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ANNA UNIVERSITY:: CHENNAI 600 025
UNIVERSITY DEPARTMENTS

R-2012
B.E. AERONAUTICAL ENGINEERING

I TO VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER – I						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	HS8151	Technical English - I	3	1	0	4
2	MA8151	Mathematics - I	3	1	0	4
3	PH8151	Engineering Physics	3	0	0	3
4	CY8151	Engineering Chemistry	3	0	0	3
5	GE8151	Computing Techniques	3	0	0	3
6	GE8152	Engineering Graphics	2	0	3	4
PRACTICAL						
7	PH8161	Physics Laboratory	0	0	2	1
8	CY8161	Chemistry Laboratory	0	0	2	1
9	GE8161	Computer Practices Laboratory	0	0	3	2
10	GE8162	Engineering Practices Laboratory	0	0	3	2
		TOTAL	**17**	**2**	**13**	**27**

SEMESTER – II						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	HS8251	Technical English II	3	1	0	4
2	MA8251	Mathematics II	3	1	0	4
3	PH8251	Materials Science	3	0	0	3
4	GE8251	Engineering Mechanics	3	1	0	4
5	ME8251	Design Concepts in Engineering	3	0	0	3
6	PR8252	Manufacturing Process	3	0	0	3
PRACTICAL						
7	PR8263	Computer Aided Part and Modeling Laboratory	0	0	3	2
8	PR8264	Conventional Machining Processes Laboratory	0	0	3	2
		TOTAL	**18**	**3**	**6**	**25**

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SEMESTER – III						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	MA8353	Numerical Methods	3	1	0	4
2	AE8301	Fluid Mechanics and Basics of Aerodynamics	3	0	0	3
3	AE8302	Principles of Flight	3	0	0	3
4	AE8303	Thermodynamics and Basics of Propulsion	3	0	0	3
5	AE8351	Solid Mechanics	3	0	0	3
6	EI8305	Electrical and Electronics Engineering	3	0	0	3
PRACTICAL						
7	AE8311	Mechanical Sciences Laboratory	0	0	3	2
8	EI8361	Electrical and Electronic Engineering Laboratory	0	0	3	2
		TOTAL	**18**	**1**	**6**	**23**

SEMESTER – IV						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	MA8357	Transform Techniques and Partial Differential Equation	3	1	0	4
2	GE8351	Environmental Science and Engineering	3	0	0	3
3	AE8401	Aircraft Structures – I	3	0	0	3
4	AE8402	Aircraft Systems and Instruments	3	0	0	3
5	AE8403	Low Speed Aerodynamics	3	0	0	3
6	PR8451	Kinematics and Dynamics of Machines	3	1	0	4
PRACTICAL						
7	AE8411	Aerodynamics Laboratory I	0	0	4	2
8	AE8412	Aircraft Structures Laboratory I	0	0	4	2
		TOTAL	**18**	**2**	**8**	**24**

SEMESTER – V						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	AE8501	Air Breathing Propulsion	3	0	0	3
2	AE8502	Aircraft Flight Mechanics	3	0	0	3
3	AE8503	Aircraft Structures – II	3	0	0	3
4	AE8504	High Speed Aerodynamics	3	0	0	3
5	AE8505	Theory of Vibrations	3	0	0	3
6		Elective – I	3	0	0	3
PRACTICAL						
7	AE8511	Aerodynamics Laboratory II	0	0	4	2
8	AE8512	Aircraft Structures Laboratory II	0	0	4	2
9	AE8513	Propulsion Laboratory	0	0	4	2
		TOTAL	**18**	**0**	**12**	**24**

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SEMESTER – VI						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	**PR8602**	Management Sciences	3	0	0	3
2	AE8601	Aircraft Stability and Control	3	1	0	4
3	AE8602	Hypersonic and Rocket Propulsion	3	0	0	3
4	AE8603	Theory of Elasticity	3	0	0	3
5		Elective – II	3	0	0	3
6		Elective – III	3	0	0	3
PRACTICAL						
7	HS8561	Employability Skills	0	0	2	1
8	AE8611	Aircraft Design Project I	0	0	4	2
		TOTAL	**18**	**1**	**6**	**22**

SEMESTER – VII						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1	AE8701	Composite Materials and Structures	3	0	0	3
2	AE8702	Computational Fluid Dynamics for Aeronautical applications	3	0	0	3
3	AE8703	Finite Element Method	3	0	0	3
4		Elective – IV	3	0	0	3
5		Elective – V	3	0	0	3
6		Elective – VI	3	0	0	3
PRACTICAL						
7	AE8712	FEM Laboratory	0	0	4	2
8	AE8711	Aircraft Design Project II	0	0	4	2
		TOTAL	**18**	**0**	**8**	**22**

SEMESTER – VIII						
S.NO.	**CODE NO.**	**COURSE TITLE**	**L**	**T**	**P**	**C**
THEORY						
1		Elective – VII	3	0	0	3
2		Elective - VIII	3	0	0	3
PRACTICAL						
3	AE8812	UAV Design Laboratory & Flight Training Laboratory	0	0	2	1
4	AE8811	Project Work	0	0	12	6
		TOTAL	**6**	**0**	**14**	**13**

TOTAL NUMBER OF CREDITS :180

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LIST OF ELECTIVES

S. No.	Code No.	COURSE TITLE	L	T	P	C
1	AE8001	Aero elasticity	3	0	0	3
2	AE8002	Aircraft Design	3	0	0	3
3	AE8003	Aircraft Engine Repairs and Maintenance	2	0	2	3
4	AE8004	Aircraft Rules and Regulations – CAR I and II	3	0	0	3
5	AE8005	Aircraft System Engineering	3	0	0	3
6	AE8006	Airframe Repair and Maintenance	3	0	0	3
7	AE8007	Approximate Methods in Structural Mechanics	3	0	0	3
8	AE8008	Avionics Systems	3	0	0	3
9	AE8009	Boundary Layer Theory	3	0	0	3
10	AE8010	Combustion in Aerospace Vehicles	3	0	0	3
11	AE8011	Design of Gas Turbine Engine Components	3	0	0	3
12	AE8012	Elements of Heat Transfer	3	0	0	3
13	AE8013	Experimental Fluid Mechanics	3	0	0	3
14	AE8014	Fatigue and Fracture Mechanics	3	0	0	3
15	AE8015	Fundamentals of Control Engineering	3	0	0	3
16	AE8016	Hypersonic Aerodynamics	3	0	0	3
17	AE8017	Industrial Aerodynamics	3	0	0	3
18	AE8018	Principles of Helicopter Aerodynamics	3	0	0	3
19	AE8019	Rockets and Missiles	3	0	0	3
20	AE8020	Satellite Technology	3	0	0	3
21	AE8021	Space Mechanics	3	0	0	3
22	AE8022	Structural Dynamics	3	0	0	3
23	AE8023	Theory of Plates	3	0	0	3
24	AE8024	UAV System Design	3	0	0	3
25	AE8025	Wind Engineering	3	0	0	3
26	AE8026	Wind Tunnel techniques	3	0	0	3
27	AE8071	Experimental Stress Analysis	3	0	0	3
28	GE8071	Fundamentals of Nanoscience	3	0	0	3
29	GE8751	Engineering Ethics And Human Values	3	0	0	3
30	MG8654	Total Quality Management	3	0	0	3
31	ME8081	Reliability Concepts in Engineering	3	0	0	3
32.	GE8072	Disaster Management	3	0	0	3
33.	GE8073	Human Rights	3	0	0	3

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HS8151	TECHNICAL ENGLISH I (For all branches of B.E / B.Tech programmes)	L T P C 3 1 0 4

OBJECTIVES

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology students.
- To ensure that students use the electronic media such as interne and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); **Speaking -** Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; **Reading -** Skimming a reading passage – Scanning for specific information - Note-making; **Writing -** Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); **Grammar -** Prepositions - Reference words - Wh-questions - Tenses (Simple); **Vocabulary -** Word formation - Word expansion (root words / etymology); **E-materials -** Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II

Listening - Listening and responding to video lectures / talks; **Speaking -** Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; **Reading –** Critical reading - Finding key information in a given text - Sifting facts from opinions; **Writing -** Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; **Grammar -** Use of imperatives - Subject-verb agreement; **Vocabulary -** Compound words - Word Association; **E-materials -** Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III

Listening - Listening to specific task - focused audio tracks; **Speaking -** Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); **Reading -** Reading and interpreting visual material; **Writing -** Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause & effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; **Grammar -** Tenses (Past) - Use of sequence words - Adjectives; **Vocabulary -** Different forms and uses of words, Cause and effect words; **E-materials -** Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

Listening - Watching videos / documentaries and responding to questions based on them; **Speaking -** Responding to questions - Different forms of interviews - Speaking at different

types of interviews; **Reading -** Making inference from the reading passage - Predicting the content of a reading passage; **Writing -** Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; **Grammar -** Adverbs – Tenses – future time reference; **Vocabulary -** Single word substitutes - Use of abbreviations & acronyms; **E-materials -** Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

Listening - Listening to different accents, Listening to Speeches / Presentations, Listening to broadcast & telecast from Radio & TV; **Speaking -** Giving impromptu talks, Making presentations on given topics; **Reading -** Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email **Writing -** Creative writing, Poster making; **Grammar -** Direct and indirect speech; **Vocabulary -** Lexical items (fixed / semi fixed expressions); **E-materials -** Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters

TOTAL : 45 PERIODS

OUTCOMES:

Learners should be able to

- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/view and comprehend different spoken discourses/excerpts in different accents

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication skills for students of science and Engineering. Orient Black Swan, Chennai,2011

REFERENCE BOOKS

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. **Technical English: Writing, Reading and Speaking.** New York: Longman, 2001.
2. Bailey, Stephen. **Academic Writing: A practical guide for students.** New York: Rutledge, 2011.
3. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering.** Reading: Garnet Publishing Limited, 2008.
4. Thorn, Michael and Alan Badrick. **An Introduction to Technical English.** Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf. **Effective Technical Communication.** New Delhi: Tata McGraw-Hill PublishingCompany, 2007.

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EXTENSIVE READERS

1. Murthy, Sudha. **Wise & Otherwise**. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. **Business @ the Speed of Thought: Succeeding in the Digital Economy.** New York: Warner Business Books, 2000.

Website Resources

1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

MA8151 MATHEMATICS – I **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **3 1 0 4**

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II INFINITE SERIES **9+3**

Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables –Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV IMPROPER INTEGRALS **9+3**

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals – Area of a curved surface.

TOTAL : 60 PERIODS

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OUTCOMES:

This course equips students to have basic knowledge and understanding in one field of materials, integral and differential calculus

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

REFERENCES:

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8151 ENGINEERING PHYSICS **L T P C**

(Common to ALL Branches of B.E./B.Tech. Programmes) **3 0 0 3**

OBJECTIVE:

To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER **9**

Elasticity - Poisson's ratio and relationship between moduli (qualitative) - Stress-strain diagram - factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young's modulus determination - Uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS **9**

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - rate of growth and decay of sound intensity - derivation of Sabine's formula - absorption coefficient and its determination - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics - production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating - industrial applications - NDT - Ultrasonic

UNIT III THERMAL PHYSICS **9**

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law, Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS **9**

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO_2, Nd:YAG and semiconductor lasers - homo junction and hetro junction - construction and working - applications - Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

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UNIT V SOLID STATE PHYSICS **9**

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL : 45 PERIODS

OUTCOMES:

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXT BOOKS:

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications,2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

REFERENCES:

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.
2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151 ENGINEERING CHEMISTRY **L T P C**

(Common to all branches of Engineering and Technology) **3 0 0 3**

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I CHEMICAL THERMODYNAMICS **9**

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY **9**

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

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UNIT III KINETICS AND CATALYSIS 9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis-Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis: Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL : 45 PERIODS

OUTCOMES:

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS

1. P. Kannan and A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India, 2011

REFERENCE BOOKS

1. P.W. Atkins and de Paula Julio, "Physical Chemistry", Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, "Fundamental of Photochemistry" New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai, 2006.

GE8151 COMPUTING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

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UNIT I INTRODUCTION **8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS **10**

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Design C Programs for problems.
- Write and execute C programs for simple applications.

TEXT BOOKS

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, " Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

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GE8152 **ENGINEERING GRAPHICS** **L T P C**
2 0 3 4

OBJECTIVES

To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING **14**

Basic Geometrical constructions, Curves used in engineering practices

Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, **Scales:** Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **14**

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **14**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **14**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **15**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) **3**

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

TEXT BOOKS

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,," Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited ,2008.
5. K. V.Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi,2008.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

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.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO UNIVERSITY EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

PH8161	PHYSICS LABORATORY (common to all branches of B.E./B.Tech. Programmes)	L T P C 0 0 2 1

OBJECTIVES

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

1.	Torsional pendulum	Determination of rigidity modulus of wire and moment of inertia of disc
2.	Non–uniform bending	Determination of young's modulus
3.	Lee's disc	Determination of thermal conductivity of a bad conductor
4.	Potentiometer	Determination of thermo e.m.f. of thermocouple
5.	Air wedge	Determination of thickness of a thin sheet of paper

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6.	i. Optical fibre	Determination of Numerical Aperture and acceptance angle
	ii. Compact disc	Determination of width of the groove using laser
7.	Acoustic grating	Determination of velocity of ultrasonic waves in liquids
8.	Post office box	Determination of Band gap of a semiconductor
9.	Spectrometer	Determination of wavelength using grating
10.	Viscosity of liquids	Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL : 30 PERIODS

OUTCOMES

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

CY8161 **CHEMISTRY LABORATORY** **L T P C**

(Common to all branches of Engineering and Technology) **0 0 2 1**

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1,10- phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics – ester hydrolysis.
13. Corrosion experiment – weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters

REFERENCE BOOKS

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemarker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

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GE8161 **COMPUTER PRACTICES LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

GE8162 **ENGINEERING PRACTICES LABORATORY** **L T P C**
(common to all branches of B.E./B.Tech. Programmes) **0 0 3 2**

OBJECTIVE

To provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE **12**

Plumbing

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

Laying pipe connection to the suction side of a pump – inlet.

Laying pipe connection to the delivery side of a pump – out let.

Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

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Wood Work

Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

Study

Study of joints in door panels, wooden furniture

Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE **9**

Basic household wiring using switches, fuse, indicator – lamp etc.,

Preparation of wiring diagrams

Stair case light wiring

Tube – light wiring

Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS) **15**

3. MECHANICAL ENGINEERING PRACTICE

Welding

Arc welding of butt joints, lap joints, tee joints

Gas welding Practice.

Basic Machining

Simple turning, drilling and tapping operations.

Machine assembly Practice.

Study and assembling the following:

Centrifugal pump, mixies and air conditioners.

Demonstration on

(a) Smithy operations like the production of hexagonal bolt.

(b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE **9**

Soldering simple electronic circuits and checking continuity.

Assembling electronic components on a small PCB and testing.

Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to fabricate carpentry components and pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to fabricate electrical and electronics circuits

HS8251	TECHNICAL ENGLISH II (For all branches of B.E / B.Tech programmes)	L T P C 3 1 0 4

OBJECTIVES

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

UNIT I

Listening - Listening to informal conversations and participating; **Speaking -** Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); **Reading -** Developing analytical skills, Deductive and inductive reasoning - Extensive reading; **Writing -** Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; **Grammar -** Regular & irregular verbs - Active and passive voice; **Vocabulary -** Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); **E-materials -** Interactive exercise on Grammar and vocabulary – blogging; **Language Lab -** Listening to different types of conversation and answering questions.

UNIT II

Listening - Listening to situation based dialogues; **Speaking -** Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); **Reading -** Reading a short story or an article from newspaper, Critical reading, Comprehension skills; **Writing -** Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); **Grammar -** modal verbs, Purpose expressions; **Vocabulary -** Phrasal verbs and their meanings, Using phrasal verbs in sentences; **E-materials -** Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - **Language Lab -** Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III

Listening - Listening to the conversation - Understanding the structure of conversations; **Speaking -** Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); **Reading -** Speed reading – reading passages with the time limit - Skimming; **Writing -** Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; **Grammar -** Conditional clauses - Cause and effect expressions; **Vocabulary -** Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); **E-materials -** Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; **Language Lab -** Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices; **Speaking -** Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping the interview skills; **Reading -** Reading the job advertisements and the profile of the company concerned – scanning; **Writing -** Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; **Grammar -** Numerical expressions - Connectives (discourse markers); **Vocabulary -** Idioms and their meanings – using idioms in sentences; **E-materials -** Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; **Language Lab -** Telephonic interview – recording the responses - e-résumé writing.

UNIT V

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; **Speaking -** Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; **Reading -** Note making skills – making notes from books, or any form of written materials - Intensive reading **Writing -** Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); **Grammar -** Use of clauses; **Vocabulary** – Collocation; **E-materials -** Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; **Language Lab -** Different models of group discussion

TOTAL : 45 PERIODS

OUTCOMES:

Learners should be able to

- Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- Write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- Listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012.
2. S.P. Danavel, English Language Teaching in India, the shifting paradigms, Tata McGraw-Hill Publishing, 2012.

REFERENCE BOOKS

1. Laws, Anne. **Presentations.** Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. **Body Language: A Guide for Professionals.** New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. **Telephoning in English.** Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Ur, Penny. **Teaching Listening Comprehension**. Cambridge: Cambridge University Press, 1984.

Attested

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EXTENSIVE READERS

1. Abdul Kalam, A P J. **Ignited Minds: Unleashing the Power within India.** New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. **C.V.Raman: A Biography.** New Delhi: Penguin Books India, 2011.

WEB RESOURCES

1. www.esl-lab.com
2. www.englishgrammar.org
3. www.englishclub.com
4. www.mindtools.com
5. www.esl.about.com

MA8251 MATHEMATICS II L T P C

(Common to all branches of B.E. / B.Tech. Programmes in II Semester) 3 1 0 4

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS 9+3

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral and volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION 9+3

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions 2 1 $, , , w z c az zz$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 9+3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems –Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem — Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions.

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Students will be able to solve problems related to engineering applications by using these techniques

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES:

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8251 **MATERIALS SCIENCE** **L T P C**

(Common to Manufacturing, Industrial, Mining, Mechanical, Aeronautical, Automobile and Production Engineering) **3 0 0 3**

OBJECTIVE:

To introduce the essential principles of materials science for mechanical and related engineering applications.

UNIT I MECHANICAL PROPERTIES **9**

Introduction to mechanical properties - tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

UNIT II PHASE DIAGRAMS **9**

Solid solutions - Hume Rothery's rules - free energy of solid solution - intermediate phases - The phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the level rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - microstructural change during cooling.

UNIT III FERROUS ALLOYS AND HEAT TREATMENT **9**

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructue of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's law - phase transformations - pearlitic transformations - T-T-T-diagram for eutectoid steel - baintic and martensitic transformations - tempering of martensite - heat treatment of steels - annealing - normalizing - quenching and tempering - case hardening - induction, flame and laser hardening - carburizing, cyaniding, carbonitriding and nitriding.

UNIT IV ELECTRONIC MATERIALS **9**

Classification of solids - energy bands - concept of Fermi level - conductor, semiconductor, insulator - Semiconductors: intrinsic, extrinsic - carrier concentration expression (qualitative) - compound semiconductors (qualitative) - dielectric materials - polarization mechanisms - dielectric breakdown - magnetic materials - ferromagnetic materials &hysterisis - ferrites - superconducting materials, properties, types and applications.

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UNIT V NEW MATERIALS AND APPLICATIONS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the different materials, their processing, and heat treatments in suitable application in mechanical engineering fields.

TEXT BOOK:

1. Raghavan, V., Materials Science and Engineering, Prentice Hall of India, 2007.
2. Palanisamy, P.K., Applied Materials Science, Scitech, 2003.
3. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

REFERENCE BOOKS:

1. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
2. Rajendarn V and Marikani A, Materials Science, Tata McGraw Hill, 2006

GE8251 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVE

To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

UNIT I BASICS AND STATICS OF PARTICLES 9 + 3

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 9 + 3

Free body diagram – Types of supports –Action and reaction forces –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 – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9 + 3

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES **9 + 3**

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

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS **9 + 3**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL: 60 PERIODS (L:45 + T:15)

OUTCOMES:

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004)
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education (2006)
3. J.L.Meriam and L.G.Kraige, " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2,Third Edition, John Wiley & Sons,(1993)
4. Rajasekaran, S and Sankarasubramanian, G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
5. Bhavikatti, S.S and Rajashekarappa, K.G. "Engineering Mechanics", New Age Ingernational (P) Limited Publishers, (1998),
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata Mc grow. Hill Publishing Company. New Delhi (2008)

ME8251 DESIGN CONCEPTS IN ENGINEERING **L T P C 3 0 0 3**

OBJECTIVE:

- To impart the importance of design in today's context of global competition, environmental awareness and customer oriented market.
- To impart the basic concepts and various aspects of design using simple examples and case studies.

UNIT I DESIGN TERMINOLOGY **9**

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT II DESIGN PROCESS **9**

Basic module in design process-scientific method and design method-Need identification, importance of definition of problem-structured problem, real life problem-gathering information-customer requirements – Quality Function Deployment (QFD) – product design specifications-generation of alternative solutions – Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation (Basics only)

UNIT III CREATIVITY IN DESIGN **9**

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) – conceptual decomposition-creating design concepts.

UNIT IV HUMAN AND SOCIETAL ASPECTS **9**

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects-environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects.

UNIT V MATERIAL AND PROCESSES IN DESIGN **9**

Material selection for performance characteristics of materials-selection from new design-substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for manufacturability (DFM) – Design for assembly (DFA).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to comprehend the steps in the new product design
- Understanding of customer equipments for new product and making specifications.
- Knowledge in the role of creativity in product design
- Ability to decide materials and processes in product development.

TEXT BOOKS:

1. George E.Dieter, "Engineering Design, A Materials and Processing Approach" 4th Edition, Tata McGraw Hill, 2008

REFERENCES:

1. Joseph E.Shingley, Charles R. Mische, "Mechanical Engineering Design", McGraw Hill International Edition, 6th Edition 2009.
2. Edward B.Magrab, "Integrated Product and Process Design and Development", CRC Press, 1997
3. James Garratt, "Design and Technology", 2nd Revised Edition, Cambridge University Press, 1996.

PR8252 MANUFACTURING PROCESSES **L T P C 3 0 0 3**

OBJECTIVE :

To learn the basic processes available to make a part/product. Will help the students to select the best manufacturing process based on quality/time/cost/mechanical properties.

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UNIT I CASTING PROCESSES **9**

Comparison of Manufacturing Processes - Pattern – mould, die – Pattern allowances – materials – types – sand – sand moulding – single box – 2 and 3 box moulding – die casting – investment casting – shell moulding – centrifugal casting – continuous casting – core – runner – riser – gate – chaplet – squeeze casting.

UNIT II WELDING PROCESSES **9**

Soldering, brazing and welding – fusion welding gas welding – flame types – process – arc welding – electrode – filler material – flux – edge preparation – joints – position – welding symbol – GMAW – GTAW – resistance welding – spot, seam, butt and projection – stud welding – friction welding – submerged arc welding – electrosleg welding.

UNIT III METAL FORMING PROCESSES **9**

Hot and cold forming – forging – rolling – extrusion – spinning – sheet metal operations – Powder metallurgy – steps – sintering – merits – demerits and applications. Types of dies – Progressive and combination dies – tube bending.

UNIT IV MACHINING PROCESSES **9**

Machine and Machine tool – Lathe types – various operations – Shaper – Planer - Quick return mechanism – drilling – types and operations – milling – types – cutters – operations – gear cutting in milling – grinding – types – grinding wheel – loading – turning & balancing of wheels - CNC machines.

UNIT V PLASTIC MATERIAL PROCESSES **9**

Injection – Blow and rotational moulding – Thermoforming Process - Reinforced plastics and composite materials – Manufacturing of honey comb structure – shaping of ceramics – Transfer moulding – MMC – CMC.

TOTAL : 45 PERIODS

OUTCOMES:

Students will be able

- To describe the difference between the hot and cold working of metals and give the advantages of each.
- To distinguish the types of manufacturing process are suited to producing different shapes of product.
- To analyse the processes are likely to be used for producing a particular product using a specific material or class of material.
- To describe the advantages and disadvantages of the different classes of manufacturing processes.

TEXT BOOKS:

1. Serope Kalpakjian, Steven R. Schmid "Manufacturing Engineering and Technology", Addison Wesley, 2001
2. P.C. Sharma, "A Text Book of Production Technology", S.Chand and Co. Ltd., New Delhi, 1996.

REFERENCE BOOKS:

1. B.H.Amstead, "Manufacturing Processes", Phillip F.Ostwald, L.Begemon, John Wiley and Sons, 8th Edition, 1998.
2. De Garmo, "Materials and Processes in Manufacturing", Prentice Hall of India, 8th Edition, 1998.
3. T.R. Banga, R.L. Agarwal and T.Manghrani, "Foundry Engineering", Khanna Publishers, New Delhi – 1995.
4. P.N.Rao, "Manufacturing Technology – foundry Forging and Welding", Tata McGraw Hill Publishing Co., New Delhi – 1988.

PR8263 COMPUTER AIDED PART MODELING LABORATORY **L T P C**
0 0 3 2

AIM: To impart practical knowledge in modeling.

OBJECTIVES:

- To get hands on experience in modeling of automotive, typical industrial components, etc.
- To practice Solid modeling and geometry creation software.

LIST OF EXPERIMENTS

1. 2 D Modeling of automotive components using Solid modeling software.
2. 3 D Modeling of components using solid modeling software
3. 3 D Modeling of industrial components using solid modeling software.
4. Assembly modeling of typical parts using solid modeling software-1
5. Assembly modeling of typical parts using solid modeling software-2
6. Sheet metal modeling using solid modeling softwares.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to use the software packers for drafting

PR8264 CONVENTIONAL MACHINING PROCESSES LAB **L T P C**
0 0 3 2

OBJECTIVE:

To get hands on experience in the conventional machines.

LIST OF EXPERIMENTS:

1. Study of all the conventions machines – identification of parts / Mechanisms and position of tool and work piece.
2. Facing, Plain turning /Step Turning operations in Lathe.
3. Taper Turning/ Threading, Knurling operations in lathe.
4. Multi start Threading/ Burnishing operations in lathe.
5. Machining to make a cube using shaper.
6. Machining to make a V-Block in shaper.
7. Counter sinking, Counter Boring, Tapping operation in a drilling machine.
8. Surfacing/Pocket Milling in a vertical milling machine.
9. Polygonal shape milling in a horizontal milling machine.
10. Flat surface grinding and cylindrical grinding operations.
11. Machining an internal spline in a slotting mode (To prepare the process planning sheets for all the operations and then follow the sequence during the machining process)
12. To mechanize the given blade using Lathe and milling machines.

TOTAL : 45 PERIODS

OUTCOME

- The student can operate the machines without any problem.
- The student can rectify the faults occurred during the machining processes in real life.

MA8353 **NUMERICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVES:

- To provide the mathematical foundations of numerical techniques for solving linear system, eigen value problems, interpolation, numerical differentiation and integration and the errors associated with them;
- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS **9+3**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION **9+3**

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae – Least square method - Linear curve fitting.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION **9+3**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods - One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

OUTCOMES:

- The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', Prentice Hall of India Private Ltd., New Delhi, 3rd Edition, 2007.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
2. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.
3. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education, New Delhi, 1st print, 2nd Edition, 2009.

AE8301 FLUID MECHANICS AND BASICS OF AERODYNAMICS **L T P C**
3 0 0 3

OBJECTIVE:

- To introduce the basic concepts of fluid statics.
- To make the student understand the basic laws governing fluid motion and its application.
- To give an introduction on fluid machines and aerodynamics.

UNIT I INTRODUCTION TO FLUID MECHANICS **9**

Definition of a fluid – Continuum hypothesis – Fluid properties – Measurement of pressure – Fluid statics – Stability of submerged and floating bodies – Center of pressure – Aerodynamic center.

UNIT II BASIC EQUATIONS **10**

Motion of a fluid particle – Fluid deformation - Velocity and acceleration – Continuity equation - Vorticity – Stream function – Stream line – Velocity potential - Momentum equation and energy equation – Navier stokes equation – Euler equation.

UNIT III INCOMPRESSIBLE INVISCID FLOW **8**

Bernoulli's equation and its Applications — Flow measurement – Orifice meter – Venturi meter – Laplace equation – Circulation – Kelvin's circulation theorem – Starting vortex - Elementary flows.

UNIT IV INCOMPRESSIBLE VISCOUS FLOW **9**

Fully developed laminar flow between parallel plates – Laminar and turbulent flow through pipes – Velocity profiles – Energy considerations in pipe flow – Calculation of head loss in Pipe flow problems – Hydraulic and energy grade lines – Moody's diagram

UNIT V DIMENSIONAL ANALYSIS AND MODEL STUDIES **9**

Dimensional analysis – The Buckingham-Pi theorem – Non-dimensional numbers – Flow similarity and model studies - Real and Ideal flow over a circular cylinder - Impact of jets - Streamlined and blunt bodies.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Exhibit the understanding on fluid properties and fluid statics
- Demonstrate the understanding on fluid kinematics and governing equations
- Have the potential to use the governing equations for fluid flow problems and understand the elementary plane flows.
- Ability to analyse laminar and turbulent flow problems.
- Acquire the knowledge on the various types of fluid machines.

TEXT BOOKS

1. White F.M,. "Fluid Mechanics", 7th Edition, Tata MCGRAW-Hill Education, 2011
2. Robert W Fox & Alan T Mc.Donald, 'Introduction to fluid Mechanics', John Wiley and Sons, 1995
3. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, First Indian Reprint, John Wiley & Sons, 2010.

REFERENCES

1. Yuan S W, 'Foundations of fluid Mechanics', Prentice-Hall, 1987
2. Rathakrishnan, E, 'Fundamentals of Fluid Mechanics', Prentice-Hall, 2007
3. Graebel, W.P. 'Engineering Fluid Mechanics' Taylor and Francis, 2001

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AE8302 **PRINCIPLES OF FLIGHT** **L T P C**
3 0 0 3

OBJECTIVE:

- To introduce the concepts of flying, International standard atmosphere, structural aspects of airplanes, brief description of systems, instruments and power plants used in airplanes.

UNIT I HISTORY OF FLIGHT **8**

Balloon flight – Ornithopters - Early airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II BASICS OF FLIGHT MECHANICS **9**

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics - Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT III AIRCRAFT CONFIGURATIONS **10**

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

UNIT IV AIRPLANE STRUCTURES AND MATERIALS **9**

General types of construction, Monocoque, semi-monocoque and geodesic constructions, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains – Hooke's law – Stress - strain diagrams - elastic constants.

UNIT V POWER PLANTS **9**

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 PERIODS

OUTCOMES:

- Identify the component of Flight
- Identify suitable materials for Aircraft structure
- Perform basic calculation on Mechanics using Newton law for lift, drag and moment.

TEXT BOOKS:

1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995.
2. Stephen.A. Brandt, Introduction to Aeronautics: A design perspective, 2nd Edition, AIAA Education Series, 2004.

REFERENCES:

1. Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997

AE8303 **THERMODYNAMICS AND BASICS OF PROPULSION** **L T P C**
3 0 0 3

OBJECTIVE:

- To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems.
- To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Properties of pure substances
- To enlighten the basic concepts of heat transfer and propulsion cycles.

UNIT I BASIC CONCEPT AND FIRST LAW **9**

Concept of continuum, macroscopic approach, thermodynamic systems –closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth

law or thermodynamics- Concept of temperature and heat. Concept of ideal and real gases First law. Application to closed and open systems, internal energy, specific heat capacities enthalpy, Steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW AND ENTROPY 9

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem. Carnot cycle, reversed Carnot cycle, efficiency, COP Thermodynamic temperature scale. Clausius inequality, concept of entropy, entropy of idea gas, principle of increase of entropy.

UNIT III THERMODYNAMIC AVAILABILITY AND AIR STANDARD CYCLES 9

Basics – Energy in non-flow processes: Expressions for the energy of a closed system - Equivalence between mechanical energy forms and exergy – Flow of energy associated with heat flow – Exergy consumption and entropy generation. Exergy in steady flow processes Expressions for exergy in steady flow processes – Exergy dissipation and entropy generation Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure, Reciprocating compressors.

UNIT IV PROPERTIES OF PURE SUBSTANCE AND POWER CYCLE 8

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and regeneration cycle.

UNIT V BASICS OF PROPULSION AND HEAT TRANSFER 10

Classification of engines - Simple jet propulsion system – Thrust equation – Specific impulse - Ideal and non-ideal cycle analysis. Conduction in parallel, radial and composite wall – Basics o Convective heat transfer - Fundamentals of Radiation heat transfer.

TOTAL: 45 PERIODS

(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

OUTCOMES:

- Apply Mathematical foundations, principles in solving thermodynamics problems.
- Critically analyse the problem, and solve the problems related to heat transfer and propulsion

TEXT BOOKS:

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
2. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2005.

REFERENCES:

1. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
4. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
5. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

AE8351 SOLID MECHANICS L T P C
3 0 0 3

OBJECTIVE:

- To introduce various behavior of structural components under various loading conditions.

UNIT I INTRODUCTION **8**

Definition of stress, strain and their relations – Relations between material constants – Axial loading - Statically determinate and indeterminate problems in tension & compression -Thermal stresses – Impact loading.

UNIT II STRESSES IN BEAMS **10**

Shear force & bending moment diagrams: Bending and shear stress variation in beams of symmetric sections, Beams of uniform strength - beams of two materials.

UNIT III DEFLECTION OF BEAMS **10**

Double integration method – Macaulay's method – moment area method – conjugate beam method – principle of superposition – Maxwell's reciprocal theorem.

UNIT IV TORSION – SPRINGS – COLUMNS **10**

Torsion of solid and hollow circular shafts – shear stress variation – open and closed-coiled helical springs – stresses in helical springs – classification of columns – Euler buckling – columns with different end conditions.

UNIT V BIAXIAL STRESSES **7**

Stresses in thin-walled pressure vessels – combined loading of circular shaft with bending, torsion and axial loadings – Mohr's circle and its construction – determination of principal stresses.

TOTAL: 45 PERIODS

OUTCOMES:

- Solve the problems related to the structural components under various loading conditions

TEXT BOOKS:

1. William Nash, 'Strength of Materials', Tata McGraw Hill, 2004
2. Timoshenko and Young "Strength of Materials" Vol. I & II.

REFERENCES:

1. Dym,C.L., and Shames,I.H., 'Solid Mechanics', McGraw Hill, Kogakusha, Tokyo, 1973.
2. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, Third Edition.
3. Timoshenko,S. and Young,D.H., 'Elements of Strength of Materials', T.Van Nostrand Co. Inc., Princeton, N.J., 1977.

EI8305 ELECTRICAL AND ELECTRONICS ENGINEERING **L T P C 3 0 0 3**

OBJECTIVES:

- To impart the knowledge on basic concepts of electrical circuits and electrical machines.
- To impart the knowledge on basic concepts of electronic components, devices and circuits

UNIT I BASIC CONCEPTS AND DC CIRCUITS **9**

Ohm's law - Electrical resistance - Series /Parallel resistive circuits - Star/Delta transformations - Kirchoff's law - Node and Mesh analysis - Thevenin's and Norton's theorem.

UNIT II A.C.CIRCUITS **9**

RMS and average value of periodic waves - Form factor - Phase and Phase difference - Simple RC.RL and RLC circuits - series and parallel resonance - power and power factor - introduction to three phase systems – power measurement in 3 phase system.

UNIT III D.C. MACHINES **10**

Construction details of DC machines - principle of operation of DC generator - EMF equation - principle of DC motor - Back EMF - Voltage and torque equation - Principle of transformer - construction and type - EMF equation - Tests on transformer - Equivalent circuit - Induction motor - Construction and basic principle of operation - Starting and Running torques.

UNIT IV ELECTRONIC COMPONENTS AND DEVICES **9**

Operating principle and characteristics of Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor - Field Effect Transistors – UJT – SCR.

UNIT V ANALOG CIRCUITS **8**

Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) - properties and typical circuits like differentiator, integrator, summer, comparator.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to use the various electrical machines like AC/ DC, electronic components and applications of analog circuits

REFERENCES:

1. Theraja, B.L., " A Text Books of Electrical Technology ", S.S.Chand and Co., New Delhi, 1998.
2. Edminister J.A., " Theory and Problems on Electric circuits ", McGraw Hill International Edition, 1994.
3. Kosow, I.L., " Electrical Machinery and Transformers ", 4th Edition, Prentice Hall of India, 1991.
4. Nagrath I.J. and Kothari D.P., "Theory and Problems of Basic Electrical Engineering", Prentice Hall of India, 1998.
5. Millman.J. and Grabel.S., Integrated Electronics, Tata McGraw Hill, 1995.
6. Horowits.P. and Hill.W., The Art of Electronics, McGraw Hill, 1995.

AE8311 MECHANICAL SCIENCES LABORATORY **L T P C 0 0 3 2**

OBJECTIVE :

To train the students in testing and quantifying the mechanical properties of Engineering Materials, Engines.

LIST OF EXPERIMENTS:

MATERIAL TESTING LAB

- Tension Test
- Torsion Test
- Testing of springs
- Impact test i) Izod, ii) Charpy
- Hardness test i) Vickers, ii) Brinell, iii) Rockwell, iv) Shore
- Deflection of Beams
- Dye Penetrant Test
- Tensile testing of polymers.
- Flex Fatigue test for Elastomers.
- Injection moulding machine operation.

IC ENGINES LAB

- Performance test on a 4 stroke engine
- Viscosity determination of the given fluid
- Moment of inertia of connecting rod
- Determination of Effectiveness of a parallel and counter flow heat exchangers.
- Valve timing of a 4 stroke engine and port timing of a 2 stroke engine.
- Determination of Flash point and Fire point of the given oil.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply determine the strength materials and thermal properties

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EI8361 ELECTRICAL AND ELECTRONIC ENGINEERING LABORATORY **L T P C**
0 0 3 2

OBJECTIVE :

- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt moor
3. Load test on S Transformer
4. Load test on Induction motor
5. Regulation of 3 Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer
12. RTD and Thermistor
13. Flapper Nozzle system

TOTAL : 45 PERIODS

OUTCOMES:

- The students will gain practical experience in designing robots in Mechatronics approach

MA8357 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS **L T P C**
3 1 0 4

OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Classification of Partial Differential Equations – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous PDE.

UNIT II FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

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UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 9+3

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM 9+3

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

TOTAL: 60 PERIODS

OUTCOMES:

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

REFERENCES:

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 11th Reprint , 2010.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi,7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

GE8351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES

To the study of nature and the facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - 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, hill slopes, etc.

UNIT II 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 municipal solid 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 III NATURAL RESOURCES 10

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 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 – role of non-governmental organization-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 production act – Air (Prevention and Control of

Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- 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 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCE BOOKS

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

AE8401 **AIRCRAFT STRUCTURES – I** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide the students an understanding on the linear static analysis of determinate and indeterminate aircraft structural components.
- To provide the design process using different failure theories.

UNIT I STATICALLY DETERMINATE & INDETERMINATE STRUCTURES 9

Plane truss analysis – Method of joints – Method of sections – Method of shear – 3-D trusses – Principle of super position, Clapeyron's 3 moment equation and moment distribution method for indeterminate beams.

UNIT II ENERGY METHODS 10

Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications. Energy theorems – dummy load & unit load methods –energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.

UNIT III COLUMNS 10

Euler's column curve – inelastic buckling – effect of initial curvature – the Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT IV FAILURE THEORIES 9

Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory.

UNIT V INDUCED STRESSES 7

Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform linear static analysis of determinate and indeterminate aircraft structural components
- Ability to design the component using different theories of failure

TEXT BOOKS:

1. Timoshenko and Gere, `Mechanics of Materials', Tata McGraw Hill, 1993.
2. Megson T M G, `Aircraft Structures for Engineering students' Elsevier Science and Technology, 2007

REFERENCES:

1. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction', McGraw Hill, 1993.
2. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985
3. Peery, D.J. and Azar,J.J., 'Aircraft Structures', 2nd edition, McGraw – Hill, N.Y, 1999.

AE8402 AIRCRAFT SYSTEMS AND INSTRUMENTS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge of the hydraulic and pneumatic systems components and types of instruments and its operation including navigational instruments to the students

UNIT I AIRCRAFT SYSTEMS **8**

Hydraulic systems – Study of typical workable systems – components – Hydraulic systems controllers – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system – Brake system – Components, Landing Gear Systems – Classification – Shock absorbers – Retractive mechanism.

UNIT II AIRPLANE CONTROL SYSTEMS **12**

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – operating principles – Modern control systems – Digital fly by wire systems – Auto pilot system, Active Control Technology

UNIT III ENGINE SYSTEMS **8**

Fuel systems – Piston and Jet Engines – Components - Multi-engine fuel systems, lubricating systems - Piston and jet engines – Starting and Ignition systems – Piston and Jet engines

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM **8**

Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems – Oxygen systems – Fire protection systems, Deicing and anti icing system.

UNIT V AIRCRAFT INSTRUMENTS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Know the operation of airplane control system, Engine system, Air conditioning and pressing system.
- Know the operation of air data Instruments system

TEXT BOOKS:

1. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
2. Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co 1993.

REFERENCES:

1. Treager, S.Gas Turbine technology, McGraw Hill 1997.

2. Mckinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 1993.
3. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995

AE8403 LOW SPEED AERODYNAMICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To make the student understand the concept of vorticity, irrotationality, theory of airfoils and wing sections.
- To introduce the basics of viscous flow.

UNIT I INTRODUCTION TO LOW SPEED FLOW 9

Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity, Green's Lemma and Stoke's Theorem, Barotropic Flow, Kelvin's theorem, Streamline, Stream Function, Irrotational flow, Potential Function, Equipontential Lines, Elementary Flows and their combinations.

UNIT II TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW 9

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, Kutta Joukowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

UNIT III AIRFOIL THEORY 9

Cauchy-Riemann relations, Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Thin Airfoil theory and its applications.

UNIT IV SUBSONIC WING THEORY 9

Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT V INTRODUCTION TO BOUNDARY LAYER THEORY 9

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Blasius solution, Basics of Turbulent flow.

TOTAL: 45 PERIODS

OUTCOMES:

- An ability to apply airfoil theory to predict air foil perform
- A knowledge of incompressible flow
- An explosive to Boundary layer theory

TEXT BOOKS:

1. Houghton, E.L., and Caruthers, N.B., Aerodynamics for Engineering students, Edward Arnold Publishers Ltd., London, 1989.
2. Anderson, J.D., Fundamentals of Aerodynamics, MaGraw Hill Book Co., 1999

REFERENCES:

1. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985
2. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 2002
3. Clancey, L J., Aerodynamics, Pitman, 1986
4. Kuethe, A.M and Chow, C.Y, "Foundations of Aerodynamics", Fifth Edition, John Wiley & Sons, 2000.

PR8451 KINEMATICS AND DYNAMICS OF MACHINES L T P C 3 1 0 4

OBJECTIVES:

To understand the basic concepts of mechanisms and machinery

UNIT I MECHANISMS 14

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint & motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (flat & vee) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III GEARING AND CAMS 12

Gear – Types and profile – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions.

UNIT IV BALANCING 11

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines – Governors and Gyroscopic effects.

UNIT V VIBRATION 11

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

TOTAL : 60 PERIODS

OUTCOMES:

- Students will be able to understand the concepts of mechanisms and machines
- Students can fabricate the mechanisms for their final year project work.

TEXT BOOKS

1. Bansal Dr.R.K. " Theory of Machines" Laxmi Publications (P) Ltd., New Delhi 2001
2. Rattan S.S."Theory of machines" Tata McGraw Hill publishing Co., New Delhi, 2002.

REFERENCES

1. Rao J.S.and Dukkipati R.V. "Mechanism and Machine Theory" Second Edition, Wiley Eastern Limited, 1992.
2. Malhotra D.R. and Gupta H.C "The Theory of machines" Satya Prakasam, 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, 1986.

AE8411 AERODYNAMICS LABORATORY – I **L T P C 0 0 4 2**

OBJECTIVES:

- To predict different aerodynamic propulsion used in aero application

LIST OF EXPERIMENTS

1. Application of Bernoulli's Equation – Venturimeter and Orifice meter.
2. Frictional Loss in laminar flow through pipes.
3. Frictional Loss in turbulent flow through pipes.
4. Calibration of a Subsonic Wind tunnel.
5. Determination of lift for the given airfoil section.
6. Pressure distribution over a smooth circular cylinder.
7. Pressure distribution over a rough circular cylinder.
8. Pressure distribution over a symmetric aerofoil.
9. Pressure distribution over a cambered aerofoil.
10. Flow visualization studies in subsonic flows.

P : 60 TOTAL : 60 PERIODS

OUTCOMES:

- Ability to use the fundamental dynamic principle in aircraft application.

AE8412 AIRCRAFT STRUCTURES LABORATORY - I **L T P C 0 0 4 2**

OBJECTIVES:

- To study the properties of materials used in Aircraft structure.
- To study the failure of different component under different loading condition

LIST OF EXPERIMENTS

1. Determination of Young's Modulus for Metallic materials
2. Determination of Flexural strength of Metallic materials.
3. Deflection of a Simply-Supported Beam
4. Deflection of a Cantilever beam.
5. Verification of Principle of Superposition Theorem
6. Verification of Maxwell's Reciprocal Theorem
7. Influence line study on beams
8. Buckling Load estimation of Slender Eccentric Columns
9. Construction of South well Plot
10. Study of Non-Destructive Testing Procedures
11. Determination of flexural rigidity of Composite beams
12. Shear Failure of Bolted and Riveted Joints
13. Calibration of proving Ring and Spring
14. Truss and Frame analysis.

Only 10 experiments will be conducted.

P: 60 TOTAL: 60 PERIODS

OUTCOMES:

- Ability to perform non-destructive testing to predict the properties of metabolic materials used in aircraft application

AE8501	**AIR BREATHING PROPULSION**	**L T P C**
		3 0 0 3

OBJECTIVE:

To introduce basic concepts and salient features of engine components of jet propelled engines which are operated in atmosphere to students. This course is also aimed at making students familiarize with advanced jet propulsion methods like hypersonic propulsion.

UNIT I FUNDAMENTALS OF AIR BREATHING ENGINES **8**

Operating principles of piston engines – Thermal efficiency calculations – Classification of piston engines - Illustration of working of gas turbine engine – The 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 INLETS, NOZZLES AND COMBUSTION CHAMBERS FOR JET ENGINES 10

Internal flow and Stall in subsonic inlets – Relation between minimum area ratio and eternal deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – . Real flow in nozzles and nozzle efficiency – losses in nozzles – equilibrium flow and frozen flow in nozzles- two phase flow in nozzles – Ejector and variable area nozzles - Interaction of nozzle flow with adjacent surfaces – thrust reversal- Classification of combustion chambers – Combustion chamber performance – Effect of operating variables on performance – Flame stabilization

UNIT III COMPRESSORS FOR JET ENGINES 9

Principle of operation of centrifugal compressor and axial flow compressor– Work done and pressure rise – Velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance characteristics of Centrifugal and Axial flow compressors– stage efficiency calculations - cascade testing

UNIT IV TURBINES FOR JET ENGINES 9

Principle of operation of axial flow turbines– limitations of radial flow turbines- Work done and pressure rise – Velocity diagrams – degree of reaction – free vortex and constant nozzle angle designs – performance characteristics of Axial flow turbine– turbine blade cooling methods – stage efficiency calculations – basic blade profile design considerations – matching of compressor and turbine

UNIT V RAMJET PROPULSION 9

Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to identify the engine components of jet propelled engines
- Know the details of advanced Jet propulsion and hypersonic propulsion

TEXT BOOKS:

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

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and Saravana muttoo, H.I.H. "Gas Turbine Theory", Longman, 1989.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
3. "Rolls Royce Jet Engine" – Third Edition – 1983.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 1999.

AE8502 AIRCRAFT FLIGHT MECHANICS L T P C 3 0 0 3

OBJECTIVES:

- To make the student understand the performance of airplanes under various flight conditions such as take off, cruise, landing, climbing, gliding, turning and other maneuvers.

UNIT I GENERAL CONCEPTS 9

International Standard atmosphere, IAS, EAS, TAS, Propeller theory- Froude momentum and blade element theories, Propeller co-efficients, Use of propeller charts, Performance of fixed and variable pitch propellers, High lift devices, Thrust augmentation

UNIT II DRAG OF BODIES: 8

Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar. Concept of Sweep. Effect of sweep on drag.

UNIT IIII STEADY LEVEL FLIGHT: **10**

General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and Endurance.

UNIT IV GLIDING AND CLIMBING FLIGHT: **9**

Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for Propeller, Jet and glider aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V ACCELERATED FLIGHT: **9**

Estimation of total take-off, landing distance and time. Methods of reducing landing distance, level turn, minimum turn radius Maximum turn rate, bank angle and load factor, Constraints on load factor, SST and MSTR .Pull up and pull down maneuvers, V-n diagram.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand concepts of take-off, climb, cruise, turn, descent and landing performance
- Understand the performance characteristics of the different types of power plants
- Understand and predict the behavior of fixed wing aircraft undertaking a typical flight profile
- Understand the factors that influence aircraft design and limit aircraft performance

TEXT BOOKS:

1. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Arnold Publishers, 1988.
2. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999.

REFERENCES:

1. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons, 1982.
2. J.J.Bertin, Aerodynamics for Engineers, Prentice-Hall, 1988.
3. L.J. Clancey, Aerodynamics, Pitman, 1986
4. Anderson, Jr., J.D. Introduction to Flight, McGraw-Hill International Edition, 1999

AE8503	AIRCRAFT STRUCTURES – II	L T P C 3 0 0 3

OBJECTIVES:

- To provide the students various methods for analysis of aircraft wings and fuselage.
- To provide the the behavior of major aircraft structural components.

UNIT I UNSYMMETRICAL BENDING **9**

Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method.

UNIT II SHEAR FLOW IN OPEN SECTIONS **9**

Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections.

UNIT III SHEAR FLOW IN CLOSED SECTIONS **9**

Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to combined bending torsion – with walls effective and ineffective in bending – shear centre of closed sections.

UNIT IV BUCKLING OF PLATES **8**

Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength estimation – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width.

UNIT V STRESS ANALYSIS OF WING AND FUSELAGE **10**

Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to analyse the aircraft wings and fuselage
- Ability to demonstrate the behavior of major aircraft structural components.

TEXT BOOKS:

1. Megson T M G , 'Aircraft Structures for Engineering Students', Elsevier Ltd, 2007
2. Peery, D.J., and Azar, J.J.,' Aircraft Structures', 2nd edition, McGraw – Hill, N.Y., 1999
3. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set Company, USA, 1985.

REFERENCES:

1. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.
2. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997

AE8504 **HIGH SPEED AERODYNAMICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the concepts of compressibility,
- To make the student understand the theory behind the formation of shocks and expansion fans in Supersonic flows.
- To introduce the methodology of measurements in Supersonic flows.

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 9

Compressibility, Continuity, Momentum and Energy equations for steady one dimensional flow, compressible Bernoulli's equation, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity – operating characteristics of nozzles- Introduction to hypersonic flows

UNIT II SHOCK AND EXPANSION WAVES 10

Normal shock relations, Prandtl's relation, Hugoniot equation, Rayleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, $\vartheta - \beta - M$ relation, Shock Polar, Reflection of oblique shocks, left running and right running waves, Interaction of oblique shock waves, slip line, shock-boundary layer interaction – transonic lambda shock – compression corner effect – incident shock interaction - Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions.

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW 9

Potential equation for 2-dimensional compressible flow, Linearisation of potential equation, perturbation potential, Linearised Pressure Coefficient, Linearised subsonic flow, Prandtl-Glauert rule, Linearised supersonic flow, Method of characteristics.

UNIT IV HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION 9

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircraft- aerodynamic heating.

UNIT V EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS 8

Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels-peculiar problems in the operation of hypersonic tunnels - Supersonic flow visualization methods

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding characteristics of fluid dlows
- Knowledge gained in shock phenomenon and fluid waves.
- understanding fluid flow characteristics over wings airfoils and airplanes.
- Usage of wind tunnels for evaluating flow behaviours.

TEXT BOOKS:

1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002.
2. Rathakrishnan., E, Gas Dynamics, Prentice Hall of India, 2004.

REFERENCES:

1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989.
3. Oosthuizen,P.H., & Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 1997

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DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

AE8505	THEORY OF VIBRATIONS	L T P C 3 0 0 3

OBJECTIVES:

- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system with more degree of freedom systems.
- To study the aeroelastic effects of aircraft wing.

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 10

Introduction to simple harmonic motion, D'Alembert's Principle, Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Transmissibility - Vibration measuring instruments.

UNIT II MULTI DEGREES OF FREEDOM SYSTEMS 10

Two degrees of freedom systems - Static and Dynamic couplings - vibration absorber- Principal co-ordinates - Principal modes and orthogonal conditions - Eigen value problems - Hamilton's principle - Lagrangean equations and application.

UNIT III CONTINUOUS SYSTEMS 8

Vibration of elastic bodies - Vibration of strings – Longitudinal, Lateral and Torsional vibrations

UNIT IV APPROXIMATE METHODS 9

Approximate methods - Rayleigh's method - Dunkerlay's method – Rayleigh-Ritz method, Matrix Iteration method.

UNIT V ELEMENTS OF AEROELASTICITY 8

Vibration due to coupling of bending and torsion - Aeroelastic problems – Collar's triangle - Wing Divergence - Aileron Control reversal – Flutter – Buffeting. – Elements of servo elasticity

TOTAL: 45 PERIODS

OUTCOMES:

- Gaining understanding of single and multi degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering

TEXT BOOKS

1. Leonard Meirovitch, 'Elements of Vibration Analysis' – McGraw Hill International Edition,2007
2. G.K.Grover, "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India, 2003
3. Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.

REFERENCES

1. William Weaver, Stephen P. Timoshenko, Donovan H. Yound., 'Vibration Problems in Engineering' – 4th Edition, Wiley Publisher,1974.
2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aeroelasticity – Addision Wesley Publication, New Tork, 1983.
3. William W Seto, 'Mechanical Vibrations' – McGraw Hill, Schaum Series.
4. TSE. F.S., Morse, I.F., Hinkle, R.T., 'Mechanical Vibrations' – Prentice Hall, New York, 1984.
5. Den Hartog, 'Mechanical Vibrations' Crastre Press, 2008

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Centre For Academic Courses
Anna University, Chennai-600 025.

AE8511 **AERODYNAMICS LABORATORY II** **L T P C**
0 0 4 2

OBJECTIVE:

- To make the student familiarize with the experiments in aerodynamics on wings, bodies and calibration of supersonic wind tunnel..

LIST OF EXPERIMENTS

1. Pressure distribution over a finite wing of symmetric aerofoil section.
2. Pressure distribution over a finite wing of cambered aerofoil section.
3. Pressure distribution over a Nose cone model.
4. Determination of Base drag of a missile model.
5. Determination of profile drag of bodies by wake survey method.
6. Study of flow field over a backward facing step.
7. Pressure distribution over a water tank model for various wind speeds.
8. Velocity profiles for different simulated terrains.
9. Calibration of Supersonic Wind Tunnel.
10. Flow visualization studies in supersonic flows.
11. Force measurements on Aircraft models

Only 10 experiments will be conducted.

P: 60 TOTAL : 60 PERIODS

OUTCOMES:

- Ability to use the fundamental dynamic principle in aircraft application.

AE8512 **AIRCRAFT STRUCTURES LABORATORY II** **L T P C**
0 0 4 2

OBJECTIVES:

- To enable the students understand the behavior of aircraft structural components under different loading conditions.
- To provide the Principle involved in photo elasticity and its applications in stress analysis for composite laminates.

LIST OF EXPERIMENTS

1. Unsymmetrical Bending of a Cantilever Beam
2. Combined bending and Torsion of a Hollow Circular Tube
3. Material Fringe Constant of a Photo elastic Models
4. Shear Centre of a Channel Section
5. Free Vibration of a Cantilever Beam
6. Forced Vibration of a cantilever Beam
7. Fabrication of a Composite Laminate.
8. Determination of Elastic constants for a Composite Tensile Specimen.
9. Determination of Elastic constants for a Composite Flexural Specimen.
10. Tension field beam
11. Moire techniques

Only 10 experiments will be conducted.

P: 60 TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course

- The students can understand the fundamental concepts of frictional loss in laminar and turbulent flow through pipes.
- The students will get enough experience on calibration of a subsonic wind tunnel.
- The students will be able to determine lift for the given airfoil sections.
- The students will be able to identify of pressure distribution over the various bodies.
- They will have a practical exposure on flow visualization techniques pertaining to subsonic

AE8513	PROPULSION LABORATORY	L T P C
		0 0 4 2

OBJECTIVE:

- To familiarize students and to expose them practically to various aircraft piston and gas turbine engines
- To give practical exposure to various testing methods of variable area ducts, propellants, jet engine components and rockets
- To practically determine the flow behavior of jets

LIST OF EXPERIMENTS

1. Study of aircraft piston and gas turbine engines
2. Velocity profiles of free jets.
3. Velocity profiles of wall jets.
4. Wall pressure measurements of a subsonic ramjet duct.
5. Flame stabilization studies using conical flame holders.
6. Variation of regression rate of solid fuel grain in a hybrid rocket.
7. Burn rate measurements of solid propellants
8. Cascade testing of compressor blades
9. Velocity and pressure measurements in co-axial jets
10. Flow visualization of secondary injection in a supersonic cross flow
11. Wall pressure distribution in subsonic diffusers.
12. Wall Pressure measurements in supersonic nozzles

Only 10 experiments will be conducted.

P: 60 TOTAL : 60 PERIODS

OUTCOMES:

- Ability to understand details of piston and gas turbine engine
- Ability to perform various testing on ducts, propellants, jet engine components

PR8602	MANAGEMENT SCIENCES	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the various processes involved in Marketing and its Philosophy.
- To learn the Psychology of consumers.
- To formulate strategies for advertising, pricing and selling

UNIT I MARKETING AND PERSONNEL MANAGEMENT 7

Functions of Marketing – Sales Promotion Methods – Advertising – Product Packaging – Marketing Variables – Distribution Channels – Organization – Market research – Market Research Techniques.

Functions of Personnel Management – Recruitment – Training – Leadership - Motivation – Communication – Conflict - Industrial Relations – Trade union – Management functions

UNIT II INVENTORY MANAGEMENT 10

Purpose of Inventory – Cost Related to inventory – Basic EOQ Model – Variations in EOQ Model – Finite Production – Quantity Discounts – ABC Analysis – MRP – Lot size under constraints.

UNIT III OPERATIONS MANAGEMENT 9

Plant Location – Layout – Materials Handling – Method Study – Time Study – Ergonomics – Aggregate Planning – Value Analysis.

UNIT IV FINANCIAL MANAGEMENT 8

Capital – Types – Sources – Break Even Analysis – Financial Statements – Income Statement – Balance Sheet – Capital Budgeting – Working Capital Management – Inventory Pricing.

UNIT V OPERATIONS RESEARCH TECHNIQUES 11

Replacement theory – Linear Programming - Transportation and assignment problems – Sequencing - Network Techniques - CPM and PERT.

TOTAL:45 PERIODS

OUTCOMES:

- The learning skills of Marketing will enhance the knowledge about Marketer's Practices and create insights on Advertising, Branding, Retailing and Marketing Research.

TEXT BOOKS:

1. R.Kesavan, C.Elanchezhian and T.Sundar Selwyn–Engineering Management–Eswar Press, 2005
2. R.Panneerselvam – Operations Research – Prentice Hall of India, 2003.

REFERENCES:

1. Koontz and Odonnel-Essentials of Management, McGraw Hill 1992.
2. Philips Kotler – Principles of marketing, Prentice Hall of India, 1995
3. I.M.Pandey – Financial Management, Vikas Publishing House, 1995
4. K.K.Ahuja – Personnel Management, Kalyane Publication 1992
5. K.Panneerselvam – Production and Operations Management – Prentice Hall of India, 2003
6. Martand T. Telesand – Industrial and Business Management – S.Chand & Co., 2001
7. R. Kesavan, C.Elanchezian and B.Vijayaramnath – Production Planning and Control, Anuratha Publishing Co. Ltd., Chennai – 2008.

AE8601 **AIRCRAFT STABILITY AND CONTROL** **L T P C**
3 1 0 4

OBJECTIVES:

- To make the student understand the concepts of static and dynamic stability of airplanes in stick fixed and stick free conditions.
- To introduce the concept of control of airplanes under various operating conditions.

UNIT I STATIC LONGITUDINAL STABILITY AND CONTROL 15

General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity, elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing

UNIT II STATIC DIRECTIONAL STABILITY AND CONTROL 12

Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability-propeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery – Relaxed static stability of CCV.

UNIT III STATIC LATERAL STABILITY AND CONTROL 12

Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed

UNIT IV DYNAMIC LONGITUDINAL STABILITY 11

Equations of motion for Aircraft, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping. Types of Oscillatory modes in Stick fixed and Stick free conditions.

UNIT V DYNAMIC LATERAL AND DIRECTIONAL STABILITY 10

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

TOTAL: 60 PERIODS

OUTCOMES:

Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and written reports:

- An understanding of the different types of motion following a disturbance
- Perform preliminary design computations to meet static stability and trim requirements
- An understanding of the contribution to directional stability from various components of the airplane and the requirements of rudder
- An understanding of the dihedral effect, rolling power and control effectiveness of aileron
- Analyze dynamic flight conditions using the non-linear equations of motion
- To get familiarized with the longitudinal, directional and lateral dynamics of the airplane
- To get familiarized with writing down the equations of motion following a disturbance, solve them and investigate the stability of the disturbed motion
- Identify the lateral and longitudinal modes and relate the important physical influences of aircraft properties on these modes.

TEXT BOOKS:

1. Perkins C.D. & Hage R.E. Airplane performance, stability and control, John Wiley & Sons 1999.
2. Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.

REFERENCES:

1. McCormick, B.W. Aerodynamics, Aernautics & Flight Mechanics John Wiley, 1995
2. Babister, A.W. Aircraft Stability and response, Pergamon Press, 1980
3. Etkin, B., Dynamics of Flight Stability and Control, John Wiley, New York, 1982.
4. Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004

AE8602 HYPERSONIC AND ROCKET PROPULSION

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge in non air-breathing and hypersonic propulsion methods to students so that they are familiar with various propulsion technologies associated with space launch vehicles, missiles and space probes.

UNIT I HYPERSONIC AIRBREATHING PROPULSION **8**

Introduction to hypersonic air breathing propulsion, hypersonic vehicles and supersonic combustion- need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles – various types scramjet combustors – fuel injection schemes in scramjet combustors – one dimensional models for supersonic combustion using method of influence coefficients.

UNIT II FUNDAMENTALS OF CHEMICAL ROCKET PROPULSION **9**

Operating principle – specific impulse of a rocket – internal ballistics – performance considerations of rockets – types of igniters- preliminary concepts in nozzle-less propulsion – air augmented rockets – pulse rocket motors – static testing of rockets & instrumentation – safety considerations

UNIT III SOLID ROCKET PROPULSION **10**

Salient features of solid propellant rockets – selection criteria of solid propellants – estimation of solid propellant adiabatic flame temperature - propellant grain design considerations – erosive burning in solid propellant rockets – combustion instability – strand burner and T-burner – applications and advantages of solid propellant rockets.

UNIT IV LIQUID AND HYBRID ROCKET PROPULSION **10**

Salient features of liquid propellant rockets – selection of liquid propellants – various feed systems and injectors for liquid propellant rockets -thrust control and cooling in liquid propellant rockets and the associated heat transfer problems – combustion instability in liquid propellant rockets – peculiar problems associated with operation of cryogenic engines - Introduction to hybrid rocket propulsion – standard and reverse hybrid systems- combustion mechanism in hybrid propellant rockets – applications and limitations

UNIT V ADVANCED PROPULSION TECHNIQUES **8**

Electric rocket propulsion– types of electric propulsion techniques - Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems – future applications of electric propulsion systems - Solar sail.

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding various propulsion systems
- Knowledge in rocket propulsion systems
- Knowing the applications and principles of liquid and solid-liquid propulsion systems
- Application of nuclear propulsion in rocketry

TEXT BOOKS:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.

REFERENCES:

1. James Award, Aerospace Propulsion System
2. Hieter and Pratt, Hypersonic Air Breathing Propulsion

AE8603 THEORY OF ELASTICITY **L T P C 3 0 0 3**

OBJECTIVE:

- To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions.

UNIT I BASIC EQUATIONS OF ELASTICITY **9**

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants.

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS **9**

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES **9**

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT IV TORSION **9**

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS **9**

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to use mathematical knowledge to solve problem related to structural elasticity.

TEXT BOOKS:

1. Timoshenko, S., and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.
3. Bhaskar, K., and Varadan, T. K., Theory of Isotropic/Orthotropic Elasticity, CRC Press USA, 2009.

REFERENCES

1. Wang, C. T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I. S., Mathematical Theory of Elasticity, McGraw – Hill, New York, 1978.
3. Volterra & J.H. Caines, Advanced Strength of Materials, Prentice Hall, New Jersey, 1991
4. Barber, J. R., Elasticity, Kluwer Academic Publishers, 2004

HS8561	EMPLOYABILITY SKILLS	L T P C 0 0 2 1

(Common to all branches of Fifth or Sixth Semester B.E / B.Tech programmes)

Objectives

- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using appropriate body language in professional contexts – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – People skills - questioning and clarifying skills – mock GD
8. Writing Project proposals – collecting, analyzing and interpreting data / drafting The final report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL: 30 PERIODS

OUTCOME

- The students will have enough confidence to present themselves well using proper oral and written communication skills to any interview (or) discussion (or) presentation.

Requirements for a class of 30 students

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD's and DVD's on relevant topics

Reference Books

1. Dhanavel, S.P. 2010. *English and Soft Skills*. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. *How to Prepare for Group Discussion and Interview*. New Delhi: Tata-McGraw-Hill, 2009.
3. D'Abreo, Desmond A. *Group Discussion and Team Building*. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. *The ACE of Soft Skills*. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. *Corporate Soft Skills*. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. *Presentation Skills for Students*. New York: Palgrave Macmillan, 2004.

Extensive Readers

1. Covey, Stephen R. *The 7 Habits of Highly Effective People*. New York: Free Press, 1989.
2. Bagchi, Subroto. *The Professional*. New Delhi: Penguin Books India, 2009.

Web Resources

1. www.humanresources.about.com
2. www.careerride.com

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AE8611 **AIRCRAFT DESIGN PROJECT I** **L T P C**
0 0 4 2

OBJECTIVES:

- To make the student work in groups and understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of different types of airplanes

1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3. Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration.
4. Drag estimation, Performance calculations, Stability analysis and V_n diagram.

P : 60 TOTAL : 60 PERIODS

AE8701 **COMPOSITE MATERIALS AND STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions.

UNIT I MICROMECHANICS **10**

Introduction - Advantages and application of composite materials – Types of reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach-Bounding Techniques – Fiber Volume ratio – Mass fraction – Density of composites. Effect of voids in Composites.

UNIT II MACROMECHANICS **10**

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of In plane strengths of a lamina - Experimental characterization of lamina. Failure theories of a lamina. Hygrothermal effects on lamina.

UNIT III LAMINATED PLATE THEORY **10**

Governing differential equation for a Laminate. Stress – Strain relations for a laminate. Different types of laminates. In plane and Flexural constants of a laminate. Hygrothermal stresses and strains in a laminate. Failure analysis of a laminate. Impact resistance and Interlaminar stresses. Netting analysis

UNIT IV FABRICATION PROCESS AND REPAIR METHODS **8**

Various open and closed mould processes, Manufacture of fibers, Importance of repair and different types of repair techniques in Composites – Autoclave and non-autoclave methods.

UNIT V SANDWICH CONSTRUCTIONS **7**

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding the mechanics of composite materials
- Ability to analyse the laminated composites for various loading eases
- Knowledge gained in manufacture of composites

TEXT BOOKS:

1. Dam Ishai., "Mechanics of Composite Materials,"
2. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 1997.
3. Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

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, 1989.
3. Calcote, L R. "The Analysis of laminated Composite Structures", Von –
4. Nostrand Reinhold Company, New York 1998.
5. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, II Edition, 1999.

AE8702 COMPUTATIONAL FLUID DYNAMICS FOR AERONAUTICAL APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To achieve an understanding of principles of Fluid Dynamics. introduce various computational techniques applicable to fluid dynamic problems and understand the Finite Volume Methods.

UNIT I INTRODUCTION TO NUMERICAL METHODS IN FLUID DYNAMICS 9

Introduction to numerical fluid dynamics - Introduction to governing equations of fluid dynamics and modeling of fluid flow – The substantial derivative and the physical meaning of divergence of a vector. Boundary conditions for various types of fluid flow conditions - Introduction to mathematical properties of fluid dynamic equations and classification of partial differential equations - General behaviour of different classes of partial differential equations and their relation to fluid dynamics - A general discussion on hyperbolic, parabolic and elliptic equations

UNIT II GRID GENERATION 8

Introduction to grid generation in computational fluid dynamics - Structured grid generation techniques – algebraic methods, conformal mapping and methods using partial differential equations - Basic ideas in numerical grid generation and mapping - Boundary value problem of numerical grid generation- grid control functions- branch cut - The boundary conditions of first kind – orthogonality of grid lines- boundary point grid control.

UNIT III SOLUTION OF FLUID FLOW EQUATIONS 8

Introduction to boundary layer equations and their solution - Description of Prandtl's boundary layer equations and the hierarchy of the boundary layer equations - Transformation of boundary layer equations and the numerical solution method - Choice of discretization model and the generalized Crank-Nicholson scheme - Discretization of the boundary layer equations and illustration of solution of a tridiagonal system of linear algebraic equations – Solution methods for elliptic, parabolic and hyperbolic equations.

UNIT IV TIME DEPENDENT METHODS **10**

Introduction to time dependent methods - Explicit time dependent methods – Euler, Backward Euler, One step trapezoidal, Backward differencing, two-step trapezoidal, Leap Frog and Adams-Bashforth Methods - Description of Lax-Wendroff Scheme and Mac Cormack's two step predictor – corrector method - Description of time split methods.

Introduction to implicit methods and respective stability properties of explicit and implicit methods - Construction of implicit methods for time dependent problems - Linearization, choice of explicit operator and numerical dissipation aspects.

UNIT V FINITE VOLUME METHOD **10**

Introduction to Finite volume Method - Different Flux evaluation schemes, central, upwind and hybrid schemes - Staggered grid approach - Pressure-Velocity coupling - SIMPLE, SIMPLER algorithms- pressure correction equation (both incompressible and compressible forms) - Application of Finite Volume Method for 1-D and 2-D problems.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to do the numerical grid generation and having knowledge about the mapping techniques.
- The students will be able obtain the solution for boundary layer equations and transformation equations.
- The students will have wide ideas about the explicit time dependent methods and their factorization schemes.
- The students will be able to do the stability analysis and linearization of the implicit methods.
- They had enough knowledge on the fundamental aspects of finite volume method and their application to fluid dynamics problem.

TEXT BOOKS:

1. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1995.
2. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995
3. Klus A. Hoffmann, "Computational Fluid Dynamic for Engineers" Volume I&II, Engineering Education System, 1993

REFERENCES:

1. John F Wendt (Ed.), "Computational Fluid Dynamics – An Introduction", Third Edition, Springer-Verlag, Berlin Heidelberg, 2009.
2. H.K. Versteeg and W. Malalsekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", Longman Scientific & Technical, 1995.
3. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
4. C. Hirch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994
5. Peric, Computational Fluid Dynamics .

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AE8703	FINITE ELEMENT METHOD	L T P C 3 0 0 3

OBJECTIVE:

- To give exposure various methods of solution and in particular the finite element method. Gives exposure to the formulation and the procedure of the finite element method and its application to varieties of problems.

UNIT I INTRODUCTION 8

Review of various approximate methods – Variational Approah and Weighted Residual Approach- Application to Structural Mechanics Problems. Finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS 10

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT III CONTINUUM ELEMENTS 8

Plane stress, Plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.

UNIT IV ISOPARAMETRIC ELEMENTS 9

Definitions, Shape function for 4, 8 and 9 noded quadrilateral elements, Stiffness matrix and consistent load vector, Evaluation of element matrices using numerical integration.

UNIT V FIELD PROBLEM AND METHODS OF SOLUTIONS 10

Heat transfer problems, Steady state fin problems, Derivation of element matrices for two dimensional problems, Torsion problems. Bandwidth- Elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages, sources of error.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem

TEXT BOOKS:

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu – Introduction to Finite Elements in Engineering – Printice Hall India, Third Edition, 2003.
2. Rao. S.S., Finite Element Methods in Engineering, Butterworth and Heinemann, 2001
3. Reddy J.N., An Introduction to Finite Element Method , McGraw Hill, 2000

REFERENCES:

1. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
2. Bathe, K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
3. Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.
4. Larry J Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wiley and Sons, Inc. 1984.

AE8712	FEM LABORATORY	L T P C 0 0 4 2

OBJECTIVES:

Students will get exposure to the use of structural analysis software for solving varieties of problems. Students will be grouped into several batches, each batch containing two students, and each batch has to select a problem solve it and verify the results with that obtained from the software.

1. Axial Loading. Statically determinate and indeterminate cases.
2. Static analysis of beam using beam element, plane stress and solid elements.
3. Buckling column using beam and plane stress element.
4. Stress concentration. Plate with hole.
5. Analysis torque arm.
6. Free vibration of beam with various end conditions.
7. Combined loading.
8. Thin cylinder under internal pressure.
9. Heat transfer in composite wall
10. Analysis heat transfer in extended surface
11. 2-D heat transfer problem
12. Thermo-structural analysis of axially loaded bar
13. Solving problems by command mode

Only 10 experiments will be conducted.

TOTAL: 60 PERIODS

OUTCOMES:

Students will

- Have overall understanding of various approximate methods used for solving structural mechanics problems.
- Understanding the formulation of governing equation for the finite element method, convergence criteria and advantage over other approximate methods.
- Capability to solve 1-D problems related to static analysis of structural members.
- Understand the formulation of element matrices for 2-D problems.
- Exposure to isoparametric element formulations and importance of numerical integration.
- Exhibit the ability to solve eigen value problems and scalar field problems.

AE8711	AIRCRAFT DESIGN PROJECT II	L T P C 0 0 4 2

OBJECTIVE:

Each group of students is assigned to continue the structural design part of the airplane. The following are the assignments are to be carried out.

1. Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment and torque diagrams
2. Detailed design of an aircraft wing – Design of spars and stringers, bending stress and shear flow calculations – buckling analysis of wing panels
3. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
4. Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations – buckling analysis of fuselage panels
5. Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads
6. Design of wing-root attachment
7. Landing gear design
8. Preparation of a detailed design report with CAD drawings

TOTAL: 60 PERIODS

OUTCOMES:

- On completion of Aircraft design project II the students will be in a position to design aircraft wings, fuselage, loading gears etc., and also able to angle the design in terms of structural point of view.

AE8812	UAV DESIGN LABORATORY AND FLIGHT TRAINING LABORATORY	L T P C 0 0 2 1

OBJECTIVES:

The objective of this laboratory is to learn and understand the low cost UAV SYSTEMS which is suitable for generating variety of datas' to verify and validate the different types of algorithms developed by the researchers and Scientists working on MINI UAV's and MAV's.

1) Model Building and working with Materials

I. Balsa : Techniques of working
II. Coro Plast : Techniques of working
III. Foam : Hot wire cutting of aero foils and Techniques of working
IV. Hinging control surfaces : techniques
V. Covering techniques using film , Mylar ,Textile coat , painting etc
VI. Integrations and Trimming of control surfaces

2) **Power system integration including setting of thrust line**

I. Various types of Power system options with Test benches

II. Propeller thrust bench glow and petrol engine

III. Brushless DC Motor power system set ups test bench of same motor with different KV ratings and voltage to understand and study the relation between torque and speed of a DC Motor

IV. Understanding the propeller: using sensors/ Anemometers to measure air flow in the case of smaller and larger props and calculating the volume of air moved by the prop and correlating it to the known pitch.

V. Understanding the procedure for choosing power systems including selection of motor/ESC and battery for a given air frame

VI. Engine fitting and adjusting thrust line

VII. Tuning of engines

VIII. Studying engine efficiency with change of propellers

3) **COMMAND AND CONTROL SYSTEM PROCEDURE**

I. Understanding PWM , PPM , FM signals (electronics experiment)

II. Servo testing and its relation to digital proportional movement and PWM Inputs

4) **Basic RF Experiments**

5) **Flight Simulator Training**

Real Flight RC Simulator training required to understand flying and the use of control systems from a practical point of view.

6) Simple flight stabilization system integration

7) Quad rotor stabilization (rotary)

Payload Communication Procedure

8) Integration and setting up of video systems both 5 V and 12 V variants

9) Auto Pilot : FY 3 ZT integration with GCS

10) Integration of Payload like Gimbal camera and its operations , sensors etc

11) Build your own UAV airframe of your own design ☺ and integrate with Autopilot system

The following experiments will be conducted by the students during the flight training programme at IIT- Kanpur in the month of November/December (Before the start of the Semester VIII) and evaluation is also done by the faculty of IIT- Kanpur

1. C.G. determination
2. Calibration of ASI and Altimeter
3. Calibration of special instruments
4. Cruise and climb performance
5. Determination of stick fixed & stick free neutral points

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6. Determination of stick fixed & stick free maneuver points
7. Verification of Lateral-directional equations of motion for a steady state side slip maneuver
8. Verification of Lateral-directional equations of motion for a steady state coordinated turn
9. Flight determination of drag polar of a glider
10. Demonstration of Phugoid motion and Dutch roll

TOTAL : 30 PERIODS

OUTCOMES:

- Upon completion of the course students will be in a position to do carry out preliminary design of a simple mini UAV.
- The students will be able to validate the algorithms currently in use for control of UAV's.

AE8811	**PROJECT WORK**	**L T P C**
		0 0 12 6

OBJECTIVE:

Students in a group of three or four will be assigned a project involving – design – fabrication – theoretical studies – experimental studies on some problem related to Aerospace Engineering. Continuous internal assessment marks for the project will be given during project review meetings. The student has to prepare and present a detailed project report at the end of the semester and give a talk about the work done. End semester examination mark will be based on viva voce examination.

OUTCOME:

- The students will be able to think innovatively.
- The students will be able to works as team.
- They will be able to understand the concept of system engineering and product developments.
- They will be in a position to use the theoretical knowledge in the practical applications.
- They will be better placed to be practically exposed in the particular field of the domain, they work.

PRACTICAL: 180 PERIODS

AE8001	AERO ELASTICITY	L T P C 3 0 0 3

OBJECTIVE:

- To make the student understand the various aero elasticity phenomenon like divergence flutter and control reversal and its effects on airplane design.

UNIT I AERO ELASTICITY PHENOMENA 8

Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vortex induced vibration – Introduction to aero servo elasticity.

UNIT II DIVERGENCE OF A LIFTING SURFACE 10

Simple two dimensional idealizations – Strip theory – Fredholm integral equation of the second kind – Exact solutions for simple rectangular wings – Semi rigid assumption and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.

UNIT III STEADY STATE AEROELASTIC PROBLEMS 10

Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semi rigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

UNIT IV FLUTTER ANALYSIS 12

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

UNIT V EXAMPLES OF AEROELASTIC PROBLEMS 5

Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges – Aircraft wing flutter.

TOTAL: 45 PERIODS

OUTCOME:

Students who successfully complete this course will be able to:

- Understanding of the different aero elastic phenomenon and the methods of counteracting it
- Explain how the aeroelastic phenomena flutter, divergence and aileron reversal arise and how they affect aircraft performance,
- Formulate aeroelastic equations of motion and use them to derive fundamental relations for aeroelastic analysis,
- Perform a preliminary aeroelastic analysis of a slender wing structure in low-speed airflow, and explain under what circumstances an aeroelastic analysis can be expected to produce useful results.
- Ability to estimate the critical divergence, reversal and flutter speeds of an airplane and to investigate the stability of the disturbed motion.
- Understand Aero servo and aero thermo elasticity.

TEXT BOOKS:

1. Fung, Y.C. An Introduction to theory of Aeroelasticity, John Wiley & Sons Inc., New York, 1999.

REFERENCES:

1. Bisplinghoff., R.L. Ashley, H., and Halfmann, R.L. Aeroelasticity, Addison Wesley Publishing Co., Inc. II ed. 1987.
2. Broadbent, E.G., Elementary Theory of Aeroelasticity, BunHill Publications Ltd., 1986.
3. Scanlan, R.H. and Rosenbam, R., Introduction to the Study of Aircraft
4. Vibration and Flutter, Macmillan Co., N.Y., 1991.
5. Blievens R.D Flow induced vibrations Von – Nostrand Reinhold Comp USA 1990

AE8002 **AIRCRAFT DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- To make the student understand the choice of the selection of design parameters, Fixing the geometry and to investigate the performance and stability characteristics of airplanes.

UNIT I INTRODUCTION **6**

State of art in airplane design, Purpose and scope of airplane design, Classification of airplanes based on purpose and configuration. Factors affecting configuration, Merits of different plane layouts. Stages in Airplane design. Designing for manufacturability, Maintenance, Operational costs, Interactive designs.

UNIT II PRELIMINARY DESIGN PROCEDURE **9**

Data collection and 3-view drawings, their purpose, weight estimation, Weight equation method – Development & procedures for evaluation of component weights. Weight fractions for various segments of mission. Choice of wind loading and thrust. Loading .

UNIT III POWER PLANT SELECTION **10**

Choices available, comparative merits, Location of power plants, Functions dictating the locations.

UNIT IV DESIGN OF WING, FUSELAGE AND EMPHANAGE **10**

Selection of aerofoil. Selection of Wing parameters, selection of sweep, Effect of Aspect ratio, Wing Design and Airworthiness requirements, V-n diagram, loads, Structural features. Elements of fuselage design, Loads on fuselage, Fuselage Design. Fuselage and tail sizing. Determination of tail surface areas, Tail design, Structural features, Check for nose wheel lift off.

UNIT V DESIGN OF LANDING GEAR AND CONTROL SURFACE **10**

Landing Gear Design, Loads on landing gear, Preliminary landing gear design. Elements of Computer Aided and Design, Special consideration in configuration lay-out, Performance estimation. Stability aspects on the design of control surface.

TOTAL: 45 PERIODS

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OUTCOMES:

Students will be able to

- Initiate the preliminary design of an aircraft starting from data collection to satisfy mission specifications;
- To get familiarized with the estimation of geometric and design parameters of an airplane
- Understanding the procedure involved in weight estimation, power plant selection, estimation of the performance parameters, stability aspects, design of structural components of the airplane, stability of structural elements, estimation of critical loads etc.
- Initiate the design of a system, component, or process to meet requirements for aircraft systems;
- Complete the design of an aircraft to a level of sufficient detail to demonstrate that it satisfies given mission specifications
- Work in a multidisciplinary environment involving the integration of engineering practices in such subjects as aerodynamics, structures, propulsion, and flight mechanics

  Communicate and present effectively, through both written and oral reporting, the results and consequences of their technical efforts.

TEXT BOOKS:

1.Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986.

2. Raymer, D.P. Aircraft conceptual Design, AIAA series,l989.

REFERENCES:

1. Kuechemann, D. Aerodynamic Design of Aircraft, Pergamon Press, 1978

AE8003 AIRCRAFT ENGINE REPAIRS AND MAINTENANCE L T P C 2 0 2 3

OBJECTIVES:

- To make the students to familiarize with the Aircraft engine maintenance procedure and practice.
- Must have knowledge of basics of Aeronautics and engine components.

UNIT I **5**

Classification of piston engines - Principles of operation - Function of components - Materials used - Details of starting the engines - carburetion and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out.Inspection and maintenance and trouble shooting - 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 II **2**

Propeller theory - operation, construction assembly and installation -Pitch change mechanism- Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

UNIT III **6**

Symptoms of failure - Fault diagnostics - Case studies of different engine systems - Rectification during testing equipments for overhaul: Tools and equipments 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 parts and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance.

UNIT IV **12**

Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors-turbines-exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance- permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage .

UNIT V **5**

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

PRACTICAL: 30 TOTAL: 60

OUTCOMES:

Students who successfully complete this course will be able to:

- Inspect and safely perform maintenance and troubleshooting on aircraft cabin atmospheric control, ice and rain control, position and warning, fire protection, and fuel systems using the manufacturer service manuals, acceptable industry practices and applicable regulations.
- Demonstrate a working knowledge and mechanical ability to inspect, maintain, service and repair aircraft electrical, engine (piston and turbine), airframe structure, flight control, hydraulic, pneumatic, fuel, navigation and instrument systems and other aircraft components
- Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic material structures
- Display proper behavior reflecting satisfactory work habits and ethics to fulfill program requirements and confidence to prepare for employment

REFERENCES:

1. Kroes & Wild, " Aircraft Power plants ", 7th Edition - McGraw Hill, New York, 1994.
2. Turbomeca, " Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.
3. United Technologies Pratt & Whitney, " The Aircraft Gas turbine Engine and its Operation", The English Book Store, New Delhi.

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AE8004 AIRCRAFT RULES AND REGULATION – CAR I AND II **L T P C**
3 0 0 3

OBJECTIVES:

- The most obvious objective of this course is to familiarize the students in Airworthiness and to ensure design levels of reliability and operating safety of civil registered aircraft through promulgation and enforcement of highest achievable standards of airworthiness

UNIT I C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS VIS-A-VIS AIRWORTHINESS DIRECTORATE **8**

Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators.

C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL - Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT II C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING **7**

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings & recordings; Maintenance control by reliability Method.

C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES

Reliability Programme (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO - Revision programme - Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

UNIT III C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS **10**

Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.

C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS:

Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT IV C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER - LICENSING **8**

Issue of AME Licence, its classification and experience requirements, Complete Series 'L'.

C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS:

Mandatory Modifications / Inspections.

UNIT V C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT **12**

Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued.

C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS:

Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge of Airworthiness requirements for transport, military, gliders and micro light aircrafts

- Understanding of Defect recording, reporting, investigation, rectification and analysis
- Knowledge of procedure for holding examinations, proficiency checks etc. for Defence personnel to fulfill the requirements for grant of civil licenses.

- Understanding of procedure relating to registration of aircraft
- Knowledge of Issue/validation and renewal of Certificate of Airworthiness
- Understanding of Airworthiness of ageing aircraft

REFERENCES:

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) ",
3. Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.
4. "Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. Advisory Circulars ", form DGCA.

AE8005 AIRCRAFT SYSTEMS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To make the students familiarise with the fundamental operating principles of aircraft flight instruments.
- To make the students understand functioning of the various subsystems of aircraft and the interaction of the subsystem.

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

Overview-Systems Definition and Concepts-Conceptual System Design- System Engineering Process- Everyday examples of systems-Aircraft systems

UNIT II DESIGN AND DEVELOPMENT PROCESS 9

Product Life Cycle –Concept Phase-Definition Phase-Design Phase-Build, Test, Operate and Disposal Phase-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION 9

Systems Architectures-Modeling and Trade-Offs- Evolution of Avionics Architectures-Systems Integration Definition- Examples of Systems Integration-Integration Skills-Management of Systems Integration

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9

Stake holders-Communications-Criticism- Configuration Control Process-Portrayal of a System-Varying Systems Configurations- Compatibility-Factors Affecting Compatibility – Systems Evolution Considerations and Integration of Aircraft Systems

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY 9

Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand the basic working principle of hydraulic and pneumatic systems and their components
- Identify the types of control systems namely conventional and modern systems and the need to choose them for specific aircraft application

- Understand the different types of fuel system used for piston engine and jet engines

REFERENCES:

1. Peter.Sydenham , "Systems Approach to Engineering", Artech house, Inc, London, 2004.
2. Aslaksen, Erik and Rod Belcher, "Systems Engineering", Prentice Hall, 1992.
3. Allan G. Seabridge and Ian Moir, "Design and Development of Aircraft Systems: An Introduction ", (Aiaa Education Series), 2004.
4. Andrew P. Sage, James E., Jr. Armstrong, "Introduction to Systems Engineering (Wiley Series in Systems Engineering and Management)", 2000.

AE8006 AIRFRAME REPAIR AND MAINTENANCE L T P C 3 0 0 3

OBJECTIVE:

- To make the students to understand the Airframe components and the tools used to maintain the components. Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.

UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 9

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

SHEET METAL REPAIR AND MAINTENANCE:

Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing. Riveted repair design - Damage investigation - Reverse engineering.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT 9

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

ADVANCED COMPOSITES IN AIRCRAFT:

Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves

UNIT III AIRCRAFT JACKING, ASSEMBLY AND RIGGING 9

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 12

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization 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 8

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

TOTAL: 45 PERIODS

OUTCOMES:

Students who successfully complete this course will be able to:

- Identify and apply the principles of function and safe operation to aircraft as per FAA
- Understand general airframe structural repairs, the structural repair manual and structural control programmes.

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- Understand the nature of airframe structural component inspection, corrosion repair and non-destructive inspection
- Understand aircraft component disassembly, reassembly and troubleshooting
- Know about aircraft adhesives, sealants, bonding techniques, repair procedures and the types and detection of defects in aircraft composite materials
- Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic material structures

TEXT BOOKS:

1. Kroes, Watkins, Delp, " Aircraft Maintenance and Repair ", McGraw Hill, New York, 1992.

REFERENCES:

1. Larry Reithmeir, " Aircraft Repair Manual ", Palamar Books, Marquette, 1992.
2. Brimm D.J. Bogges H.E., " Aircraft Maintenance ", Pitman Publishing corp., New York,1940.
3. Delp. Bent and Mckinely "Aircraft Maintenance Repair", McGraw Hill, New York, 1987.

AE8007 APPROXIMATE METHODS IN STRUCTURAL MECHANICS **L T P C**
3 0 0 3

OBJECTIVE:

- To understand the various approximate methods for solving both boundary value and initial value problems involved in structural mechanics.

UNIT I ANALYTICAL AND NUMERICAL METHODS **7**

Review of analytical methods for solving ordinary differential equations related to structural mechanics problems, boundary conditions, initial conditions, Need for approximate methods, different forms of approximate solution, Numerical integration, Elementary study on calculus of variation.

UNIT II APPROXIMATE METHODS **9**

Weighted residual methods: Least square method, collocation method, sub-domain method, method of moments, basic Galerkin form and modified Galerkin form. Variational method: Rayleigh Ritz method.

UNIT III STATIC, DYNAMIC AND STABILITY ANALYSIS **11**

Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis. Improvement of solution accuracy.

UNIT IV FINITE DIFFERENCE METHOD **11**

Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis.

UNIT V CODE DEVELOPMENT **7**

Numerical integration; Solution of simultaneous algebraic equations; Code generation for structural mechanics problems using approximate methods.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able

- To understand the definition and the need for the approximate methods.

- To understand the principle and procedure related to variational approach and weighted residual method and their applications.
- To do static and stability analysis of 1-D problems,
- To apply numerical methods like finite difference scheme and finite element approach.
- To develop code related to the implementation of the approximate methods.

TEXT BOOKS:

1. Szilard, R., Theory and Analysis of Plates – Classical and Numerical Methods, Prentice Hall, 1984.
2. Chajes, A., Principles of Structural Stability Theory, Prentice Hall. Inc., 1987.
3. Asghar Bhatti, M., Fundamental Finite Element Analysis and Applications: with Mathematica and *MATLAB* Computations, John Wiley & Sons Inc, 2005
4. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

REFERENCES:

1. Tauchert, T.R., Energy Principles in Structural Mechanics, McGraw Hill, International Student Edition, 1989.
2. Bathe, K.J., and Wilson, E. L., Numerical Methods in Finite Element Method, Prentice Hall (India) Ltd., 1985.
3. Chandrupatla R. Tirupathi, Belegundu D Ashok., Introduction to Finite Elements in Engineering, Prentice Hall (India) Ltd, 2007.
4. Reddy, J. N., An Introduction to the Finite Element Method, McGraw-Hill, 2004.

AE8008 AVIONICS SYSTEMS L T P C 3 0 0 3

OBJECTIVES:

- To introduce the basic of avionics and its need for civil and military aircrafts
- To impart knowledge about the avionic architecture and various avionics data buses
- To gain more knowledge on various avionics subsystems

UNIT I INTRODUCTION TO AVIONICS 9

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – Data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT III FLIGHT DECKS AND COCKPITS 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS 9

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT V AIR DATA SYSTEMS AND AUTO PILOT **9**

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to built Digital avionics architecture
- Ability to Design Navigation system
- Ability to design and perform analysis on air system

TEXT BOOKS:

1. Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 2004
2. Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 1996.

REFERENCES:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3. Spitzer. C.R. The Avionics Hand Book, CRC Press, 2000
4. Pallet.E.H.J., Aircraft Instruments and Integrated Systems, Longman Scientific

AE8009 BOUNDARY LAYER THEORY **L T P C 3 0 0 3**

OBJECTIVES

- To make the student understand the importance of viscosity and boundary layer in fluid flow. To introduce the theory behind laminar and turbulent boundary layers.

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW **8**

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non-dimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II SOLUTIONS OF VISCOUS FLOW EQUATIONS **10**

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARY LAYER EQUATIONS 12

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body- Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

UNIT IV TURBULENT BOUNDARY LAYER 8

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modelling

UNIT V COMPRESSIBLE BOUNDARY LAYERS 7

Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

TOTAL: 45 PERIODS

OUTCOMES:

- To introduce the fundamental equations of the viscous flow and practical examples
- To expose students to solve methods of the viscous flow
- To make the students to understand the importance off viscosity and shear flow adjacent to the airframe of the aerospace vehicles
- To demonstrate the laminar boundary layer concepts and solution methods
- To make the students to understand the importance of turbulence boundary layer in an aerospace engineering problem

TEXT BOOKS:

1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York, 1985.

REFERENCES:

1. Schlicting, H., Boundary Layer Theory, McGraw-Hill, New York, 1979.
2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

AE8010 COMBUSTION IN AEROSPACE VEHICLES L T P C 3 0 0 3

OBJECTIVES:

- To impart knowledge to students in the combustion mechanism of various aircraft engines including piston and gas turbine engines. Advanced concepts like supersonic combustion will be helpful in understanding hypersonic propulsion.
- Combustion mechanism of rockets will be useful for the study of rocket propulsion.

UNIT I FUNDAMENTAL CONCEPTS IN COMBUSTION, CHEMICAL KINETICS AND FLAMES 9

Thermochemical equations – heat of reaction- first, second and third order reactions – premixed flames – diffusion flames – laminar and turbulent flames - measurement of burning velocity – various methods – effect of various parameters on burning velocity – flame stability – deflagration – detonation – Rankine-Hugoniot curves – radiation by flames

UNIT II COMBUSTION IN AIRCRAFT PISTON ENGINES 8

Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT III COMBUSTION IN GAS TURBINE AND RAMJET ENGINES 10

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency, factors affecting combustion efficiency, estimation of adiabatic flame temperature in gas turbine combustion chambers – combustion stability – ramjet combustion – differences between the design of combustion chambers of ramjet and gas turbine engines - various types of flame holders for combustion chambers – salient features of after-burners

UNIT IV SUPERSONIC COMBUSTION 9

Introduction to supersonic combustion – supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors – high intensity combustors.

UNIT V COMBUSTION IN SOLID, LIQUID AND HYBRID ROCKETS 9

Solid propellant combustion - double and composite propellant combustion – various combustion models – combustion in liquid rocket engines – single fuel droplet combustion model – combustion models for hybrid rockets

TOTAL: 45 PERIODS

OUTCOMES:

- The student will be in a position to understand the detailed mechanism of Aerospace Vehicles and Aircraft Engines.
- The student will be able to analyse and impart the combustion processes that occur in Aircraft Engines and Rocket Vehicles

TEXT BOOKS:

1. Sharma, S.P., and Chandra Mohan, "Fuels and Combustion", Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.

REFERENCES:

1. Loh, W.H.T., "Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design", Springer Verlag, New York, 1982.
2. Beer, J.M., and Chiger, N.A. "Combustion Aerodynamics", Applied Science Publishers Ltd., London, 1981.
3. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.

AE8011 DESIGN OF GAS TURBINE ENGINE COMPONENTS L T P C
3 0 0 3

OBJECTIVE:

- At the end of the course, the students are expected to understand what constitutes the design, how the gas turbine engine components namely inlets, compressor, combustion chamber, turbine and nozzles are designed..

UNIT I GAS TURBINE ENGINE DESIGN FUNDAMENTALS 8

Design Process- compressible flow relationship; Constrain Analysis- Concept-Design tools-preliminary estimates; Mission analysis-Concept- design tools-Aircraft weight and fuel consumption data-Example problems on Constrain analysis, Mission analysis

UNIT II ON DESIGN AND OFF-DESING PARAMETRIC ANALYSIS 9

Total and static properties-corrected mass flow rate-Engine Cycle Design- One-Dimensional Through flow Area-Flow path force on components- aircraft constraint analysis, aircraft mission analysis, engine parametric (design point) analysis, engine performance (off-design) analysis, engine installation drag and sizing

UNIT III DESIGN OF ROTATING COMPONENTS 10

Engine Component Design-Fan and Compressor Aerodynamics-Diffusion factor-Aerofoil geometry-Flow path dimension-Radial variation-Turbine Aerodynamics- Constant axial velocity-adiabatic-selected Mach number-Mean line stage Design-stage pressure ratio-Airfoil geometry-radial variation-turbine cooling-range of turbine parameter-Engine life-Design Example –fan-compressor-turbine.

UNIT IV COMBUSTION CHAMBER DESIGN 9

Engine Component Design: Combustion system components- Combustion- Chemical reactor theory. Combustor Stability map-Stirring and mixing-Total pressure loss-Fuels-Ignition-Combustion Systems of Main Burner Design: Air partitioning- Main burner component Design: Diffuser-types of burner-inner and outer casing Design-Fuel- nozzle-Dome and liner-Primary zone- swirler-Secondary holes-Dilution holes-Transition duct-Example Design calculation: Design of Afterburners-Design parameters-Components-Diffuser-Fuel injection-Ignition-Flame stabilization-Flame spread and after burner length-Examples design calculation.

UNIT V INLET AND NOZZLE DESIGN 9

Inlets and Exhaust Nozzles Design: Elements of a Successful Inlet-Engine Integration Program- Definition of Subsonic Inlet-Engine Operational Requirements- Definition of Supersonic Inlet-Engine Operational Requirements- Engine Impact on Inlet Design- Inlet Impact on Engine Design- Validation of Inlet-Engine System-Exhaust nozzle design-Nozzle types and their design -Jet control methods for reduction of infrared signature-Simple design problem on dimensional nozzle flow

TOTAL: 45 PERIODS

OUTCOMES:

- Upon successful completion of the course, the student will be able to perform design calculations of a Gas Turbine Engine from System Engineering point of view.
- The student will be able to match performances of a various sub systems of a Gas Turbine Engine.
- The student will be able to complete the preliminary design of an axial flow Jet Engine.

TEXT BOOKS:

1. Aircraft Engine Design, Second Edition, by J.D. Mattingly, W.H. Heiser, and D.T. Pratt, 2002, AIAA Education Series, AIAA
2. Aircraft Propulsion Systems Technology and Design, by G.C. Oates (ed.), 1989, AIAA Education Series, AIAA
3. Cohen Rogers,and Saravana muttoo, "Gas Turbine Theary"

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REFERENCES:

1. High-Speed Flight Propulsion Systems, by S.N. Murthy and E.T. Curran (eds.), 1991, Volume 137, Progress in Astronautics and Aeronautics, AIAA
2. Jet Propulsion: A Simple Guide to the Aerodynamics and Thermodynamics Design and Performance of Jet Engines, by N. Cumpsty, 1998, Cambridge Engine Technology Series, No 2
3. Applied Gas Dynamics, by E.Rathakrishnan, John Wiley & Sons (Asia) Pte Ltd, 2010
4. Aircraft Gas Turbine Engine Technology, 3rd ed., by I.E. Treager, 1995, Glencoe McGraw-Hill, Inc.

AE8012	ELEMENTS OF HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on various modes of heat transfer and methods of solving problems. Also to give exposure to numerical methods employed to solve heat transfer problems.

UNIT I CONDUCTION **8**

Governing equation in Cartesian, cylindrical and spherical coordinates. 1-D steady state heat conduction with and without heat generation. Composite wall- Electrical analogy – Critical thickness of insulation – Heat transfer from extended surface – Effect of temperature on conductivity- 1-D Transient analysis

UNIT II CONVECTION **12**

Review of basic equations of fluid flow – Dimensional analysis- Forced convection – Laminar flow over flat plate and flow through pipes-Flow across tube banks. Turbulent flow over flat plate and flow through pipes – Free convection – Heat transfer from vertical plate using integral method – Empirical relations - Types of heat exchangers – Overall heat transfer coefficient – LMTD and NTU methods of analysis.

UNIT III RADIATION **9**

Basic definitions – Concept of black body - Laws of black body radiation-Radiation between black surfaces – Radiation heat exchange between grey surfaces – Radiation shielding – Shape factor-Electrical network analogy in thermal radiation systems.

UNIT IV NUMERICAL METHODS **12**

1-D and 2-D steady and unsteady state heat conduction – composite walls-heat generation-variable thermal conductivity- extended surfaces analysis using finite difference method-Convective heat transfer- Stream function- vorticity method- Creeping flow analysis-convection-diffusion 1-D, 2-D analysis using finite difference approximation. Numerical methods applicable to radiation heat transfer.

UNIT V PROBLEMS IN AEROSPACE ENGINEERING **4**

Heat transfer problems in gas turbines, rocket thrust chambers- Aerodynamic heating – Ablative heat transfer

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the Students can able to understand and apply different heat transfer principles of different applications.

TEXT BOOKS:

1. Yunus,A.Cengel, Heat Transfet-A Practical Approach, Tata McGraw Hill, Second edition, 2003.
2. Holman,J.P., Heat Transfer,McGraw Hill Book Co.,Inc., New York, Sixth Edition,1991.
3. Sachdeva,S.C., Fundamentals of Engineering Heat and Mass Transfer,Wiley EasternLtd., New Delhi,1981.

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REFERENCES:

1. Lienhard,J.H., A Heat Transfer Text Book, Prentice Hall Inc., 1981.
2. Sutton,G.P., Rocket Propulsion Elements,John Wiley and Sons, Fifth Edition,1986.
3. Mathur,M. and Sharma,R.P., Gas Turbine and Jet and Rocket Propulsion, Standard Publishers, New Delhi, 1988.

AE8013 EXPERIMENTAL FLUID MECHANICS L T P C
3 0 0 3

OBJECTIVE:

- To provide details, operating principles and limitations of forces, pressure, velocity and temperature measurements. To describe flow visualization techniques and to highlight in depth discussion of analog methods.

UNIT I BASIC MEASUREMENTS IN FLUID MECHANICS 7

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization –Components of measuring systems – Importance of model studies.

UNIT II CHARACTERISTICS OF MEASUREMENTS 10

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation of wind tunnels – Turbulence-Wind tunnel balance –principles, types and classifications -Balance calibration.

UNIT III FLOW VISUALIZATION AND ANALOGUE METHODS 9

Principles of Flow Visualization – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank

UNIT IV PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS 9

Measurement of static and total pressures in low and high speed flows- Pitot-Static tube characteristics - Pressure transducers – principle and operation – Velocity measurements - Hot-wire anemometry – LDV – PIV: Temperature measurements.

UNIT V SPECIAL FLOWS AND UNCERTAINTY ANALYSIS 10

Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning - Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation - Uses of uncertainty analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge on measurement techniques in aerodynamic flow.
- Acquiring basics of wind tunnel measurement systems
- Specific instruments for flow parameter measurement like pressure, velocity

TEXT BOOKS:

1. Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRC Press – Taylor & Francis, 2007.
2. Robert B Northrop, "Introduction to Instrumentation and Measurements", Second Edition, CRC Press, Taylor & Francis, 2006.

REFERENCES:

1. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985. Bradsaw Experimental Fluid Mechanics.
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998
3. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore

AE8014	FATIGUE AND FRACTURE MECHANICS	L T P C 3 0 0 3

OBJECTIVE:

- To understand the basic concepts involved in fatigue analysis and to study the importance of fracture mechanics in aerospace applications.

UNIT I FATIGUE OF STRUCTURES **7**

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves – Fatigue of composite materials.

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR **10**

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 **10**

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 **8**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to apply mathematical knowledge to define fatigue behaviors
- Ability to perform fatigue design
- Ability to analyse the fracture due to fatigue

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, 1983.

REFERENCES:

1. Sih C.G., "Mechanics of fracture." Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., "Fundamentals of Fracture Mechanics," - Buterworth & Co., Ltd., London, 1983.
3. Kare Hellan ,'Introduction to Fracture Mechanics', McGraw Hill, Singapore,1985

AE8015	FUNDAMENTALS OF CONTROL ENGINEERING	L T P C
		3 0 0 3

OBJECTIVE:

- To introduce the mathematical modeling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.
- To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain.
- To introduce sampled data control system.

UNIT I INTRODUCTION **9**

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

UNIT II OPEN AND CLOSED LOOP SYSTEMS **9**

Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS **9**

Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, 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 **9**

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

UNIT V SAMPLED DATA SYSTEMS **9**

Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to apply mathematical knowledge to model the systems and analyse the frequency domain
- Ability to check the stability of the both time and frequency domain

TEXT BOOKS:

1. OGATO, Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2. Azzo, J.J.D. and C.H. Houpis Feed back control system analysis and synthesis, McGraw-Hill international 3rs Edition, 1998.

REFERENCES:

1. Kuo, B.C. Automatic control systems, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2. Houpis, C.H. and Lamont, G.B. Digital control Systems, McGraw Hill Book co., New York, U.S.A. 1995.
3. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi,1998.

AE8016	HYPERSONIC AERODYNAMICS	L T P C
		3 0 0 3

OBJECTIVE:

- To introduce fundamental concepts and features peculiar to hypersonic flow to students to familiarize them with the aerodynamical aspects of hypersonic vehicles and the general hypersonic flow theory.

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9

Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

UNIT V HIGH TEMPERATURE EFFECTS in HYPERSONIC FLOWS 9

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb's free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge in basics of hypersonic and supersonic aerodynamics
- Acquiring knowledge in theory of hypersonic flow.
- Understanding of boundary layers of hypersonic flow and viscous interaction
- Role of chemical and temperature effects in hypersonic flow.

TEXT BOOKS:

1. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", Mc.Graw hill Series, New York, 1996.

REFERENCES:

1. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", Mc. Graw Hill Publishing Company, New York, 1996.
2. John T. Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington. D.C., 1994.

AE8017 **INDUSTRIAL AERODYNAMICS** **L T P C**
3 0 0 3

OBJECTIVE:

- To familiarize the learner with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

UNIT I ATMOSPHERE **9**

Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

UNIT II WIND ENERGY COLLECTORS **9**

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III VEHICLE AERODYNAMICS **9**

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV BUILDING AERODYNAMICS **9**

Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics.

UNIT V FLOW INDUCED VIBRATIONS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Use of aerodynamics for non- aerodynamics such as vehicle, building.
- Solve the problems and able to analyse vibrations during flow

TEXT BOOKS:

1. M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and Road vehicles", Plenum press, New York, 1978.
2. P. Sachs, "Winds forces in engineering", Pergamon Press, 1978.

REFERENCES:

1. R.D. Blevins, "Flow induced vibrations", Van Nostrand, 1990.
2. N.G. Calvent, "Wind Power Principles", Charles Griffin & Co., London, 1979.

AE8018 **PRINCIPLES OF HELICOPTER AERODYNAMICS** **L T P C**
3 0 0 3

OBJECTIVE:

- To make the student familiarize with the principles involved in helicopters and to study the performance and stability aspects of Helicopter under different operating conditions.

UNIT I INTRODUCTION **9**

Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

UNIT II AERODYNAMICS OF ROTOR BLADE 9

Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

UNIT III POWER PLANTS AND FLIGHT PERFORMANCE 9

Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

UNIT IV STABILITY AND CONTROL 9

Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.

UNIT V ROTOR VIBRATIONS 9

Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight. Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- To perform the Aerodynamics calculation of Rotor blade
- To perform stability and control characteristics of Helicopter
- To perform and control Rotor vibration

TEXT BOOKS:

1. John Fay, The Helicopter and How It Flies, Himalayan Books 1995.
2. Lalit Gupta, Helicopter Engineering; Himalayan Books New Delhi 1996.

REFERENCES:

1. Joseph Schafer, Basic Helicopter Maintenance, Jeppesen 1980
2. R W Prouty, Helicopter Aerodynamics.

AE8019 ROCKETS AND MISSILES L T P C

3 0 0 3

OBJECTIVE:

- To give exposure on important topics like rocket motion, rocket aerodynamics and staging & control of rockets to students to enrich their knowledge in the area of missile flight.

UNIT I CLASSIFICATION OF ROCKETS AND MISSILES 9

Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket programme with respect to international scenario

UNIT II AERODYNAMICS OF ROCKETS AND MISSILES 10

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles – slender body aerodynamics – method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – upwash and downwash in missile bodies – rocket dispersion.

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 determine burn out velocity and altitude – estimation of culmination time and altitude.

UNIT IV STAGING OF ROCKETS AND MISSILES 8

Design philosophy behind multistaging of launch vehicles and ballistic missiles – optimization of multistage vehicles – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics –

UNIT V CONTROL OF ROCKETS AND MISSILES 8

Introduction to aerodynamic and jet control methods – various types of aerodynamic control methods for tactical and short range missiles- aerodynamic characteristics- various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles and ballistic missiles – .

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge in types of rockets and missiles with respect to Indian & international scenario
- Gaining informations on aerodynamics of rocket and missiles
- Knowledge on stages and remote control of rockets missiles

TEXT BOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co.,Ltd, London, 1982
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.

REFERENCES:

1. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.

AE8020	SATELLITE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the concept of orbital mechanics, satellite system, their configuration and control and make the students eligible to enter into R&D organization.

UNIT I INTRODUCTION TO SATELLITE SYSTEMS **9**

Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT II ORBITAL MECHANICS **9**

Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements.

UNIT III SATELLITE STRUCTURES & THERMAL CONTROL **9**

Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

UNIT IV SPACECRAFT CONTROL **9**

Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors

UNIT V POWER SYSTEM AND BUS ELECTRONICS **9**

Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Ka etc), their characteristics and applications- Coding Systems – Onboard computer- Ground checkout Systems.

TOTAL: 45 PERIODS

OUTCOMES:

- Aware of the mission, configuration and applications of satellites.
- Understand the concepts of Orbits and their mechanics
- Understand the concepts of Bus electronics and power subsystem
- Understand the concepts of structural design, analyzing techniques and various types of loads in satellite structural subsystem
- Understand the importance of thermal control subsystem and its design studies.
- Understand the concepts of satellite sensors and actuators that needed for Attitude control subsystem development
- Acquired the knowledge of satellite attitude as well as orbital dynamics in order to design the satellite control subsystem
- Graduate will able to understand the concepts of Space Research and have interest to do research in R&D organizations.

TEXT BOOKS:

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA, 1980.
2. Space Systems Engineering Rilay, FF, McGraw Hill, 1982.
3. Principles of Astronautics Vertregt.M., Elsvier Publishing Company, 1985.
4. Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.
5. Space Vehicle Design, Michael D. Griffin and James R. French, AIAA Education Series, 1991.

REFERENCES:

1. Spacecraft Thermal Control, Hand Book, Aerospace Press, 2002.
2. Structural Design of Missiles & Space Craft Lewis H. Abraham, McGraw Hill, 92.
3. Space Communications Systems, Richard.F, Filipowsky Eugen I Muehllorf Prentice Hall, 1995.
4. Hughes, P.C. Space Craft Altitude Dynamics, Wilsey, 1986.

AE8021 SPACE MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To introduce concepts of satellite injection and satellite perturbations, trajectory computation for interplanetary travel and flight of ballistic missiles based on the fundamental concepts of orbital mechanics.

UNIT I SPACE ENVIRONMENT 8

Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time

UNIT II BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM 10

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws – Newton's universal law of gravitation - the many body problem - Lagrange-Jacobi identity – the circular restricted three body problem – libration points – the general N-body problem – two body problem – relations between position and time.

UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS 10

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.

UNIT IV INTERPLANETARY TRAJECTORIES 8

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert's theorem

UNIT V BALLISTIC MISSILE TRAJECTORIES 9

Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform satellite injection, satellite perturbations and trajectory control
- Apply orbital mechanics to control ballistic missile

TEXT BOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co.,Ltd, London, 1982
2. Rilay F.F. "Space Systems Engineering" Me Graw Hill, 1982.

REFERENCES:

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

AE8022	STRUCTURAL DYNAMICS	L T P C
		3 0 0 3

OBJECTIVE:

- To study the effect of periodic and aperiodic forces on mechanical systems with matrix approach and also to get the natural characteristics of large sized problems using approximate methods.

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

Constraints and Generalized coordinates – Virtual work and generalized forces – Force – Deflection influence functions – stiffness and flexibility methods.

UNIT II PRINCIPLES OF DYNAMICS 9

Free and forced vibrations of systems with finite degrees of freedom – Response to periodic excitation – Impulse Response Function – Convolution Integral

UNIT III NATURAL MODES OF VIBRATION 9

Equations of motion for Multi degree of freedom Systems - Solution of Eigen value problems – Normal coordinates and orthogonality Conditions. Modal Analysis.

UNIT IV ENERGY METHODS 9

Rayleigh's principle – Rayleigh – Ritz method – Coupled natural modes – Effect of rotary inertia and shear on lateral vibrations of beams – Natural vibrations of plates.

UNIT V APPROXIMATE METHODS 9

Approximate methods of evaluating the Eigen frequencies and eigen vectors by reduced, subspace, Lanczos, Power, Matrix condensation and QR methods.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowing various options of mathematical modeling of structures
- Method of evaluating the response of structures under various dynamically loaded conditions
- Knowledge in natural modes of vibration of structures
- Gaining knowledge in numerical and approxite methods of evaluating natural modes of vibration.

TEXT BOOKS:

1. F.S. Tse, I.E. Morse and H.T. Hinkle, "Mechanical Vibrations: Theory and Applications" , Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
2. W.C. Hurty and M.F. Rubinstein, "Dynamics of Structures", Prentice Hall of India Pvt. Ltd., New Delhi 1987.

REFERENCES:

1. R.K. Vierck, "Vibration Analysis", 2nd Edition, Thomas Y. Crowell & Co Harper & Row Publishers, New York, U.S.A. 1989.
2. S.P. Timoshenko ad D.H. Young, "Vibration Problems in Engineering", John Willey & Sons Inc., 1984.
3. V.Ramamurthi, "Mechanical Vibration Practice and Noise Control" Narosa Publishing House Pvt. Ltd, 2008

AE8023	THEORY OF PLATES	L T P C
		3 0 0 3

OBJECTIVE:

- Gives exposure to formulation of governing equations, various types of analyses plate problems and the methods of solution.

UNIT I CLASSICAL PLATE THEORY **8**

Assumptions – Governing Equation – Boundary Conditions – Methods of Solution

UNIT II RECTANGULAR PLATES **10**

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions and loadings.

UNIT III CIRCULAR PLATES **9**

Governing equation. Boundary conditions. Bending of circular and annular plates for different support conditions and loading cases.

UNIT IV STABILITY AND FREE VIBRATION ANALYSIS **8**

Governing equation for buckling of plates. Buckling analysis of simply supported plates for different loadings. Governing equation for free vibration of rectangular plates. Natural frequency for rectangular plates for different boundary conditions.

UNIT V APPROXIMATE METHODS **10**

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand the basic theory related to the analysis of plate.
- apply various exact methods used for the static analysis of rectangular plates.
- use governing equation and solution to circular plate bending problems.
- comprehend stability and basic dynamic analysis of plates.
- Understand the use of various approximate methods for solving plate bending problems.

TEXT BOOKS:

1. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.
2. Ansel Ugural, Stresses in Plates & Shells, McGraw Hill, 1981
3. Varadhan.T.K. & Bhaskar.K., "Analysis of Plates – Theory and Problems", Narosa Publishing House, 2000

REFERENCES:

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, McGraw Hill Book Co., 1986.
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Llyod Hamilton, Donald, "Beams, Plates and Shells", McGraw Hill, 1976.
5. Reddy.J.N., "Theory & Analysis of Elastic Plates", CRC, I Edition, 1999

AE8024 **UAV SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To make the students to understand the basic concepts of UAV systems design.

UNIT I INTRODUCTION TO UAV **9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects- UK,USA and Europe- Design for Stealth--control surfaces-specifications.

UNIT III AVIONICS HARDWARE **9**

Autopilot –AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT V THE DEVELOPMENT OF UAV SYSTEMS **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to design UAV system
- Ability to identify different hardware for UAV

REFERENCES:

1. Reg Austin "UNMANNED AIRCRAFT SYSTEMS UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
4. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998,
5. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed
6. Martin Aeronautics Company, 2001

AE8025 **WIND ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- Apply fundamental principles of wind engineering theory to determine wind effects on civil engineering structures.
- Apply wind loading codes for structural design.
- Apply experimental methods for determining wind effects on buildings and structures.

UNIT I THE ATMOSPHERE **6**

Atmospheric Circulation - Stability of atmospheres -definitions & implications - Effects of friction ~ Atmospheric motion - Local winds, Building codes, Terrains different types.

UNIT II ATMOSPHERIC BOUNDARY LAYER **9**

Governing Equations - Mean velocity profiles, Power law, logarithmic law wind speeds, Atmospheric Turbulence profiles - Spectral density function -. Length scale of turbulence, . Roughness parameters simulation techniques in wind tunnels.

UNIT III BLUFF BODY AERODYNAMICS **10**

Governing equations Boundary layers and Flow separation - Wake and Vortex formation two dimensional- Strouhal Numbers, Reynold's numbers .¬Separation and Reattachments Oscillatory Flow patterns Vortex sheding flow Time varying forces to Wind velocity in turbulent flow ¬Structures in three dimensional

UNIT IV WIND LOADING **10**

Introduction, Analysis and synthesis-loading coefficients, local• & global coefficients- pressure shear stress coefficients, force and moment coefficients - Assessment methods - Quasi steady method - Peak factor method - Extreme value method

UNIT V AERO ELASTIC PHENOMENA: **10**

Vortex shedding and lock in phenomena in turbulent flows across wind'-galloping wake galloping Torsional divergence, along wind galloping of circular cables, cross wind galloping of circular dlble'S', Wind loads &. Turbulent effects on tall. Structures - Launch vehicles

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course the student will be in a position to design wind turbines for production of wind power on alternative energy source.
- Also the student will be able to carry out structural analysis of various industrial structural units which are subjected to wind loads.

TEXT BOOKS:

1. EMIL SIMIU & ROBERT H SCANLAN, 'Wind effects of structures fundamentals and applications to design; John Wiley & Sons INC New York, 1996.

REFERENCES:

1. TOM LAWSON, BUilding Aerodynamics; Imperial College Press London, 2001.
2. COOK N J,, Design Guides to wind loading of buildings structures. Part I & II, Burterworths, London, 1985.
3. IS: 875 (1987) Part III Wind. loads, - Indian Standards for Building Codes.

AE8026	WIND TUNNEL TECHNIQUES	L T P C 3 0 0 3

OBJECTIVE:

- The students are exposed to various types and techniques of Aerodynamic data generation on aerospace vehicle configurations in the aerospace industry.

UNIT I PRINCIPLES OF MODEL TESTING **6**

Buckingham Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities.

UNIT II TYPES AND FUNCTIONS OF WIND TUNNELS **6**

Classification and types – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT III CALIBRATION OF WIND TUNNELS **9**

Test section speed – Horizontal buoyancy – Flow angularities – Flow uniformity & turbulence measurements – Associated instrumentation – Calibration of subsonic & supersonic tunnels.

UNIT IV CONVENTIONAL MEASUREMENT TECHNIQUES **12**

Force measurements and measuring systems – Multi component internal and external balances – Pressure measurement system - Steady and Unsteady Pressure- single and multiple measurements - Velocity measurements – Intrusive and Non-intrusive methods – Flow visualization techniques- surface flow, oil and tuft - flow field visualization, smoke and other optical and nonintrusive techniques

UNIT V SPECIAL WIND TUNNEL TECHNIQUES **12**

Intake tests – store carriage and separation tests - Unsteady force and pressure measurements – wind tunnel model design

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to use various techniques of Aerodynamic data generation.

TEXT BOOKS:

1. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998

REFERENCES:

1. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
2. Bradsaw, Experimental Fluid Mechanics. 1985
3. Short term course on Flow visualization techniques, NAL , 2009
4. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

AE8071	EXPERIMENTAL STRESS ANALYSIS	L T P C 3 0 0 3

OBJECTIVE:

- To study the various experimental techniques involved for measuring displacements, stresses, strains in structural components.

UNIT I EXTENSOMETERS AND DISPLACEMENT SENSORS 8

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages, Capacitance gauges, Laser displacement sensors.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 12

Principle of operation and requirements, Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges, load cells, Data acquisition, six component balance.

UNIT III PHOTOELASTICITY 11

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polariscopes, Interpretation of fringe pattern, Calibration of photoelastic materials, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE TECHNIQUES 7

Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

UNIT V NON – DESTRUCTIVE TESTING 7

Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing,

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge of stress and strain measurements in loaded components.
- Acquiring information's the usage of strain gauges and photo elastic techniques of measurement .
- Knowledge in NDT in stress analysis

TEXT BOOKS:

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.
3. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.

REFERENCES:

1. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall,1993.
3. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
4. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

GE8071	FUNDAMENTALS OF NANOSCIENCE	L T P C
		3 0 0 3

OBJECTIVES:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION **10**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS **10**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES **5**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS **10**

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES **10**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL:45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

1. Edelstein, A.S. and Cammearata, R.C., eds. Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. John Dinardo, N., Nanoscale. Characterization of Surfaces & Interfaces, 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES

1. G Timp, G. (Editor). Nanotechnology, AIP Press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor). The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations, Prentice-Hall of India (P) Ltd, New Delhi, 2007.

GE8751	ENGINEERING ETHICS AND HUMAN VALUES	L T P C 3 0 0 3

OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time– Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – The Challenger Case Study

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl Case Studies

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXT BOOK

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001

WEB SOURCES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

MG8654 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - BPR.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL : 45 PERIODS

OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint , 2006.

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition , 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

ME8081	RELIABILITY CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

To impart knowledge in reliability concepts, reliability estimation methods and reliability improvement methods

UNIT I RELIABILITY CONCEPT **9**

Reliability definition –Reliability parameters- f(t), F(t) and R(t) functions- Measures of central tendency – Bath tub curve – A priori and posteriori probabilities of failure – Component mortality - Useful life.

UNIT II LIFE DATA ANALYSIS **9**

Data classification – Non parametric methods: Ungrouped, Grouped, Complete, Censored data – Time to failure distributions – Probability plotting: Exponential, Weibull - Goodness of fit tests – Survival graphs.

UNIT III RELIABILITY ESTIMATION **9**

Series parallel configurations – Parallel redundancy – m/n system – Complex systems: RBD approach – Baye's method – Minimal path and cut sets - Fault Tree analysis – Standby system.

UNIT IV RELIABILITY MANAGEMENT **8**

Reliability testing: Failure terminated test – Time terminated test – Upper and lower MTBFs – Sequential Testing – Reliability growth monitoring – Reliability allocation.

UNIT V RELIABILITY IMPROVEMENT **10**

Analysis of downtime – Repair time distribution – Maintainability prediction – Measures of maintainability – Availability definitions – System Availability – Replacement decisions – Economic life.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, students will be able to apply the reliability concepts to basic aerospace systems such as rotorshaft, compressors, turbines and aircraft control systems.

REFERENCES:

1. An Introduction to Reliability and Maintainability Engineering, Charles E.Ebeling, TMH, 2000.
2. Roy Billington and Ronald N. Allan, Reliability Evaluation of Engineering Systems, Springer, 2007.

GE8072 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOK:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE8073 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.