17 (PC: 17, PE: 0); EE: 3; OE: 0; Total: 25

Engineering Elective Courses (Semester III)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AED201	Aircraft Design	3	0	0	3	3
2	AED202	Elements of Avionics	3	0	0	3	3

Semester IV

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	MAA203	CF(BS)	Numerical Methods	3	1	0	4	4
2	AEB221	CC(PC)	Aerodynamics - I	3	1	0	4	4
3	AEB222	CC(PC)	Aircraft Structures-I	3	1	0	4	4
4	AEB223	CC(PC)	Aircraft Systems and Instrumentation	3	0	0	3	3
5	AEB224	CC(PC)	Mechanics of Machines	3	0	0	3	3
6		EE	Engineering Elective-II	3	0	0	3	3
7		OE	Open Elective-I	3	0	0	3	3
8	SSA232		Aptitude – II	1	0	1	1	2
Practical								
9	AEB230	CC(PC)	Computer Aided Design & Modelling Lab	0	0	3	1	3
10	AEB231	CC(PC)	Aircraft Structures Lab	0	0	3	1	3
11	AEB232	CC(PC)	Aerodynamics Lab	0	0	3	1	3
Total							28	35

CF: 4 (BS: 4, ES: 0); CC: 17 (PC: 17, PE: 0); EE: 3; OE: 3;

Total: 28

Engineering Elective Courses (Semester IV)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AED240	Advanced Materials and their Performance	3	0	0	3	3
2	AED241	Introduction to NDT	3	0	0	3	3

Semester V

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	AEB301	CC(PC)	Propulsion-I	3	1	0	4	4
2	AEB302	CC(PC)	Aerodynamics – II	3	1	0	4	4
3	AEB303	CC(PC)	Aircraft Structures –	3	1	0	4	4
4	AEB304	CC(PC)	CAR - I	3	0	0	3	3
5		CC (PE)	Professional Elective-I	3	0	0	3	3
6		EE	Engineering Elective III	3	0	0	3	3
7		OE	Open Elective II	3	0	0	3	3
8	SSA331		Placement Preparatory Program	1	0	1	1	2
Practical								
9	AEB311	CC (PC)	Propulsion Lab	0	0	3	1	3
10	AEB312	CC (PC)	Aircraft Structures Repair Lab	0	0	3	1	3
11	AEB313	CC (PC)	Design and Drafting	0	0	3	1	3
Total							28	35

CF: 0, CC: 21 (PC: 18, PE: 3), EE: 3, OE: 3 TOTAL: 28

Engineering Elective Courses (Semester V)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AED320	Air Transportation & Aircraft Maintenance	3	0	0	3	3
2	AED321	Computer Integrated Manufacturing	3	0	0	3	3

Professional Elective Courses- PE (Semester V)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
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1	AEC301	Aero Engine Maintenance and Repair	3	0	0	3	3
2	AEC302	Experimental Stress Analysis	3	0	0	3	3
3	AEC303	Measurements & Instrumentation	3	0	0	3	3

Semester VI

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	AEB340	CC(PC)	Flight Dynamics	3	1	0	4	4
2	AEB341	CC(PC)	Propulsion II	3	1	0	4	4
4	AEB342	CC(PC)	Control Engineering	3	0	0	3	3
3		CC(PE)	Professional Elective-II	3	0	0	3	3
4		CC(PE)	Professional Elective-III	3	0	0	3	3
5		EE	Engineering Elective- IV	3	0	0	3	3
6		OE	Open Elective-II	3	0	0	3	3
Practical								
7	AEB350	CC(PC)	Aircraft Design Project-I	0	0	3	1	3
8	AEB351	CC(PC)	Aero Engine Repair And Maintenance Lab	0	0	3	1	3
9	ELA331	CF	Communication Skills & Personality Development	0	0	2	1	1
Total							26	30

CF: 1, CC: 19 (PC: 13, PE: 6), EE: 3, OE: 3 TOTAL: 26

Engineering Elective Courses (Semester VI)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AED350	UAV - OPERATIONAL AND INDUSTRIAL ASPECTS	3	0	0	3	3

2	AED351	Theory of Elasticity	3	0	0	3	3
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Professional Elective Courses- PE (Semester VI)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AEC361	Computational Fluid Dynamics	3	0	0	3	3
2	AEC362	Airframe Maintenance & Repair Practices	3	0	0	3	3
3	AEC363	Heat Transfer	3	0	0	3	3
4	AEC364	Helicopter Maintenance	3	0	0	3	3
5	AEC365	Aircraft Navigation Systems	3	0	0	3	3

Semester – VII

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Theory								
1	AEB401	CC(PC)	Avionics	3	0	0	3	3
2	AEB402	CC(PC)	Composite Materials and Structures	3	0	0	3	3
3		CC(PE)	Professional Elective-IV	3	0	0	3	3
4		CC(PE)	Professional Elective-V	3	0	0	3	3
5		CC (PE)	Professional Elective-VI	3	0	0	3	3
6		EE	Engineering Elective-V	3	0	0	3	3
7		OE	Open Elective-IV	3	0	0	3	3
8		CF	Environmental Science & Engineering	3	0	0	3	3
Practical								
9	AEB410	CC(PC)	Avionics Laboratory	0	0	3	1	3
10	AEB411	CC(PC)	Aircraft Systems Laboratory	0	0	3	1	3
11	AEB412	CC(PC)	Aircraft Design Project-II	0	0	3	1	3
12	AEB413	CC (PC)	Viva-voce	-	-	-	2	-
Total							29	33

CF: 3; CC: 20 (PC: 11, PE: 9); EE: 3; OE: 3;

Total: 29

Engineering Elective Courses (Semester VII)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AED421	Wind Tunnel Techniques	3	0	0	3	3

2	AED422	Vibration and Aero Elasticity	3	0	0	3	3
3	AED423	Fatigue and Fracture Mechanics	3	0	0	3	3

Professional Elective Courses- PE (Semester VII)

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	AEC440	Aircraft General Engineering & Maintenance Practices	3	0	0	3	3
2	AEC441	Finite Element Methods	3	0	0	3	3
3	AEC442	High Temperature Materials	3	0	0	3	3
4	AEC443	Rockets & Missiles	3	0	0	3	3
5	AEC444	Cryogenic Propulsion	3	0	0	3	3
6	AEC445	Airbone radar systems	3	0	0	3	3

Semester - VIII

Sl. No.	Course Code	Course classification	Course Title	L	T	P	C	TCH
Practical								
1	AEB460	PC	Project & Viva-voce	0	0	24	6	24
Total							6	24

CF: 0; CC: 6(PC: 6, PE: 0); EE: 0; OE: 0;

Total: 6

SEMESTER - I

ELA101 TECHNICAL ENGLISH

L	T	P	C
3	0	0	3

GOAL

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

OBJECTIVES

The course should enable the students to:

1. Widen the capacity of the learners to listen to English language at the basic level and understand its meaning.
2. Enable learners to communicate in an intelligible English accent and pronunciation.
3. Assist the learners in reading and grasping a passage in English.
4. Learn the art of writing simple English with correct spelling, grammar and punctuation.
5. Cultivate the ability of the learners to think and indulge in divergent and lateral thoughts.

OUTCOME

The students should be able to:

1. Have the self-confidence to improve upon their informative listening skills by an enhanced acquisition of the English language.

2. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
3. Read, comprehend and answer questions based on literary, scientific and technological texts.
4. Write instructions, recommendations, checklists, process-description, letter-writing and report writing.
5. Have the confidence to develop thinking skills and participate in brainstorming, mind-mapping, audiovisual activities, creative thinking and also answer tests in the job-selection processes.

UNIT I LISTENING SKILL 9

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

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

UNIT II SPEAKING SKILL 9

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

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

UNIT III READING SKILL 9

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

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

UNIT IV WRITING SKILL 9

Writing emails, notes, messages, memos, notices, agendas, advertisements, leaflets, brochures, instructions, recommendations & checklists -- Writing paragraphs --

Comparisons & contrasts Process description of Flow charts - Interpretation of Bar charts & Pie charts - Writing the minutes of a meeting -- Report writing -- Industrial accident reports -- Letter-writing -- Letter to the editors - Letter inviting & accepting or declining the invitation - Placing orders - Complaints -- Letter requesting permission for industrial visits or implant training, enclosing an introduction to the educational institution -- Letters of application for a job, enclosing a CV or Resume - Covering letter.

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

UNIT V THINKING SKILL 9

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

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

REFERENCES

1. Norman Whit by. Business Benchmark: Pre-Intermediate to Intermediate - BEC Preliminary. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).
2. Devaki Reddy & Shreesh Chaudhary. Technical English. New Delhi: Macmillan, 2009.
3. Rutherford, Andrea J. Basic Communication Skills for Technology. 2nd edition. New Delhi: Pearson Education, 2006.

MAA101 ENGINEERING MATHEMATICS- I

L T P C
3 1 0 4

GOAL

To create the awareness and comprehensive knowledge in engineering mathematics.

OBJECTIVES

The course should enable the students to:

1. Find the inverse of the matrix by using Cayley Hamilton Theorem and Diagonalisation of matrix using transformation.
2. Understand the Evolutes and Envelope of the curve.

3. Learn the solutions of second order linear differential equations of standard types and Legendre's linear differential equation.
4. Learn partial differentiations involving two and three variables and expansions of functions using Taylor series.
5. Learn the expansions of trigonometric, hyperbolic functions and their relations.

OUTCOME

The students should be able to:

1. Identify Eigen value problems from practical areas and obtain its solutions and using transformation diagonalising the matrix which would render Eigen values.
2. Find out effectively the geometrical aspects of curvature and appreciates mathematical skills in constructing evolutes and envelopes in mechanics and engineering drawing.
3. Recognize and to model mathematically and solving, the differential equations arising in science and engineering.
4. Understand and model the practical problems and solve it using maxima and minima as elegant applications of partial differentiation.
5. Acquire skills in using trigonometric and hyperbolic and inverse hyperbolic functions.

UNIT I: - MATRICES

12

Review: Basic concepts of matrices-addition, subtraction, multiplication of matrices - adjoint -inverse - solving cubic equations. Characteristic equation - Properties of Eigen values - Eigen values and Eigen vectors - Cayley Hamilton theorem (without proof) - Verification and inverse using Cayley Hamilton theorem. Diagonalization of matrices - Orthogonal matrices - Quadratic form - Reduction of symmetric matrices to a Canonical form using orthogonal transformation - Nature of quadratic form

UNIT II:-DIFFERENTIAL CALCULUS

12

Review: Basic concepts of differentiation - function of function, product and quotient rules. Methods of differentiation of functions - Cartesian form - Parametric form - Curvature - Radius of curvature - Centre of curvature - Circle of curvature. Evolutes of parabola, circle, ellipse, hyperbola and cycloid - Envelope.

UNIT III: - ORDINARY DIFFERENTIAL EQUATIONS

12

Review: Definition, formation and solutions of differential equations. Second order differential equations with constant coefficients - Particular integrals - $e^{ax}\cos bx$, $e^{ax}\sin bx$. Euler's homogeneous linear differential equations - Legendre's linear differential equation Variation of parameters.

UNIT IV: - PARTIAL DIFFERENTIATION

12

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

UNIT V: - TRIGONOMETRY

12

Review: Basic results in trigonometry and complex numbers - De Moivre's theorem.

Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ where n is a positive integer. Expansions of $\sin^{-1} x$ in terms of sines and cosines of multiples of θ where m and n are positive integers. Hyperbolic and inverse hyperbolic functions - Logarithms of complex numbers - Separation of complex functions into real and imaginary parts - Simple problems.

Note: Questions need not be asked from review part.

TOTAL: 60

TEXT BOOKS

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

REFERENCES

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

PHA101

ENGINEERING PHYSICS

L T P C

3 0 0 3

GOAL

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

OBJECTIVES

The course should enable the students to:

1. Develop strong fundamentals of properties and behaviour of the materials
2. Enhance theoretical and modern technological aspects in acoustics and ultrasonic.

3. Enable the students to correlate the theoretical principles with application oriented study of optics.
4. Provide a strong foundation in the understanding of solids and materials testing.
5. Enrich the knowledge of students in modern engineering materials.

OUTCOME

The students should be able to:

1. Understand the properties and behaviour of materials.
2. Have a fundamental knowledge of acoustics which would facilitate in acoustical design of buildings and on ultrasonic and be able to employ it as an engineering tool.
3. Understand the concept, working and application of lasers and fiber optics.
4. Know the fundamentals of crystal physics and non-destructive testing methods.
5. Have an understanding of the production, characteristics and application of the new engineering materials. This would aid them in the material selection stage.

UNIT I:- PROPERTIES OF MATTER

9

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

UNIT II:-ACOUSTICS AND ULTRASONICS

9

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

UNIT III:- LASER AND FIBER OPTICS

9

Principle of lasers - Stimulated absorption - Spontaneous emission, stimulated emission - population inversion - pumping action - active medium - laser characteristics - Nd-Yag laser - CO₂ laser Semiconductor laser - applications - optical fiber - principle and propagation of light in optical fibers Numerical aperture and acceptance angle - types of optical fibers - single and multimode, step index and graded index fibers - applications - fiber optic communication system.

UNIT IV:- CRYSTAL PHYSICS AND NON- DESTRUCTIVE TESTING 9

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

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

UNIT V:-MODERN ENGINEERING MATERIALS AND SUPERCONDUCTING MATERIALS 9

Modern Engineering Materials: Metallic glasses: Preparation properties and applications.

Shape memory alloys (SMA): Characteristics, applications, advantages and disadvantages of SMA. Nano Materials: Synthesis -Properties and applications.

Superconducting Materials: Superconducting phenomena - Properties of superconductors - Meissner effect - Type I and Type II Superconductors - High T_c superconductors (qualitative) - uses of superconductors.

TOTAL = 45

TEXT BOOKS

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

REFERENCES

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

CYA101

ENGINEERING CHEMISTRY

L T P C

3 0 0 3

To impart basic principles of chemistry for engineers.

OBJECTIVES

The course should enable the students to

1. Make the students conversant with the basics of
(a) Water technology and (b) Polymer science
2. Provide knowledge on the requirements and properties of a few important engineering materials.
3. Educate the students on the fundamentals of corrosion and its control.

4. Give a sound knowledge on the basics of a few significant terminologies and concepts in thermodynamics.
5. Create an awareness among the present generation about the various conventional energy sources.

OUTCOME

The students should be able to

1. Gain basic knowledge in water analysis and suitable water treatment method.
2. Get an idea on the type of polymers to be used in engineering applications.
3. Get awareness about new materials
4. Get knowledge on the effects of corrosion and protection methods will help the young minds to choose proper metal / alloys and also to create a design that has good corrosion control.
5. Get exposure on the important aspects of basic thermodynamics will be able to understand the advanced level thermodynamics in engineering applications.
6. Get a good background on the various aspects of energy sources will create awareness on the need to utilize the fuel sources effectively and also for exploring new alternate energy resources.

UNIT I: - WATER TECHNOLOGY AND POLYMER CHEMISTRY 9

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

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

UNIT II:- ENGINEERING MATERIALS 9

Properties of Alloys - Heat Treatment of Steel - Polymer Composites - types and applications. Lubricants - Classification, properties and applications - Mechanism of Lubrication - MoS₂ And Graphite - Adhesives - classification and properties - Epoxy resin (Preparation, properties and applications) - Refractories - Classification, Properties and General Manufacture - Abrasives Classification , Properties and Uses - Carbon nano tubes - preparation, properties and applications.

UNIT III:-ELECTROCHEMISTRY AND CORROSION 9

Conductometric Titration - HCl vs NaOH and mixture of acids vs NaOH - Electrochemical Series and its applications - Nernst Equation - problems - Polarization, Decomposition Potential, Over-voltage (definitions only) - Galvanic series - Corrosion (Definition, Examples, effects) - Mechanism of Dry Corrosion and Wet Corrosion -

Differential aeration Corrosion , examples - Factors Influencing Corrosion - Metal and Environment - Corrosion Control - Design -Cathodic Protection methods - Protective Coatings - Galvanising - Anodising - Electroplating (Cu and Ni) and Electrodeless plating (Cu and Ni) Constituents of Paints and varnish.

UNIT IV:- CHEMICAL THERMODYNAMICS

9

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

UNIT V: - FUELS AND ENERGY SOURCES

9

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

L=45 TOTAL = 45

TEXT BOOKS

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

REFERENCES

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

CSA101

COMPUTER PROGRAMMING L T P C

3 0 0 3

GOAL

To introduce computers and programming and to produce an awareness of the power of computational techniques that are currently used by engineers and scientists and to develop programming skills to a level such that problems of reasonable complexity can be tackled successfully.

OBJECTIVES

The course should enable the students to:

1. Learn the major components of a Computer system.
2. Learn the problem solving techniques.
3. Develop skills in programming using C language.

OUTCOMES

The student should be able to:

1. Understand the interaction between different components of Computer system and number system.
2. Devise computational strategies for developing applications.
3. Develop applications (Simple to Complex) using C programming language.

UNIT I: - COMPUTER FUNDAMENTALS

9

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

UNIT II: - COMPUTER PROGRAMMING AND LANGUAGES

9

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

UNIT III: - PROGRAMMING WITH C

9

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

UNIT IV: - FUNCTIONS, ARRAYS AND STRINGS

9

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

UNIT V:-POINTERS, STRUCTURES AND UNION

9

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

TOTAL = 45

TEXT BOOK

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

REFERENCES

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

MEA101 COMPUTER AIDED ENGINEERING DRAWING

L T P C

2 0 2 3

GOAL

To develop graphical skills for communicating concepts, ideas and designs of engineering products and to give exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice.

OBJECTIVES

The course should enable the students to

1. Introduce drawing standards and use of drawing instruments.
2. Introduce first angle projection.
3. Practice of engineering hand sketching and introduce to computer aided drafting
4. Familiarize the students with different type of pictorial projections.
5. Introduction to Solid modeling
6. Introduce the process of design from sketching to parametric 3D CAD and 2D orthographic drawings to BIS

OUTCOME

The students should be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact

Note: Only first angle projection is to be followed

UNIT I:-BASICS OF ENGINEERING GRAPHICS AND PLANE CURVES 12

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

Drafting methods - introduction to Computer Aided Drafting – Computer Hardware – Workstation – Printer and Plotter – Introduction to software for Computer Aided Design and Drafting – Exposure to Solid Modeling software – Geometrical Construction-Coordinate Systems/Basic Entities

UNIT II:-VISUALIZATION, ORTHOGRAPHIC PROJECTIONS AND FREE HAND SKETCHING 15

Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Pictorial Projection methods - Layout of views- Free hand sketching of multiple views from pictorial views of objects. Drafting of simple Geometric Objects/Editing

General principles of presentation of technical drawings as per BIS - Introduction to Orthographic projections - Naming views as per BIS - First angle projection method. Conversion to orthographic views from given pictorial views of objects, including dimensioning – Drafting of Orthographic views from Pictorial views.

UNIT III: - PROJECTIONS OF POINTS, LINES, SURFACES AND SOLIDS 18

Introduction to Projections of points – Projections of straight lines located in first quadrant using rotating line method only – Projections of plane surfaces when the surface of the lamina is inclined to one reference plane only – Projections of simple solids when the axis of the solid is inclined to one reference plane only – Sectioning of above solids in simple positions – Section Views. Practice includes drafting the projection of lines and solids using appropriate software. 2D drawing commands: Zoom, Picture editing commands, Dimensioning and 2D drafting.

UNIT IV: - GEOMETRICAL MODELING AND ISOMETRIC VIEWS 15

Solid Modeling – Types of modeling - Wire frame model, Surface Model and Solid Model – Introduction to graphic software for solid modeling. Principles of isometric projection and solid modeling. Isometric drawing – Iso Planes and 3D Modeling commands. Projections of Principal Views from 3-D Models

UNIT V:- COMPUTER AIDED DESIGN AND DRAFTING 15

Preparation of solids of machine components like slide block, solid bearing block,

bushed bearing, gland, wall bracket, guide bracket, shaft bracket, jig plate, shaft support (open type), vertical shaft support etc. using appropriate modeling software.

Introduction to computer aided drafting and dimensioning using appropriate software. Generate 2D drawing from the 3D models – generate and develop the lateral surfaces of the objects. Presentation Techniques of Engineering Drawings – Title Blocks – Printing/Plotting of drawing.

TOTAL = 75

TEXT BOOKS

1. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd., New Delhi, 2010.
2. Warren J. Luzadder and Jon. M.Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., Eleventh Edition, 2003.

REFERENCES:

1. Introduction to AutoCAD – 2D and 3D Design, A.Yarmwood, Newnes Elsevier, 2011
2. Engineering Drawing and Graphic Technology-International Edition, Thomas E. French, Charles J. Vierck, Robert J. Foster, McGraw-Hill, 1993
3. Engineering Drawing and Design-Sixth Edition, C. Jensen, J.D. Hesel, D.R. Short, McGraw-Hill, 2002
4. Technical Drawing-Fourteenth Edition, F. E. Giesecke, A. Mitchell, H. C. Spencer, I.L. Hill, J.T. Dygdon, J.E., Novak, Prentice-Hall, 2012,
5. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2007.
6. Mechanical Engineering Drawing-Self Taught, Jashua Rose, <http://www.gutenberg.org/files/23319/23319-h/23319-h.htm>

Bureau of Indian Standards (BIS) for Engineering Drawing:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.

**PHA131 PHYSICS LABORATORY
(COMMON TO ALL BRANCHES)**

L	T	P	C
0	0	3	1

S. No.	List of Experiments
1	Torsional Pendulum - Determination of rigidity modulus of the material of a wire.
2	Non Uniform Bending - Determination of Young's Modulus.
3	Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.
4	Lee's Disc - Determination of thermal conductivity of a bad conductor.
5	Air Wedge - Determination of thickness of a thin wire.
6	Spectrometer - Refractive index of a prism.
7	Semiconductor laser - Determination of wavelength of Laser using Grating.

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 30 STUDENTS

1	Torsional Pendulum	(500 gm, wt, 60 cm wire Al-Ni Alloy)	5 nos.
2	Travelling Microscope	(X10)	15 nos.
3	Capillary tube	(length 10cm, dia 0.05mm)	5 nos.
4	Magnifying lens	(X 10)	15 nos.
5	Lee's disc apparatus	(std form)	5 nos.
6	Stop watch	(+/- 1 s)	5 nos.
7	Meter scale	1m length	5 nos.
8	Spectrometer	(main scale 360 deg, ver 30")	5 nos.
9	Grating	(2500 LPI)	5 nos.
10	Laser	(632.8 nm)	5 nos.
11	Semi-transparent glass plate	Al coating, 65 nm thickness, 50% visibility	5 nos.
12	Equilateral prism	(n = 1.54)	5 nos.
13	Thermometer	+/- 1 deg	8 nos.
14	Screw gauge	(+/- 0.001cm)	12 nos.
15	Vernier calliper	(+/- 0.01 cm)	8 nos.
16	Steam Boiler	1 L	5 nos.
17	Scale	50 cms	5 nos.
18	Cylindrical mass	100 gms	10 sets
19	Slotted wt	300 gms	5 sets
20	Heater	1.5 KW	5 nos.

21	Transformer sodium vapour lamp	1 KW	10 nos.
22	Sodium vapour lamp	700 W	5 nos
23	Burette	50 mL	5 nos
24	Beaker	250 mL	5 nos
25	Spirit level		10 nos

REFERENCE:

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

CYA131 CHEMISTRY LABORATORY

**L T P C
0 0 3 1**

S. No.	List of Experiments
1	Estimation of Commercial soda by acid-base titration
2	Determination of Percentage of nickel in an alloy
3	Determination of Temporary, permanent and total hardness of water by EDTA method
4	Determination of Chloride content in a water sample
5	Potentiometric Estimation of iron
6	Conductometric Titration of a strong acid with a strong base
7	Conductometric Titration of mixture of acids.
8	Determination of Degree of polymerization of a polymer by Viscometry

List of Glassware and Equipment's required for a batch of 30 students

1	Burette	(50 mL)	30 nos
2	Pipette	(20 mL)	30 nos.
3	Conical Flask	(250 mL)	30 nos
4	Distilled water bottle	(1 L)	30 nos
5	Standard flask	(100 mL)	30 nos
6	Funnel	(small)	30 nos
7	Glass rod	20 cm length	30 nos

8	Reagent Bottle	(250 mL)	30 nos.
9	Reagent Bottle	(60 mL)	30 nos
10	Beaker	(100 mL)	30 nos
11.	Oswald Viscometer	Glass	30 nos
12.	Measuring Cylinder	(25 mL)	30 nos
13.	Digital Conductivity Meter	PICO make	8 nos
14.	Conductivity cell	(K=1)	12 nos
15.	Digital Potentiometer	PICO make	8 os
16.	Calomel Electrode	Glass	12 nos
17.	Platinum Electrode	Polypropylene	12 nos
18.	Burette Stands	Wooden	30 nos
19.	Pipette stands	Wooden	30 nos
20.	Retard stands	Metal	30 nos
21.	Porcelain Tiles	White	30 nos
22.	Clamps with Boss heads	Metal	30 nos

REFERENCES

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

CSA131 COMPUTER PROGRAMMING LABORATORY

L T P C

0 0 3 1

(Common to all branches)

GOAL

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

OBJECTIVES

The course should enable the students to:

1. To gain knowledge about Microsoft office, Spread Sheet.
2. To learn a programming concept in C.

OUTCOME

The students should be able to

1. Use MS Word to create document, table, text formatting and Mail merge options.
2. Use Excel for small calculations using formula editor, creating different types of charts and including pictures etc.
3. Write and execute the C programs for small applications.

LIST OF EXPERIMENTS

a) Word Processing	12
1. Document creation, Text manipulation with Scientific notations.	
2. Table creation, Table formatting and Conversion.	
3. Mail merge and Letter preparation.	
4. Drawing- flow Chart	
b) Spread Sheet	9
5. Chart - Line, XY, Bar and Pie.	
6. Formula - formula editor.	
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document	
c) Programming in C	24
8. To write a C program to prepare the electricity bill.	
9. Functions	
(a) Call by value (b) Call by reference.	
10. To write a C program to print the Fibonacci series for the given number.	
11. To write a C program to find the factorial of number using recursion.	
12. To write a C program to implement the basic arithmetic operations using Switch Case statement.	
13. To write a C program to check whether the given number is an Armstrong number.	
14. To write a C program to check whether the given string is a Palindrome.	
15. To write a C program to create students details using Structures.	
16. To write a C program to demonstrate the Command Line Arguments.	
17. To write a C program to implement the Random Access in Files.	
18. To write C programs to solve some of the Engineering applications	
	TOTAL: 45

HARDWARE/SOFTWARE REQUIRED FOR BATCH OF 30 STUDENTS

HARDWARE

LAN system with 33 nodes (OR) Standalone PCs - 33 Nos

Printers - 3 Nos

SOFTWARE

OS - Windows / UNIX

Application package - MS office

Software - C language

ELA131 COMMUNICATION SKILLS LABORATORY- 1

L T P C

0 0 3 1

Goal

The goal of the programme is to provide a practical input towards nurturing accomplished learners who can function effectively in the English language skills.

OBJECTIVES

The course should enable the students to

1. Extend the ability of the learners to be able to listen to English and comprehend its message.
2. Enable the learners to have a functional knowledge of spoken English.
3. Assist the learners to read and grasp the meaning of technical and non-technical passages in English.
4. Help the learners develop the art of writing without mistakes.
5. Expand the thinking capability of the learners so that they would learn how to view things from a different angle.

OUTCOME

The students should be able to

1. Listen to and evaluate English without difficulty and comprehend its message.
2. Develop a functional knowledge of spoken English so as to use it in the institution and at job interviews.
3. Read and comprehend the meaning of technical and non-technical passages in English.
4. Develop the art of writing so as to put down their thoughts and feelings in words.
5. Think independently and contribute creative ideas.

UNIT I LISTENING SKILL

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

UNIT II SPEAKING SKILL

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

UNIT III READING SKILL

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

UNIT IV WRITING SKILL

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

UNIT V THINKING SKILL

Practice in preparing thinking blocks to decode diagrammatical representations into English words, expressions, idioms and proverbs - Inculcating interest in English using thinking blocks. Making pictures and improvising diagrams to form English words, phrases and proverbs -- Picture reading

REFERENCES

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

Websites for learning English

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

GEA131 ENGINEERING PRACTICE LABORATORY - I (Common to all branches)

**L T P C
0 0 3 1**

GOAL

To provide the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

OBJECTIVES

The course should enable the students to

1. Relate theory and practice of basic Civil and Mechanical Engineering
2. Learn concepts of welding and machining practice
3. Learn concepts of plumbing and carpentry practice

OUTCOMES

The students should be able to

1. Identify and use of tools, Types of joints used in welding, carpentry and plumbing operations.
2. Have hands on experience on basic fabrication techniques such as carpentry and plumbing practices.
3. Have hands on experience on basic fabrication techniques of different types of welding and basic machining practices.

LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING PRACTICE

15

1. Welding
Arc welding: Butt joints, Tee and lap joints.
2. Basic Machining
Facing, turning, threading and drilling practices using lathe and drilling operation with vertical drilling machine.
3. Machine assembly practice
Study of centrifugal pump
4. Study on
 - a. Smithy operations - Productions of hexagonal headed bolt.
 - b. Foundry operations - Mould preparation for gear and step cone pulley.

II. CIVIL ENGINEERING

12

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

TOTAL =45

REFERENCE:

1. Jeyapooan T and Saravanapandian M., Engineering practices lab manual, 4th Edition, Vikas publishing House, New Delhi, 2010.

List equipment and components

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools:
 - (a) Rotary Hammer 2 Nos
 - (b) Demolition Hammer 2 Nos
 - (c) Circular Saw 2 Nos
 - (d) Planer 2 Nos
 - (e) Hand Drilling Machine 2 Nos
 - (f) Jigsaw 2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner One each.

SEMESTER-II

MAA102

ENGINEERING MATHEMATICS – II
(Common to All Branches)

L T P C
2 1 1 4

GOAL

The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subject using MATLAB.

OBJECTIVES

1. To understand effectively the evaluation of double and triple integrals and their applications
2. To know the basics of vector calculus comprising of gradient, divergence, curl, line surface and volume integrals along with the classical theorems involving them
3. To have a sound knowledge of Laplace transform and its properties. Solutions of Laplace transform using MATLAB.
4. To understand and expand periodic functions as Fourier series using MATLAB.

OUTCOME

1. To understand effectively the evaluation of double and triple integrals and their applications
2. To know the basics of vector calculus comprising of gradient, divergence, curl, line surface and volume integrals along with the classical theorems involving them
3. To have a sound knowledge of Laplace transform and its properties. Solutions of Laplace transform using MATLAB.
4. To understand and expand periodic functions as Fourier series using MATLAB

UNIT I MULTIPLE INTEGRALS

12(8+4)

Double integration – Cartesian and polar co-ordinates – Change of order of integration. Area as a double integral – Triple integration in Cartesian coordinates – Volume as a triple integral - Change of variables between Cartesian and polar coordinates.

Lab: Area and Volume of double integration and triple integration.

UNIT II VECTOR CALCULUS 12(8+4)

Gradient, Divergence and Curl – Unit normal vector, Directional derivative – angle between surfaces-Irrotational and solenoidal vector fields.

Green's theorem - Gauss divergence theorem and Stoke's theorem (without proof) – Verification and evaluation of the above theorems - Simple applications to regions such as square, rectangle, triangle, cuboids and rectangular parallelepipeds.

Lab: Green's theorem - Gauss divergence theorem and Stoke's theorem

UNIT III LAPLACE TRANSFORM 12(8+4)

Laplace transform – Conditions of existence – Transform of elementary functions – properties - Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of periodic functions. Inverse Laplace transforms using partial fraction and convolution theorem. Solution of linear ODE of second order with constant coefficients.

Lab: Solutions of differential equations using Laplace transform

UNIT IV FOURIER SERIES 12(8+4)

Dirichlet's Conditions – General Fourier Series – Odd and even functions – Half range sine and cosine series –Harmonic Analysis.

Lab: Solutions of Fourier series and Harmonic Analysis.

UNIT V COMPLEX VARIABLES 12(8+4)

Functions of a complex variable – Analytic function - Cauchy - Riemann equations (Statement only) – Properties of analytic function (Statement only) – Construction of Analytic functions by Milne – Thomson method.

Lab: Cauchy - Riemann equations, Milne – Thomson method

TOTAL: 60

TEXT BOOK:

1. Venkatraman M.K, Mathematics, Volume – II & Volume -III, National Publishing Company, Chennai, 1985.

REFERENCE:

1. Kandasamy P, Engineering Mathematics Volume II, S. Chand & Co., New Delhi, 1987.
2. Grewal B.S, "Engineering Maths – II", Sultan Chand, New Delhi, 1993.
3. Bali N.P, Manish Goyal, Text book of Engineering Mathematics, 3rd Edition, Lakshmi Publications, 2003.
4. Chandrasekaran A, Engineering Mathematics, Volume – II, Dhanam Publication, 2008.

EEB122 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L T P C

1. To explain basic laws, circuits, principles and theories of electrical instruments like ammeter, voltmeter etc
2. To enable the learners about principle and applications of major electrical equipments like generators, motors, transformers etc.
3. To enable the learners about the concept of semiconducting and device like diodes, rectifiers and transistors.
4. To enable the learners to understand about binary number system, logic gates and other electronic devices.
5. To enable learners about the fundamentals of communication systems and signals

3 1 0 4

1. The learners will be able to understand the basic concepts of electrical circuits and measurements
2. The learners can understand the mechanism of electrical equipments and basic equations to calculate their performance.
3. The learners can understand about the semiconducting devices, its circuits and applications
4. The learners can understand about binary number system, counters and its usage.
5. The learners can understand about basic concepts of communication system and working of various basic communication equipment's like radio, television, fax and the basic principle of satellites

Goal

To impart basic principles of electrical circuits and its applications. To understand about digital electronics, its devices and application in aerospace industry.

OBJECTIVES

OUTCOME

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS

12

Ohm's Law – Kirchhoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS

12

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS

12

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V: FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL HOURS: 60

TEXT BOOKS:

1. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).

2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press (2005).
3. Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, (2002).
5. Premkumar N, “Basic Electrical Engineering”, Anuradha Publications

MEA102 ENGINEERING MECHANICS L T P C

3 1 0 4

OBJECTIVES

The course should enable the students to:

- 1) The course should enable the student to :
- 2) Understand the Basics & Statics of particles
- 3) Study the Equilibrium of rigid bodies and resolution of forces
- 4) Understand the basics of properties of surfaces & solids
- 5) Study the Dynamics of particles
- 6) Study the friction and elements of rigid body dynamics

OUTCOME

The students should be able to:

- 1) The Vectorial representation of forces, Moment & principle of transmissibility
- 2) The types of supports & Reactions and Equilibrium of Rigid bodies in two & Three dimensions
- 3) First moment of area and the Centroid of various shapes & sections
- 4) The Relative motion particles and Impact of elastic bodies
- 5) The frictional force & types of friction and Translation and Rotation of Rigid Bodies

UNIT I BASICS & STATICS OF PARTICLES

12

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

UNIT II EQUILIBRIUM OF RIGID BODIES

12

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

UNIT III PROPERTIES OF SURFACES AND SOLIDS

12

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

UNIT IV DYNAMICS OF PARTICLES

12

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

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

12

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

TOTAL: 60

TEXT BOOK

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

REFERENCES

Rajasekaran, S, Sankarasubramanian, G., “*Fundamentals of Engineering Mechanics*”, Vikas Publishing House Pvt. Ltd., (2000).

Hibbeler, R.C., “*Engineering Mechanics*”, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).

Palanichamy, M.S., Nagam, S., “*Engineering Mechanics – Statics & Dynamics*”, Tata McGraw-Hill, (2001).

AEB101 ELEMENTS OF AERONAUTICS

L T P C
3 0 0 3

GOAL

To introduce the basic concepts of aerospace engineering and the current developments in the field.

OBJECTIVES

The course should enable the student to:

1. Understand the Historical evaluation of Airplanes
2. Study the different component systems and functions
3. Understand the basic properties and principles behind the flight
4. Study the different structures & construction
5. Study the various types of power plants used in aircrafts

OUTCOME

The student should be able to understand:

1. The history of aircraft & developments over the years
2. The types & classifications of components and control systems
3. The basic concepts of flight & Physical properties of Atmosphere
4. The types of fuselage and constructions and Landing gear systems
5. Different types of Engines and principles of Rocket

UNIT I- HISTORICAL EVALUATION

8

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

UNIT II- AIRCRAFT CONFIGURATIONS

5

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

UNIT III - INTRODUCTION TO PRINCIPLES OF FLIGHT 10

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

UNIT IV - INTRODUCTION TO AIRPLANE STRUCTURES 12

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

UNIT V - POWER PLANTS USED IN AIRPLANES 10

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

Total 45

TEXT BOOKS

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

REFERENCE

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

ELA102 Personality Development and Soft Skills

**L T P C
2 0 2 3**

GOAL

- To enhance holistic development of students and improve their employability skills.
- To nurture the language skills and cultivate in them the ability to indulge in rational thinking, independent decision-making and lifelong learning
- To help them become responsible members or leaders of the society in and around their workplace or living space
- to communicate successfully at the individual or group level on engineering activities with the engineering community in particular, and on multi-disciplinary activities in general, with the world at large.

OBJECTIVES

The course should enable the students to

1. Develop inter personal skills and be an effective goal oriented team player.
2. Develop professionals with idealistic, practical and moral values.
3. Develop communication and problem solving skills.
4. To face the challenges in the world and enable the students excel in the world of work and life.

OUTCOME

The students should be able to:

1. Develop self-confidence to improve upon their informative listening skills by an enhanced acquisition of the English language.
2. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
3. Read, comprehend and answer questions based on literary, scientific and technological texts.
3. Think creatively and participate in mind-mapping, audiovisual activities, brain storming, and creative thinking and also answer tests in the job-selection processes.
4. Make right decisions, communicate effectively, and develop self-management talents, to lead a healthy and productive life.
5. Imbibe the requisite employability skills, learned skills, intuitive skills and people skills

UNIT I SPEAKING SKILLS

9 hours

Art of Speaking- Body Language and speaking- Non Verbal communication- -Vocal Communication Techniques- Intercultural communication- The difference in Approach in five countries- Vocabulary Enrichment- Pronunciation of words-Mark the stress on appropriate syllable-split the word into syllables- Speaking as an Art-Simple Oral Interaction-Body Language and Speaking- Five characteristics of an ideal GD- group discussions - role plays- short speeches-Extempore – JAM –Debate-Talk shows-Power point presentation and speaking

UNIT II LANGUAGE SKILLS

13 hours

Functional Grammar: Synonyms and Antonyms – Active and Passive Voice- Direct and Indirect Speech- Conditional Clauses- collocations- rearrange the jumbled sentences and make meaningful sentences- Language functions: apologising, greeting, clarifying, inviting, advising, agreeing, disagreeing, refusing, thanking, interrupting, expressing obligation, expressing preferences, CV / application letters- Job interviews-FAQ's – e-mail etiquette

UNIT III PEOPLE SKILLS/SOFT SKILLS

8 hours

SWOT analysis- JOHARI window- Goal setting- speaking on Goals - goals to be achieved- modes of behavior to achieve the goals- decision making- time management - stress management- power of positive attitude

UNIT IV COMPREHENSION SKILLS

7 hours

Art of Listening- listening to English news- listening to debates on current issues - Listening to dialogues for general meaning and specific information- listening to toast master speeches- cloze exercises-open comprehension questions-Art of Listening- Reading passages –interpreting in own words- reading articles in magazines/journals/newspapers- writing articles for newspaper-reporting events-completing the middle/end of a story.

UNIT V PERSONALITY DEVELOPMENT

9 hours

Define Personality- Types of Personality-Personality test- Leadership Skills - Interpersonal Skills- Team Work - Mind Mapping- concept maps- Study skills and techniques - Edward De Bono's lateral thinking-exercises-questionnaires-project

TEXT BOOK:

English for Life and the workplace through LSRW&T skills by Dr. Dolly John, Pearson Publications

REFERENCES

1. Education and Personality Development, Dr. P.K. Manoharan, APH Publishing Corporation.
2. Effective technical Communication, M. Ashraf Rizvi, Tata McGraw Hill Companies
3. Professional Speaking Skills, Aruna Koneru, Oxford University Press
4. Essential Grammar in Use, Fourth Edition by Raymond Murphy, Cambridge University Press
5. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.
6. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.

Web links for reference for Flipped classroom sessions

1. <https://owl.english.purdue.edu/exercises/28/12/33>
2. http://englishplaza.vn/flexpaper/pdf/english-collocations-in-use_1405952201.pdf
3. <http://www.htsb.org/wp-content/uploads/2014/07/Academic-Language-Functions-toolkit.pdf>
4. <http://www.intelligencetest.com/puzzles/lateral.htm>
5. http://www.teachingenglish.org.uk/sites/teacheng/files/mind_map.pdf
6. <http://www.teachingenglish.org.uk/article/using-mind-maps-develop-writing>.
7. <http://www.teachingenglish.org.uk/article/jigsaw-readingArrange>

8. <http://www.teachthought.com/critical-thinking/10-team-building-games-that-promote-critical-thinking>
9. http://www.myenglishpages.com/site_php_files/grammar-exercise-conditionals.php
10. <http://flax.nzdl.org/greenstone3/flax?a=fp&sa=collActivity&c=copyrightlaw>
11. <http://www.humanmetrics.com/personality/type>

**PHA131 PHYSICS LABORATORY
(COMMON TO ALL BRANCHES)**

**L T P C
0 0 3 1**

S. No.	List of Experiments
1	Torsional Pendulum - Determination of rigidity modulus of the material of a wire.
2	Non Uniform Bending - Determination of Young's Modulus.
3	Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.
4	Lee's Disc - Determination of thermal conductivity of a bad conductor.
5	Air Wedge - Determination of thickness of a thin wire.
6	Spectrometer - Refractive index of a prism.
7	Semiconductor laser - Determination of wavelength of Laser using Grating.

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 30 STUDENTS

1	Torsional Pendulum	(500 gm, wt, 60 cm wire Al-Ni Alloy)	5 nos.
2	Travelling Microscope	(X10)	15 nos.
3	Capillary tube	(length 10cm, dia 0.05mm)	5 nos.
4	Magnifying lens	(X 10)	15 nos.
5	Lee's disc apparatus	(std form)	5 nos.
6	Stop watch	(+/- 1 s)	5 nos.
7	Meter scale	1m length	5 nos.
8	Spectrometer	(main scale 360 deg, ver 30")	5 nos.
9	Grating	(2500 LPI)	5 nos.
10	Laser	(632.8 nm)	5 nos.

11	Semi-transparent glass plate	Al coating, 65 nm thickness, 50% visibility	5 nos.
12	Equilateral prism	(n = 1.54)	5 nos.
13	Thermometer	+/- 1 deg	8 nos.
14	Screw gauge	(+/- 0.001cm)	12 nos.
15	Vernier calliper	(+/- 0.01 cm)	8 nos.
16	Steam Boiler	1 L	5 nos.
17	Scale	50 cms	5 nos.
18	Cylindrical mass	100 gms	10 sets
19	Slotted wt	300 gms	5 sets
20	Heater	1.5 KW	5 nos.
21	Transformer sodium vapour lamp	1 KW	10 nos.
22	Sodium vapour lamp	700 W	5 nos
23	Burette	50 mL	5 nos
24	Beaker	250 mL	5 nos
25	Spirit level		10 nos

REFERENCE:

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

CYA131 CHEMISTRY LABORATORY

L T P C

0 0 3 1

S. No.	List of Experiments
1	Estimation of Commercial soda by acid-base titration
2	Determination of Percentage of nickel in an alloy
3	Determination of Temporary, permanent and total hardness of water by EDTA method
4	Determination of Chloride content in a water sample
5	Potentiometric Estimation of iron
6	Conductometric Titration of a strong acid with a strong base

7	Conductometric Titration of mixture of acids.
8	Determination of Degree of polymerization of a polymer by Viscometry

List of Glassware and Equipment's required for a batch of 30 students

1	Burette	(50 mL)	30 nos
2	Pipette	(20 mL)	30 nos.
3	Conical Flask	(250 mL)	30 nos
4	Distilled water bottle	(1 L)	30 nos
5	Standard flask	(100 mL)	30 nos
6	Funnel	(small)	30 nos
7	Glass rod	20 cm length	30 nos
8	Reagent Bottle	(250 mL)	30 nos.
9	Reagent Bottle	(60 mL)	30 nos
10	Beaker	(100 mL)	30 nos
11.	Oswald Viscometer	Glass	30 nos
12.	Measuring Cylinder	(25 mL)	30 nos
13.	Digital Conductivity Meter	PICO make	8 nos
14.	Conductivity cell	(K=1)	12 nos
15.	Digital Potentiometer	PICO make	8 os
16.	Calomel Electrode	Glass	12 nos
17.	Platinum Electrode	Polypropylene	12 nos
18.	Burette Stands	Wooden	30 nos
19.	Pipette stands	Wooden	30 nos
20.	Retard stands	Metal	30 nos
21.	Porcelain Tiles	White	30 os
22.	Clamps with Boss heads	Metal	30 nos

REFERENCES

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

GEA132 ENGINEERING PRACTICES LABORATORY II

L T P C
0 0 3 1

LIST OF EXPERIMENTS

1. Electrical Engineering

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

2. Electronics Engineering

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

Total = 30

Text Book:

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

EIB146 ELECTRICAL & ELECTRONICS LAB

**L T P C
0 0 3 1**

Goal

To provide practical knowledge in Electronic Devices. To provide practical knowledge in Electric Circuits and various measurement methods for different electronic instruments.

Objectives

The course will enable the student to

- (i) Determine the device parameters of P-N junction diode and to study the characteristics of BJT, FET.
- (ii) Work with basic LED, LCD and other photo electronics devices.
- (iii) Encompass a clear knowledge of the basic theorems in Electric Circuits
- (iv) Know the analysis methods in series and parallel resonance circuits.
- (v) Understand the transient response of RL and RC circuits.

Outcome

At the end of the course student should be able to

- (i) Outline the static characteristics of P-N junction diode, Zener diode, BJT& FET
- (ii) Design signal conditioning circuits.
- (iii) Design circuits by applying various network theorems.
- (iv) Examine the frequency response analysis of series and parallel resonance circuits
- (v) Generate the transient response analysis of RL and RC circuits.

LIST OF EXPERIMENTS

1. Static characteristics of transistor under CE, CB, CC and determination of hybrid parameters
2. Static characteristics and parameter determination of JFET
3. Static characteristics of semiconductor diode, zener diode and study of simple voltage regulator circuits
4. Static characteristics of UJT and its application as a relaxation oscillator
5. Fixed and self-biasing of BJT & FET
6. Photodiode, Phototransistor characteristics and study of light activated relay circuit
7. Single phase half wave and full wave rectifiers with inductive and capacitive filters
8. Differential amplifiers using FET
9. Frequency response of CE amplifiers
10. Design of RC phase shift oscillator
11. Design of Clipper and Clamper circuits
12. Study of Opto Electronic Devices – LED, LCD & Seven segment Display

P = 45 TOTAL = 45

SYLLABUS FOR 3RD SEMESTER

MAA202 ENGINEERING MATHEMATICS – III

L T P C
3 1 0 4

Objectives

The course should enable the students to:

- 1) Learn techniques of solving the standard types of first and second partial differential equations.
- 2) Grasp the Fourier series expansions for the given periodic function in the specific intervals and their different forms.
- 3) Learn solving one dimensional wave equation, One and two dimensional heat equation using Fourier series.
- 4) Understand the problems using Fourier transform and learns their properties.
- 5) Understand the problems using Z – transform and learns their properties.

Outcome

The students should be able to:

1. Formulate mathematically certain practical problems in terms of partial differential equations, solve them and physically interpret the results.
2. Use the knowledge of Fourier series, their different possible forms and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
3. Formulate and identify certain boundary and initial value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve the vibration and heat flow problems and then interpret the results.
4. Apply Fourier transform pair, their properties, with the possible special cases with attention to their applications
5. Apply the basics of Z – transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z – transform technique bringing out the elegance of the procedure involved.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

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

UNIT II Fourier series 12

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

UNIT III Boundary value problems 12

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

UNIT IV Fourier Transform 12

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

UNIT V Z -TRANSFORM AND DIFFERENCE Equations 12

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

TOTAL: 60

Text Books

1. Grewal, B.S., “Higher Engineering Mathematics”, Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., “Engineering Mathematics Volume III”, S. Chand & Company ltd., New Delhi, 1996.

References

1. Andrews, L.A., and Shivamoggi B.K., “Integral Transforms for Engineers and Applied Mathematicians,” MacMillan, New York, 1988.

2. Narayanan, S., Manikavasagom Pillai, T.K. and Ramaniah, G., “Advanced Mathematics for Engineering Students”, Volumes II and III, S. Viswanathan (Printers and Publishers) Pt. Ltd. Chennai, 2002.

AEB202 Solid Mechanics

L T P C
3 1 0 4

Objectives

The course should enable the student:

1. Stress and Strain – Hooke’s Law – Elastic constants and their relationship– Statically determinate cases - bar with uniform and varying section statically indeterminate cases –composite bar. Thermal Stresses – stresses due to freely falling weight.
2. Shear force and bending moment diagrams for simply supported and cantilever beams – Bending stresses in straight beams – Shear Stresses in bending of beams with various cross sections – beams of uniform strength
3. Beam Deflections through various methods
4. Torsion of circular shafts - shear stresses and twist in solid and hollow circular shafts – closely coiled helical springs.
5. Stresses in thin circular cylinder and spherical shell under internal pressure, volumetric Strain. Combined loading, Principal and maximum Shear Stresses - Analytical and Graphical methods.

Outcomes

The students should be able to:

1. Proportional Limit, Elastic Limit, Elastic Constants and relations. Determinacy and indeterminacy. Elongation of bars with uniform varying section. Elongation of compound bars and thermal stresses
2. Calculation of reaction forces. Differentiate between cantilever and simple support beams. Draw the shear force and bending moment diagrams for various load cases. Establish the relation between Moment, Moment of Inertia, Radius of curvature, Young’s modulus. Understand shear stresses and obtain shear stress for various cross sections.
3. Double integration method – McCauley’s method - Area moment method – Conjugate beam method.

4. Distinguish difference between bending moment & twisting moment and effects of twisting moment. Find out shear stresses for solid & hollow shafts and study of helical springs
5. Understand Hoops stress, Meridional stress for thin cylinders and obtain pressure for spherical shell. Calculate principal planes and find principal stresses. Represent as Mohr's circles in graphical form

UNIT I - BASICS AND AXIAL LOADING 12

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

UNIT II - STRESSES IN BEAMS 12

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

UNIT III - DEFLECTION OF BEAMS 12

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

UNIT IV – TORSION 12

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

UNIT V - BI AXIAL STRESSES 12

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

Total 60

TEXT BOOKS

1. Nash William – *“Strength of Materials”*, TMH, 1991
2. Timoshenko.S. And Young D.H. – *“Elements of strength materials Vol. I and Vol. II”*. T. Van Nostrand Co-Inc Princeton-N.J. 1990.

REFERENCES

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

OBJECTIVES

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

OUTCOME

1. The student should be able to understand the basic thermodynamic systems.
2. Understanding about the air cycles, and understanding about the plot of the PV diagrams of four stroke and two stroke IC Engines
3. Understand about the One Dimensional fluid flow and the applications of the Continuity equation and understand about the simple jet propulsion systems.
4. Understand about the Principles of refrigeration and Air conditioning and understand the Coefficient of performance and Properties of refrigerants

UNIT I BASIC THERMODYNAMICS

12

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

UNIT II AIR CYCLES

12

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

UNIT III THERMODYNAMICS OF ONE DIMENSIONAL FLUID FLOW 12

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

UNIT IV REFRIGERATION AND AIR CONDITIONING 12

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

UNIT V AIR COMPRESSORS 12

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

Total 60

TEXT BOOKS

1. Rathakrishnan, E, “*Fundamentals of Engineering Thermodynamics*”, Prentice – Hall, India, 2000
2. Nag. P.K., “*Engineering Thermodynamics*”, Tata McGraw-Hills Co., Ltd., Seventh Edn., 1993
3. Yunus A.Cengal. “*Thermodynamics an Engineering Approach*”, Tata McGraw-Hill Co. Ltd., 3rd Edition, 2002.

REFERENCES

1. Mayhew, A. and Rogers, B., “*Engineering Thermodynamics*”, Longman Green & Co. Ltd., London, E.L.B.S. Edition, 1990.
2. Van Wylen, G.J. and Sonntag, R.E., “*Fundamentals of Classical Thermodynamics (S.I.Version)*”, Second Edition, 1986.
3. Bacon, D.H., “*Engineering Thermodynamics*”, Butterworth & Co., London, 1989.
4. Saad, M.A., “*Thermodynamics for Engineers*”, Prentice-Hall of India Pvt. Ltd., 1989.
5. Reynolds, “*Thermodynamics*”, Int. Student Edn., McGraw-Hill Book Co., Ltd., 1990

OBJECTIVES

The course should enable the student to :

1. Understand the principles of Basic concepts and properties of Fluid
2. Understand the Fluid Kinematics and its Dynamics
3. Study the basic concepts of Incompressible Flows
4. Study the basic concepts of Fluid Machines and Hydraulic turbines
5. To study the Hydraulic pumps & its applications

OUTCOME

The student should be able to understand :

1. The basic terms like Pressure , Density, Surface Tension & Fluid Statics
2. The types of flows , stream functions, Velocity Potential & familiarize in equations of Fluid Motion
3. The Laminar Flows , Flow through Pipes , Boundary Layers
4. The working Principles of Various Turbines like Kaplan , Pelton , Francis

The working Principles of Pumps like Centrifugal & Reciprocating Pumps

UNIT I BASIC CONCEPTS AND PROPERTIES**6**

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

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS**12**

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms). Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline -

Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's π theorem- applications - similarity laws and models.

UNIT III INCOMPRESSIBLE FLUID FLOW 12

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

UNIT IV HYDRAULIC TURBINES 8

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

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

UNIT V HYDRAULIC PUMPS 7

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

TOTAL: 45

TEXT BOOKS

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

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., “*Aerodynamics for Engineering students*”, Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., “*Theoretical aerodynamics*”, Macmillan, 1985.
3. Clancey, L.J., “*Aerodynamics*”, Pitman, 1986

OBJECTIVES

1. To know about various types of materials and get knowledge of various types of hardness testing machines and various types of hardness numbers Linear and non-linear elastic properties- Stress and Strain Curves.
2. To know about the materials used in aircraft construction- Aluminium, Magnesium and Titanium
3. To know about the materials used in aircraft construction- Steel, Copper alloys and Super alloys.
4. To know about the adhesives and sealants used in aircraft industries.
5. To know about the non metals used in aircraft construction

OUTCOME

1. Understand the different materials used and know the various types of hardness testing machine. Knowledge of Stress-strain curves for different type of materials.
2. Knowledge about the properties of the material, the process of machining them and heat treating them.
3. Knowledge about the specification of materials, their structural applications and properties.
4. Finding out the different types of adhesives and sealant used, their advantages and the knowledge of the sandwich and honeycomb structure.
5. Knowledge about the non metals like wood, fabrics, glass, plastics and the use of composite materials

UNIT I MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS 9

Various types of hardness testing machines and various types of hardness numbers, Linear and non-linear elastic properties - Stress and Strain Curves – Yielding and strain Hardening , Toughness – Modulus of resilience -- Bauchinger’s effect – Effect of notches – Non destructive testings.

UNIT II MATERIALS IN AIRCRAFT CONSTRUCTION – I 9

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

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

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

UNIT III MATERIALS IN AIRCRAFT CONSTRUCTION - II 9

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

Maraging Steels: Properties and Applications

Copper Alloys – Monel, K Monel

Super Alloys - Introduction & Its Use

UNIT IV ADHESIVE AND SEALANTS FOR AIRCRAFT 9

Advantages of Bonded structure in airframes – Crack arresting – Weight saving – Technology of adhesive Bonding Structural adhesive materials – Test for bonding structure. Non destructive tests for bonded joint.

Sandwich structures – Honeycomb structures – Methods of construction of honeycombs

UNIT V NON METALS IN AIRCRAFT CONSTRUCTION 9

Wood and fabric in aircraft construction. Glues, Use of glass, plastics and rubber in aircraft, Introduction to composites.

Total 45

Text Books

- 1.Lalith Gupta, “*Aircraft General Engineering*” Himalaya Book House, Delhi 2003
- 2.HajiraChowdhry, “*Workshop Technology* “ – Vol 1 & 2 ,Nedia Promoters, Mumbai

REFERENCE

- 1.“*Aircraft Material & Process*” , Titterton 2004
- 2.“*Advanced Composite Materials* “ ,Lalith Gupta 2006, Himalaya Book House, Delhi

SSA231

APTITUDE – I

L T P C
1 0 1 1

PURPOSE:

The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential.

INSTRUCTIONAL OBJECTIVES

1. To guide thought process
2. Appear for placement aptitude tests confidently
3. To develop Communication skill
4. To build confidence

- Acquire aptitude skills for employment

METHODOLOGY:

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

- Group Activities + Individual activities
- Collaborative learning
- Interactive sessions
- Ensure participation
- Empirical learning

LOGICAL REASONING:

Number, Letter series, Analogies- Coding, Decoding – Blood relations, direct sense, Operator based questions – Clock & Calendars
Distribution, Binary Logic and Puzzles – Arrangements, Selections.
Routes & Networks, Comparison – Cubes & Venn Diagrams.

VERBAL ABILITY:

Critical Reasoning – Antonym, Synonym
Odd man – fill in the blank
Sentence Construction / Completion – Idiomatic expression
Detection of errors.
Jumbled sentences, Vocabulary, Alphabetical sequence, cloze passage.

EVALUATION:

- University Theory Question paper
- Activities assessed by both group and individual participation
- Continuous assessment based on daily participation

SCHEME OF INSTRUCTION:

Marks allocated for regular participation in all oral activities in class.

SCHEME OF EXAMINATION:

Complete internal evaluation on regular basis.

AEB211 STRENGTH OF MATERIALS LABORATORY L T P C

0 0 3 2

S.No	OBJECTIVE	OUTCOME
1	To test a specimen using Brinell hardness testing machine.	The hardness of the material is found out and verified.
2	To test a specimen using Rockwell hardness testing machine.	The hardness of the material is found out and verified.

3	To perform tension test on mild steel a rod using universal testing machine.	The yield load, ultimate load of the mild steel rod is found out.
4	To perform torsion test on a mild steel rod using universal testing machine.	The ultimate torque of the mild steel rod is found out.
5	To perform impact test using Izod impact testing machine.	The impact load of the material is found out.
6	To perform impact test using Charpy impact testing machine.	The impact load of the material is found out.
7	To perform fatigue test in rotating beam using fatigue tester	The fatigue load of the rotating beam is found out.
8	To perform tension and compression test on open and closed helical spring setup.	The ultimate compressive load and tensile loads are found out.
9	To perform tension and compression test on wood using UTM .	The ultimate compressive load is found out
10.	To verify Maxwell reciprocal theorem	Maxwell reciprocal theorem is verified.

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENTS

S.No	Details of Equipments	Qty Required	For Experiments
1	Brinell Hardness Testing Machine	1	1
2	Rockwell Hardness Testing Machine	1	1
3.	Universal Testing Machine	1	2,3,7
4.	Izod Impact Testing Machine	1	4
5.	Charpy Impact Testing Machine	1	4

6.	Fatigue tester- Rotating Beam	1	5
7.	Fatigue tester –Reverse plate bending	1	5

AEB212 FLUID MECHANICS AND MACHINERY LAB L T P C
0 0 3 2

OBJECTIVES

The subject should enable the student to:

1. Understand the properties of the fluid and also to learn about the pressure and velocity of the flowing fluid using venturimeter, orifice meter.
2. Understand the discharge of fluid by using pump like centrifugal, reciprocating and gear pump and also to find the rate of flow using rota meter.
3. Understand the efficiency of turbine like Kaplan and francis.
4. Understand the change in pressure (friction factor) of given set of pipes.
5. Understand the efficiency of Pelton wheel.

OUTCOME

The students should be able to:

1. Determine the coefficient of discharge of orifice meter and venturimeter.
2. Conduct experiments and draw the characteristic curves of centrifugal pump, submergible pump, reciprocating pump, Gear pump and also can find the discharge of the pump.
3. Conduct experiments and draw the characteristics curves of Francis turbine and Kaplan turbine and also can find the efficiency of the turbine.
4. Conduct experiments and draw the characteristics curves of Pelton wheel.
5. Determine the friction factor of given set of pipes when there is change in pressure& Calculate the rate of flow using Rotameter

LIST OF EXPERIMENTS

1. Calibration of venturimeter

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

LIST OF EQUIPMENTS

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

OBJECTIVES

- 1.To carry out performance test on a 4 stroke engine
2. To carry out valve timing of a 4 stroke engine and Port timing of a 2 stroke engine
- 3.To carry out test on effectiveness of a parallel flow heat exchanger
4. To carry out test on effectiveness of a counter flow heat exchanger
- 5.To carry out test for determination of viscosity of a given liquid
6. To carry COP test on a vapour compression refrigeration test rig.
7. To carry COP test on a vapour compression A/C test rig
- 8.To study about the characteristics of a Gas turbine Engine
- 9.To carry out experiment on evaluation of conductive Heat transfer coefficient
10. To carry out experiment on evaluation of thermal resistance of composite wall

OUTCOME

- 1.Understand the 4 stroke engine cycle and performance
- 2.Clearly understand the port timing mechanism and valve timing mechanism of stroke engine
3. To get a clear idea about effectiveness of a parallel flow heat exchanger
4. To get a clear idea about effectiveness of a counter flow heat exchanger
- 5.Understand the viscosity effects in a given fluid flow
6. To carry COP test on a vapour compression refrigeration test rig
7. To carry COP test on a vapour compression A/C test rig
- 8.Can clearly understand the performance of a Gas Turbine Engine
9. To understand importance of thermal resistance of composite wall

10.To understand importance of thermal resistance of composite wall

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENTS

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

SYLLABUS FOR IVth SEMESTER

MAA203 NUMERICAL METHODS L T P C

3 1 0 4

Objectives

The course should enable the students to:

- 1) Learn the techniques of solving the algebraic and transcendental equations.
- 2) Learn to interpolate using Newton's forward and backward difference formulae for equal and unequal intervals
- 3) Understand the use of numerical differentiation and understands to find the approximate area using numerical integration.
- 4) Understand solving numerically the initial value problems for ordinary differential equations using single step and multi step method.
- 5) Learn the methods of solving second order partial differential equations numerically and use it to solve initial and boundary value problems for partial differential equations.

Outcome

The students should be able to:

- 1) Find out the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations by direct and indirect methods.
- 2) Solve problems where huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.
- 3) Use the numerical differentiation and integration when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.
- 4) Solve engineering problems which are characterized in the form of nonlinear ordinary differential equations, since many physical laws are couched in terms of rate of change of one independent variable
- 5) Solve the initial and boundary value problems related heat flow, both one and two dimensional and vibration problems. Understands the numerical techniques of solving the partial differential equation in engineering applications

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

12

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

UNIT II INTERPOLATION AND APPROXIMATION

12

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

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

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

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

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

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

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

TOTAL: 60

TEXT BOOKS

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

REFERENCES

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

AEB221 AERODYNAMICS – I

L T P C

3 1 0 4

OBJECTIVES

The course should enable the student :

- 1) To understand the fluid mechanics concepts for advanced applications
- 2) To study two dimensional flows in aerodynamics
- 3) To integrate the mathematics with aerodynamics
- 4) To study ideal flows over wings
- 5) To study real time viscous flows

OUTCOME

Student should able to:

- 1) Should be able to apply fluid mechanics concepts
- 2) Should be able to model flow over wing
- 3) Should be able to differentiate between ideal and real flows
- 4) Develops mathematical modelling ability.
- 5) Understand the real time viscous flow and Boundary Layer behaviour.

UNIT I REVIEW OF BASIC FLUID MECHANICS

6

Continuity, momentum and energy equations.

UNIT II TWO DIMENSIONAL FLOWS

14

Basic flows – Source, Sink, Free and Forced vortex, uniform parallel flow. Their combinations, Pressure and velocity distributions on bodies with and without circulation

in ideal and real fluidflows. Kutta Joukowski's theorem.

UNIT III CONFORMAL TRANSFORMATION 12

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

UNIT IV AIRFOIL AND WING THEORY 14

Joukowski, Karman - Trefftz, Profiles - Thin aerofoil theory and its applications. Vortex line,

Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations

UNIT V VISCOUS FLOW 14

Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum

thickness, Flow over a flat plate, Blasius solution.

TOTAL : 60

TEXT BOOKS

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

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., "*Aerodynamics for Engineering students*", Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., "*Theoretical aerodynamics*", Macmillan, 1985.
3. Clancey, L.J., "*Aerodynamics*", Pitman, 1986

AEB222 AIRCRAFT STRUCTURES – I

L T P C

3 1 0 4

OBJECTIVES

The course should enable the student :

1. Understand various structural elements
2. Understand statically determinate and indeterminate structural analysis.

3. Understand various energy method
4. able to understand columns with various end condition.
5. To understand various failure theories

OUTCOME

The students should be able to:

1. Analyze structural elements in aircraft.
2. Solve three moment equation and moment distribution.
3. To make simplified analysis of a/c structures & apply energy methods.
4. Understand and solve the column problems
5. Apply failure theories for various loading conditions

UNIT I STATICALLY DETERMINATE STRUCTURES 12

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

UNIT II STATICALLY INDETERMINATE STRUCTURES 12

Shear force and bending moment of fixed-fixed beam, propped cantilever beam – continuous beam - Clapeyron's Three Moment Equation - Moment Distribution Method.

UNIT III ENERGY METHODS 12

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

UNIT IV COLUMNS 12

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

UNIT V FAILURE THEORY 12

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

TOTAL 60

TEXT BOOK

1. Donaldson, B.K., “*Analysis of Aircraft Structures – An Introduction*”, McGraw-Hill, 1993.

REFERENCE

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

AEB223 AIRCRAFT SYSTEMS AND INSTRUMENTS L T P C **3 0 0 3**

OBJECTIVES

The course should enable the students :

1. To know the various types of Airplanes control systems, its components & its applications.
2. To know the working principle of Autopilot system, ILS & communication system.
3. To understand the purpose of hydraulic system & its component requirement in a modern aircraft.
4. Study of piston and gas turbine engine system and the various components of engines, its material requirements.
5. To know the various auxiliary system used in the modern Jet aircraft & its purpose.

The students should be able to :

1. Understand the working principle of modern control system & its advantages.
2. Describe the working principle of communication & navigation system.
3. Draw a schematic diagram of a hydraulic system for a modern aircraft and explain its function in detail.
4. Describe the various systems of piston & gas turbine engines and the purpose of each system.
5. Describe the working principle of air-conditioning system & Fire protection system.
6. Understand the working principle of aircraft instruments and engine instruments in detail.

OBJECTIVE

The subject should enable the student to:

1. The Kinematic analysis of simple mechanisms and its velocity and accelerations.
2. To know the various belt and rope drives and friction in screw and nut.
3. To know the Gear and cam profile and geometry.
4. To study the Static and dynamic balancing of the various masses
5. To study the vibrations of single degree of freedom systems and Vibration isolation and absorption

OUTCOME

The students should be able to :

1. Understand the various mechanisms and its degree of freedom
2. Learn to find out the effect of centrifugal and initial tension in both drives and Condition for maximum power transmission.
3. Learn to determine the speed and torque of the various types of gear geometry and also the follower motions of cam profile.
4. Understand the concept of balancing in rotating mass and Balancing of radial V engine (reciprocating mass).
5. Understand the Free, forced and damped vibrations and its force transmitted to supports

UNIT I MECHANISMS 12

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

UNIT II FRICTION 12

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

UNIT III GEARING AND CAMS**12**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains - Determination of speed and torque - Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

UNIT IV BALANCING**12**

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

UNIT V VIBRATION**12**

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

TOTAL 60

TEXT BOOKS

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

REFERENCES

1. Rao, J.S and Dukkupati, R.V, “*Mechanism and Machine Theory*”, Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., “*The Theory of Machines*”, SatyaPrakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., “*Theory of Machines and Mechanisms*”, Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., “*Theory of Machines and Mechanisms*”, McGraw-Hill, 1980.
5. Burton Paul, “*Kinematics and Dynamic of Planer Machinery*”, Prentice Hall

PURPOSE:

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INSTRUCTIONAL OBJECTIVES

1. To guide thought process
2. Appear for placement aptitude tests confidently
3. To develop Communication skill
4. To build confidence
5. Acquire aptitude skills for employment

METHODOLOGY:

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group Activities + Individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure participation
5. Empirical learning

QUANTITATIVE APTITUDE:

Sample Equation, Ratio, Proportion, Variation.

Percentage, Profit & Loss, Partnership.

Averages, Mixtures, Allegations: Simple & Compound Interest.

Time Work, Time Distance.

Geometry & Mensuration.

Permutation, Combination & Probability.

Data Interpretation & Data Sufficiency.

Analytical reasoning:

Non- Verbal Reasoning

Word problem

EVALUATION:

1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

SCHEME OF INSTRUCTION:

Marks allocated for regular participation in all oral activities in class.

SCHEME OF EXAMINATION:

Complete internal evaluation on regular basis.

AEB230 COMPUTER AIDED DRAFTING AND MODELLING LAB L T P C**0 0 3 2****OBJECTIVES**

The course should enable to

1. Understand the drawing with curves like parabola, spiral, involute
2. Understand the three view of simple solids.
3. Creation of 3D models of simple objects.
4. Understand a simple steel truss.
5. Understand the isometric projection of simple objects

OUTCOME

Student should able to

1. Draw the different curves with B spline or cubic spline method.
2. Draw the front view, side view and top view of solids.
3. Obtaining 2D and multi view drawing of 3D models.
4. Analyze the truss problems using CAD.
5. Plotting the drawings of prism, pyramid, cylinder, and cone.

List of exercises using software capable of drafting and modelling:

1. Study of capabilities of software for drafting and modelling –Co-ordinate system- Creation of simple figures like polygon and general multi line figures
2. Drawing a title block with necessary text and projection symbols
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone. etc
5. Drawing of front view, side view and top view of objects from the given pictorial views
6. Drawing of a plan of residential building
7. Drawing of a simple steel truss
8. Drawing sectional views of prism, pyramid, cylinder, cone. etc,
9. Drawing isometric projection of simple objects

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

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

AEB231 AIRCRAFT STRUCTURES LAB L T P C
0 0 3 2

OBJECTIVES

1. Determination of young's modulus of steel using mechanical extensometers.
2. Determination of young's modulus of steel using Electrical extensometers.
3. Determination of fracture strength and fracture pattern of ductile materials.
4. Determination of fracture strength and fracture pattern of brittle materials.
5. Stress strain curve for various engineering materials
6. Deflection of beams at various end condition
7. Verification of Maxwell's reciprocal theorem and principle of super position
8. Column Testing
9. South – Well's plot
10. Riveted joints

OUTCOME

1. To understand the basic concepts of material and science and real experience getting to determine a young's modulus value of Aluminium.
2. To understand the difference of accuracy and precision value from both mechanical and electrical extensometer.
3. To understand the breaking strength which specimen fail via fracture. Determined by given the specimen by tensile load test. More understand about materials stress strain relationship.

- 4.To understand the difference of brittle and ductile materials. Studies on deformation elastic and plastic and metal fatigue. More understand that failure of compressive stress.
- 5.To understand the application of Aircraft material science.
- 6.To determine the deflection of a simply supported beams and better understand of types of beams and application.
- 7.To verify the Maxwell's theorem using the supported beam and tested.
- 8.To determine the buckling load of the column in various section like fixed and hinged.
- 9.To determine the buckling load of the column in various section like fixed and hinged and more understand about the south well's theorem.
- 10.To analyze the riveted joints and type s. and more understand about the high strength structural steel rivet, semi tabular rivet, blind rivet, drive rivet, flush and frictional lock rivet.

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENTS

Sl. No.	Equipment	Qty	Experiments No.
1.	Universal Testing Machine	1	1,2,3,4,5,10
2.	Mechanical Extensometer	1	1
3.	Electrical stain gauge	10	2
4.	Stain indicator	1	2,5
5.	Dial Gauges	12	3,4

6.	Beam Test set up with various end conditions	2	6,7
7.	Weight 1 Kg	10	6,7
8.	Weight 2 Kg	10	6,7,8
9.	Weight Pans	6	6,7,8
10.	Column Test Apparatus	1	5,6,7,8
11.	Rivet	30	10

AEB232 AERODYNAMICS LAB L T P C
0 0 3 2

OBJECTIVES

The course should enable the student :

1. To study performance of subsonic wind tunnel.
2. To study experimentally the pressure distribution of circular, symmetric and unsymmetrical aerofoil
3. To know the Force measurement using wind tunnel balance
4. To study Flow visualization studies in low speed flow over airfoil with different angle of incidence
5. To study performance of supersonic wind tunnel.

OUTCOME

The students should be able to:

1. Measure the velocity of the subsonic wind tunnel at various RPM
2. Pressure distribution of various aerofoils can be identified and lift can be calculated.
3. Coefficient of Lift and drag for symmetric and unsymmetrical aerofoils are analysed.
4. Identify the various flows acting on the aerofoil

5. Study the Supersonic flow and characteristics of it

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENT

Sl.	Items	Quantity	Experiment No.
1.	Wind Tunnel test section size around	1 No.	1, 2,3,4,5
2.	Wings of various airfoil sections	2 Nos. each	3, 4
3.	Angle of incidence changing mechanism	1 No.	3, 4
4.	Multiple Manometer stands with	4 Nos.	2,3,4
5.	U-Tube Manometer	1 No.	1,2,3,4
6.	Static Pressure Probes	4 Nos.	1,2,3,4
7.	Total Pressure Probest	4 Nos.	1,2,3,4
8.	Pitot-Static Tubes	4 Nos.	1,2,3,4
9.	Wooden Models of Three Dimensional bodies (eg. Cylinder etc..)	2 Nos. each	2
10.	Wind Tunnel balances	1 No.	5
11.	Pressure Transducers with digital display	1 No.	1,2,3,4
12.	Hele-Shaw apparatus, Smoke Tunnel, Water flow channel	1 each	6,7,8
13.	Supersonic Wind tunnel of test section size 100 x 100 mm with storage tank capacity of 500ft ² at 20 bar	1 No.	9,10

14.	Wooden models of cone, wedge and blunt body configurations of suitable size for flow visualization in a	1 No.	9,10
15.	Schlieren System	1 No.	9,10

Engineering Elective Courses (Semester III)

AED201 AIRCRAFT DESIGN

L T P C

3 0 0 3

GOAL

Computer Integrated Manufacturing aims in portraying the flexible manufacturing system and the ability of user to interact with the system to increase the production by software interfacing.

OBJECTIVES

The course should enable the students to :

1. Understand the basic types and configurations of aircraft layouts, Maneuvering loads on tail planes
2. Know the different types of power plants and characteristics of propeller and its configurations
3. Know the basic manoeuvres such as gliding flight and calculations of takeoff and landing
4. Know the layout of special designs and specifications of aircraft
5. Understand the structural design of fuelage, wing and other aircraft parts.

OUTCOME

The students should be able to :

1. Understand the basic configurations of aircraft layouts and balancing loads effects on aircraft
2. Identify the power plant and the procedures for the propeller configuration

3. Solve the calculations of take off and landing, gliding and manoeuvring flight
4. Be clear in design of new prototype of aircrafts and able to present new layout or plan
5. Understand the various designs of wing, fuselage, U/C and other aircraft parts with good knowledge about the aircraft materials.

UNIT I REVIEW OF DEVELOPMENTS IN AVIATION 12

Categories and types of aircraft specifications - various configurations - Layouts and their relative merits - strength, stiffness, fail safe and fatigue requirements.

UNIT II POWER PLANT TYPES AND CHARACTERISTICS 12

Characteristics of different types of power plants - Propeller selection - Relative merits and effect on stability based on location of power plant.

UNIT III PRELIMINARY DESIGN 12

Drag estimation, Weight estimation of complete aircraft - Level flight, climb, take - off and landing calculations - range and endurance - control requirements.

UNIT IV SPECIAL PROBLEMS 12

Layout peculiarities of subsonic and supersonic aircraft – changes in wing and fuselage design for supersonic aircraft – transonic and supersonic airfoils

UNIT V STRUCTURAL DESIGN 12

Structural design of fuselage, wings and undercarriages and joints. Materials for modern aircraft - Methods of analysis, testing.

TOTAL : 60

REFERENCES

- G. Corning, "Supersonic & Subsonic Airplane Design", II Edition, Edwards Brothers Inc., Michigan, 1953.
- E.F. Bruhn, "Analysis and Design of Flight Vehicle Structures", Tristate Offset Co., U.S.A., 1980.

OBJECTIVES	OUTCOME
The course should enable the student to :	The students should be able to:
1) Study about Need for Avionics in civil and military aircraft and space systems	1) Understand the avionics system in weapons design and technologies are studied.
2) Study about the principles of digital systems	2) Understand the digital computers, microprocessors and memories are studied.
3) Study about some of the digital avionics architecture.	3) Understand the avionics system architecture like data bus MIL STD 1553, B ARINC 429 are studied.
4) Study about the flight deck and cockpit instruments.	4) Understand the control and display technologies like CRT, LED, LCD, EL and plasma panel are studied.
5) Study about avionics systems like communication system and navigation systems	5) Understand the communication system, flight control system and radar electronic warfare

UNIT I INTRODUCTION TO AVIONICS

6

Need for Avionics in civil and military aircraft and space systems - Integrated Avionics and Weapon system - Typical avionics sub systems - Design and Technologies.

UNIT II PRINCIPLES OF DIGITAL SYSTEMS

10

Digital Computers - Microprocessors - Memories

UNIT III DIGITAL AVIONICS ARCHITECTURE

6

Avionics system architecture-Data buses MIL-STD 1553 - B, ARINC 429, ARINC 629.

UNIT IV FLIGHT DECK AND COCKPITS

8

Control and display technologies CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) - Civil cockpit and military cockpit : MFDS, HUD, MFK, HOTAS

UNIT V INTRODUCTION TO AVIONICS SYSTEMS

15

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

TOTAL: 45

TEXT BOOKS

1. Malcrno A.P. and Leach, D.P., "Digital Principles and Application", Tata McGraw-Hill, 1990.
2. Gaonkar, R.S., "Microprocessors Architecture - Programming and Application", Wiley and Sons Ltd., New Delhi, 1990.

REFERENCES

1. Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1919.
2. Spitzer, C.R., "Digital Avionic Systems", Prentice Hall, Englewood Cliffs, N.J., USA., 1917.

Engineering Elective Courses (Semester IV)

AED211 ADVANCED MATERIALS & THEIR PERFORMANCE L T P C

OBJECTIVES	OUTCOME
<p>The course should enable the students to :</p> <ol style="list-style-type: none"> 1) Study about the various materials and alloys. 2) Study about the various smart and intelligent materials 3) Study about fatigue performance of materials 4) Study about the materials used in cryogenic temperature. 5) Study about materials at high temperature 	<p>The students should be able to get:</p> <ol style="list-style-type: none"> 1) Knowledge about materials their properties, testing and classification of alloys. 2) Knowledge about piezo, pyro, and ferro electric effects and its application to aerospace vechicles. 3) Understanding about S-N curves, high and low cycle fatigue. 4) Understanding about cryogenic testing equipment, experimental program and low temperature alloys. 5) Understanding about the various materials used at high temperature like ceramic and refractory materials.

UNIT I MATERIALS AND ALLOYS

9

Classification of materials, Mechanical properties, testing of aerospace materials, Classification of alloys - aluminum, steel, titanium, and other alloys used in aerospace.

UNIT II SMART AND INTELLIGENT MATERIALS 9

Introduction, piezo, pyro and Ferro electric effects, hysteretic effects, fundamentals of continuum mechanics. Application to aerospace vehicles.

UNIT III FATIGUE PERFORMANCE

9

S-N curves, endurance limits, effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams, Notches and stress concentration factors, plastic stress concentration factors, High cycle and low cycle fatigue, cumulative damage - Minor's theory

UNIT IV MATERIALS AT CRYOGENIC TEMPERATURE 9

Cryogenic testing equipment, Experimental program, cold worked 300 series stainless steel, aluminum alloys, titanium alloys.

UNIT V MATERIALS AT HIGH TEMPERATURE

9

Material requirements and principles, component system analysis, structural and material analysis, material system principles, ceramic reinforced, refractory materials.

TOTAL : 45

TEXT BOOK

- E.R.Parker, "Materials for Missiles and Spacecraft", McGraw Hill Book Co. Inc, 1978.

REFERENCES

- Madayag, A.F., "Metal Fatigue: Theory and Design", John Wiley & Sons, Inc.1968.
- Broutman, L. J., "Fatigue and Fracture", Vol. 5, ACADEMIC PRESS, 1974.

OBJECTIVES	OUTCOME
The course should enable the students to :	The students should be able to:
1) Study the basics of NDT, its history and applications.	1) Understand the background of NDT and its applications.
2) Study the process of various visual testing techniques used in NDT.	2) Understand the different methods of visual testing and their advantages.
3) Study the process of radiographic testing and its applications.	3) Understand the technique of radiographic testing and its equipments.
4) Study the process of ultrasonic testing and its applications.	4) Understand the technique of ultrasonic testing and its equipments
5) Study the other methods used in NDT technique	5) Understand other different method used in NDT.

UNIT I INTRODUCTION

8

Introduction to NDT, concern in NDT, History, NDT vs. Destructive, Conditions for NDT, Personal Considerations, Certification, Primary production of metal, castings, cracks, welding discontinuities, corrosion induced discontinuities, fatigue cracking, creep, brittle fracture, geometric discontinues.

UNIT II VISUAL TESTING

10

History and Development, Theory and Principles, Equipment and Accessories, Applications and Techniques, Evaluation of Test Results, Advantages and Limitations, Penetrate Testing- Introduction, History and Development, Theory and Principles, Penetrate Equipment and Materials, Penetrant Procedures, Techniques and Variables, Evaluation and Disposition, Penetrate Testing Applications, Quality Control Considerations, Advantages and Limitations, Glossary of Penetrate Testing Terms, Magnetic Particle Testing - History and Development, Theory and Principles, Equipment and Accessories, Techniques, Variables, Evaluation of Test Results and Reporting, Applications, Advantages and Limitations.

UNIT III RADIOGRAPHIC TEST

10

History and Development, Theory and Principles, Radiographic Equipment and Accessories, Variables, Techniques and Procedures, Radiographic Evaluation, Applications, Advantages and Limitations of Radiography, Compendium of Radiographs

UNIT IV ULTRASONIC TESTING

10

History, Theory and Principles, Equipment for Ultrasonic Applications, Techniques, Variables, Evaluation of Test Results, Applications, Advantages and Limitations, Eddy Current Testing- History and Development, Theory and Principles, Alternating Current Principles, Eddy Currents, Test Equipment, Eddy Current Applications and Signal Display, Advantages and Limitations, Other Electromagnetic Test Techniques

UNIT V OTHER METHODS

7

Thermal Infrared Testing - History and Development, Theory and Principles, Equipment and Accessories, Techniques, Variables, Data Storage, Applications, Advantages and Limitations, Acoustic Emission Testing - History and Development, Principles of Acoustic Emission Testing, Advantages and Limitations of Acoustic Emission Testing.

TOTAL 45

TEXT BOOK:

- P. E. Mix, "Introduction to non-destructive testing", Wiley Interscience., John Wiley & Sons, Inc, Publ., 2005

REFERENCE:

- C. Hellier, "Handbook of Nondestructive Evaluation", McGraw-Hill, 1994.

SEMESTER V

GOAL

To study in detail about fundamentals of aircraft propulsion, advanced propulsion systems in gas turbine engine. To understand the principles of operation and design of aircraft power plants.

OBJECTIVES

The course should enable the students to:

1. Know the fundamentals of gas turbines and its components
2. Know the design and performance of subsonic and supersonic inlets
3. To know the different types of combustion chambers and factors affecting the combustors.
4. To study the types of nozzles and flow conditions in nozzles.
5. To study the types of compressors and their working principles

OUTCOME

The students should be able to:

1. Understand the working principle of gas turbine engines, thermodynamic cycles and performance characteristics of gas turbine engines.
2. To understand the internal flow and external characteristics near the inlets. Starting problems and different modes of operation in supersonic inlets.
3. To understand the types and working methods in combustion chambers. The flame stabilization and flame techniques.
4. To understand the flow through nozzle, choking, losses in nozzle, variable area nozzle and thrust vector control.
5. To know the types and working principles of compressors, velocity diagrams, blade design and performance characteristics of compressors.

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES

12

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

UNIT II SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES

12

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

UNIT III COMBUSTION CHAMBERS

12

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

UNIT IV NOZZLES

11

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

UNIT V COMPRESSORS

13

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

**TOTAL
45**

TEXT BOOKS

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

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1919.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1915.
3. "Rolls Royce Jet Engine" - Third Edition - 1913.

4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 1999.

AEB302 AERODYNAMICS - II

L T P C

3 1 0 4

GOAL

To understand the behaviour of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows.

OBJECTIVES

The course should enable the student to:

1. Study the basic equations of one dimensional compressible flow.
2. Study about the normal, oblique shock waves and expansion waves.
3. Study the differential equations of motion for steady compressible flow.
4. Study about the airfoils in high speed flows.
5. Study about the high speed wind tunnels.

OUTCOME

The student should be able to understand:

1. The energy, momentum and continuity equations.
2. The various parameters affecting the normal and oblique shock waves.
3. The various theories regarding the steady compressible flow.
4. The various parameters of airfoil in high speed flow.
5. The various methods for creating supersonic flow in wind tunnels.

UNIT I ONE DIMENSIONAL COMPRESSIBLE FLOW

10

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

UNIT II NORMAL, OBLIQUE SHOCKS AND EXPANSION WAVES

15

Prandtl equation and Rankine - Hugoniot relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations. Hodograph and pressure turning angle, shock polars, flow past wedges and

concave corners, strong, weak and detached shocks, Rayleigh and Fanno Flow. Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion waves, Families of shocks, Methods of Characteristics, Two dimensional supersonic nozzle contours.

UNIT III DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS 12

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

UNIT IV AIRFOIL IN HIGH SPEED FLOWS 12

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

UNIT V HIGH SPEED WIND TUNNELS 11

Blow down, indraft and induction tunnel layouts and their design features. Transonic, supersonic and hypersonic tunnels and their peculiarities. Helium and gun tunnels, Shock tubes, Optical methods of flow visualization.

Total 60

TEXT BOOK

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

REFERENCES

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

GOAL

To study the behaviour of various aircraft structural components under different types of loads.

OBJECTIVES

The course should enable the students to :

1. Understand Unsymmetrical bending stress distribution in beams
2. Understand shear centre and shear flow in open beam section under shear load
3. Understand the shear centre and shear flow in closed section beams under shear load and torsional load
4. Understand buckling and crippling of axially loaded thin walled sheets
5. Understand the stress analysis of fuselage, wing sections, shear web, tension field web etc.

OUTCOME

The students should be able to :

1. Analyze for maximum bending stress in unsymmetrical sections
2. Analyze for flexural shear flow and shear stress in open section beams
3. Analyze for flexural, Torsional shear flow and shear stress in closed section beams
4. Analyze for Panel Buckling, crippling and other local failure modes
5. Analyze for fuselage, wing sections, shear and tension filed webs of spar

UNIT I UNSYMMETRICAL BENDING 12

Bending stresses in beams of unsymmetrical sections - Bending of symmetric sections with Skew loads – Principal axis method – Neutral axis method- Generalized K method.

UNIT II SHEAR FLOW IN OPEN SECTIONS 12

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

UNIT III SHEAR FLOW IN CLOSED SECTIONS 12

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

UNIT IV BUCKLING OF PLATES 12

Bending of thin 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 IN WING AND FUSELAGE

12

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

**TOTAL
60**

TEXT BOOK

1. Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw-Hill, N.Y., 1993.
2. Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 1995.
3. Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri - state off set company, USA, 1973

REFERENCES

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

GOAL

To make the students to understand the Indian aviation rules 1937, relating to aviation and civil aviation requirement in India (DGCA).

OBJECTIVES

The course should enable the students to :

1. To enhance the knowledge of aircraft act 1934, and aircraft rules.
2. To understand the responsibility of owner/operator of a/c and objective of CAD.
3. To understand the procedure for the preparation of MEL, from MMEL.
4. Enhance the knowledge on the different types of maintenance programme their approval.
5. Understand the procedure for getting the approvals of organizations in different categories.

OUTCOME

The students should be able to :

1. Describe the Indian aircraft rules and the related publications.
2. Know the procedure for keeping the aircraft in airworthiness conditions.
3. Describe the use of MEL, and the procedure for releasing the a/c under MEL.
4. Describe the different types of maintenance programme.
5. Understand the requirements for getting AO in different categories.

Unit I

Series A

Procedure for issue of civil airworthiness requirements and responsibility of operator vis-a-vis airworthiness directorate, Responsibilities of Operators/ Owners, Procedure for CAR issue, amendments etc., Objectives and Targets of Airworthiness, Airworthiness Regulation and Safety Oversight of Engineering Activities of Operators,

Series B

Approval of Cockpit Check List, MEL, CDL
Minimum Equipment List (MEL), Preparation and use of Cockpit and emergency check list, Preparation and use of Cockpit and Emergency Check List.

Unit II

Series C

DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING,
Defect recording, reporting, investigation, rectification and analysis ,Flight Report -
Recording of IN-FLIGHT instrument reading and reporting of flight defect, Reporting
and rectification of defects observed on all aircraft except...Analytical study of in-flight
readings & recordings, Maintenance Control by Reliability Method

Series D

AIRCRAFT MAINTENANCE PROGRAMMES

Reliability Programme (Engines), Aircraft maintenance programme and their approval,
On-condition maintenance of reciprocating engines (Piston engines), Time between
overhaul - Revision programme, Maintenance of fuel and oil consumption records - Light
aircraft piston engines, Fixing routine maintenance periods and component TBOs-Initials
and Revisions,

Unit III

Series E

APPROVAL OF ORGANISATIONS

Approval of organization, Approval of organization - Cat. A – Manufacturers, Approval
of organization - Cat. B - Process Organization, Approval of organization - Cat. C –
Maintenance, Approval of organization - Cat. D - Testing Laboratory, Approval of
organization - Cat. E - Aviation Fuel, Aviation Lubricants and special products, Approval
of firms - Cat. F - Stores and Distribution, Approval of organization - Cat. G - Training
schools/Establishments, Requirements for infrastructure at stations other than parent
base,

Unit IV

Series F

AIRWORTHINESS AND CONTINUED AIRWORTHINESS

Procedures relating to registration/deregistration of aircraft , Procedure for
issue/revalidation of Type Certificate of aircraft and its engines/propeller ,
Issue/validation and renewal of Certificate of Airworthiness , Issue/validation and
suspension of Certificate of Airworthiness , Suspension of Certificate of Airworthiness
and its subsequent revalidation , Rebuilding of aircraft, Special Flight permits,
Maintenance and Certification of Aircraft , Airworthiness of ageing aircraft, Inspection
of wooden aircraft, Airworthiness requirements for Gliders , Registration and
airworthiness of microlight aircraft , Requirements for manufacture, registration and
airworthiness control of hot air balloons, Pooling of aircraft parts by National Airlines of
India with Foreign airlines, Manufacture of aircraft and accessories and airworthiness
certification thereof, Load and trim sheet - requirements thereof

Unit V

Basic knowledge about the following

- CAR 145----Approval of Maintenance Organizations,

- CAR M---Continuing Airworthiness Requirements
- CAR 147--Approved Maintenance Training Organization (Type Training)
- CAR 21 - Certification Procedures for Aircraft and related products),

TOTAL 45

Text book

1. Aircraft manual (India) volume - latest edition, the English book store, 17-1, Connaught circus, New Delhi.
2. Civil aviation requirements with latest amendment (section 2 airworthiness) - published by DGCA, the English book store, 17-1, Connaught circus, New Delhi.
3. Aeronautical information circulars (relating to airworthiness) from DGCA. Advisory circulars fromDGCA.

GOAL

To understand concepts of aircraft propulsion and carry out experiments

OBJECTIVES

The course should enable the students to :

1. To study aircraft piston engine, and jet engines
2. To study about forced Convective Heat transfer
3. To study about free Convective heat transfer
4. To perform Cascade testing of a model of axial compressor blade row
5. To determine heat of combustion of aviation fuel
6. To study Combustion performance in a jet engine combustion chamber
7. To study about the free jet
8. To study about the wall jet

OUTCOME

The students should be able to :

1. Knowledge about the various systems of aircraft piston engine, jet engines and show the systems on the engines available in the Lab
2. Understanding the concept of forced convective heat transfer and perform experiment on the heat transfer apparatus
3. Understanding the concept of free convection heat transfer and perform experiment on the heat transfer apparatus
4. Understanding the cascade arrangement of a model axial compressor blade row
5. Heat of combustion of aviation fuel is found out using given set up
6. Understanding the concept of Combustion performance in a jet engine combustion chamber
7. Understanding the concept of free jet
8. Understanding the concept of wall jet

LIST OF EXPERIMENTS

- | | |
|--|---|
| 1. Study of an aircraft piston engine and jet engines and its components | 6 |
| 2. Study of forced convective heat transfer. | 6 |
| 3. Study of free convective heat transfer. | 6 |
| 4. Cascade testing of a model of axial compressor blade row | 3 |
| 5. Determination of heat of combustion of aviation fuel | 6 |
| 6. Combustion performance studies in a jet engine combustion chamber | 6 |
| 7. Study of free jet | 6 |
| 8. Study of wall jet | 6 |

TOTAL 45

LIST OF EQUIPMENTS

Sl.No	Equipments	Qty	Experiments No.
1	Piston engines	2	1
2	Jet Engine /Engine model	1	2
3	Forced Convective apparatus	1	3
4	Free Convective apparatus	1	4
5	Bomb calorimeter	1	5
6	Free jet Apparatus	1	7, 8
7	Low speed wind tunnel	1	4

GOAL

To give training on riveting, patchwork and welding

OBJECTIVES

The course should enable the students to:

1. Welded patch repair by TIG in Aluminium sheet.
2. Welded patch repair by MIG in mild steel.
3. Riveted patch repairs in Aluminium sheet.
4. Sheet metal forming.
5. Control cable inspection and repair.
6. Repair on Perspex glass panels.
7. Pipe flaring.

OUTCOME

The students should be able to:

1. The TIG welding.
2. The MIG welding.
3. The Riveted patch repair by manual and pneumatic.
4. The forming of different shapes in sheet metal.
5. The repair techniques of control cables
6. The repairing of non metallic window panels of Aircraft
7. The preparation of pipe ends for connecting components.

LIST OF EXPERIMENTS

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

Total 45

LIST OF EQUIPMENT

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

GOAL

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

OBJECTIVES

The Subject should enable the student to:

1. Understand the design of riveted joints (Lap joint), learn the advantages and disadvantages.
2. Understand the design of riveted joints (Butt joint); learn the advantages and disadvantages and types of riveted joints.
3. Understand the design of the welded joint.
4. Understand Layout of typical wing structure
5. Understand Layout of typical fuselage structure.
6. Understand the Computer aided modelling of typical aircraft wing.
7. Understand the Computer aided modelling of typical fuselage structure.
8. Understand the Computer aided modelling of landing gear
9. Understand the design of Three view diagram of a typical aircraft
10. Understand the concepts and design of control system.

OUTCOME

The students should be able to:

1. Design of riveted joints (Lap joint).
2. Design of riveted joints (Butt joint with single and double straps).
3. Design of welded joints.
4. Layout of typical wing structure.
5. Layout of typical fuselage structure.
6. Computer aided modelling of typical aircraft wing.
7. Computer aided modelling of typical fuselage structure.
8. Computer aided modelling of landing gear
9. Three view diagram of a typical aircraft
10. Layout of control systems

LIST OF EXERCISES

1. Design of riveted joints (Lap joint)

2.	Design of riveted joints (Butt joint with single and double straps).	6
3.	Design of welded joints.	3
4.	Layout of typical wing structure.	6
5.	Layout of typical fuselage structure.	6
6.	Computer aided modelling of typical aircraft wing.	3
7.	Computer aided modelling of typical fuselage structure.	3
8.	Computer aided modelling of landing gear Three view diagram of a typical	6
9.	aircraft	3
10.	Layout of control systems	6

Total 45

LIST OF EQUIPMENT

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

SEMESTER VI

AEB340 FLIGHT DYNAMICS

L T P C

3 1 0 4

GOAL

To understand the performance of an aircraft in various operating conditions, and static, dynamic response for different disturbances.

OBJECTIVES

The course should enable the students to :

1. Understand drag force acting on an airplane, and variations due to velocity and altitude
2. Understand elements of airplane performance
3. Understand static longitudinal stability of an aircraft
4. Understand lateral and directional stability
5. Understand dynamic stability of an aircraft

OUTCOME

The students should be able to :

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

UNIT I DRAG ON THE AIRPLANE

12

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

UNIT II AIRCRAFT PERFORMANCE **15**

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

UNIT III STATIC LONGITUDINAL STABILITY **15**

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

UNIT IV LATERAL AND DIRECTIONAL STABILITY **8**

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

UNIT V DYNAMIC STABILITY **10**

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

TOTAL 60

TEXT BOOK

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

REFERENCES

1. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, New York, 1912.
2. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1910.
3. Dommasch, D.O., Shelby, S.S., and Connolly, T.F., "Aeroplane Aero dynamics", Third Edition,
4. Issac Pitman, London, 1911.4. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 1991

GOAL

To have introduction of advanced propulsion system

OBJECTIVES

The course should enable the students to :

1. To study about the turbines and its performance for various conditions.
2. To study the basics of ramjet and scramjet with their performance characteristics
3. To study the types of rockets and their working principles
4. To study about chemical rockets and propellants used in chemical rockets.
5. To study the advances in rocket propulsion and space propulsion

OUTCOME

The students should be able to:

1. To understand the working of turbine, blade profiles, performance, cooling methods in turbine blades and its limitations.
2. To understand the operating principle of ramjet, combustion and its performance. Basics of scramjet engine and integral ram engine.
3. To understand the rocket operating principles. Rocket nozzle classifications and performance of rockets.
4. To understand in detail about solid and liquid propellant rockets and the various types of propellants used with their grain structure and their burning rates.
5. To understand about electric, ion and nuclear rockets. The basics of solar sails and its operating principle.

UNIT I AIRCRAFT GAS TURBINES

13

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

12

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

UNIT III FUNDAMENTALS OF ROCKET PROPULSION **12**

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

UNIT IV CHEMICAL ROCKETS **15**

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

UNIT V ADVANCED PROPULSION TECHNIQUES **8**

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

Total 60

TEXT BOOKS

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5thEdn. 1993.
2. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison - Wesley Longman INC, 1999.

REFERENCES

1. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., "Gas Turbine Theory", Longman Co., ELBS Ed., 1919.
2. Gorden, C.V., "Aero thermodynamics of Gas Turbine and Rocket Propulsion", AIAA Education Series, New York, 1919.
3. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi, 1911.

GOAL

To understand the basic concepts of flight control system.

OBJECTIVES

The course should enable the students to :

1. Study and solve problems on Simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies.
2. Study and solve problems on Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph.
3. Study and solve problems on Response of systems to different inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.
4. Study and solve problems on Routh - Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.
5. Study about digital control system, Digital Controllers and Digital PID Controllers.

OUTCOME

The students should be able to :

1. The Simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies based problems.
2. The Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph and problems based on it.
3. The Response of systems to different inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit and problems based on it.
4. The Routh - Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response and problems based on it.
5. The digital control system, Digital Controllers and Digital PID Controllers.

UNIT I INTRODUCTION

6

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

UNIT II OPEN AND CLOSED LOOP SYSTEMS

6

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

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS 10

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

UNIT IV CONCEPT OF STABILITY 15

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

UNIT V SAMPLED DATA SYSTEMS 8

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

TOTAL 45

TEXT BOOKS

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

REFERENCES

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

GOAL

To develop the basic concept of aircraft design by assigning each student a preliminary specification to design an airplane or helicopter or any flight vehicle.

OBJECTIVES

The course should enable the students to :

1. To compare different configuration of airplanes on Specifications and performance details of aircraft.
2. To prepare comparative data sheets.
3. To compare different graph and selection of main parameters for the design.
4. To calculate the preliminary weight estimations, power plant selection, airfoil selection, wing tail and control surfaces.
5. To estimate the drag of the aircraft.

OUTCOME

The students should be able to :

1. See how aircraft design changes from one mission to another.
2. Based upon the mission of the aircraft the students designated for a collection of data are collected from different aircraft having the same mission as selected by the student.
3. Calculate the main design parameter for the aircraft is selected.
4. Give the approximate weight of the aircraft that they design by specifying the different types of weight of the aircraft, the types of power plant selected as well as aerofoil selection and tail empennage.
5. Estimate the overall drag of the newly designed aircraft for further calculation on performance of the aircraft.

LIST OF EXPERIMENTS

1.	Comparative configuration study of different types of airplanes	6
2.	Comparative study on specification and performance details of aircraft	3
3.	Preparation of comparative data sheets	3
4.	Work sheet layout procedures	6
5.	Comparative graphs preparation and selection of main parameters for the design	3
6.	Preliminary weight estimations, selection of main parameters,	3
7.	Power plant selection, Aerofoil selection, Wing tail and control surfaces	6

8. Preparation of layouts of balance diagram and three view drawings 6
9. Drag estimation, Weight calculation and v-n diagram 3
10. Detailed performance calculations and stability estimates 6

Total 45

LIST OF EQUIPMENTS

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

ELA331

(Common to all Undergraduate Third-year Branches)

SEMESTER VI – 2015-2016

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UNIT – I 9

Listening and typing – Listening and sequencing of sentences – Filling in the blanks – Listening and answering the questions - Filling in the blanks - Cloze Exercises – Vocabulary building – Reading and answering questions.

UNIT – II 9

Phonetics: Intonation – Ear Training – Correct Pronunciation – Sound recognition exercises -Common Errors in English - Conversations: Face to Face Conversation - Telephone conversation –Role play activities (Students take on roles and engage in conversation)

UNIT – III 9

Resume / Report presentation / Letter writing - Structuring the resume / report – Letter writing / E-mail communication Samples, Presentation Skills - Elements of an effective presentation – Structure of a presentation – Presentation tools – Voice Modulation – Audience analysis – Body Language – Video Samples

UNIT – IV 9

Soft Skills - Time Management – Articulativeness – Psychometrics – Innovation and Creativity – Stress Management & Poise – Video Samples, Group Discussion - Why is GD part of selection process? – Structure of a GD – Moderator – led and other GDs – Strategies in GD – Team work – Body Language – Mock GD – Video Samples

UNIT – V 9

Interview Skills - Kinds of Interviews – Required key Skills – Corporate culture – Mock Interviews – Video Samples

References:

Books:

1. Meenakshi Raman and Sangeetha Sharma: Technical Communication – Principles and Practice, Oxford University Press, New Delhi (2004)
2. Barker. A –Improve your communication Skills – Kogan Page India Pvt. Ltd., New Delhi (2006)

3. John Seely, The Oxford Guide to writing and speaking. Oxford University Press, New Delhi (2004).
4. M. Ashraf Rizan: Effective technical communication, Tata Mcgraw Hill company Ltd (2005)

CD's

1. Communication skills Software by Globarena
2. Train2success series: 1. Telephone Skills, 2. Interview Skills, 3. Negotiation Skills by Zenith Global Consultants Ltd, Mumbai
3. 21 Steps to Personality Development by SP software (P) Ltd, Hyderabad.

Mode of Examination: **Online examination, Group Discussion and Presentation**

AEB351 AERO ENGINE REPAIR & MAINTENANCE LABORATORY

L T P C

0 0 3 1

GOAL

To make the students to understand the maintenance and repair procedures of both Piston and Gas Turbine Engines and their procedures followed for overhaul of aero engines.

OBJECTIVES

The course should enable the students to :

1. Understand the procedure for stripping of piston engines
2. Know the detailed procedure for cleaning, inspection & NDT checks on Piston engine components.
3. Understand the procedure & Precautions of Piston engine Re-assembly.
4. Know the detailed procedure for stripping of Aircraft Gas Turbine Engine(APU)
5. To familiarise with various checks carried out on Aircraft Gas Turbine Engine components
6. To know the procedure and precautions to be followed for Re-assembly of an APU.
7. To study the Piston and Gas Turbine Engine starting procedure.
8. Study of different types of propellers and its pitch setting.

OUTCOMES

The students should be able to :

1. Carry out stripping of aircraft piston engine as per standard procedure.
2. Carry out dimensional check and NDT checks on piston engine components.
3. Carry out Piston engine Re-assembly as per standard procedure.
4. Carryout stripping of APU with proper precautions.
5. Carryout NDT checks and dimensional checks on Aircraft Gas Turbine Engine components.
6. Carry out re-assembly of an APU as per standard procedures.
7. Understand the precautions of Aero engine with precautions.
8. Describe the types of propeller and it's pitch setting.

LIST OF EXPERIMENTS

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

Total 45

LIST OF EQUIPMENTS

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



SEMESTER – VII

AEB402 COMPOSITE MATERIALS AND STRUCTURES

L T P C

3 0 0 3

GOAL

Analysis and design of composite structures using moulding methods of construction, fabrication to evaluate and understand the concept of laminated plates.

OBJECTIVES

The course should enable the students to :

1. Know the types of composites
2. Understand the need for stress strain relation
3. Understand the laminated plates
4. Study of sandwich structures & analysis of composite materials.
5. Understand the fabrication methods

OUTCOMES

The students should be able to :

1. Understanding various types of composite & its properties.
2. Should do microscopic and macroscopic analysis
3. Should be able to construct and analysis different composite technique
4. Should analyze sandwich and laminated plates
5. Should be aware of fabrication techniques

UNIT I STRESS STRAIN RELATION

6

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

UNIT II METHODS OF ANALYSIS

12

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

UNIT III LAMINATED PLATES

12

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

UNIT IV SANDWICH CONSTRUCTIONS

8

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

UNIT V FABRICATION PROCESS

7

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

TOTAL 45

TEXT BOOKS

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

REFERENCES

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

GOAL

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

OBJECTIVES

- 1.To introduce role of avionics system and its architecture
- 2.To understand the trends in display technology
- 3.To understand the avionics system design development and integration using simulation tools
- 4.To know modular navigation requirements in avionics
- 5.To study autopilot system principle and its function

OUTCOME

The students should be able to:

1. Use his general awareness for design and fabrication of modern aircraft cockpit.Appreciate the need for avionics and Role of avionics
2. Identify various cock pits in real time
3. Should identify the real time applications of Data bus and in aircraft
4. Awareness of communication and navigation systems and their applications.
5. Apply basic concepts of autopilotand its function.

UNIT - I INTRODUCTION TO AVIONICS

Role for Avionics in Civil and Military Aircraft systems, Avionics sub-systems and design, defining avionics System/subsystem requirements-importance of 'ilities', Avionics system architectures

UNIT - II AVIONICS SYSTEM ESSENTIALS: DISPLAYS, I/O DEVICES AND POWER

Trends in display technology, Alphanumeric displays, character displays etc., Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS, Synthetic and enhanced vision, situation awareness, Panoramic/big picture display, virtual cockpit-Civil and Military Electrical Power requirement standards, comparing the Military and Civil Requirements and Tips for PowerSystem Design

UNIT - III AVIONICS SYSTEM DATA BUSES, DESIGN AND INTEGRATION

MIL-STD-1553B, ARINC-429, ARINC-629, CSDB, AFDX and its Elements, Avionics system design, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation

UNIT – IV NAVIGATION

Definition – Types of Navigation – Radio Navigation: ADF, DME, VOR, ILS – Inertial Navigation System: Block Diagram Strap down INS – Satellite Navigation: GPS

UNIT – V AUTOPILOT

Autopilot Concepts – Autopilot Function – Flight Director – Follow Route – Fly Heading – Maintain Altitude – BlockDiagram.- Longitudinal Autopilot

TEXT BOOKS

1. Malcrno A.P. and Leach, D.P., "Digital Principles and Application", Tata McGraw-Hill, 1990.
2. Gaonkar, R.S., "Microprocessors Architecture - Programming and Application", Wiley and Sons Ltd., New Delhi, 1990.
3. R.P.G. Collinson, "Introduction to Avionics", Chapman & Hall Publications, 1996.

REFERENCES

1. Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1919.
2. Spitzer, C.R., "Digital Avionic Systems", Prentice Hall, Englewood Cliffs, N.J., USA. 1917.
3. Brain Kendal, "Manual of Avionics", The English Book House, 3rd Edition, New Delhi, 1993.

CYA402 ENVIRONMENTAL SCIENCE AND ENGINEERING

L T P C
3 0 0 3

Objectives

- To make the students aware of the existing natural resources such as forest water resources etc. and to educate them to understand the need for preserving the resources.
- To educate the students about the functions of various ecosystems and biodiversity.
- To provide knowledge on the various aspects of different types of pollution such as air pollution, water pollution, soil pollution etc.
- To give a basic knowledge on the social issues such as global warming, acid rain, ozone layer depletion, nuclear hazards etc. and to educate them about the various Environmental Protection Acts.
- To create an awareness among the present generation about the various aspects of human population and their effect on environment

Outcome

- The students would have understood the effects of over exploitation of water resources, forest resources etc. and their impact on day to day life on earth.
- Knowledge on the functions of several of ecosystems will help the students to design the processes that are ecofriendly.
- Knowledge on the different types of pollution will help the young minds to device Exposure on the issues such as global warming, acid rain, ozone layer depletion, and nuclear hazards will make the students understand the significances of sustainable development and the need to enforce Environmental Acts.
effective control measures to reduce rate of pollution.
- Educating on the various aspects of population explosion will create awareness on population control for effective utilization of the resources and the need to explore new alternate energy resources for a healthy environment.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

10

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMS AND BIODIVERSITY

14

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Field study of common plants, insects, birds- Field study of simple ecosystems – pond, river, and hill slopes, etc.

UNIT III ENVIRONMENTAL POLLUTION

8

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Soil waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Field Study of local polluted site – Urban / Rural / Industrial / Agricultural

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

7

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

TOTAL : 45

TEXT BOOKS

1. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co., 1971.
3. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, 1999.
4. Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-Science Publications, 1998.

REFERENCES

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India, 2004.
2. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
4. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelph

GOAL

This laboratory is divided into three parts to train the students to learn about basic digital electronics circuits, programming with microprocessors, design and implementation of data buses in avionics with MIL - Std. 1553-B and remote terminal configuration and their importance in different applications in the field of Avionics.

OBJECTIVES

The course should enable the students to :

1. Understand the addition, subtraction of binary numbers using logic gates.
2. To know about the multiplexer and demultiplexer circuits, encoder and decoder circuits.
3. To understand the addition, subtraction for 8-bit and 16-bit numbers using microprocessor.
4. To understand the ascending and descending order of data in microprocessor.
5. To understand the series with or without carry in microprocessor.
6. To understand the avionics data bus MIL STD. 1553-B.

OUTCOME

The students should be able to :

1. Describe the logic gates and truth table for addition, subtraction.
2. Carry out the multiplexer and demultiplexer, encoding and decoding circuits in digital electronics.
3. Understand the addition, subtraction concepts and storing the data in microprocessor.
4. Understand the data flow by ascending or descending order.
5. Understand how the microprocessor handles the carry data.
6. Understand the avionics data bus MIL STD. 1553-B and how the data's are transmitting and receiving.

LIST OF EXPERIMENTS**DIGITAL ELECTRONICS****15**

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

MICROPROCESSORS**20**

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

by Digital to Analog Converter.

AVIONICS DATA BUSES

10

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

Total 45

LIST OF EQUIPMENT

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

GOAL

To get the practical knowledge and "On-HAND" experience in maintenance of various aircraft systems and common snags rectification procedure un various aircraft system.

OBJECTIVE

The course should enable the students to :

1. Understand the aircraft jacking up procedure and its precaution.
2. Understand the various methods of aircraft levelling and its procedure.
3. Understand the various check to be carried out to ensure the alignment of control surfaces.
4. Know the procedure and precaution of aircraft symmetry check.
5. Understand the various test carried out on hydraulic system components to assess leakage and blockage.
6. Know the procedure for carrying out the landing gear retraction test.
7. Understand the various common snags in aircraft hydraulic and fuel systems and its rectification procedure.

OUTCOME

The students should be able to :

1. Carry out aircraft jacking safely without any damage to men equipment.
2. Carry out aircraft levelling as per procedure.
3. Describe the various checks to be carry out to ensure the alignment of control surfaces.
4. Carryout aircraft symmetry check, as per procedure.
5. Carryout flow test, and pressure test on hydraulic system.
6. Describe the procedure for landing gear retraction test and various precautions to be undertaken before carrying out the test.
7. Carry out rectification of comon snags in aircraft hydraulic system as per procedure.

LIST OF EXPERIMENTS

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

Total 45

LIST OF EQUIPMENTS

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

Engineering Elective Courses (Semester V)

AED320 AIR TRANSPORTATION AND AIRCRAFT MAINTENANCE

L T P C

3 0 0 3

GOAL

To study the concepts of air transportation and the maintenance management of aircraft

OBJECTIVES

The course should enable the students to :

1. Know about fundamentals of Air Transportation
2. Understand the Airline Economics
3. Understand the Principles of Airline Scheduling
4. Study the Aircraft Reliability
5. Study the Technology in Aircraft Maintenance

OUTCOME

The students should be able to understand :

1. The developments and organization structure of an Airline
2. The Fleet planning, the aircraft selection process, operating cost , Valuation & Depreciation etc.,
3. The Flight operations, and crew scheduling and details about Flight planning.
4. The Maintenance schedule & its determinations
5. The Air traffic control and Navigation aids

UNIT I INTRODUCTION

8

Development of air transportation, comparison with other modes of transport - Role of IATA, ICAO - The general aviation industry airline - Factors affecting general aviation, use of aircraft, airport: airline management and organisation - levels of management, functions of management, Principles of organisation planning the organisation - chart, staff departments & line departments.

UNIT II AIRLINE ECONOMICS

10

Forecasting - Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. - Passenger fare and tariffs - Influence of geographical, economic & political factors on routes and route selection.

FLEET PLANNING: The aircraft selection process - Fleet commonality, factors affecting choice of fleet, route selection and Capital acquisition - Valuation & Depreciation - Budgeting, Cost planning - Aircrew evaluation - Route analysis - Aircraft evaluation.

UNIT III PRINCIPLES OF AIRLINES SCHEDULING

10

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule - hub & spoke scheduling, advantages / disadvantages & preparing flight plans - Aircraft scheduling in line with aircraft maintenance practices.

UNIT IV AIRCRAFT RELIABILITY**9**

Aircraft reliability - The maintenance schedule & its determinations - Condition monitoring maintenance - Extended range operations (EROPS) & ETOPS - Ageing aircraft maintenance production.

UNIT V TECHNOLOGY IN AIRCRAFT MAINTENANCE**8**

Airlines scheduling (with reference to engineering) - Product support and spares - Maintenance sharing - Equipments and tools for aircraft maintenance - Aircraft weight control - Budgetary control.

On board maintenance systems - Engine monitoring - Turbine engine oil maintenance - Turbine engine vibration monitoring in aircraft - Life usage monitoring - Current capabilities of NDT - Helicopter maintenance - Future of aircraft maintenance.

TOTAL 45**TEXT BOOKS**

1. FEDRIC J.H., "Airport Management", 2000.
2. C.H. FRIEND, "Aircraft Maintenance Management", 2000.

REFERENCES

1. GENE KROPF, "Airline Procedures".
2. WILSON& BRYON, "Air Transportation".
3. PHILIP LOCKLIN D, "Economics of Transportation".
4. "Indian Aircraft manual" - DGCA Pub.
5. ALEXANDER T WELLS, "Air Transportation", Wadsworth Publishing Company, California, 1993.

GOAL

Computer Integrated Manufacturing aims in portraying the flexible manufacturing system and the ability of user to interact with the system to increase the production by software interfacing.

OBJECTIVE

The course should enable the students to :

1. Understand the basic components of CIM, product planning and production management
2. Know the application of Group technology and CAD/CAM, CAPP process
3. Know the Shop floor control and SIM architecture
4. Know the application of CMS in data communication systems
5. Understand the open system databases for CIM industry.

OUTCOME

The students should be able to :

1. Able to understand the CIM wheel and the sequences to be followed while manufacturing a product in industry
2. Able to work in the CAD ,CAMP softwares for the product design
3. Can understand the shop floor management and CIMOSA for effective production management
4. Be clear in the steps involved in CMS data communication systems while handling a product
5. Apply the concepts of open system database for effective and efficient product management.

UNIT I INTRODUCTION

8

The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems- manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

10

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems- facility design using G.T. - benefits of G.T. - cellular manufacturing.

Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems.

UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

9

Shop floor control-phases -factory data collection system -automatic identification methods- Bar code technology-automated data collection system.

FMS-components of FMS - types -FMS workstation -material handling and storage systems- FMS layout -computer control systems-application and benefits.

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION

10

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram
CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture-
Product data management-CIM implementation software.

Communication fundamentals- local area networks -topology -LAN implementations -
network management and installations.

UNIT V OPEN SYSTEM AND DATABASE FOR CIM

8

Open systems-open system inter connection - manufacturing automations protocol and
technical office protocol (MAP /TOP).Development of databases -database terminology-
architecture of database systems-data modeling and data associations -relational data bases -
database operators - advantages of data base and relational database.

TOTAL 45

TEXT BOOK

1. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.

REFERENCES

1. Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill, 1913.
2. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1916.
3. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
4. Roger Hanman "Computer Intergrated Manufacturing", Addison - Wesley, 1997.
Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1991.
5. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
6. Radhakrishnan P, SubramanyanS.and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

Engineering Elective Courses (Semester VI)

GOAL:

1. To study advanced terminology, models and prototypes of operational aspects of UAV.
2. To learn the UAV system in term of Robotics, Devices Simulation and Operational Regimes

UNIT - I INTRODUCTION

8

General group – Military robotics history – Military robotics history Operations –Civil robotics history –Civil robotics history operations– Design Considerations -Acquisition & Life Cycle Costs – UGV Architecture - UGV Components – Ground Vehicle concepts –Payloads and sensors

UNIT – II TYPES AND ROLES

8

Categories/Classification –Small size UGV –Large UGV –Law Enforcement Usage –Future Combat System(FCS) –FCS plan and overview –FCS current situation

UNIT-III SENSORS AND CHARACTERISTICS

15

Sensor Acquisition -Optical (EO) -Infrared (IR) -Multi Spectral Imaging (MSI) -Hyper Spectral Imaging (HSI) -Laser Detection & Ranging (LIDAR) -Synthetic Aperture Radar (SAR) -UGV Perception concept -Environmental and Weather Effects -Sensor integration - Future Sensor Trends Control Definitions -Low Level Control (LLC) -High Level Control (HLC) -Vision and sensing -Automatic control functionality -Autonomous control functionality -Advanced AI Applications -Intelligent Control Techniques

UNIT-IV CASE STUDY AND OPERATIONAL SYSTEM DESIGN CONSIDERATIONS 20

The Need for Alternative Propulsion -Alternative Power Trends & Forecast -Energy Storage Methods & Density -Fuel Cell Basics & UGV Integration -Fuel Cells Used in Current UGVs - Hybrid Power train -Future UGV power train Designs -UGV Design Considerations -Platform Design Process -Navigation and Control -Propulsion Considerations -Communication issues - Manoeuvrability and Stability -Ground Control Station -Support / peripheral equipment - Mobility and Transportability -Current State of Communication -Future Needs of Communication -Line of Sight Fundamentals -Beyond Line of Sight

UNIT –V HUMAN MACHINE INTERFACE

9

Human Factors Engineering -Human Machine Interface -Voice Recognition & Control -Brain Computer Interface -Health and Maintenance -Diagnostics -Recovery methods -Health monitoring -Safety module -Remote maintenance Adaptation and Learning -Adaptation - Learning -Programming -Optimization Special Features

Total: 60

Text Books:

1. Handbook of Military Industrial Engineering, Adedeji B. Badiru, Marlin U. Thomas – 2009: ISBN 1420066293.
2. Human-robot Interactions in Future Military Operations,Michael Barnes, Florian Jentsch – 2010: ISBN 1409486354.
3. Computer Safety, Reliability, and Security, Erwin Schoitsch –2010 : ISBN 3642156509.

AED351 THEORY OF ELASTICITY

L T P C

3 0 0 3

UNIT I: INTRODUCTION & BASIC EQUATIONS OF ELASTICITY

DEFINITION AND NOTATION: Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.

STRAIN AT A POINT: Compatibility Equations, Principal Strains, Generalised Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems.

UNIT II: PLANE STRESS AND PLANE STRAIN PROBLEMS

TWO DIMENSIONAL PROBLEMS: Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure.

UNIT III: POLAR CO-ORDINATES

GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATES: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration.

UNIT IV: TORSION

STRESSES IN AN INFINITE PLATE (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.

TORSION OF CIRCULAR, ELLIPTICAL AND TRIANGULAR BARS: membrane analogy, torsion of thin open sections and thin tubes.

UNIT V: THERMAL STRESSES AND UNIQUENESS THEOREMS

THERMAL STRESSES: Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs and in long circular cylinder, sphere.

UNIQUENESS THEOREM: Principle of super position, reciprocal theorem, saint venant principle

Total 45 Hrs

Text Books:

1. **Advanced Mechanics of solids**, L. S. Srinath, Tata Mc. Graw Hill, 2003
2. **Theory of Elasticity**: S. P. Timoshenko and J. N Gordier, Mc. Graw Hill International, 3rd edition, 1972

Reference Books:

1. **Theory of Elasticity**: Dr. Sadhu Singh, Khanna Publications, 1988
2. **Elasticity, Theory, Applications & Numericals**: Martin H Sadd, Elsevier. 2005
3. **Applied Elasticity**, Seetharamu & Govindaraju, Interline Publishing
4. **Applied Elasticity**, C.T. WANG Sc. D. Mc. Graw Hill Book Co.

Total 45 Hrs

Text Books:

3. Advanced Mechanics of Solids, L. S. Srinath, Tata Mc. Graw Hill, 2003
4. Theory of Elasticity: S. P. Timoshenko and J. N Gordier, Mc. Graw Hill International, 3rd edition, 1972.

Reference Books:

1. Theory of Elasticity: Dr. Sadhu Singh, Khanna Publications, 1988
2. Elasticity, Theory, Applications & Numericals: Martin H Sadd, Elsevier. 2005
3. Applied Elasticity, Seetharamu & Govindaraju, Interline Publishing
4. Applied Elasticity, C.T. WANG Sc. D. Mc. Graw Hill Book Co.

Engineering Elective Courses (Semester VII)

AED421 WIND TUNNEL TECHNIQUES

L T P C
3 0 0 3

GOAL

Wind tunnel techniques course depicts the types, working and characteristics of wind tunnels in the laboratory. The flow characteristics, flow visualisation in the tunnel are recorded for further observations

OBJECTIVES

The course should enable the students to :

1. Understand the Nondimensional number by Buckingham theorem
2. Differentiate the wind tunnels on the basis of circuit, air flow and working..
3. Know the calibration of a wind tunnel.
4. Understand the pressure and force measurements in wind tunnel.
5. Deduce the flow visualization techniques used in the wind tunnel testing

OUTCOME

The students should be able to :

1. Solve the Buckingham theory to find the SI unit of a parameter
2. Clearly understand the working of Blow down, Indraft tunnels and their specifications
3. Know about horizontal buoyancy, Flow angularities are checked while calibration
4. Know about component axis balance and internal balances are read and understood for the measurements in wind tunnel
5. Get a clear idea about the smoke and tuft flow visualisation procedures in WT testing

UNITI PRINCIPLES OF MODEL TESTING

Buckingham Theorem - Non-Dimensional Numbers -Scale Effect Types of Similarities.

UNIT II WIND TUNNELS**8**

Classification - Special problems of Testing in Subsonic, Transonic, supersonic and hypersonic speed regions - Layouts - sizing and design parameters.

UNIT III CALIBRATION OF WIND TUNNELS**11**

Test section speed - Horizontal buoyancy - Flow angularities - Turbulence measurements - Associated instrumentation - Calibration of supersonic tunnels.

UNIT IV WIND TUNNEL MEASUREMENTS**12**

Pressure and velocity measurements - Force measurements - Three component and six component balances - Internal balances.

UNIT V FLOW VISUALIZATION**8**

Smoke and Tuft grid techniques - Dye injection special techniques - Optical methods of flow visualization.

TOTAL 45**TEXT BOOK**

1. Rae, W.H. and Pope, A. "Low Speed Wind Tunnel Testing", John Wiley Publication, 1914.

REFERENCE

1. Pope, A., and Goin, L., "High Speed wind Tunnel Testing", John Wiley, 1915

AED422 VIBRATIONS AND AEROELASTICITY**L T P C
3 0 0 3****GOAL**

Vibration and Aero elasticity deals with the motion of aircraft motions alongside their interactions and their vibrations.

OBJECTIVES

The course should enable the students to :

1. Understand the SHM and terminologies involved in D Alembert principle of motion
2. Divide vibrations based on parameters and their significance and characteristics
3. Know the multi degree freedom of a system and its importance.
4. Know the natural frequency of a given object by numerical method
5. Understand the application of Aero elasticity and its effects on aircraft components

OUTCOME

The students should be able to :

1. Understand the basics of vibrations and simple harmonic motion.
2. Differentiate types of vibrations according to dampness and particle motion.
3. Clearly understand the need of a multi degree of freedom particle and its characteristics.
4. Solve Rayleigh and Holzer method to find natural frequency of an object.

5. Understand the formation of Aileron reversal, flutter and wing divergence.

UNIT I BASIC NOTIONS **8**

Simple harmonic motion - Terminologies - Newton's Law - D' Alembert's principle - Energy Methods

UNIT II SINGLE DEGREE OF FREEDOM SYSTEMS **12**

Free vibrations - Damped vibrations - Forced Vibrations, with and without damping - support excitation - Vibration measuring instruments.

UNIT III MULTI DEGREES OF FREEDOM SYSTEMS **10**

Two degrees of freedom systems - Static and Dynamic couplings vibration absorber- Principal co-ordinates, Principal modes and orthogonal condition - Eigen value problems.

Hamilton's principle- Lagrangean equation and application - Vibration of elastic bodies- Vibration of strings- Longitudinal, Lateral and Torsional vibrations.

UNIT IV APPROXIMATE METHODS **5**

Rayleigh's and Holzer Methods to find natural frequencies.

UNIT V ELEMENTS OF AEROELASTICITY **10**

Concepts - Coupling - Aero elastic instabilities and their prevention - Basic ideas on wing divergence, loss and reversal of aileron control - Flutter and its prevention.

TOTAL 45

TEXT BOOKS

1. TIMOSHENKO S., "Vibration Problems in Engineering"- John Wiley and Sons, New York, 1993.
2. FUNG Y.C., "An Introduction to the Theory of Aeroelasticity" - John Wiley & Sons, New York, 1995.

REFERENCES

1. BISPLINGHOFF R.L., ASHELY H and HOGMAN R.L., "Aeroelasticity" - Addison Wesley Publication, New York, 1913.
2. TSE. F.S., MORSE, I.F., HUNKLE, R.T., "Mechanical Vibrations", - Prentice Hall, New York, 1914.
3. SCANLAN R.H. & ROSENBAUM R., "Introduction to the study of Aircraft Vibration & Flutter", John Wiley and Sons. New York, 1912.
4. BENSON H.TONGUE, "Principles of Vibration", OxfordUniversity Press, 2000.

GOAL

To understand the basic characteristics of fatigue and creep mechanisms in the aircraft structures.

OBJECTIVES

The course should enable the students to :

1. Understand fatigue load
2. Understand low and high cycle fatigue
3. Understand crack initiation and growth
4. Understand potential energy and surface energy
5. Understand safe life and fail safe design

OUTCOMES

The students should be able to :

1. Become familiar with definitions
2. Analyze for cumulative damage
3. Analyze for crack initiation & crack growth
4. Analyze for strength of cracked bodies
5. Analyze damage tolerant structures

UNIT I FATIGUE OF STRUCTURES

12

S.N. curves - Endurance limit - Effect of mean stress - Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - plastic stress concentration factors - S-N curves for typical notched geometries.

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR

11

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

10

Phase in fatigue life - Crack initiation - Crack growth - Final fracture - Dislocations - Fatigue fracture surfaces.

UNIT IV FRACTURE MECHANICS

15

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

12

Safe life and fail safe design philosophies - Importance of Fracture Mechanics in aerospace structure - Application to composite materials and structures.

TOTAL 60

TEXT BOOKS

1. Prasanth Kumar - "Elements of fracture mechanics" - Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pergamon press. Oxford, 1913.

REFERENCES

1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1919.
2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth& Co., Ltd., London, 1913.

PROFESSIONAL ELECTIVE COURSES

Professional Elective Courses- PE (Semester V)

AEC301 AERO ENGINE MAINTENANCE & REPAIR

GOAL

To make the students to understand the basic concepts of maintenance and repair of both piston and gas turbine engines and the procedures followed for overhaul of aero engines.

OBJECTIVE

The course should enable the students to :

1. Understand the types of piston engines, principle of operation.
2. Know the inspection, maintenance and troubleshooting procedure of aircraft piston engines
3. Understand the piston engine overhaul procedure and engine testing procedure.
4. Familiarize with 112 types of jet engines and its principle of operations.
5. Understand the maintenance troubleshooting, testing procedure of gas turbine engines.
6. Understand the overhaul procedure of aircrafts gas turbine engines.
7. Familiarize with gas turbine engine, health monitoring and corrective methods.

OUTCOME

The students should be able to :

1. Describe the function of each component in piston engines and its materials.
2. Carryout inspections and maintenance checks on aircraft piston engines.
3. Describe the piston engine overhaul procedure.
4. Know the types and function of each component in gas turbine engines.
5. Describe the troubleshooting and rectification procedures of gas turbine engines.
6. Know the overhaul procedures and balancing of gas turbine components.
7. Describe the detail procedure for gas turbine engine, health monitoring.

UNIT I CLASSIFICATION OF PISTON ENGINE COMPONENTS

5

Types of piston engines - Principles of operation - Function of components - Materials used - Details of starting the engines - Details of carburetion and injection systems for small and large engines - Ignition system components - Spark plug details - Engine operating conditions at various altitudes - Maintenance and inspection check to be carried out.

UNIT II INSPECTION OF PISTON ENGINES

8

Inspection and maintenance and troubleshooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.

UNIT III INSPECTION OF PISTON ENGINES

10

Symptoms of failure - Fault diagnostics - Case studies of different engine systems - 1: Tools and equipment requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection - Methods and instruments for non destructive testing techniques - Equipment for replacement of part and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance.

UNIT IV CLASSIFICATION OF JET ENGINE COMPONENTS

12

12 Types of jet engines - Principles of operation - Functions of components - Materials used - Details of starting and operating procedures - Gas turbine engine inspection & checks - Use of instruments for online maintenance - Special inspection procedures : Foreign Object Damage - Blade damage - etc.

Maintenance procedures of gas turbine engines - Trouble shooting and rectification procedures - Component maintenance procedures - Systems maintenance procedures.

Gas turbine testing procedures - test schedule preparation - Storage of Engines - Preservation and de-preservation procedures.

UNIT V OVERHAUL PROCEDURES

10

Engine Overhaul procedures - Inspections and cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting - Procedures for rectification - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

Total 45

TEXT BOOK

1. KROES & WILD, "Aircraft Power plants", 7th Edition - McGraw Hill, New York, 1994.

REFERENCES

1. TURBOMECA, "Gas Turbine Engines", The English Book Store, New Delhi, 1993.
2. UNITED TECHNOLOGIES PRATT & WHITNEY, "The Aircraft Gas turbine Engine and its Operation", (latest edition) The English Book Store, New Delhi.

AEC302 EXPERIMENTAL STRESS ANALYSIS

L T P C
3 0 0 3

GOAL

To determine the stress and strain in materials and structures subjected to static or dynamic forces or loads.

OBJECTIVES

The course should enable the students to :

1. Understand instrumentation concepts
2. Understand optics and its application to photo elasticity
3. Understand strain gauges and their applications
4. Understand significance of NDT Methods.
5. Understand the Concept of two dimensional photo elasticity.

OUTCOME

The students should be able to :

1. Analyze instruments for measurements
2. Awareness of NDT methods
3. Use strain gauge effectively
4. Analyze photo elastic results
5. Estimate the Interpretation of fringe pattern

UNIT I MEASUREMENTS **4**
Principles of measurements, Accuracy, Sensitivity and range of measurements.

UNIT II EXTENSOMETERS **6**

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

UNIT III ELECTRICAL RESISTANCE STRAIN GAUGES **10**

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

UNIT IV PHOTOELASTICITY **10**

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

UNIT V NON - DESTRUCTIVE TESTING **15**

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

TOTAL : 45

TEXT BOOK

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

REFERENCES

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

Professional Elective Courses- PE (Semester VI)

AEC361 COMPUTATIONAL FLUID DYNAMICS

L T P C

3 0 0 3

GOAL

To make the students to understand the basic concepts of fluid dynamics and to get a clear picture of the condition of a flow in real motion.

OBJECTIVES

The course should enable the students to :

1. Understand the basic flow equations, characteristics of mathematical models for a given flow.
2. Know the importance and significance of panel methods
3. Understand the concept of discretization, upwind differencing and implicit explicit solutions
4. Familiarize with Finite element techniques in Computational Fluid dynamics.
5. Familiarize with Finite Volume techniques in Computational fluid analysis.

OUTCOME

The students should be able to :

1. Describe the flow phenomena in a flow field with correspondence with elliptic, parabolic and hyperbolic equations
2. Clearly understand the steps involved in Source and panel methods
3. Describe the upwind concept and its effects in a given flow. Can understand the discretization of a flow model for analysis.
4. Can clearly understand the weighted variational formulae and Galerkin method for finite volume technique.
5. Know the numerical finite volume methods (Runge Kutta method, Lax Wendroff) in Computational analysis.

UNIT I FUNDAMENTAL CONCEPTS

10

Introduction - Basic Equations of Fluid Dynamics - Incompressible Inviscid Flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations - Elliptic, Parabolic and Hyperbolic equations - Well posed problems - discretization of partial Differential Equations - Transformations and grids - Explicit finite difference methods of subsonic, supersonic and viscous flows.

UNIT II PANEL METHODS

7

Introduction - Source panel method - Vortex panel method - Applications.

UNIT III DISCRETIZATION

8

Boundary layer Equations and methods of solution - Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation - Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems - Further advantages of upwind differencing.

UNIT IV FINITE ELEMENT TECHNIQUES

10

Finite Element Techniques in Computational Fluid Dynamics; introduction - Strong and Weak Formulations of a Boundary Value Problem - Strong formulation - Weighted Residual Formulation - Galerkin Formulation - Weak Formulation - Variational Formulation - Piecewise defined shape functions - Implementation of the FEM - The Solution Procedure.

UNIT V FINITE VOLUME TECHNIQUES

10

Finite Volume Techniques - Cell Centered Formulation - Lax - Wendroff Time Stepping -

Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy -. Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques - Central and Up-wind Type Discretization - Treatment of Derivatives.

TOTAL 45

TEXT BOOK

1. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Vols. I and II, Springer - Verlag, Berlin, 1911.

REFERENCES

1. John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer - Verlag, Berlin, 1992
2. Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II. John Wiley & Sons, New York, 1911.
3. Klaus A Hoffmann and Steve T. Chiang. "Computational Fluid Dynamics for Engineers", Vols. I & II Engineering Education System, P.O. Box 20071, W.Wichita, K.S., 67201 - 1071 USA, 1993.
4. Anderson, Jr.D., "Fundamentals of Aerodynamics", McGraw-Hill, 2000.

AEC364 HELICOPTER MAINTENANCE

L T P C
3 0 0 3

GOAL

To make the students to understand the basic concepts of Helicopter maintenance and repair procedures followed for overhauling.

OBJECTIVE

The subject should enable the students to

1. Fundamentals of Helicopter and ground handling of bearings
2. Basic concepts of Head maintenance, vibration tracking of helicopter blades. Flight control systems and mast adjustment concepts
3. Concept of main rotor transmission, spray clutch with importance of torque meter maintenance
4. Importance of power plants and tail rotors servicing and system rigging is executed
5. Basic fuselage maintenance and special hardware requirements

OUTCOME

The students should be able to

1. Helicopter basics are clearly understood and various maintenance procedures are followed
2. Get a clear idea about Head maintenance with flight and mast control systems.
3. Understand the transmission process in helicopter rotor and torque meter working.
4. Power plant rotors and tail rotor working is studied. Concept of rigging is clearly understood.
5. Get an idea about fuselage maintenance procedures with special hardware requirements.

UNIT I HELICOPTER FUNDAMENTALS **5**
Basic directions - Ground handling, bearing - Gears.

UNIT II MAIN ROTOR SYSTEM **9**

Head maintenance - blade alignment - Static main rotor balance - Vibration - Tracking - Span wise dynamic balance - Blade sweeping -Electronic balancing - Dampener maintenance - Counter weight adjustment - Auto rotation adjustments - Mast & Flight Control Rotor - Mast - Stabilizer, dampeners- Swash plate flight control systems collective - Cyclic - Push pull tubes - Torque tubes - Bell cranks - Mixer box - Gradient unit control boosts - Maintenance & Inspection control rigging.

UNIT III MAIN ROTOR TRANSMISSIONS **12**

Engine transmission coupling - Drive shaft - Maintenance clutch - Freewheeling units - Spray clutch - Roller unit - Torque meter - Rotor brake - Maintenance of these components - vibrations - Mounting systems - Transmissions.

UNIT IV POWER PLANTS & TAIL ROTORS **12**

Fixed wing power plant modifications - Installation - Different type of power plant maintenance. Tail rotor system - Servicing tail rotor track - System rigging.

UNIT V AIRFRAMES AND RELATED SYSTEMS **7**

Fuselage maintenance - Airframe Systems - Special purpose equipment.

TOTAL 45

TEXT BOOK

1. JEPPESEN, "Helicopter Maintenance", Jeppesons and Sons Inc., 2000.

REFERENCES

1. "Civil Aircraft Inspection Procedures", Part I and II, CAA, English Book House, New Delhi, 1916.
2. LARRY REITHMIER, "Aircraft Repair Manual", Palamar Books Marquette, 1992.

AEC362 AIRFRAME MAINTENANCE & REPAIR PRACTICES

L T P C
3 0 0 3

GOAL

Airframe Maintenance & Repair deals with the maintenance and safety precautions and procedures of airframe systems and their troubleshooting practices.

OBJECTIVES

The course should enable the students to:

1. Understand the basic steps in welding and soldering, brazing of aircraft components
2. Depict the composite and plastic components maintenance in aircraft industry
3. Gain knowledge about rigging, jacking of aircraft in maintenance hangar. To explain the steps involved in the maintenance process
4. Know about Hydraulic and Pneumatic system.
5. Understand the safety practices in aircraft maintenance and equipment handling

OUTCOME

The students should be able to:

1. Explain the welding, brazing process with the requirements of the process and significance of NDT
2. Understand the various maintenance practices in plastic and composite parts of aircraft
3. Understand the precautionary steps involved in rigging, jacking process.
4. Gain thorough understanding in parts, working methodology of basic aircraft systems.
5. Get a clear idea about safety practices and troubleshooting of an aircraft.

UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS

10

Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing.

SHEET METAL REPAIR AND MAINTENANCE

Inspection of damage - Classification - Repair or replacement - Sheet metal inspection - N.D.T. Testing - Riveted repair design, Damage investigation - reverse technology.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT

10

Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., various repair schemes - Scopes.

Inspection and Repair of composite components - Special precautions - Autoclaves.

UNIT III AIRCRAFT JACKING, ASSEMBLY AND RIGGING 8

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces - Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 10

Trouble shooting and maintenance practices - Service and inspection. - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurisation system, water and waste system. Installation and maintenance of Instruments - handling - Testing

Inspection. Inspection and maintenance of auxiliary systems - Fire protection systems - Ice protection system - Rain removal system - Position and warning system - Auxiliary Power Units (APUs)

UNIT V SAFETY PRACTICES 7

Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting - Theory and practices.

Total 45

TEXT BOOK

1. KROES, WATKINS, DELP, "Aircraft Maintenance and Repair", McGraw-Hill, New York, 1992.

REFERENCES

1. LARRY REITHMEIR, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.
- BRIMM D.J. BOGGES H.E., "Aircraft Maintenance", Pitman Publishing corp. New York, 1940

AEC363 HEAT TRANSFER

**L T P C
3 0 0 3**

GOAL

The course is intended to build up necessary background for understanding the physical behaviour of various modes of heat transfer, like, conduction, convection and radiation

OBJECTIVES

The course should enable the students to :

1. The physical behaviour of various modes of heat transfer, like, conduction, convection and radiation.
2. The application of various experimental heat transfer correlations in engineering calculations.
3. The thermal Analysis and sizing of heat exchangers.
4. The basic concept of mass transfer, its types & its correlations.
5. Study the Heat Transfer problems in aircraft and rocket engine combustion chamber.

OUTCOME

The students should be able to :

1. Understand the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction.
2. Learn to use the basic methods in Conduction. Understand the concept of Lump Parameter analysis and when it is applicable and learn the concepts of boundary layer.
3. Learn to apply various correlation used in Convective Heat Transfer and Understand the concepts of Black Body, Grey Body, View factor, Radiation shielding.
4. Design/size Heat Exchanger and understand the concept of Mass transfer, its types & laws associated with it.
5. Learn to apply various technique used for high speed flow heat transfer.

UNIT I HEAT CONDUCTION

11

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

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

UNIT II CONVECTIVE HEAT TRANSFER

12

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

UNIT III RADIATIVE HEAT TRANSFER

12

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

UNIT IV HEAT EXCHANGERS

13

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

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING

12

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

TEXT BOOKS

1. Yunus A. Cengel., "Heat Transfer - A practical approach", Second Edition, Tata McGraw-Hill, 2002.
2. Incropera. F.P.andDewitt.D.P. " Introduction to Heat Transfer", John Wiley and Sons - 2002.

REFERENCES

1. Lienhard, J.H., "A Heat Transfer Text Book", Prentice Hall Inc., 1911.
2. Holman, J.P. "Heat Transfer", McGraw-Hill Book Co., Inc., New York, 6thEdn., 1991.
3. Sachdeva, S.C., "Fundamentals of Engineering Heat & Mass Transfer", Wiley Eastern Ltd., New Delhi, 1911.
4. Mathur, M. and Sharma, R.P. "Gas Turbine and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1911.

AEC365 Aircraft Navigation Systems

L T P C
3 0 0 3

OBJECTIVES

1. To Introduce The Basic Functional Elements Of Navigation Systems
2. To Introduce The Fundamentals Of Inertial Navigation Systems
3. To Educate On The Tracking And Safety Systems Techniques
4. To Introduce Inertial Sensor Technologies
5. To Introduce Satellite Navigation & Hybrid Navigation

OUTCOMES

1. Understand The Basic Functional Elements Of Navigation Systems
2. Apply the navigation systems to Different co-ordinate systems – Transformation Techniques
3. Understand the tracking and safety systems
4. Understand the various inertial sensor.
5. Apply the INS and GPS integration with loosely and tightly coupled.

UNIT I NAVIGATION SYSTEMS & INERTIAL SENSORS

6

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

UNIT II INERTIAL NAVIGATION SYSTEMS

9

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

UNIT III NAVIGATION, TRACKING AND SAFETY SYSTEMS

12

Global Navigation Satellite Systems - Basic concepts of GPS. Space segment, Control segment, user segment, GPS constellation, GPS measurement characteristics, selective availability (AS), Anti spoofing (AS). Applications of Satellites and GPS for 3D position, Velocity, determination as function of time, Interdisciplinary applications. Regional Navigation Systems- Distress and Safety- Cospas-Sarsat- Inmarsat Distress System- Location-Based service

UNIT IV INERTIAL SENSOR TECHNOLOGIES

9

Gyroscopes, Accelerometers, Feedback Control Technology, Rotating Coriolis Multisensors, Laser Technology and Lightwave Gyroscopes, Vibratory Coriolis Gyroscopes (VCGs), MEMS Technology, Inertial Sensor Models, System Implementation Models, System-Level Error Models.

UNIT V SATELLITE NAVIGATION & HYBRID NAVIGATION

9

Introduction to DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

TOTAL: 45 PERIODS

REFERENCES:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 2nd edition, 1997
2. Global Navigation Satellite Systems, Inertial Navigation, and Integration, 3rd Edition Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone
2. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
3. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
4. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
6. Sen, A.K. & Bhattacharya, A.B. "Radar System and Radar Aids to Navigation", Khanna Publishers, 1988.
7. Slater, J.M. Donnel, C.F.O and others, "Inertial Navigation Analysis and Design", McGraw-Hill.

Professional Elective Courses- PE (Semester VII)

**AEC440 AIRCRAFT GENERAL ENGINEERING MAINTENANCE &
PRACTICES**

**L T P C
3 0 0 3**

GOAL

To understand the various Aircraft engine maintenance procedures and standard tools for

checks in aircraft engine.

OBJECTIVES

The course should enable the students to :

1. Understand the Ground Handling of Aircraft and special procedures such as Mooring, Jacking etc.
2. Study the Air conditioning and pressurization systems
3. Study the safety precautions in aircraft maintenance procedures
4. Study the Various inspections and ATA specifications while Aircraft maintenance
5. Study the Aircraft Hardware systems and their procedures of implementation.

OUTCOME

The students should be able to :

1. The ground handling procedures and types of equipments with special maintenance
2. The ground servicing of sub systems in Aircraft
3. The shop safety, Environment cleanliness in an aircraft materials shop
4. The FAA airworthiness regulations and the checklist involved in each inspection of aircraft
5. The terminology and specifications involved in Aircraft hardware selection. Identification of fluid line fittings.

UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT

10

Mooring, jacking, levelling and towing operations - Preparation - Equipment - precautions - Engine starting procedures - Piston engine, turboprops and turbojets - Engine fire extinguishing - Ground power units.

UNIT II GROUND SERVICING OF VARIOUS SUB SYSTEMS

8

Air conditioning and pressurization - Oxygen and oil systems - Ground units and their maintenance.

UNIT III MAINTENANCE OF SAFETY

5

Shop safety - Environmental cleanliness - Precautions.

UNIT IV INSPECTION

10

Process - Purpose - Types - Inspection intervals - Techniques - Checklist - Special inspection - Publications, bulletins, various manuals - FAR Air worthiness directives - Type certificate Data Sheets - ATA specifications.

UNIT V AIRCRAFT HARDWARE, MATERIALS, SYSTEMS PROCESSES

12

Hand tools - Precision instruments - Special tools and equipments in an airplane maintenance shop - Identification terminology - Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc.) - American and British systems of specifications - Threads, gears, bearings, etc. - Drills, tapes & reamers. - identification of all types of fluid line fittings. Materials, metallic and non-metallic - Plumbing Connectors - Cables - Swaging procedures, tests, Advantages of swaging over splicing.

TOTAL 45

TEXT BOOK

1. KROES WATKINS DELP, "Aircraft Maintenance and Repair" - McGraw-Hill, New York 1993.

REFERENCES

1. A & P MECHANICS, "Aircraft hand Book" - F. A. A. Himalayan Book House, New Delhi, 1996.
2. A & P MECHANICS, "General hand Book" - F. A. A. Himalayan Book House, New Delhi, 1996.

AEC441 FINITE ELEMENT METHOD

L T P C
3 0 0 3

GOAL

Finite Element Method capable of writing to solve different problems such as Boundary value problems, Linear equation to approximate the solution stepwise integration algorithms have to written in Mathematical Script.

OBJECTIVES

The course should enable the students to :

1. Understand the basic steps in finite element method and convergence criteria
2. Discretize the domain in to finite elements and to obtain stiffness matrix for bar, beam and frame elements.
3. Know the plane stress and plane strain problem application in 2d structures.
4. Know the application of isoparametric problems in 3d structures.
5. Understand the application of finite element methods in heat transfer and fluid flow problems.

OUTCOME

The students should be able to :

1. Write flow chart of finite element steps and understand the convergence of the problem
2. Solve stiffness matrix for bar, beam and frame problems using suitable boundary condition.
3. Plane stress and plane strain condition are used to understand 2d structures.
4. Modelling of 2d and 3d structures using isoparametric elements
5. Apply the concepts of finite element methods to solve fluid flow and heat transfer problems.

UNIT I INTRODUCTION

4

Review of basic analysis - Stiffness and Flexibility matrix for simple cases - Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS **12**

Bar, Frame, beam elements - Application to static, dynamic and stability analysis.

UNIT III CONTINUUM ELEMENTS **10**

Various types of 2-D-elements Application to plane stress, plane strain and axisymmetric problems.

UNIT IV ISOPARAMETRIC ELEMENTS **10**

Applications to two and three-dimensional problems.

UNIT V FIELD PROBLEM **9**

Applications to other field problems like heat transfer and fluid flow.

TOTAL 45

TEXT BOOK

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India, Third Edition, 2003.

REFERENCES

1. Reddy J.N. "An Introduction to Finite Element Method", McGraw-Hill, 2000.
2. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw-Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1915.

AEC442 HIGH TEMPERATURE MATERIALS

L T P C
3 0 0 3

GOAL

To learn damage mechanism and failure of components at elevated temperature.

OBJECTIVE

The course should enable the students to :

1. Study creep behaviour and effect of different factors like stress, temporary, strain rate on creep.
2. Study design transient creep, different phenomenon like time hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monk man-Grant relationship.
3. Study fracture and various types and fracture maps for differnt alloys and oxides.
4. Study oxidation and hot corrosion; alloy additions and effect of alloying elements on oxidation and hot-corrosion.
5. Introduce super alloys and various types; different fabrication methods and inter-metallic, high temperature ceramics.

OUTCOME

The students should be able to :

1. Know about creep behaviour, and effect of different factors like stress, temporary, strain rate on creep.
2. Know about design of transient creep, time hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.
3. Know about various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro-void diffusion controlled void growth; fracture maps for different alloys and oxides.
4. Know about Oxidation, Pilling, Bed-worthratio, kinetic laws of oxidation-defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of corrosion.
5. Know about Iron base, Nickel base and Cobalt base super-alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Inter-metallic, high temperature ceramics.

UNIT I CREEP

9

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

UNIT II DESIGN FOR CREEP RESISTANCE

9

Design of transient creep time, expressions of rupture life of creep, Effect of creep on ductile and brittle materials, Monkman-Grant relationship.

UNIT III FRACTURE

9

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, and ductile fracture due to micro void coalescence-diffusion controlled void growth.

UNIT IV OXIDATION AND HOT CORROSION

9

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, methods of combat hot corrosion.

UNIT V SUPERALLOYS AND OTHER MATERIALS

9

Iron base, Nickel base and Cobalt base super alloys, TCP phase, embrittlement, Intermetallics, high temperature ceramics.

TOTAL : 45

TEXT BOOKS

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1915.
2. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

REFERENCES

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1913.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1911.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1915.

AEC443 ROCKET AND MISSILES

L T P C
3 0 0 3

GOAL

To introduce basic concepts of design and trajectory estimation of rocket and missiles, to study the performance of rocket and missiles under various operating conditions and the fundamentals of design concepts.

OBJECTIVE

The course should enable the students :

1. To know the various system of rocket, its functions and operations.
2. To know the working principle and system in rockets.
3. To understand the Aerodynamics of Rockets, Missiles and Airframe Components.
4. To study the Rocket Motion in Free Space and Gravitational Field.
5. Determination of range and Altitude Simple Approximations to Burnout Velocity.
6. To know the Staging and Control of Rockets and Missiles.
7. Selection of Materials for Rockets and Missiles.

OUTCOME

The students should be able to :

1. Design Consideration of liquid Rocket Combustion Chamber.
2. Design Considerations of Igniter and types of igniters.
3. Describe the drag and lift forces acting on rocket and missile. The various methods of
4. Describing Aerodynamic Forces and Moments. Lateral Damping Moment and Longitudinal Moment of a Rocket.
5. Explain the One Dimensional and Two Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields.
6. Explain the description of Vertical and Inclined and Gravity Turn Trajectories. It will give the various methods of thrust determinations and thrust vector control. It will also describe the rockets Separation Techniques.
7. Understanding of selection criteria for materials and Special Requirements of Materials to Perform under Adverse Conditions.

UNIT I ROCKET SYSTEMS**10**

Ignition System in rockets - types of Igniters - Igniter Design Considerations - Design Consideration of liquid Rocket Combustion Chamber, Injector Propellant Feed Lines, Valves, Propellant Tanks 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**13**

Airframe Components of Rockets and Missiles - Forces Acting on a Missile While Passing Through Atmosphere - Classification of Missiles - methods 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**10**

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 Burnout Velocity.

UNIT IV STAGING AND CONTROL OF ROCKETS AND MISSILES**7**

Rocket Vector Control - Methods - Thrust determination - SITVC - Multistaging of rockets - Vehicle Optimization - Stage Separation Dynamics - Separation Techniques.

UNIT V MATERIALS FOR ROCKETS AND MISSILES**5**

Selection of Materials - Special Requirements of Materials to Perform under Adverse Conditions.

TOTAL : 45**TEXT BOOK**

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

REFERENCES

1. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1991.
2. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1912.
3. Parket, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1912.

GOAL

To study the engineering concept of cryogenic and its application in various field.

OBJECTIVES

The course should enable the students to :

1. Study the basics of cryogenic technology and its applications.
2. Study the different properties of cryogenic materials and their process.
3. Study the technique of cryogenic insulation.
4. Study the different methods for storing the cryogenics and instruments used in cryogenics.
5. Study the different cryogenic equipments used for various process.

OUTCOME

The students should be able to :

1. Understand the background of cryogenic technology and its applications.
2. Understand the properties of cryogenic materials and their production.
3. Understand the different methods used for cryogenic insulation.
4. Understand the technique for storing cryogenics.
5. Understand the different cryogenic equipments and their applications.

UNIT I INTRODUCTION TO CRYOGENIC ENGINEERING**10**

Thermo physical and fluid dynamic properties of liquid and gas hydrogen, Thermo physical and fluid dynamic properties of liquid and gas helium, Liquefaction systems of hydrogen and helium gases, Liquefaction systems of hydrogen and helium gases, Refrigeration and liquefaction principals; Joule Thomson effect and inversion curve; Adiabatic and isenthalpic expansion with their comparison

UNIT II PROPERTIES**10**

Cryogenic fluids, Solids at cryogenic temperatures; Superconductivity, Recuperative - Linde - Hampson, Claude, Cascade, Heylandt, Kapitza, Collins, Simon; Regenerative - Stirling cycle and refrigerator, Slova refrigerator, Gifford-McMahon refrigerator, Vuilleumier refrigerator, Pulse Tube refrigerator; Liquefaction of natural gas

UNIT III CRYOGENIC INSULATION**6**

Vacuum insulation, Evacuated porous insulation, Gas filled Powders and fibrous materials, Solid foams, Multilayer insulation, Liquid and vapour Shields, Composite insulations.

UNIT IV STORAGE AND INSTRUMENTATION OF CRYOGENIC LIQUIDS**9**

Design considerations of storage vessel; Dewar vessels; Industrial storage vessels; Storage of cryogenic fluids in space; Transfer systems and Lines for cryogenic liquids; Cryogenic valves in transfer lines; Two phase flow in Transfer system; Cool-down of storage and transfer systems, Measurement of strain, pressure, flow, liquid level and Temperature in cryogenic environment; Cryostats.

UNIT V CRYOGENIC EQUIPMENT

10

Cryogenic heat exchangers - recuperative and regenerative; Variables affecting heat exchanger and system performance; Cryogenic compressors, Pumps, expanders; Turbo alternators; Effect of component inefficiencies; System Optimization, Magneto-caloric refrigerator; 3He-4He Dilution refrigerator; Cryopumping; Cryogenic Engineering applications in energy, aeronautics, space, industry, biology, preservation Application of Cryogenic Engineering in Transport.

TOTAL 45

TEXT BOOK

1. T.M. Flynn, Marcel Dekker., Cryogenic Engineering,

REFERENCES

1. A. Bose and P. Sengupta, "Cryogenics: Applications and Progress", Tata McGraw Hill.
2. J.G. Weisend II, Taylor and Francis , "Handbook of Cryogenic Engineering",
3. R.Barron,"Cryogenic Systems", Oxford University Press.
4. K.D.Timmerhaus and T.M. Flynn, "Cryogenic Process Engineering", Plenum Press.
5. G.G.Haselden,"CryogenicFundamentals", AcademicPress.
6. C.A.Bailey,"AdvancedCryogenics",PlenumPress.
7. R.W. Vance and W.M. Duke , "Applied Cryogenic Engineering", John Wiley & sons.

AEC445 AIRBONE RADAR SYSTEMS

L T P C
3 0 0 3

OBJECTIVES

1. To learn the Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars.
2. To know principles of antennas and propagation as related to radars, also study of transmitters and receivers.

3. To understand principles of flight radar systems , in addition to approach and landing aids as related to navigation.
4. To Explore basic aspects of modern radar systems and design including: Radar cross section, noise, modulation, radar range equation, waveform design.
5. Learn the design of Pulse compression, detection, antennas, propagation, synthetic aperture radar, and miscellaneous general topics.

OUTCOMES

1. Apply the relevant design equations to phased array antennas and detect moving targets , and understand the advantages and constraints of tracking radars
2. Derive and discuss the antennas and propagation as related to radars
3. Use of flight radar systems, in addition to approach and landing aids as related to navigation
4. Apply the relevant design equations of Radar cross section, noise, modulation, radar range equation
5. Understand the design of antennas, propagation, synthetic aperture radar signals and FM radar

UNIT I INTRODUCTION TO RADAR EQUATION

9

Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar – Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations

UNIT II MTI AND PULSE DOPPLER RADAR

9

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks – Digital MTI Processing – Moving Target Detector – Limitations to MTI Performance – MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy – Low-Angle Tracking – Tracking in Range – Other Tracking Radar Topics -Comparison of Trackers – Automatic Tracking with Surveillance Radars (ADT).

UNIT III DETECTION OF SIGNALS IN NOISE

9

Matched –Filter Receiver –Detection Criteria – Detectors –Automatic Detector – Integrators – Constant-False-Alarm Rate Receivers – The Radar operator – Signal Management – Propagation Radar Waves – Atmospheric Refraction -Standard propagation – Nonstandard Propagation – The Radar Antenna – Reflector Antennas – Electronically Steered Phased Array Antennas – Phase Shifters – Frequency-Scan Arrays Radar Transmitters and Receivers – Introduction –Linear Beam Power Tubes – Solid State RF Power Sources – Magnetron – Crossed Field Amplifiers – Other RF Power Sources – Other aspects of Radar Transmitter.– The Radar Receiver – Receiver noise Figure – Super heterodyne Receiver – Duplexers and Receiver Protectors- Radar Displays.

UNIT IV RADIO DIRECTION AND RANGES

9

Introduction – Four methods of Navigation .– The Loop Antenna – Loop Input Circuits – An Aural Null Direction Finder – The Goniometer – Errors in Direction Finding – Adcock Direction Finders – Direction Finding at Very High Frequencies – Automatic Direction Finders – The Commutated Aerial Direction Finder – Range and Accuracy of Direction Finders – The LF/MF Four course Radio Range – VHF Omni Directional Range(VOR) – VOR Receiving Equipment – Range and Accuracy of VOR – Recent Developments.Hyperbolic Systems of Navigation (Loran and Decca) – Loran-A – Loran-A Equipment – Range and precision of Standard Loran – Loran-C – The Decca Navigation System -Decca Receivers – Range and Accuracy of Decca – The Omega System.

UNIT V FLIGHT RADAR SYSTEM

9

History of flight radar-Role of radar in military and civil aircraft-Airborne Radars-Special Radar System & Applications -Aircraft Doppler Stabilization and Navigation-Applications of Doppler Weather Radar-Air Traffic Control radar beacon system-Applications of microwave radar to improve aviation safety & efficiency.

**TOTAL: 45
PERIODS.**

TEXTBOOKS:

1. Merrill I. Skolnik ,” Introduction to Radar Systems”, 3rd Edition Tata Mc Graw-Hill 2003.
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