RAJALAKSHMI
ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

B.E.
AERONAUTICAL ENGINEERING

AUTONOMOUS CURRICULUM

REGULATION – 2017

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	HS17151	Communicative English	HS	3	0	0	3
2	MA17151	Engineering Mathematics – I	BS	3	2	0	4
3	PH17151	Engineering Physics	BS	3	0	0	3
4	CH17151	Engineering Chemistry	BS	3	0	0	3
5	GE17151	Problem Solving and Phython Programming	ES	3	0	0	3
6	GE17152	Engineering Graphics	ES	2	0	4	4
PRACTICALS							
7	GE17161	Problem Solving and Python Programming Lab	ES	0	0	4	2
8	GE17162	Physics and Chemistry Laboratory	BS	0	0	4	2
		TOTAL	**31**	**17**	**2**	**12**	**24**

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	HS17251/ HS17252	Technical English / Professional English	HS	3	0	0	3
2	MA17251	Engineering Mathematics – II	BS	3	2	0	4
3	PH17251	Material Science	BS	3	0	0	3
4	CY17251	Environmental Science and Engineering	HS	3	0	0	3
5	EE17252	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	0	0	3
6	GE17251	Engineering Mechanics	ES	2	2	0	3
PRACTICALS							
7	GE17261	Engineering Practice Laboratory	ES	0	0	4	2
8	GE17262	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ES	0	0	4	2
		TOTAL	**29**	**17**	**4**	**8**	**23**

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	MA17351	Transforms and Partial Differential Equations	BS	3	2	0	4
2	AE17301	Manufacturing Technology	PC	3	0	0	3
3	AE17302	Aero Engineering Thermodynamics	PC	2	2	0	3
4	AE17303	Fluid Mechanics and Machinery	ES	2	2	0	3
5	AE17304	Solid Mechanics	ES	2	2	0	3
6	AE17305	Element of Aeronautics	PC	3	0	0	3
PRACTICALS							
7	AE17361	Solid Mechanics and Fluid Mechanics Laboratory	ES	0	0	4	2
8	AE17311	Thermodynamics Laboratory	PC	0	0	4	2
9	AE17312	Computer Aided Modeling Laboratory	PC	0	0	4	2
		TOTAL	**35**	**15**	**8**	**12**	**25**

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	MA17451	Numerical Methods	BS	3	2	0	4
2	AE17401	Aerodynamics - I	PC	3	0	0	3
3	AE17402	Aircraft Systems and Instruments	PC	3	0	0	3
4	AE17403	Mechanics of Machines	PC	2	2	0	3
5	AE17404	Aircraft Structures - I	PC	2	2	0	3
6	AE17405	Aircraft Performance	PC	2	2	0	3
PRACTICALS							
7	AE17411	Aero Engine and Systems Laboratory	PC	0	0	4	2
8	AE17412	Aerodynamics Laboratory - I	PC	0	0	4	2
9	AE17413	Aircraft Component Drawing	PC	0	0	4	2
		TOTAL	**35**	**15**	**8**	**12**	**25**

SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	AE17501	Propulsion - I	PC	2	2	0	3
2	AE17502	Aircraft Structures - II	PC	2	2	0	3
3	AE17503	Aerodynamics - II	PC	2	2	0	3
4	AE17504	Aircraft Stability and Control	PC	2	2	0	3
5	AE17505	Control Engineering	PC	3	0	0	3
6		Elective - I	PE	3	0	0	3
PRACTICALS							
7	AE17511	Aircraft Structures Laboratory	PC	0	0	4	2
8	AE17512	Airframe Repair Laboratory	PC	0	0	4	2
9	AE17513	Aerodynamics Laboratory - II	PC	0	0	4	2
10	AE17514	Industrial Training*	EEC	0	0	0	1
		TOTAL	**34**	**14**	**8**	**12**	**25**

*To be conducted during summer vacation. Evaluation marks to be carried over to VI semester

SEMESTER VI

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	AE17601	Propulsion - II	PC	2	2	0	3
2	AE17602	Finite Element Methods	PC	2	2	0	3
3	AE17603	Flight Vehicle Design	PC	3	0	2	4
4	AE17604	Composite Materials and Structures	PC	3	0	0	3
5	AE17605	Experimental Aerodynamics	PC	3	0	0	3
6	GE17651	Management for Engineers	PC	3	0	0	3
7		Open Elective – I	OE	3	0	0	3
PRACTICALS							
8	AE17611	Structural Analysisand MATLAB Laboratory	PC	0	0	4	2
9	HS17561	Communication Skills - Laboratory Based	HS	0	0	4	2
		TOTAL	**32**	**16**	**4**	**12**	**26**

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SEMESTER VII

SL. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1	AE17701	Avionics	PC	3	0	0	3
2	AE17702	Computational Fluid Dynamics	PC	2	2	0	3
3	AE17703	Vibrations and Elements of Aeroelasticity	PC	2	2	0	3
4	AE17704	Rockets and Missiles	PC	3	0	0	3
5		Open Elective – II	OE	3	0	0	3
6		Elective – II	PE	3	0	0	3
PRACTICALS							
7	AE17711	Flow Simulation Laboratory	PC	0	0	4	2
8	AE17712	Avionics Laboratory	PC	0	0	4	2
9	AE17713	Project Work (Phase I)	EEC	0	0	4	2
		TOTAL	**32**	**16**	**4**	**12**	**24**

SEMESTER VIII

SL. No.	3COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1		Elective – III	PE	3	0	0	3
2		Elective – IV	PE	3	0	0	3
PRACTICALS							
7	AE17811	Project Work (Phase II)	EEC	0	0	12	6
		TOTAL	**18**	**6**	**0**	**12**	**12**

Total Number of Credits to be Earned for Award of the Degree = 184

ELECTIVE FOR B.E. AERONAUTICAL ENGINEERING

SEMESTER V
ELECTIVE – I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AE17E51	Theory of Elasticity	3	0	0	3
2	AE17E52	Heat Transfer	3	0	0	3
3	AE17E53	Airframe Maintenance and Repair	3	0	0	3
4	AE17E54	Total Quality Management	3	0	0	3
5	AE17E55	Applied Aerodynamics	3	0	0	3

SEMESTER VII
ELECTIVE– II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AE17E71	Helicopter Dynamics	3	0	0	3
2	AE17E72	Combustion and Flames	3	0	0	3
3	AE17E73	Aircraft General Engineering and Maintenance Practices	3	0	0	3
4	AE17E74	Experimental stress Analysis	3	0	0	3
5	AE17E75	Space Mechanics	3	0	0	3

SEMESTER VIII
ELECTIVE – III& IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	AE17E81	Boundary Layer Theory	3	0	0	3
2	AE17E82	Fatigue and Fracture	3	0	0	3
3	AE17E83	Air Traffic Control and Planning	3	0	0	3
4	AE17E84	Aero Engine Maintenance and Repair	3	0	0	3
5	AE17E85	Hypersonic Aerodynamics	3	0	0	3
6	AE17E86	Entrepreneurship Development	3	0	0	3
7	AE17E87	UAV Systems	3	0	0	3
8	AE17E88	Structural Dynamics	3	0	0	3
9	AE17E89	Spray Theory	3	0	0	3
10	AE17E90	Introduction to Product Development				

LIST OF OPEN ELECTIVE

OPEN ELECTIVES OFFERED BY DEPT. OF AERO

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	OAE1701	Introduction to Aeronautical Engineering	OE	3	0	0	3
2	OAE1702	Fundamentals of Jet Propulsion	OE	3	0	0	3
3	OAE1703	Introduction to space flight	OE	3	0	0	3
4	OAE1704	Industrial Aerodynamics	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF AUTO

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	OAT1701	Automotive Systems	OE	3	0	0	3
2	OAT1702	Intelligent Vehicle Systems	OE	3	0	0	3
3	OAT1703	Automotive Sensors and Actuators	OE	3	0	0	3
4	OAT1704	Electric and Hybrid vehicles	OE	3	0	0	3
5	OAT1705	Automotive Electronics	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF BME

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OBM1701	Anatomy and Physiology for Engineers	OE	3	0	0	3
2.	OBM1702	Biomaterials and Artificial Organs	OE	3	0	0	3
3.	OBM1703	Medical Instrumentation	OE	3	0	0	3
4.	OBM1704	Engineering Mechanics for Medical Applications	OE	3	0	0	3
5.	OBM1705	Basics of Biosensors and Biophotonics	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF BT

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	OBT1701	Basic Bioinformatics	OE	3	0	0	3
2	OBT1702	Nanotechnology for Bioproduct Development	OE	3	0	0	3
3	OBT1703	Medical Sciences for Engineers	OE	3	0	0	3
4	OBT1704	Food and Nutrition	OE	3	0	0	3
5	OBT1705	Application of Biotechnology for Environmental protection	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF CHEMICAL

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	OCH1701	Food Technology	OE	3	3	0	0
2	OCH1702	Petroleum Technology	OE	3	3	0	0
3	OCH1703	Fertilizer Technology	OE	3	3	0	0
4	OCH1704	Process Plant Utilities	OE	3	3	0	0
5	OCH1705	Fuel cell Technology	OE	3	3	0	0

OPEN ELECTIVES OFFERED BY DEPT. OF CSE

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OCS1701	Web Design and Management	OE	3	3	0	0
2.	OCS1702	Mobile Application Development	OE	3	3	0	0
3.	OCS1703	IT Essentials	OE	3	3	0	0
4.	OCS1704	Fundamentals of Database	OE	3	3	0	0
5.	OCS1705	Web Programming with XML	OE	3	3	0	0
6.	OCS1706	IoT and its Applications	OE	3	3	0	0

OPEN ELECTIVES OFFERED BY DEPT. OF CIVIL

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OCE1701	Disaster management	OE	3	0	0	3
2.	OCE1702	Coastal Zone Management	OE	3	0	0	3
3.	OCE1703	Smart structures and Smart Materials	OE	3	0	0	3
4.	OCE1704	Non Destructive Testing of Materials	OE	3	0	0	3
5.	OCE1705	Architecture	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF EEE

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	OEE 1701	Renewable power generation systems	OE	3	0	0	3
2	OEE1702	Sensors and Transducers	OE	3	0	0	3
3	OEE1703	Electric power utilization	OE	3	0	0	3
4	OEE1704	Microprocessors and Microcontrollers	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF ECE

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OEC1701	Micro Electro Mechanical Systems	OE	3	0	0	3
2.	OEC1702	Consumer Electronics	OE	3	0	0	3
3.	OEC1703	Measurement and Instrumentation	OE	3	0	0	3
4.	OEC1704	Pattern Recognition and Artificial Intelligence	OE	3	0	0	3
5.	OEC1705	Embedded systems	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF IT

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OIT1701	Data Science	OE	3	0	0	3
2.	OIT1702	Cyber Security	OE	3	0	0	3
3.	OIT1703	Business Intelligence	OE	3	0	0	3
4.	OIT1704	Computer Vision	OE	3	0	0	3
5.	OIT1705	Knowledge Management	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF MECH

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OME1701	Design of Experiments	OE	3	0	0	3
2.	OEC1702	Industrial Safety	OE	3	0	0	3
3.	OEC1703	Quality Concept	OE	3	0	0	3
4.	OEC1704	Production Engineering	OE	3	0	0	3
5.	OEC1705	Supply chain and Logistics Management	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF MCT

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OMT17091	Industrial Robotics	OE	3	0	0	3
2.	OMT17093	Fundamentals Of Automation	OE	3	0	0	3
3.	OMT17094	Artificial Intelligence for Mechatronics Systems	OE	3	0	0	3
4.	OMT17095	CNC Systems: Design And Applications	OE	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPT. OF H&S

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OEMA1701	Computer based Numerical methods	OE	3	0	0	3
2.	OEMA1702	Number theory and applications	OE	3	0	0	3
3	OEPH1701	Materials Synthesis and Characterization Techniques	OE	3	0	0	3
4.	OEPH1702	Nanophysics	OE	3	0	0	3
5.	OECY1701	Green Chemistry in Energy and Environment	OE	3	0	0	3
6.	OECY1702	Interface Chemistry and Engineering	OE	3	0	0	3

GENERAL OPEN ELECTIVES

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	OGE1701	Human Rights	OE	3	0	0	3
2.	OGE1702	Intellectual Property Rights	OE	3	0	0	3
3.	OGE1703	Foreign Language/German	OE	3	0	0	3
4.	OGE1704	Foreign Language/French	OE	3	0	0	3

SEMESTER I

		L	T	P	C
HS17151	**COMMUNICATIVE ENGLISH**	**4**	**0**	**0**	**4**

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting. Writing- completing sentences- developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- WhQuestions- asking and answering yes or no questions. Subject-Verb agreement – regular and irregular verbs. Vocabulary development- prefixes- suffixes- articles.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence-main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures. Listening-telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave. Language development – prepositions, conjunctions. Vocabulary development- guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT

12Reading- short texts and longer passages (close reading). Writing- understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences. Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-emails-conventions of personal email. Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend. Language development- Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development-synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 12

Reading- longer texts- close reading. Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing. Listening – listening to talks- conversations. Speaking – participating in conversations- short group conversations. Language development-modal verbs- present/ past perfect tense. Vocabulary development-collocations.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions.
- Comprehend conversations and short talks delivered in English
- Express ideas about oneself freely
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. CengageLearning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skillsfor BusinessEnglish. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013

MA17151 ENGINEERING MATHEMATICS – I

L	T	P	C
3	2	0	4

OBJECTIVES :

- To learn the basics and concepts of traditional calculus.
- To provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
- To understand the concepts of single variable and multivariable calculus that plays an important role in the field of science, engineering & technology.

UNIT I DIFFERENTIAL CALCULUS **15**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES **15**

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

UNIT III INTEGRAL CALCULUS 15

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts – Bernoulli's formula, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS 15

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.

UNIT V DIFFERENTIAL EQUATIONS 15

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

TOTAL : 45+30 PERIODS

OUTCOMES :

On completion of the course students will be able to:

- Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.
- To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.
- Solve problems involving integration using different methods such as substitution, partial fractions, by parts .
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH 17151	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams – area moment of inertia - bending moment – cantilever - applications – uniform and non-uniform bending- I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) –CO_2 laser - Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) – electron microscope - scanningtunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances -reciprocal lattice - coordination number and packing factor for SC, BCC, FCC, and HCP –Polymorphism and allotropy: diamond and graphite structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL :45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.
- Use the concepts of waves and optical devices and their applications in fiber optics.
- Use the concepts of thermal properties of materials and their applications in heat exchangers.
- Use the advanced physics concepts of quantum theory and its applications in tunneling microscopes.
- Apply the basics of crystals, their structures and different crystal growth techniques in fabrication of devices.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.

3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. &Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

CY17151 ENGINEERING CHEMISTRY L T P C

3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – portable water treatment – desalination of brackish water - Reverse Osmosis – UASB process (Upflow Anaerobic Sludge Blanket).

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis:Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III METALLURGY, ALLOYS AND PHASE RULE 9

Metallurgy: Minerals and ores – flux and slags – extraction of metal (Al only) – concentration(gravity separation, froth flotation and magnetic concentration) – calcination, roasting, smelting, aluminothermic reduction. Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel.Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell, methanol oxygen fuel cell, SOFC and supercapacitors.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
2. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.

GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

3 0 0 3

OBJECTIVES

1. To develop an understanding of algorithmic problem solving
2. To read and write simple Python programs.
3. To develop Python programs with conditionals and loops.
4. To define Python functions and call them.
5. To use Python data structures –- lists, tuples, dictionaries.
6. To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Introduction to Computers, Characteristics, Basic Organization of a Computer, Algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion)

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, booleans, strings, and lists; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, test for leap year.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, scope: local and global, composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum the array of numbers, linear search, binary search.

UNIT IV COMPOUND DATA: LISTS, TUPLES, DICTIONARIES 9

Lists, list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples, tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension, Illustrative programs: selection sort, insertion sort, merge sort, quick sort.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator, command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file

OUTCOMES

Upon completion of the course, students will be able to

1. Develop algorithmic solutions to simple computational problems
2. Read, write, execute by hand simple Python programs.
3. Structure simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries.
6. Read and write data from/to files in Python Programs.

TEXT BOOK:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

REFERENCES:

1. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd. 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. The Python Tutorial, https://docs.python.org/2.7/tutorial/

GE17102 ENGINEERINGGRAPHICS L T P C

2 0 4 4

OBJECTIVES:

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

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importanceofgraphicsinengineeringapplications–Useofdraftinginstruments–

BISconventionsandspecifications–Size,layoutand foldingofdrawingsheets– Letteringanddimensioning.

UNIT IPLANECURVESANDFREEHANDSKETCHING 7+12

Basic Geometrical constructions,Curvesusedinengineeringpractices: Conics–Constructionofellipse, parabolaandhyperbolaby eccentricitymethod– Construction ofcycloid– constructionofinvolutesofsquareandcircle–Drawingof tangentsandnormaltotheabovecurves.

Visualization concepts and Free Hand sketching: Visualization principles – RepresentationofThreeDimensionalobjects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTIONOFPOINTS,LINESAND PLANESURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straightlines (only First angle projections) inclined to both the principal planes - Determinationof true lengths and trueinclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTIONOFSOLIDS 5+12

Projectionofsimplesolids likeprisms,pyramids,cylinder, cone and truncated solids whentheaxis is inclinedtooneof the principalplanes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS ANDDEVELOPMENTOF SURFACES 5+12

Sectioningofabovesolidsinsimpleverticalpositionwhen the cuttingplane is inclined to the one of the principal planesand perpendiculartotheother – obtainingtrueshapeofsection. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC ANDPERSPECTIVEPROJECTIONS 6+2

Principlesofisometricprojection–isometricscale–Isometric projections of simple solids and truncatedsolids - Prisms, pyramids,cylinders, cones- combination of two solid objects in simple vertical positions - Perspectiveprojectionof simple solids-Prisms, pyramidsandcylindersbyvisualraymethod .

TOTAL: 30+60 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- perform freehand 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.

TEXTBOOK:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers,Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International(P)Limited, 2008.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. 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.
5. Shah M.B., and Rana B.C.,"EngineeringDrawing", Pearson, 2nd Edition, 2009.

PublicationofBureau ofIndianStandards:

1. IS10711– 2001:TechnicalproductsDocumentation– Sizeand layout of drawing sheets.
2. IS9609(Parts0&1)–2001:TechnicalproductsDocumentation–Lettering.
3. IS10714(Part20)–2001&SP46–2003: Linesfortechnical drawings.
4. IS11669– 1986&SP46–2003:DimensioningofTechnicalDrawings.
5. IS15021(Parts1 to4)–2001:Technicaldrawings–Projection Methods.

GE17161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	3	2

Objectives

1. Be familiar with the use of Office software.
2. Be exposed to presentation and visualization tools.
3. Be exposed to problem solving techniques and flow charts.
4. To write, test, and debug simple Python programs.
5. To implement Python programs with conditionals and loops.
6. Use functions for structuring Python programs.
7. Represent compound data using Python lists, tuples, dictionaries.
8. Read and write data from/to files in Python.

List of programs

1. Search, generate, manipulate data using Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. Compute the GCD of two numbers.
5. Find the square root of a number (Newton's method)
6. Exponentiation (power of a number)
7. Linear search and Binary search
8. First n prime numbers
9. Find the maximum of a list of numbers
10. Selection sort, Insertion sort
11. Removing all the duplicate elements in a list
12. Merge sort, Quick sort
13. Multiply matrices
14. Programs that take command line arguments (word count)
15. Find the most frequent words in a text read from a file

Platform needed

Python 3 interpreter for Windows/Linux

Outcomes

Upon completion of the course, students will be able to

1. Apply good programming design methods for program development.
2. Write, test, and debug simple Python programs.
3. Implement Python programs with conditionals and loops.
4. Develop Python programs step-wise by defining functions and calling them.
5. Use Python lists, tuples, dictionaries for representing compound data.

Read and write data from/to files in Python

GE17162	**PHYSICS AND CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	(Common to all branches of B.E. / B.Tech Programmes)	**0**	**0**	**3**	**2**

OBJECTIVE:

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

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer

6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the principle of elasticity viz Young's modulus & regidity modulus of Engineering materials.
- Apply the principle elasticity in determining compressibility of liquids using ultrasonic waves
- Apply the principle of optics in fiber optical communication.
- Apply thermal properties of various insulating materials in Engineering applications.
- Use the basic instruments like vernier caliber, micrometer and microscope for various basic measurements.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To acquire practical skills in the determination of water quality parameters.
- To gain the knowledge about spectrophotometer and flamephotometer.
- To acquire knowledge on the determination of corrosion rate.

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 7 Experiments)

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. Determination of strength of given hydrochloric acid using pH meter.

6. Estimation of iron content of the given solution using potentiometer.

7.Conductometric titration of strong acid vs strong base.

8. Determination of strength of acids in a mixture of acids using conductivity meter.

9. Estimation of copper content of the given solution by Iodometry.

10. Estimation of iron content of the water sample using spectrophotometer (1, 10-

Phenanthroline / thiocyanate method).

11. Estimation of sodium and potassium present in water using flame photometer.

12. Corrosion experiment-weight loss method.

OUTCOMES:

On completion of the course students will be able to

- Apply the quantitative chemical analysis of water quality related parameters.
- Analyse characteristics of water.
- Measure the corrosion rate in metals.
- Apply instrumentation skills in analysing metallic elements in water.
- Analyse quantitatively the strength of acids and bases in water.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

SEMESTER II

HS17251	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I Introduction Technical English 12

Listening- listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –asking for and giving directions. Reading – reading short technical texts from journals- newsapapers. Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations. Vocabulary Development- technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II Reading and Study Skills 12

Listening- listening to longer technical talks and completing exercises based on them. Speaking – describing a process. Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing. Writing- interpreting charts, graphs. Vocabulary Development-vocabularyused in formal letters/emails and reports. Language Development- impersonal passive voice, numerical adjectives.

UNIT III Technical Writing and Grammar 12

Listening- listening to classroom lectures/ talks on engineering/technology. Speaking – introduction to technical presentations. Reading – longer texts both general and technical, practice in speed reading. Writing-Describing a process, use of sequence words. Vocabulary Development- sequence words. Misspelled words. Language Development- embedded sentences

UNIT IV Report Writing 12

Listening- listening to documentaries and making notes. Speaking – mechanics of presentations. Reading – reading for detailed comprehension. Writing- email etiquette- job application – cover letter. Résumé preparation(via email and hard copy)- analytical essays and issue based essays. Vocabulary Development- finding suitable synonyms-paraphrasing. Language Development- clauses- if conditionals.

UNIT V Group Discussion and Job Applications 12

Listening- TED talks; Speaking –participating in a group discussion. Reading– reading and understanding technical articles. Writing– writing reports- minutes of a meeting- accident and survey. Vocabulary Development- verbal analogies, foreign words and phrases Language Development- reported speech, common errors in English.

TOTAL : 60 PERIODS

OUTCOMES:

At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.
- Write error free language.

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

Students can be asked to read Tagore, Chetan Bhagat and for suplementary reading.

HS17252 PROFESSIONAL ENGLISH COMMUNICATION L T P C
4 0 0 4

OBJECTIVES

- To prepare students to be competent in a global business environment.
- To think accurately, clearly and deeply in communicative contexts.
- To improve career opportunities – get English language skills that are needed to be successful.

UNIT-I CRITICAL/ INFORMATIONAL LISTENING 12

Short conversations or Monologues – Listening for specific information- Conversations or Monologues with factual information- listen to fill up missing information- business related discussions or interview(two or more speakers).

UNIT-II CONVERSATIONAL/ PRESENTATION SKILLS 12

Speak about oneself - Face-to-face speaking for real-life context – pick and talk - personal opinion on business related topics- mini presentations on a business theme- discussion with another candidate on business related topics.

UNIT-III INTENSIVE/ EXTENSIVE READING AND INTERPRETING 12

Short texts (signs,messages,emails,labels and notes) -Short descriptions-graph or chart. Reading to find factual information- decision making from a written text- a leaflet or a newspaper- magazine or article- reading to understand correct grammar, contextually- reading to understand the structure of a text-read and transfer information from memos, advertisements, notices.

UNIT-IV FORMAL COMMUNICATION 12

Business Correspondence - writing business letters to people outside the company. Internal Company Communication- a note, a message, a memo or an email.

UNIT – V VERBAL ABILITY/ FUNCTIONAL GRAMMAR 12

Grammar – tenses – concord- prepositions – articles- punctuations. Vocabulary – advanced vocabulary – synonyms and antonyms. Sentence correction – sentence completion - cloze passage - verbal reasoning: analogies, meaning - usage match.

TOTAL 60 PERIODS

Outcomes

On completion of the course students will be able to

- Listen to, understand and give opinions in meetings.
- Apply for new jobs and develop their career.
- Write short business messages and reports.
- Use language in both official and unofficial contexts.
- Speak effectively in business communication

Text Book:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.

Reference Books:

1. Hartley, Mary. "The Power of Listening," Jaico Publishing House; First Edition (2015).
2. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.
3. Lesikar V. Raymond, Flatley E. Marie, Rentz, Kathryn and Pande, Neerja. "Business Communication," Eleventh Edition, Tata McGraw Hill Education Private Limited.

MA17251 ENGINEERING MATHEMATICS – II L T P C
3 2 0 4

OBJECTIVES :

- To handle practical problems arising in the field of engineering and technology.
- To solve problems using the concept of Matrices, Vectors calculus, complex analysis, Laplace transforms.

UNIT I MATRICES 15

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 VECTOR CALCULUS 15

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

UNIT III ANALYTIC FUNCTIONS 15

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c,\ cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 15

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.

UNIT V LAPLACE TRANSFORMS 15

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 second order ordinary differential equations with constant coefficients.

TOTAL: 45+30PERIODS

OUTCOMES :

On completion of the course students will be able to:

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems.
- Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.
- Evaluate line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH 17251	MATERIALS SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

UNIT I PHASE DIAGRAMS 9

Solid solutions - Hume Rothery's rules - The phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT II FERROUS ALLOYS AND HEAT TREATMENT 9

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - TTT-diagram for eutectoid steel – pearlitic, 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 III MECHANICAL PROPERTIES 9

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 IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

Ferromagnetism – Domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation –

frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials, properties.

UNIT V NEW MATERIALS 9

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fiber reinforced plastics – Metallic glasses – types , glass forming ability of alloys – Inoue criteria – melt spinning process – applications - Shape memory alloys – phases, shape memory effect, pseudoelastic effect – NiTi alloy – applications – Nanomaterials – preparation: bottom up and top down approaches (outline only) – properties and applications – carbon nanotubes: types.

TOTAL :45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Use various phase diagrams and their applications.
- Analyze Fe-Fe_3C phase diagrams, various microstructures and alloys.
- Use mechanical properties of materials.
- Apply magnetic, dielectric and superconducting properties of materials.
- Use the basic of ceramics, composites and nano materials for designing of components.

TEXT BOOKS:

1. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. "Physical Metallurgy: Principles and Practice". PHI Learning, 2015.
3. Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. "Materials Science and Engineering". Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

CY17251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

3 00 3

OBJECTIVES:

- To the study of nature and the facts about environment.
- To find and implement 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 – Bio geographical 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. 27

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 OverUtilization 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:

Upon successful completion of the course, students will be able to:

- 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 environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

1. Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, Second Edition, Pearson Education 2004.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, 2006.

REFERENCES:

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 Publishing, 2001.
3. Dharmendra S. Sengar, “Environmental law”, Prentice Hall, 2007.
4. Rajagopalan.R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2005.

EE17252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on DC and AC Circuits.
- To study the working principle of DC and AC Machines.
- To expose to the construction and operation of various electronic devices.
- To provide knowledge on digital electronics.
- To impart knowledge on working principle of various measuring instruments.

UNIT I DC AND AC CIRCUIT ANALYSIS 9

Basic circuit components - Ohms Law - Kirchoff’s Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis - Mesh analysis. Introduction to AC circuits – waveforms and RMS value – power and power factor for single phase circuits.

UNIT II DC AND AC MACHINES 9

Principle of operation and characteristics of DC machines, Transformers (single and three phase), Synchronous machines, three phase and single phase induction motors (Qualitative Analysis Only).

Application of Electrical Drives to Aerospace Engineering.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 9

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters.

UNIT V INSTRUMENTATION 9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes - three-phase power measurements – instrument transformers

TOTAL : 45 PERIODS

OUTCOMES:

After completion of this course, the student will be able to:

- analyse the working of DC and AC circuits
- realize the working principle of electrical machines
- realize the working principle and operation of various electronic devices.
- understand and verify the truth table of Logic gates, Adders, Flip-Flops, Registers and Counters.
- choose appropriate instruments for electrical measurement for a specific application

TEXT BOOKS

1. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016

REFERENCES

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016
7. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

		L	T	P	C
GE17251	**ENGINEERINGMECHANICS**	**3**	**2**	**0**	**4**

OBJECTIVES:

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

UNIT I STATICS OF PARTICLES 12

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 12

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 12

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 12

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 RIGID BODY DYNAMICS 12

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 45+30 PERIODS

OUTCOMES:

- Have adequate knowledge on fundamental principles of forces and vector notion.
- Have skill in solving rigid body problems both in 2D and 3D
- Ability to find the centroid, moment of inertia of regular and composite planes and objects.
- Ability to explain the differential principles apply to solve engineering problems dealing with force, displacement, velocity and acceleration.
- Ability to solve the dynamic forces on rigid bodies including friction.

TEXT BOOKS:

1. Beer, F.P and Johnston 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. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and

Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

GE17261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- 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 & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 15

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

2. Fluorescent lamp wiring.

3. Stair case wiring

4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

5. Measurement of energy using single phase energy meter.

6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

OUTCOMES:

Student will be able to

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipment to join the structures.
- Do house hold wiring
- Make electrical circuits.
- Describe electronic devices

		L	T	P	C
EE17262	**BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVE:

- To study and validate the principles of operation of DC motors.
- To understand the principles of operation of AC motors.
- To study the principles of operation of Transformer and its testing methods.
- To study the applications of PN junction Diode.
- To obtain the characteristics of various transducers.

LIST OF EXPERIMENTS:

1. Load test on DC Shunt Motor and DC series motor
2. Load test on Single phase Transformer
3. Load test on Induction motor (single, three phase)
4. Regulation of 3phase Alternator

5. Diode based application circuits
6. Transistor based application circuits
7. Study of Logic gates and Flip-Flops
8. Characteristics of LVDT
9. Characteristics of RTD
10. Characteristics of Thermistor

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- draw the speed characteristic of different types of DC motors.
- draw the speed characteristic of different types of AC machines.
- obtain the performance parameters of Transformer.
- design an application involving diodes and transistors.
- obtain characteristics of transducers.

SEMESTER III

MA17351	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	2	0	4

OBJECTIVES

- To introduce Fourier series 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.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 15

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order pde:$f(p,q)=0, f(z,p,q)=0, z=px+qy+f(p,q), f(x,p)=f(y,q)$ -Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT II FOURIER SERIES 15

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 15

Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 15

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval'sidentity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 15

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) –Convolution theorem - Formation of difference equations – Solution of difference equations using Z- transform.

TOTAL : 75 PERIODS

OUTCOMES

On completion of the course students will be able to

- Develop skills to solve different types of partial differential equations
- Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
- Classify different types of PDE and solve boundary value problems.
- Develop skills to solve differential equations using Fourier transform techniques.
- Solve difference equations using Z – transforms that arise in discrete time systems.

TEXT BOOKS

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.

REFERENCES

1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, LaxmiPublications Pvt Ltd, 2007.
2. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education,2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw HillEducation Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta K.B., "Mathematical Methods of Science and Engineering", Cengage Learning IndiaPvt Ltd, Delhi, 2013.

AE17301	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.
- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine
- To provide knowledge on basics of Rapid Prototyping and Reverse Engineering

UNIT I CASTING **8**

Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

UNIT II WELDING **8**

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

UNIT III MACHINING **13**

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, cylindrical grinding machine, Capstan and Turret lathe, Non traditional Machining.Basics of CNC machines,Numerical Control (NC) machine tools, CNC types, constructional details, special features, machining centre.

UNIT IV METAL FORMING AND SHAPING OF PLASTICS **8**

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning ,Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics and Thermosets – Working principles and typical applications. Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods.

UNIT V INTRODUCTION TO RAPID PROTOTYPING AND REVERSE ENGINEERING **8**

History – Development of RP systems – Applications in Product Development, Rapid Tooling, Rapid Manufacturing-Principle – Fundamental – File format – Other translators – medical applications of RP – On demand manufacturing – Direct material deposition – Shape Deposition Manufacturing, Reverse Engineering.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course students will be able to

- Develop skills on basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.
- Describe the basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- Perform programming in Computer Numerical Control (CNC) machines
- Differentiate the plastics and applications of them in industries.
- Develop skills on basics of Rapid Prototyping and Reverse Engineering

TEXT BOOKS

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.

REFERENCES

1. Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education, Inc. 2007.
2. Chua C.K, Leong K.F and Lim C.S, "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific, 2003
3. Rafiq I. Noorani, Rapid Prototyping, "Principles and Applications", Wiley & Sons, 2006
4. Jain. R.K. and S.C. Gupta, "Production Technology", Khanna Publishers. 16th Edition,2001. "H.M.T. Production Technology – Handbook", Tata McGraw-Hill, 2000.

AE17302	**AERO ENGINEERING THERMODYNAMICS**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

OBJECTIVES

- 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.

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 of thermodynamics- concept of temperature and heat, internal energy, specific heat capacities, enthalpy - concept of ideal and real gases. First law of thermodynamics - applications to closed and open systems - steady flow processes with reference to various thermal equipments.

UNIT II SECOND LAW AND ENTROPY 9

Second law of thermodynamics – kelvin planck 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 ideal gas, principle of increase of entropy.

UNIT III THERMODYNAMIC AVAILABILITY 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

UNIT IV PROPERTIES OF PURE SUBSTANCE AND POWER CYCLE 9

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 HEAT TRANSFER AND AIR STANDARD CYCLES 9

Otto, diesel, dual and brayton cycles - air standard efficiency - mean effective pressure – reheat and regeneration cycle. conduction in parallel, radial and composite wall – basics of convective and radiation heat transfer.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course students will be able to

- Apply Mathematical foundations, principles in solving thermodynamics problems.
- Critically analyse the problem, and solve the problems related to heat transfer and propulsion
- Describe the various forms of energy associated with systems and surroundings.
- Differentiate the various cycle process and compare the efficiencies
- Demonstrate the various heat exchangers and perform the test on various cycle.

TEXT BOOKS

1. Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 2013.
2. Rathakrishnan E., “Fundamentals of Engineering Thermodynamics”, Prentice-Hall India, 2005.

REFERENCES

1. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2009
2. Holman.J.P., “Thermodynamics”, 3rd Edition, McGraw-Hill, 2007.
4. Arora C.P, “ Thermodynamics”, Tata McGraw-Hill, New Delhi, 2017.
5. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2013.

		L	T	P	C
AE17303	**FLUID MECHANICS AND MACHINERY**	**2**	**2**	**0**	**3**

OBJECTIVES

- To understand the basic principles and equations of of fluid mechanics and applications of the conservation laws to flow through pipes and hydraulic machines.
- To understand the concepts of boundary layer.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

Introduction and Basic Concepts [Not for Examination] 1

Introduction-What is Fluid?-Application area of Fluid Mechanics, The No-Slip Condition, A brief history of Fluid Mechanics.

UNIT – I PROPERTIES OF FLUIDS 8

Classification of Fluid Flows- System and Control Volume **-** Continuum-Properties of Fluids and their influence on fluid motion.

Pressure: -Pressure at a point – Variation of pressure with depth, The barometer and atmospheric pressure, Gaugeand vacuum pressures-Static, dynamic and Stagnation Pressures- – measurement of pressure- Piezometer, U-tube and differential manometers-Pitot tube- Buoyancy.

UNIT-II 11

Fluid kinematics: Lagrangian and Eulerian description, Stream line, Stream tube, path line and streak lines, Refractive and Surface flow visualization techniques-Plots of Fluid flow data-Equation of continuity for one dimensional flow.

Fluid dynamics: Surface and body forces –Newton's law and conservation of momentum -Euler's and Bernoulli's equations for flow alonga stream line, Total energy line-Hydraulic gradient line. General energy equation.

Closed conduit flow: Reynold's experiment- Reynolds number-The Entrance Region-Entry length-Laminar flow in pipes-Darcy Weisbach equation- Turbulent Flow in Pipes-Minor losses inpipes- Pipes in series and Pipes in parallel-Measurement of flow: Venturimeter and orifice meter, Flow through nozzle-basics

UNIT – III 11 Boundary

Layer Concepts: Definition, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, characteristics along thin plate, Development of laminar and turbulent boundary layers, boundary layer in transition, separation of boundary layer, submerged objects – drag and lift-Drag force on a flat plate due to Boundary layer.

Dimensional Analysis and Modeling: Need for dimensional analysis-Dimensional Homogeneity – Dimensional Analysis and Similarity –The Method of Repeating Variables and the Buckingham Pi Theorem – Similitude –Types of similitude - Dimensionless parameters- Application of dimensionless parameters – Model analysis.

UNIT – IV 7

Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done andefficiency, flow over radial vanes.Pump scaling laws.
Centrifugal pumps: Classification, working, work done – barometric head- losses and efficiencies - performance characteristic curves, NPSH.

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

UNIT – V 7

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine - working principle, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

Performance of hydraulic turbines:Turbine scaling laws- Specific speed, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surgetank, water hammer.

TOTAL: 45 PERIODS

OUTCOMES

`Upon completion of this course, the students

- Can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can able to analyze fluid motion and forces acting on a fluid.

- Can able to apply the boundary layer concepts in real fluid flow problems.
- Can critically analyze the performance of pumps.
- Can critically analyze the performance of turbines.

TEXT BOOKS

1. Yunus A. Cengel and John M. Cimbala. "Fluid Mechanics Fundamentals and Applications", McGraw Hill Edition 2006, Sixth Reprint 2009.
2. Dr.R.K.Bansal "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, Revised Ninth Edition.

REFERENCES

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2004.
2. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
3. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004.
4. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
5. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011

AE17304	SOLID MECHANICS	L	T	P	C
		2	2	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 - stress-strain curves – relations between material constants – axial loading - statically determinate and indeterminate problems in tension & compression - Thermal Stress.

UNIT II STRESSES IN BEAMS 10

Shear force & bending moment diagrams: bending and shear stress variation in beams of symmetric sections, a typical spar section: beams of uniform strength - beams of two materials.

UNIT III DEFLECTION OF BEAMS 8

Double integration method – Macaulay's method – moment area method – conjugate beam method - Maxwell reciprocal theorem.

UNIT IV TORSION – SPRINGS – COLUMNS 10

Torsion: Torsion of solid and hollow circular shafts – shear stress variation. **Springs:** Open and closed-coiled helical springs – stresses in helical springs. **Columns:**Buckling of columns - Euler's column curve –columns with different end conditions.

UNIT V BIAXIAL STRESSES 9

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

- Obtain knowledge on the stress and strain in the material, could be able to identify and solve statically determinate and indeterminate problems on thermal & impact loading conditions.
- Draw shear force & bending moment diagrams for various beams.
- Identify the slope and deflection of the beam.

- Design and analyse the shaft and springs, also the behaviour of columns.
- Understands the basics of bi-axial stresses

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.

AE17305	ELEMENT OF AERONAUTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts and evolution of flight
- To understand different types of aircraft
- To study basic aerodynamics
- To introduce basic concepts of aircraft structure
- To introduce piston and jet engines

UNIT I AIRCRAFT CONFIGURATIONS 8

History of flight-different types of flight vehicles,classification,components and functions of typical transport aircraft, three view diagram, helicopter and UAV parts and functions,

UNIT II BASICS OF AERODYNAMICS 12

Physical properties and structure of the atmosphere, ISA, temperature, pressure and altitude relationships, Newton’s law of motions applied to aeronautics - aerofoil and wing geometry, NACA series airfoils, generation of lift, Mach number and ranges, aerodynamic center, pressure coefs, aspect ratio, types of drag- induced drag, lift and drag curves, sweepback on wing, basics of pitot tube.

UNIT III AIRPLANE STRUCTURES AND MATERIALS 9

General types of construction, monocoque and semi-monocoque, typical wing and fuselage structure. metallic and non-metallic materials, use of aluminium alloy, titanium, stainless steel , plastics ,composite materials and smart structures, applications.

UNIT IV POWER PLANTS 9

Basics about piston, turbojet, turboprop and turbofan - use of propeller and jets for thrust production -equations, principles of operation of rocket, types of rockets and typical applications, exploration into space- India

UNIT V BASICS OF SPACE MECHANICS 7

Keplar laws, equation, two body problem, fundamentals of orbital mechanics, orbital elements. orbital transfers, space environment-atmosphere, radiation and magnetic field,

TOTAL: 45 PERIODS

OUTCOMES

- Identify the component of aircraft
- Perform basic calculation on lift, drag and moment.
- Identify suitable materials for aircraft structure

- Identify types of jet engines
- Understands basics of space mechanics

TEXT BOOKS

Anderson, J.D., “Introduction to Flight”, Tata McGraw-Hill, 2010.

REFERENCES

1. Kermode, A.C., “Mechanics of Flight”, Pearson Education; 11th edition.
2. Kermode, A.C, “Flight without Formula”, Pearson Education; 5th edition.

AE17361	SOLID MECHANICS AND FLUID MECHANICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads.
- This would enable the student to have a clear understanding of the design for strength and stiffness
- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals - Brinnell and Rockwell Hardness Number
5. Compression test on helical springs
6. Double shear test on metal
7. Study of various types of strain gauges
8. Determination of the coefficient of discharge for given Orifice meter and Venturimeter.
9. Determination of friction factor for a given set of pipes.
10. Determination of characteristic curves of centrifugal pump.
11. Determination of characteristic curves of reciprocating pump.
12. Determination ofperformance curves of Pelton wheel turbine.
13. Determination ofperformance curves of Francis turbine.
14. Flow visualization studies on various models at different Reynold's number.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform different destructive testing
- Ability to characterize materials
- Ability to use the instruments for deflection measurement.
- Ability to use the equipment for flow discharge measurement
- Ability to do performance test on different fluid machinery.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Experiment No.	Quantity
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1	1
2	Torsion Testing Machine (60 NM Capacity)	2	1
3	Impact Testing Machine (300 J Capacity)	3	1
4	Brinell Hardness Testing Machine	4	1
5	Rockwell Hardness Testing Machine	4	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	5	1
7	Orificemeter setup	6	1
8	Venturimeter setup	6	1
9	Pipe Flow analysis setup	7	1
10	Centrifugal Pump setup	8	1
11	Pelton wheel turbine setup	9	1
12	Francis turbine setup	10	1

AE17311	THERMODYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE

- To enhance the basic knowledge in applied thermodynamics

LIST OF EXPERIMENTS

1. Draw the Valve timing diagram of 4-Stroke engine
2. Draw the Port timing diagram of 2-Stroke engine
3. Performance test on a 4-Stroke engine(Load test)
4. Determination of effectiveness of a parallel flow heat exchanger and calculate the overall heat transfer coefficient (u) in the parallel flow heat exchanger
5. Determination of effectiveness of a counter flow heat exchanger and calculate overall heat transfer coefficient (u) in the counter flow heat exchanger
6. Determination of convective heat transfer coefficient during forced convection.
7. Determination of convective heat transfer coefficient during free convection
8. Determination of thermal conductivity of metal by Guarded hot plate method
9. Determination of thermal resistance of a composite wall
10. Determine the COP of a Refrigeration unit
11. Determine the COP of a Air-conditioning unit
12. Determination of specific heat of solid by Bomb calorimeter.
13. Determination of Thermal conductivity of a pipe insulation using lagged pipe apparatus.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course students will be able to

- Differentiate the petrol and diesel engine
- Develop skills on heat exchangers and its applications
- Acquire knowledge about the heat transfer in materials
- Peform tests on AC and refrigeration units.
- Describe the various types of fuels used in automobile industry.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Quantity
1	4 stroke twin cylinder diesel engine	1
2	Cut section model of 4 stroke diesel engine and cut section model of 2 stroke petrol engine	1
3	Parallel and counter flow heat exchanger test rig	1
4	Bomb Calorimeter	1
5	Vapour compression refrigeration test rig	1
6	Vapour compression air-conditioning test rig	1
7	Conductive heat transfer set up	1
8	Composite wall setup	1
9	Free and force convection set up	1

AE17312	COMPUTER AIDED MODELLING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

To gain practical experience in handling 2D drafting and 3D modelling software systems.

LIST OF EXPERIMENTS

1. Introduction to Modelling software
2. Drafting of 2D riveted joints
3. Draftiing of 2D Welded Joints
4. Drafting of layout of Typical wing structure
5. Drafting of rectangular plates with holes
6. Drafting of machine component
7. Creation of 3D assembly model of Flange coupling.
8. Creation of 3D assembly model ofPlummer Block
9. Creation of 3D assembly model ofScrew Jack
10. Creation of 3D assembly model ofUniversal Joint
11. Creation of 3D assembly model of Foot Step Bearing
12. Creation of 3D assembly model of Knuckle Joint

TOTAL: 45 PERIODS

OUTCOMES

- Ability to understand the basic differences on 2D and 3D designs.
- Ability to develop 2D sketches using modeling software.
- Ability to develop 3D models using modeling software.
- Ability to perform assembly of different 3D components using modeling software.
- Ability to get job opportunities on design based industries

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Equipments	Quantity
1	Internal server (or) Work station	1
2	Computers	30
3	Modelling packages (AUTOCAD/CATIA)	30 licenses
4	UPS	1
5	Printer	1

SEMESTER IV

MA17451 NUMERICAL METHODS L T P C

Common to AERO, Civil, Chemical & EEE 3 2 0 4

OBJECTIVES:

- To provide the necessary basic concepts of a few numerical methods.
- To provide procedures for solving numerically different kinds of problems occurring in the field ofEngineering and Technology.

UNIT I SOLUTION OF EQUATIONS 15

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 method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT II INTERPOLATION 15

Interpolation with equal intervals - Newton's forward and backward difference formulae - Interpolation with unequal intervals – Newton's divided difference interpolation- Lagrange's interpolation – Cubic Splines

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 15

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

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 15

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

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 15

Finite difference method for solving second order differential equations - Finite difference techniques for the solution of two dimensional Laplace and Poisson equations on rectangular domain – One dimensional heat flow equation by implicit and explicit methods – One Dimensional Wave Equation by Explicit method.

TOTAL : 75 PERIODS

OUTCOMES

On completion of the course students will be able to

- To solve algebraic equations and eigen value problems that arise during the study of Engineering problems.
- To use various interpolation techniques for solving problems in Engineering.
- To use numerical methods to solve problems involving numerical differentiation and integration.
- To solve initial value problems numerically that arise in Science and Engineering.
- Solve boundary value problems that encounter in different fields of Engineering study.

TEXT BOOKS

1. Kandasamy, P., Thilagavathy K., and Gunavathy,S., 'Numerical Methods', Chand and Co., 2007.
2. Grewal. B.S., and Grewal. J.S.,"Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi, 2007.
3. S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice- Hall of India PVT. LTD., 4th edition, New Delhi, 2006

REFERENCES

1. T. Veerarajan., T. Ramachandran., 'Numerical Methods with Programs in C and C++' Tata McGraw Hill., 2007.
2. Jain, M.K., Iyengar, S.R., and Jain, R.K., 'Numerical Methods for Scientific and Engineering Computation',New Age Publishers. 6th edition, 2007.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGrawHill, New Delhi, 2015.
4. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.
5. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of IndiaPrivate, 3rd Edition, New Delhi, 2007.
6. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
7. Rajaraman V.,Computer-Oriented Numerical Methods, Third Edition, Published by PHI Learning Private Limited (2013).

AE17401	**AERODYNAMICS - I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT – I FUNDAMENTAL EQUATIONS 8

Modeling of Fluid Flow - Control Volume: Fixed and Moving - Infinitesimal Fluid Element: Moving and Fixed - Substantial Derivative - Reynolds Transport Theorem - Type of fluid flows - Governing Equations of Fluid Flows: Continuity, momentum and energy equations in integral and differential form in Cartesian co-ordinate system.

UNIT – II AERODYNAMIC FORCES 9

Euler equation, incompressible Bernoulli's equation. Streamlined and bluff-bodies. Airfoil Nomenclature and classification, Low speed aerodynamic characteristics of symmetric and cambered airfoils, centre of pressure, aerodynamic centre and aerodynamic moment, generation of lift, drag and moment, incompressible flows over airfoils, calculation of lift and drag from measured pressure distribution. Low speed wind tunnels.

UNIT – III POTENTIAL FLOWS 9

Circulation and vorticity, Stoke's theorem, streamline, stream function. Irrotational flow, potential function, equipotential lines, governing equation for irrotational and incompressible fluid flow, elementary flows and their combinations. Ideal Flow over a circular cylinder, D'Alembert's paradox, Magnus effect, Kutta joukowski's theorem, real flow over smooth and rough cylinder.

UNIT – IV AIRFOILS AND WINGS 10

Concept of point vortex, line vortex and vortex sheet, Kutta condition, Kelvins circulation theorem and starting vortex, Classical thin airfoil theory - symmetric & cambered airfoils.

Finite wing nomenclature. Incompressible flow over wing, vortex filament, bound vortex, horse shoe vortex, downwash, induce angle of attack and drag. Type of drag, Biot- savart law and Helmholtz's vortex theorem. Prandtl's lifting line theory and limitations. Elliptic lift distributions, expression for induced angle of attack and induce drag. Two dimensional and three dimensional wings lift curve slope and effect of aspect ratio. High lift devices.

UNIT – V VISCOUS FLUIDFLOWS 9

Boundary layer equations for a steady, two dimensional incompressible flow, boundary layer growth over a flat plate, critical Reynolds number, Blasius solution - self-similar solutions and other important results. Basics of turbulent flow – one and two equation models.

TEXT BOOKS

1. Anderson, Jr., J.D., Fundamentals of Aerodynamics, McGraw-Hill Education; 5 edition, 2010
2. Bertin, J.J., Aerodynamics for Engineers, Fourth edition, Pearson Education, 2011
3. Kuethe, A.M., and Chow, C., Foundations of Aerodynamics, 5th Edn., Wiley, 2010.

REFERENCES

1. Kuchemann, D., the Aerodynamic Design of Aircraft, Pergamum,1978.
2. McCormick, B.W., Aerodynamics, Aeronautics, & Flight Mechanics, second edition,John Wiley, 2009.

AE17402	AIRCRAFT SYSTEMS AND INSTRUMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge of the aircraft control systems
- To gain knowledge on hydraulic and pneumatic systems of aircraft
- Basic knowledge of piston and jet engine fuel and lubrication systems
- To impart knowledge on aircraft environment systems
- To gain knowledge on flight and engine instruments.

UNIT I AIRPLANE CONTROL SYSTEMS 8

Conventional Systems – power assisted and fully powered flight controls – push pull rod and cable system – perating principles – modern control systems – FBW and FBL systems – auto pilot system.

UNIT II AIRCRAFT SYSTEMS 12

Hydraulic systems – Study of typical hydraulic systems Boeing 727 components – hydraulic systems operation – selector valves-accumulators-Control valves – pneumatic systems – Schematic diagram and operation – brake system-typical brake system Boeing 757 – landing gear systems – components – shock strut operation-retraction systems.

UNIT III ENGINE SYSTEMS 8

Typical fuel systems – piston and jet engines – components – typical fuel 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 - air cycle machine cooling system – cooling pack-oxygen systems – Typical oxygen system Cessna– fire protection systems-fire extinguishing agents-deicing and anti-icing system-pneumatic deicing of large aircraft-thermal anti-icing.-probe anti-icing.

UNIT V AIRCRAFT INSTRUMENTS 9

Flight and engine instruments – accelerometers, air speed indicators – mach meters – altimeters – typical Boeing system with air data computer- gyroscopic instruments– principles and operation – study of various types of engine instruments – tachometers – oil temperature gauges-EGT-EPR- fuel quantity indicators- operation and principles.

TOTAL: 45 PERIODS

OUTCOMES

- Understands the aircraft control systems
- Acquires knowledge on hydraulic and pneumatic systems of aircraft
- Understands piston and jet engine fuel and lubrication systems
- Understands the aircraft environment systems
- Identify flight and engine instruments

TEXT BOOKS

1. Kroes, Watkins and Delp, "Aircraft Maintenance and Repair", Tata McGraw Hill, 2010

REFERENCES

1. Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993.
2. Kroes and Wild,"Aircraft Power plants", Tata McGraw Hill 2010
3. Instrument Flying Handbook: FAA-H-8083-15B, Sky Pony Press; Clr Csm edition, 2017.

AE17403	MECHANICS OF MACHINES	L	T	P	C
		2	2	0	3

OBJECTIVES

- To understand the principles in the formation of mechanisms and their kinematics.
- To understand the effect of friction in different machine elements.
- To analyse the forces and toques acting on simple mechanical systems
- To understand the importance of balancing.

UNIT I KINEMATIC OF MECHANICS 8

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain –Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons.

UNIT II CAMS AND GEARS 11

Cams – classifications – displacement diagrams - layout of plate cam profiles– derivatives of followers motion - Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT III FRICTION 8

Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches – Belt and rope drives - Ratio of tensions – Effect of centrifugal and initial tension– Condition for maximum power transmission – Open and crossed belt drive

UNIT IV FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT V BALANCING AND MECHANISM FOR CONTROL 9

Static and Dynamic balancing – Single and several masses in different planes –Balancingof reciprocating masses-primary balancing and concepts of secondary balancingGyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL 45 PERIODS

OUTCOMES

- will be able to understand the principles in the formation of mechanisms and their kinematics.
- will be able to understand the importance of cams and gear mechanism
- will be able to understand the effect of friction in different machine elements.
- will be able to analyse the forces and toques acting on simple mechanical systems
- will be able to understand the importance of balancing.

TEXT BOOKS

1. Ambekar A.G., "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press, 2003
3. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.

2. Ghosh.A, and A.K.Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1992.
4. Ramamurthi. V, "Mechanisms of Machine", Narosa Publishing House, 2002.
5. Robert L. Norton, "Design of Machinery", McGraw-Hill, 2004.

AE17404	AIRCRAFT STRUCTURES - I	L	T	P	C
		2	2	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 8

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 9

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 – application to buckling problems using energy methods – theory of beam columns – beam columns with differentend and loading loading conditions – stresses in beam columns.

UNIT IV FAILURE THEORIES AND IT’S APPLICATIONS 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 9

Impact loading – Fatigue – Types of Fatigue – Fatigue Life Curves –Basics of Fracture Mechanics - Review of basic fracture mechanics - Atomic view of fracture Griffith energy criterion – Creep – Various stages of 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
3. Peery and Azar, "Aircraft Structures"
4. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 1996.

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.

		L	T	P	C
AE17405	**AIRCRAFT PERFORMANCE**	**2**	**2**	**0**	**3**

OBJECTIVE

- To make the student understand the performance of airplanes under various flight conditions like 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 III 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 take-off and landing distances, 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; 5th Edition, 1997. 2. John J Bertin., Aerodynamics for Engineers, Prentice Hall; 6th edition, 2013.
2. Clancy, L J., Aerodynamics, Shroff publishers (2006)
3. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015 AE7504 PROP

AE17411 **AERO ENGINE AND SYSTEM LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVE

- To dismantle piston and jet engine, clean, and perform NDT test
- To perform the checks for aircraft symmetry, leveling and jacking
- To understand filter element clogging in the aircraft engine
- To perform brake torque load test on aircraft wheel brakes
- To understand the starting procedure of aircraft piston engine

LIST OF EXPERIMENTS

1. Dismantling of a piston engine and components identification
2. Inspection of Piston Engine - cleaning, and perform NDTchecks.
3. Identification of Jet Engine – components &defects.
4. Static balancing of Propeller.
5. Starting procedure of Piston engine in Cessna Aircraft
6. Identification of Ignition system in Cessna Aircraft.
7. Experiment on Aircraft "Jacking up and Leveling" Procedure.
8. Control surface "Rigging check.
9. Experiment on "Symmetry check" in Cessna Aircraft.
10. Perform the "Flow test" to assess filter element clogging.
11. Perform the "Brake Torque Load Test" on wheel brake units.
12. Identification of fuel systems in Cessna Aircraft.

TOTAL: 45 PERIODS

OUTCOMES

- Able to dismantle piston and jet engine ,clean, and perform NDT test
- Able to perform the checks for aircraft symmetry, leveling and jacking
- Understands filter element clogging in the aircraft engine
- Able to perform brake torque load test on aircraft wheel brakes
- Able to understand the starting procedure of aircraft piston engine

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Equipments	Quantity
1	Piston Engines	1
2	Jet Aero Engines	1
3	Standard tools for dismantling and assembly	2 sets
4	Precision instruments (Vernier Caliper, Micro meter, Cylinder bore gauge, depthgauge, Bevel Protector and DTI)	2 sets
5	NDT Equipment	1 set
6	Serviceable aircraft with all abovesystems	1
7	Hydraulic Jacks (Screw Jack)	3
8	Trestle adjustable	3
9	Spirit Level	2
10	Levelling Boards	2
11	Cable Tensiometer	1
12	Adjustable Spirit Level	1
13	Plumb Bob	1

AE17412 **AERODYNAMICS LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES

- To visulalize and understand the low speed flows
- To practice techniques which predict/measure aerodynamics forces
- To understand the interactions of flow fields

LIST OF EXPERIMENTS

1. Calibration of velocity profile in the test section of a subsonic wind tunnel.
2. Smoke flow visualization on an airfoil model at different angles of incidence at low speeds.
3. Tuft flow visualisation on airfoil models at different angles of incidences at low speeds.
4. Surface pressure distribution on a symmetrical airfoil at an angle of incidence and calculation of lift and pressure drag.
5. Surface pressure distribution on a cambered airfoil at an angle of incidence and calculation of lift and pressure drag.
6. Calculation of pressure drag of a cambered airfoil at a low incidence using pitot-static probe wake survey.
7. Measurement of aerodynamic loads on symmetric and cambered airfoils using wind tunnel balance.
8. Surface pressure distribution on an airfoil (infinite wing) with flap.
9. Pressure distribution over smooth and rough circular cylinders.
10. Surface pressure distribution around cylinder models in multiple model arrangement.

TOTAL: 45 PERIODS

OUTCOME

- Ability to use the fundamental aerodynamic principlesfor aircraft tesing applications.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Equipments	Quantity
1	Subsonic Wind tunnel (including all accessories)-	1
2	Gang Manometer	1
3	Pitot static tube and Pitot rake	1 each
5	Airfoil and cylinder models	6
6	Smoke flow generator	1
7	Force balance	1
8	Angle of attack modulator	1

AE17413	AIRCRAFT COMPONENT DRAWING	L	T	P	C
		0	0	4	2

OBJECTIVES

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

LIST OF EXPERIMENTS

1. Introduction to surface modelling
2. Drafting of aircraft wing
3. Drafting of aircraft fuselage
4. Drafting of enpennage
5. Drafting of aircraft engine turbine
6. Drafting of typical aircraft.
7. Drafting of landing gear
8. Drafting of control component's gear
9. Drafting of control component's push-pull rod
10. Layout of control system

TOTAL: 45 PERIODS

OUTCOMES

- Will be able to develop in students graphic skills for communication of concepts ,ideas of engineering products .
- Ability to perfom surface modeling using modeling software.
- Ability to develop surface modeling in a/c and its parts
- Ability to perform drafting on 3D models
- Ability to get job opportunities on design based industries

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Equipments	Quantity
1	Internal server (or) Work station	1
2	Computers	30
3	Modelling packages (AUTOCAD/CATIA)	30 licenses
4	UPS	1
5	Printer	1

SEMESTER V

		L	T	P	C
AE17501	**PROPULSION – I**	**2**	**2**	**0**	**3**

OBJECTIVES

- To introduce basic concepts and salient features of engine components of jet propelled engines which are operated in atmosphere to students. To familiarize with hypersonic propulsion.

UNIT I FUNDAMENTALS OF AIR BREATHING ENGINES 9

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 AND NOZZLES 10

Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternaldeceleration 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– ejector and variable area nozzles - thrust reversal.

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 JET ENGINE COMBUSTORS AND RAMJET PROPULSION 8

Classification of combustion chambers – combustion chamber performance – effect of operating variables on performance – flame stabilization. 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. Coding for jet engine problems.

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, NewYork, 1985.
3. Rathakrishnan., E,"Gas Dynamics" ,Fifth edition Published by PHI Learning, 2014.

AE17502	AIRCRAFT STRUCTURES– II	L	T	P	C
		2	2	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 — 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

AE17503	AERODYNAMICS – II	L	T	P	C
		2	2	0	3

UNIT-I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 9

Isentropic relations, definition of compressibility of flow and its measure, speed of sound, Mach number, flow regimes, compressible Bernoulli's equation. Mach lines/waves/cones.

1D, ISENTROPIC FLOWS

Steady one-dimensional flow equations, area- velocity relation, isentropic flow through variable area duct, critical conditions, characteristic Mach number, Area-Mach number relation, maximum discharge velocity, mass flow rate, effect of stagnation conditions, back pressure. Choked flow, isentropic flow, ideally expanded, over-expanded, under-expanded flows-appearance of normal shock, Wave reflection from free boundary, Brief outline of operation of supersonic wind tunnels employing convergent-divergent nozzles. Types of supersonic wind tunnels.

UNIT-II 1D, NON-ISENTROPIC FLOWS 9

Normal shock waves: basic equations, relations across a normal shock, calculation of normal shock wave properties, measurements of airspeed in supersonic flows. Entropy rise across normal shock and its relation to pressure rise. Hugoniot equation. Moving normal shock waves - one-dimensional piston motion in a constant area tubes, Jump start, propagation of shock wave in front and expansion wave behind, x-t diagram, particle velocity, pressure density & temperature relations. Rayleigh flows and Fanno flows.

UNIT-III OBLIQUE SHOCKS AND EXPANSION WAVES 11

Oblique shock relations, Supersonic flow over wedges with attached shock, large wedge angle and shock detachment, Oblique shock charts: strong shock and weak shock boundary, pressure, density and entropy rise, Oblique shock of vanishing strength and Mach wave, Mach angle and Mach line, supersonic compression by turning, smooth nearly isentropic turn, Numerical exercise with oblique shock charts,

Regular reflection from solid wall, pressure deflection diagram, phenomenological description of shock wave-boundary layer interaction at the wall, intersection of shocks, Mach reflection and slip stream. Numerical exercises with shock reflection and shock intersection. Detached shock wave in front of bluff 2-D body.

Supersonic expansion by turning, Prandtl-Meyer function & expansion fan, Shock expansion theory-application to supersonic airfoils.

UNIT-IV COMPRESSIBLE SUBSONIC, TRANSONIC FLOWS 8

Subsonic Flow: The velocity potential, perturbation potential, linearized governing equation in two dimension, the pressure coefficient-Prandtl-Glauert compressibility correction, application to swept wings, critical Mach no, drag divergence Mach no.

Transonic Flow: The sound barrier. Buffeting, supercritical airfoils, swept wings at transonic-speeds, 2nd order equation for transonic flows, Wing-body combination, Whitcomb's Transonic area rule: application to transonic aircraft.

UNIT-V LOADS ON SUPERSONIC AIRFOILS AND WINGS 9

Linearized supersonic flow-governing equations, boundary conditions. Pressure coefficient, application to supersonic airfoils-- Lift, drag, pitching moment. Wedge, flat plate, diamond and biconvex airfoils at small angle of attack.Air loads over flat rectangular wings of finite span, Delta wing with supersonic leading edge and subsonic leading edge.

Method of Characteristics – Supersonic Nozzle Design

Brief outline of the method of characteristics-Statement (without proof) of compatibility relations, application to supersonic nozzle design.

TOTAL 45 PERIODS

TEXT BOOKS

1. Anderson, J.D., Modern compressible Flow with Historical Perspective, third ed., McGraw-Hill, 2017.
2. Rathakrishnan E., Gas Dynamics, Prentice- Hall of India, 2017.

REFERENCES

1. Carscallen, William E. Oosthuizen, Patrick H, "Introduction to Compressible Fluid Flow", CRC Press, II Edition, 2014.
2. McCormick, B.W., Aerodynamics, Aeronautics & Flight Mechanics, second ed., John Wiley, 2009.
3. Liepmann, H. W., and Roshko, A., Elements of Gas Dynamics, John Wiley, 2013.
4. S. M. Yahya, "Fundamentals of Compressible Flow", New Age Publications, 2009.

		L	T	P	C
AE17504	**AIRCRAFT STABILITY AND CONTROL**	**2**	**2**	**0**	**3**

OBJECTIVE:

- To make the student understand the concepts of stable and nonstable configuration of airplanes. Also to introduce the concepts 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.

UNIT III STATIC LATERAL STABILTY AND CONTROL 12

Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stabilitycontribution 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

Aircraft Equations of motion, 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.

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: 45 PERIODS

OUTCOMES

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

- An understanding of the contribution to static longitudinal stability from various components of the airplane and the requirements of rudder
- 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
- To get familiarized with the longitudinal, directional and lateral dynamics of the airplane
- 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 1976.
2. Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.

REFERENCES

1. McCormick, B.W. Aerodynamics, Aeronautics & 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, Wiley, third edition 1995. 4.Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004.

AE17505	CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the mathematical modelling 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 10

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

UNIT V SAMPLED DATA SYSTEMS 8

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

TOTAL: 45 PERIODS

OUTCOMES

- Ability to understand the importance of mathematical modeling of a system
- Ability to Demonstrate the concept and needs of feedback control systems and its application
- Ability to Determine the response of different order systems for various step inputs
- Ability to Determine the (absolute) stability of a closed-loop control system
- Ability to understand the concept of data system sampling and digital controller

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., U.S.A. 1995.
3. Naresh K Sinha, "Control Systems", New Age International Publishers, New Delhi, 1998.

AE17511	AIRCRAFT STRUCTURES LABORATORY	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 study the failure of different component under different loading condition

LIST OF EXPERIMENTS

1. Determination of deflection of a beam under different emd conditions
2. Verification of superposition theorem
3. Verification of Maxwell's reciprocal theorem
4. Determination of member forces in the truss
5. Determination of principal axis in unsymmetrical bending of a cantilever beam
6. Determination of Shear entre of a channel section
7. Fabrication of a Composite Laminate using Glass fibre as per ASTM standard
8. Determination of strength value in tapered beam section
9. Estimation of buckling load in column with both ends are hinged.
10. Determination of natural frequency in Forced vibration of a cantilever beam
11. Determination of deflection in the cantilever frame
12. Identify the fringe pattern in the using photo elastic models

OUTCOMES

- Be able to understand the importance of aircraft structures which are the load carrying members.
- The analytical ability of calculating the bending stresses in beams of un-symmetrical sections.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Quantity	Experiment No.
1	Beams with weight hangers and dial gauges	6	1,2,3
2	Truss model and	1	4
3	Frame model	1	11
4	Unsymmetrical bending set up	1	5
5	Constant strength beam set up	1	8
6	Column set up with dial gauges	2	9
7	Vibration set up with accessories	1	10
8	Photo elasticity set up	1	12

AE17512 **AIRFRAME REPAIR LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES

- To build skill on riveting,
- To train on patch work,
- To develop skill on welding

LIST OF EXPERIMENTS

1. Aircraft wood gluing on a single scarf joint.
2. Aircraft wood gluing on a double scarf joint.
3. MIG welding of single & double V-joints.
4. TIG welding of single & double V-joints
5. Patch repair work on Perspex plate.
6. Riveting of lap and butt joints on an aluminum plate.
7. Bending and Flaring of aluminum tube.
8. Making a channel and angle section by bending aluminum strip.
9. Performing aircraft magnetic compass swing (direct readingtype).
10. Performing mooring on bolted and riveted joints

TOTAL: 45 PERIODS

OUT COMES

- Ability to join the different types of aircraft wood
- Develop skills on riveting,mooring and patch work
- Differentiate the welding process and weld the materials
- Ability to bend the sheet metals
- perform the balancing of aircraft

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Name of the Equipment	Quantity	Experiment No.
1	Shear cutter pedestal type	1	4,6
2	Drilling Machine	1	4,5,6
3	Bench Vices	1	1, 2, 6, 7, 8
4	Radius Bend bars	1	7
5	Pipe Flaring Tools	1	7
6	Welding machine	1	4
7	Glass fibre, epoxy resin	1	9
8	Strain gauges and strain indicator	1	10

AE17513	AERODYNAMICS LABORATORY-II	L	T	P	C
		0	0	4	2

OBJECTIVES

- To enable the students understand the behavior supersonic flows
- To study the different expansion levels of jets.

LIST OF EXPERIMENTS

1. Principle of operation and calibration of supersonic jet rig.
2. Effect of inlet total pressure on the flow development of supersonic C-D nozzle.
3. Mach number distribution in C-D nozzle for un-choked inlet total pressure(s).
4. Mach number distribution in C-D nozzle for choked inlet total pressure(s).
5. Pitot Pressure study of an over-expanded jet.
6. Pitot Pressure study of correctly-expanded jet.
7. Pitot Pressure study of an under-expanded jet.
8. Pitot Pressuremeasurements to study characteristic decay of subsonic jet.
9. Pitot Pressuremeasurements to study radial spread of subsonic jet.
10. Use of Shadow graph system to visualize shock waves.
11. Noise Characteristics of subsonic jets.
12. Noise Characteristics of supersonic jets.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Name of the Equipment	Quantity
1	Supersonic Jet Rig Setup (includes compressors, reservoir and settling chamber and pressure gauges)	1
2	Pressure Regulating Valves	2
3	C-D nozzle models	2
4	Gang manometer	1
5	Pitot tube	1
6	Multi-Channel Pressure scanner	1
7	Flow Visualization setup	1
8	Anechoic Chamber with microphone and DAQ	1

AE17514	INDUSTRIAL TRAINING	L	T	P	C
		0	0	1	1

A 4-6-week industry internship is a compulsory course requirement during summer vacation. Evaluation marks to be carried over to next semester. Every student of the course is expected to work in the industry for a period of 4 - 6 weeks, during the months of May to June, after completing four semesters of the academic program. The Industry Internship Placement process is held to help the students find internships and at the same time, help recruiters find students to intern with their firms challenging projects.

SEMESTER VI

		L	T	P	C
AE17601	**PROPULSION - II**	**2**	**2**	**0**	**3**

OBJECTIVES:

- 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 9

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 combustor .

UNIT II FUNDAMENTALS OF CHEMICAL ROCKET PROPULSION 10

Introduction to chemical rocket propulsion-applications of chemical rocket motors with advantages and disadvantages –Operating principle– specific impulse of a rocket – internal ballistics – performance considerations of rockets – various feed systems -preliminary concepts in nozzle-less propulsion – air augmented rockets – pulse rocket motors – static testing of rockets & instrumentation –safety considerations.

UNIT III SOLID ROCKET PROPULSION 9

Selection criteria of solid propellants– types of igniters – estimation of solid propellant adiabatic flame temperature - propellant grain design considerations – erosive burning in solid propellant rockets – combustion instability – strand burner and T-burner.

UNIT IV LIQUID AND HYBRID ROCKET PROPULSION 9

Selection of criteria liquid propellants 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 - 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
- Differentiate various rocket propulsion systems
- Knowledge about the applications and principles of liquid and solid-liquid propulsion systems
- Develop hybrid propulsion and cryogenic in rocketry
- Aquire knowledge in electric propulsion systems

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.

AE17602	FINITE ELEMENT METHODS	L	T	P	C
		2	2	0	3

OBJECTIVES

- 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 approach 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 nodal 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

OUTCOME

- 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", 2nd Edition, John Wiley and Sons, 1984.

AE17603	FLIGHT VEHICLE DESIGN	L	T	P	C
		3	0	2	4

UNIT I OVERVIEW OF DESIGN PROCESS 9

Introduction, Requirements, Phases of design, Conceptual Design Process, Initial Sizing, Take-off weight build up, Empty weight estimation, Fuel fraction estimation, Take- off weight calculation, Thrust to Weight Ratio & Wing Loading: Thrust to Weight Definitions, Statistical Estimate of T/W. Thrust matching, Spread sheet in design, Wing Loading and its effect on Stall speed, Take-off Distance, Catapult take-off, and Landing Distance. Wing Loading for Cruise, Loiter, Endurance, Instantaneous Turn rate, Sustained Turn rate, Climb, & Glide, Maximum ceiling.

UNIT II CONFIGURATION LAYOUT & LOFT 9

Conic Lofting, Conic Fuselage Development, Conic Shape Parameter, Wing-Tail Layout & Loft. Aerofoil Linear Interpolation. Aerofoil Flat-wrap Interpolation. Wing aerofoil layout-flap wrap. Wetted area determination. Special considerations in Configuration Layout: Aerodynamic, Structural, Detectability. Crew station, Passenger, and Payload arrangements. Design of Structural Components: Fuselage, Wing, Horizontal & Vertical Tail. Spreadsheet for fuselage design. Tail arrangements, Horizontal & Vertical Tail Sizing. Tail Placement. Loads on Structure. V-n Diagram, Gust Envelope. Loads distribution, Shear and Bending Moment analysis.

UNIT III ENGINE SELECTION & FLIGHT VEHICLE PERFORMANCE 9

Turbojet Engine Sizing, Installed Thrust Correction, Spread Sheet for Turbojet Engine Sizing. Propeller Propulsive System. Propeller design for cruise. Take-off, Landing & Enhanced Lift Devices. Ground Roll, Rotation, Transition, Climb, Balanced Field Length, Landing Approach, Braking. Enhanced lift design -Passive & Active.

UNIT IV STATIC STABILITY & CONTROL 9

Longitudinal Static Stability, Pitch Trim Equation. Effect of Airframe components on Static Stability. Lateral stability. Contribution of Airframe components. Directional Static stability. Contribution of Airframe components. Aileron Sizing, Rudder Sizing. Flying qualities. Cooper Harper Scale. Environmental constraints, Aerodynamic requirements.

UNIT V DESIGN ASPECTS OF SUBSYSTEMS 9

Flight Control system, Landing Gear and subsystem, Propulsion and Fuel System Integration, Air Pressurisation and Air Conditioning System, Electrical & Avionic Systems, Structural loads, Safety constraints, Material selection criteria.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Aircraft Design - A Conceptual Approach- Daniel P. Raymer, AIAA Education Series, IVth Edition © 2006
2. Design of Aircraft-Thomas C. Corke, Pearson Edition. Inc. © 2003.

REFERENCES

1. Aeroplane Design -VOL 1 to 9 - J Roskam, Roskam Aviation & Engineering Corporation, 1989.
2. Introduction to Aircraft Design - John Fielding, Cambridge University Press, 2009 3. Standard Handbook for Aeronautical & Astronautical Engineers, Editor Mark Davies, Tata McGraw Hill, 2010.

AE17604	COMPOSITE MATERIALS AND STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

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

UNIT I MICROMECHANICS 9

Introduction - Advantages and application of composite materials - reinforcements and matrices – Introduction to Nano composite -Micro mechanics – Mechanics of materials approach, elasticity approach-Effect of voids - hygro thermal effects on a lamina.

UNIT II MACROMECHANICS 9

Macro mechanics - 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 material properties - Experimental characterization of lamina.

UNIT III LAMINATED PLATE 9

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

UNIT IV FABRICATION PROCESS AND REPAIR METHODS 9

Various open and closed mould processes, Manufacture of fibers, Types of resins, properties and applications, Netting analysis. importance of repair and different types of repair techniques in composites

UNIT V SANDWICH CONSTRUCTIONS 9

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. Jones, R.M., "Mechanics of Composite Materials," Taylor & Francis, II Edition, 2000.
2. 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 – Nostrand Reinhold Company, New York 1998.
4. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, II Edition, 1999.

5. Autar K Kaw, „Mechanics of Composite Materials", CRC Press, 1997.

AE17605	EXPERIMENTAL AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To describe flow visualization techniques and to highlight in depthdiscussion of analog methods.
- To describeabout calibration and instrumentation of various wind tunnels and force measurements.
- To provide details, operating principles and limitations of pressure, velocity,temperature, mass and volume flow measurements.
- To understand the concepts in data acquisition systems, error estimation and uncertainty analysis.

UNIT I MEASUREMENTS IN FLUIDS 9

Fundamentals measurements in fluid mechanics:

Objectives of experimental studies – Fluid mechanics measurements -Measurement systems – Quantities associated with fluid flow measurements- Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers

Flow visualization and analogue methods:

Principles ofFlow Visualization – Visualization techniques-Smoke tunnel-design and application –Compressible flows –Interferometer – Fringe-Displacementmethod – Schlieren system – Shadowgraph-Analogue methods-Heleshaw apparatus-Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

UNIT II INSTRUMENTATION AND CALIBRATION OF WIND TUNNELS 10

Power losses-subsonic and supersonic wind tunnels – Compressor tunnel matching-mass flow-Running time of blow down tunnels- Instrumentation and calibration of low speed wind tunnels - Wind tunnel balance –principles, types and classifications - balance calibration-boundary correction- Calibration of supersonic and hypersonic tunnels -Ludwieg tube-operating principle -Hypersonic simulation requirements.

UNIT III PRESSURE AND VELOCITYMEASUREMENTS 10

Pressure measurement techniques:

Introduction-Barometers – Manometers – Dial type pressure gauge – Pressure transducers –Pitot, static and Pitot-Static tube - factors and characteristics –Pitot, static and Pitot-Static probes –Yaw effect-static pressure measurement in compressible Flows-Determination of flow direction –Low pressure measurements – Preston and Stanton Tubes - Sound measurements – Dynamic pressure gauges.

Velocity measurement:

Velocity and mach number from pressure measurements– Laser DopplerVelocimetry (LDV) – Particle Image Velocimetry (PIV) – Hot-wire anemometry –Constantcurrent and Constant temperature Hot-Wire anemometer – Hot-wire probes – Hot-wire bridge for classroom demonstration – effect of compressibility and limitations.

UNIT IV TEMPERATURE, MASS AND VOLUME FLOW MEASUREMENTS 8

Temperature measurements Techniques:

Temperature scales – Temperature measurements – by thermal expansion and electrical effects – Practical Thermocouple measurements – The Resistance temperature detector – Pyrometer – Temperature measuring problems in fluid flow – Dynamic response of temperature sensors.

Mass and volume flow measurements:

Direct – indirect methods – Volume flow meter – Direct mass flow meter.

UNIT V DATA ACQUISITION SYSTEMS AND UNCERTAINTY ANALYSIS 8

Data acquisition and processing – Signal conditioning - Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty analysis - Uncertainty calculation - Uses of uncertainty analysis.

TOTAL: 45 PERIODS

OUTCOMES

- Knowledge on measurement techniques and flow visualization in aerodynamic flow.
- Acquiring basics of wind tunnel measurement systems.
- Specific instruments for flow parameter measurement like pressure, velocity, temperature etc.
- Knowledge on data acquisition systems and importance of error estimation and uncertainty principle.

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.BradsawExperimental 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

GE17651 MANAGEMENT FOR ENGINEERS

L	T	P	C
3	0	0	3

OBJECTIVES

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers -managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques-Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and development, Performance Management , Career planning and management.

UNIT IV DIRECTING **9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication –communication and IT.

UNIT V CONTROLLING **9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES

- Understands the evolution of Management
- Gains knowledge on the functions of management
- Gain knowledge on planning function in details
- Knowledge on organising, directing and controlling
- Knowledge on application of the principles in an organisation

TEXTBOOKS

1. Stephen P. Robbins & Mary Coulter, “Management”, 10th Edition, Prentice Hall (India) Pvt. Ltd.,2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education,2004.

REFERENCES

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”7th Edition, Pearson Education, 2011.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

AE17611	STRUCTURAL ANALYSIS AND MATLAB LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To make the students familiarize with structural analysis software tools. By employing these tools for Aerospace applications students will have an opportunity to expose themselves to simulation software.

LIST OF EXPERIMENTS

1. Design and analysis of a truss.
2. Design and analysis of beam distributed load.
3. Structural analysis of a tapered wing
4. Structural analysis of a fuselage structure
5. Analysis of a composite laminate structure
6. Structural analysis of a landing gear
7. Thermo structural analysis of a composite laminate structure
8. Vibration analysis of spring-mass systems.
9. Modal analysis of Beams.
10. Harmonic, transient and spectrum analysis of simple systems.
11. MATLAB functions for Shear force and Bending moment calculations
12. Analysis of two- and three- dimensional frame structures using MATLAB

TOTAL: 45 PERIODS

OUTCOMES

- Will be able to design and model structural components
- will be able to perform structural analysis using simulation software packages
- Will be familiarised to concepts of FEM in analytical software
- will be able to understand different analytical reports from simulation
- Ability to get job opportunities on structural analysis-based industries

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Equipment	Qty
1	Internal server (or) Work station	1
2	Computers	30
3	Modelling packages(i) CATIA OR Pro E (ii) ANSYS or NASTRAN	30 licenses
4	UPS	1
5	Printer	1

HS17561	COMMUNICATION SKILLS-LABORATORY BASED	L	T	P	C
		0	0	4	2

OBJECTIVES

- To enable learners to develop their communicative competence
- To facilitate them to sharpen their soft skills.

UNIT I LISTENING AND SPEAKING SKILLS 12

Conversational skills (formal and informal) – group discussion and interview skills – making presentations. Critical/Analytical Listening – Watching videos (Talk Shows, news, Ted Talks etc).

UNIT II READING AND WRITING SKILLS 12

Reading Types: Skimming, scanning, intensive and extensive reading – Writing: formal and informal letter, Job Application, resume, cover letter, emails, reports and article writing.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS

12An introduction to : International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defense Services Examination, Staff Selection- (Language Related) – Aptitude tests.

UNIT IV SOFT SKILLS (1) 12

Communication – self motivation – leadership – responsibility – team work – problem solving – decisiveness – ability to work – time management – flexibility – negotiation.

UNIT V SOFT SKILLS (2) 12

Creative and critical thinking – Learning styles and strategies - Intelligences: Verbal/Linguistic, Logical/Mathematical, Visual/Spatial, Bodily-Kinesthetic, Musical, Interpersonal, Intrapersonal, Naturalistic and Existential.

TOTAL: 60 PERIODS

OUTCOMES

On completion of the course students will be able to

- Make presentations and participate in Group discussions
- Face and answer questions in interviews boldly
- Face international exams such as IELTS and TOEFL
- Develop leadership qualities, team work and problem solving skills.
- Develop interpersonal skills and creative thinking.

REFERENCES

1. Barker, A. Improve Your Communication Skills. New Delhi: Kogan Page India Pvt. Ltd., 2006.
2. John Seely. The Oxford Guide to Writing and Speaking. New Delhi: Oxford University Press, 2004.
3. Ramesh, Gopalswamy and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.

SEMESTER VII

		L	T	P	C
AE17701	**AVIONICS**	**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 Microprocessor and memories.

UNIT II : DIGITAL AVIONICS ARCHITECTURE **8**

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 **10**

Radio navigation – VOR/DME, Hyperbolic navigation-LORAN and OMEGA, Landing system-ILS, MLS, Inertial Navigation Systems (INS)- INS block diagram – Satellite navigation systems – GPS.

UNIT V : SOFTWARE ASSESSMENT AND AUTO PILOT **9**

Fault tolerant systems -Software Assessment and Validation -Civil and Military standards - Certification of Civil Avionics. Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

OUTCOMES

- Students will be able to understand the concept of designing avionics systems
- Be able to understand the principle of digital avionics systems
- Able to know the practical and working of flight deck equipment
- Students understand the principle and working of navigation system
- Be able to understand the air data systems and auto pilot

TEXTBOOKS

1. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.
2. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.

REFERENCES

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
2. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000
3. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific

AE17702	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		2	2	0	3

OBJECTIVES

- To provide basic understanding of fundamental concepts involved in CFD
- To comprehend numerical techniques involved in CFD

UNIT I FUNDAMENTAL CONCEPTS **9**

Introduction - Governing equations of fluid dynamics - panel method - lifting flows over arbitrary bodies. Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations - Well posed problems.

UNIT II GRID GENERATION **9**

Structured grids. Types and transformations. Generation of structured grids. Unstructured grids – Mesh refinement – Adaptive mesh

UNIT III GRID DISCRETIZATION **9**

FINITE DIFFERENCE SCHEME: Derivation of finite difference equations – Simple Methods –Explicit and Implicit time dependent methods. Stability properties of explicit and implicit methods
FINITE VOLUME TECHNIQUES: Finite Volume Techniques -Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Accuracy

UNIT IV FLOW FIELD ANALYSIS AND TURBULENCE **9**

Staggered grid , SIMPLE algorithm and its variants - Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models

UNIT V INTRODUCTION TO CFD COMMERCIAL CODES **9**

Basic programming rules, Data type arrays – pointers – operators-code flow chart- Write codes to- impose initial condition, parabolic velocity profile, forward, backward Euler time integration.

TOTAL: 45 PERIODS

OUTCOMES

- able to describe the concepts involved in CFD simulation
- able to develop CFD model for simple flow systems, simulate and better understand underlying physics
- Should be able to use the various discretization methods, solution procedures and turbulence modeling to solve momentum transfer and heat transfer problems.

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition – 2007
2. John D. Anderson, JR" Computational Fluid Dynamics", McGraw-Hill Book Co., Inc., New

REFERENCES

1. C.Y.Chow, "Introduction to Computational Fluid Dynamics", John Wiley, 1979.
2. A.A. Hirsch, 'Introduction to Computational Fluid Dynamics", McGraw-Hill, 1989.
3. T.J. Chung, Computational Fluid Dynamics, Cambridge University Press, 2002
4. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1995.

AE17703	VIBRATIONS AND ELEMENTS OF AEROELASTICITY	L	T	P	C
		2	2	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 II CONTINUOUS SYSTEMS 8

Vibration of elastic bodies - vibration of strings – longitudinal, lateral and torsional vibrations

UNIT II APPROXIMATE METHODS 9

Approximate methods - Influence Co-efficient method– 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 - collars 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. Grover. G.K., “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, Donovan H. Young. „Vibration Problems in Engineering‟ – John Wiley and Sons, New York, 2001
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.

AE17704	ROCKETS AND MISSILES	L	T	P	C
		3	0	0	3

OBJECTIVES

- 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 ofsurface to surface, surface to air, air to surface and air to air missiles – Examples of various Indianspace launch vehicles and missiles – Current status of Indian rocket programme with respect tointernational scenario.

UNIT II AERODYNAMICS OF ROCKETS AND MISSILES 10

Airframe components of rockets and missiles – forces acting on a missile while passing throughatmosphere – classification of missiles – slender body aerodynamics – method of describing forcesand 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 gravitationalfields –description of vertical, inclined and gravity turn trajectories – determination of range andaltitude – simple approximations to determine burn out velocity and altitude – estimation ofculmination time and altitude.

UNIT IV STAGING OF ROCKETS AND MISSILES 8

Design philosophy behind multistaging of launch vehicles and ballistic missiles – optimization ofmultistage vehicles – stage separation techniques in atmosphere and in space – stage separationdynamics 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. Parker, E.R., “Materials for Missiles and Spacecraft”, McGraw Hill Book Co. Inc. 1982.
2. Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishersand Distributors, Delhi, 1988.

AE17711	FLOW SIMULATION LABORATORY	L	T	P	C

0 0 4 2

OBJECTIVE

- To make students understand the concept of computer aided simulations
- To enable students, perform basic flow simulations using available commercial software

LIST OF EXPERIMENTS

1. Flow analysis of laminar boundary layer over a flat plate.
2. Flow analysis of laminar and turbulent flows through pipe.
3. Flow analysis of subsonic wind tunnel.
4. Flow analysis of supersonic wind tunnel.
5. Analysis of subsonic flow over a streamlined body.
6. Analysis of subsonic flow over a bluff body.
7. Analysis of supersonic flow over a streamlined body.
8. Analysis of supersonic flow over a bluff body.
9. Unsteady flow past a cylinder.
10. Analysis of supersonic flow over a slender body.
11. Analysis of supersonic flow over a blunt body.
12. Laminar Convection: Nusselt Problem.
13. Turbulent Forced Convection.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No	Details of Equipment	Quantity
1.	Internal server (or) Work station	1
2.	Computers	30
3.	UPS	1
4.	Printer	1
5.	ANSYS software / Open Source tools	30 lisences

L	T	P	C
0	0	4	2

AVIONICS LABORATORY

OBJECTIVE

- This laboratory is to train students, to study about basic digital electronics circuits, various microprocessor applications in Control surface, Displays fault tolerant computers, to study the stability analysis and design using MATLAB.

LIST OF EXPERIMENTS

1. Addition/Subtraction of 8 bit and 16 bit data for control surface deflection.
2. Sorting of Data in Ascending & Descending order for voting mechanism.
3. Sum of a given series with and without carry for identifying flap data.
4. Greatest in a given series & Multi-byte addition in BCD mode.
5. Addition/Subtraction of binary numbers using adder and Subtractor circuits.
6. Multiplexer & Demultiplexer Circuits
7. Encoder and Decoder circuits.
8. MIL-Std – 1553 Data Buses Configuration with Message transfer.
9. Stability analysis using Root locus, Bode plot techniques.
10. Design of lead, lag and lead –lag compensator for aircraft dynamics.

OUTCOMES

- Ability to understand and apply the principles of Assembly Language Programming in developing microprocessor based applications.
- Ability to understand digital electronics circuits.
- Ability to perform stability analysis
- Student can get the basic knowledge to work with military standards data bus.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Details of Equipments	Quantity	Experiment Nos.
1.	Microprocessor 8085 Kit	10	1,2,3,4
2.	Adder/Subtractor Binary bits Kit	10	5
3.	Encoder Kit	10	7
4.	Decoder Kit	10	7
5.	Multiplexer Kit	10	6
6.	Demultiplexer Kit	10	6
7.	Computers	10	8,9,10,11
8.	Matlab software	-	10,11
9.	MILSTD 1553	2	8

AE17713	PROJECT WORK (PHASE I)	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review.
- To train the students in preparing project reportsand to face reviews and viva voce examination.

The students in a group of 2 to 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive phase 1 report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A phase 1 project report is required to be submitted at the end of the semester. Evaluation is based on oral presentation and the phase 1 project report jointly by internal examiners constituted by the Head of the Department.

TOTAL:30 PERIODS

OUTCOMES:

On Completion of the project work phase 1, students will be in a position to conduct experimental or computational investigations relevant to practical problems by formulating proper methodology.

AE17811	PROJECT WORK (PHASE II)	L	T	P	C
		0	0	12	6

OBJECTIVES:

- To utilize the knowledge gained from literature survey and continue to solve the chosen problem (in phase 1) till the successful solution of the same.
- To train the students in preparing project reportsand to face reviews and viva voce examination.

The students in a group of 2 to 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL:30 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

ELECTIVE - I

AE17E51	THEORY OF ELASTICITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- 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

AE17E52	HEAT TRANSFER	L	T	P	C
		3	0	0	3

UNIT I HEAT CONDUCTION 9

Basic Modes of Heat Transfer – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces – Unsteady state. Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.

UNIT II CONVECTIVE HEAT TRANSFER 10

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

UNIT III RADIATIVE HEAT TRANSFER 9

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

UNIT IV HEAT EXCHANGERS 9

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

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 7

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

TOTAL: 45 PERIODS

TEXT BOOKS

1. Sachdeva, S.C., "Fundamentals of Engineering Heat & Mass Transfer", Wiley Eastern Ltd., New Delhi, Fifth Ed, 2017.
2. Holman, J.P. "Heat Transfer", McGraw-Hill Book Co., Inc., New York, 10th Ed., 2017.

REFERENCES

1. David P. Dewitt, Theodore L. Bergman, Adrienne S. Lavine Frank P. Incropera, "Principals of Heat and Mass Transfer" Wiley; Seventh edition (2013)– 2002.
2. Nag P., "Heat and Mass Transfer", Tata-McGraw Hill, 2011.
3. Lienhard, J.H., "A Heat Transfer Text Book", Prentice Hall Inc., 1981.
4. Yunus A. Cengel., "Heat Transfer – A practical approach", Second Edition, Tata McGraw-Hill, 2002.

AE17E53	AIRFRAME MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to understand welding and sheet metal repair in aircraft
- To study plastic and composite repair
- To understand the concept of jacking and rigging
- To study inspection and maintenance of aircraft systems
- To understand the safety precautions

UNIT I MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS 10

Equipments used in welding shop - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser and plasma welding-electric arc welding-safety equipments-types of welding joints-Sheet metal repair- Repair patches - Sheet metal inspection – NDT-Testing- Riveted repair design - Damage investigation - Reverse engineering.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT 9

Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc – composite NDI-Repair Schemes- FRP/honeycomb sandwich materials-patch and plug repair - Vacuum-bag process- special precautions – Autoclaves.

UNIT III AIRCRAFT JACKING AND RIGGING 9

Airplane jacking procedure-leveling of aircraft-rigging of control and fixed surfaces-tensiometer-rigging tool-universal protractor for measurements- Balancing of control surfaces - inspection and maintenance of cable control system- Helicopter flight controls-Tracking and balancing of main rotor.

UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 10

Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system- Refueling and defueling of aircraft - Inspection and maintenance of auxiliary systems – Ice and rain removal systems - Position and warning systems, APU

UNIT V SAFETY PRACTICES 7

Hazardous materials storage and handling-safety equipments, Biological and physical hazard- Aircraft furnishing practices - Trouble shooting and chart, theory and practices.

TOTAL: 45 PERIODS

OUTCOMES

- Understands welding and sheet metal repair in aircraft
- Understands plastic and composite repair
- Understands the concept of jacking and rigging
- Ability to know inspection and maintenance of aircraft systems
- Understands the safety precautions

TEXT BOOKS

1. Kroes, Watkins and Delp, "Aircraft Maintenance and Repair", TATA McGraw Hill, 2010

REFERENCES

1. FAA series Airframe Hand book 2007

AE17E54	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of productand service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran andCrosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customersatisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES **9**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation,Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal- Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering,Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND 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 AND TECHNIQUES II **9**

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) -Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing -QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation inmanufacturing and service sectors.

TOTAL: 45 PERIODS

OUTCOMES

Understand of evolution of quality

- Knowledge on TQM prinicples
- Understand TQM tools
- Gains knowledge on TQM techniques
- Understand quality systems

TEXTBOOK

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition,Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition,
2. First Indian Edition, Cengage Learning, 2012.
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
5. (India) Pvt. Ltd., 2006.

AE17E55	APPLIED AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- 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 racing car, 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. Sachs. P., “Winds forces in Engineering”, Pergamum Press, 1978.

REFERENCES

1. Blevins. R.D., “Flow Induced Vibrations”, Van Nostrand, 1990.
2. Calvent. N.G., “Wind Power Principles”, Charles Griffin & Co., London, 1979.

ELECTIVE - II

		L	T	P	C
AE17E71	HELICOPTER DYNAMICS	3	0	0	3

OBJECTIVES

- To make student familiarize with the evolution of Helicopters as a flying machine.
- To familiarize students with the aerodynamic theories of rotor.
- To teach students design calculation procedures involved in selection of engine and control systems.
- To familiarize students with the static and dynamic stability concepts of rotorcraft.
- To familiarize students with the problems associated with vibrations of the main rotor system.

UNIT I INTRODUCTION **9**

A history of helicopter flight; Fundamentals of Rotor Aerodynamics; Momentum theory analysis in hovering flight. Disk loading, power loading, thrust & power coefficients. Figure of merit, rotor solidity and blade loading coefficient. Power required in flight. Axial climb, descent, and autorotation. Blade Element Analysis: Blade element analysis in hovering and forward flight. Rotating blade motion. Types of rotors. Concept of blade flapping, lagging and coning angle. Equilibrium about the flapping hinge, and lead/lag hinge.

UNIT II BASIC HELICOPTER PERFORMANCE **9**

Hovering and axial climb performance. Forward flight performance; Induced power, blade profile power, parasite power, tail rotor power, climb power total power. Effects of gross weight, density and altitude. Speed for minimum power, maximum range. Factors affecting forward speed, and ground effect.

UNIT III ROTOR AIRFOIL AERODYNAMICS **9**

Rotor airfoil requirements, effects of Reynolds number and Mach number. Airfoil shape definition, Airfoil pressure distribution. Pitching moment. Maximum lift and stall characteristics, high angle of attack range. Rotor Wakes and Blade Tip Vortices: Flow visualization, Characteristics of rotor wake in hover, and forward flight. Other characteristics of rotor wake. Structure of the tip vortices. Flow topology of dynamic stall.

UNIT IV HELICOPTER FLIGHT DYNAMICS **9**

Forward speed disturbance, vertical speed disturbance, pitching angular velocity disturbance, side-slip disturbance, yawing disturbance. Static stability of helicopters: longitudinal, lateral-directional. Dynamic stability aspects. Main rotor and tail rotor control.

UNIT V STANDARDS, SPECIFICATIONS AND TESTING ASPECTS **9**

Scope of requirements. General and operational requirements. Military derivatives of civil rotorcraft. Structural strength and design for operation on specified surfaces. Rotorcraft vibration classification. Flight and Ground Handling Qualities-General requirements and definitions. Control characteristics, beak forces. Levels of handling qualities. Flight Testing- General handing flight test requirements and, basis of limitations. Conceptual Design of Helicopters: Overall design requirements. Design of main rotors, Fuselage design, Empennage design, Design of tail rotors, High speed rotorcraft.

OUTCOMES

After successful completion of this course students should be able to

- Acknowledge the evolution of rotary wing flying machines.
- Understand and apply the ADT and BET in the aerodynamic design of helicopter rotors.
- Understand and apply the performance relations in the design/selection of engine for helicopters.
- Understand the stability characteristics of simple helicopter configurations.
- Identify the areas of vehicle design to be taken care to avoid problems associated with rotor vibrations

TEXT BOOKS

1. Principles of Helicopter Aerodynamics - J. Gordon Leishman, Cambridge University Press, 2000.
2. Helicopter Performance Stability and Control by Prouty Raymond 2002
3. Antonio Filippone -Flight Performance of Fixed and Rotary Wing Aircraft, Elsevier Aerospace Engineering Services. (2006)

REFERENCES

1. Edward Seckel, Stability and Control of Airplanes and Helicopters, Elsevier, 1964
2. Helicopter Dynamics- ARS Bramwell, George Done, and David Balmford, 2nd Edition, Butterworth-Heinemann Publication, 2001.
3. Engineering Design Handbooks - Helicopter Engineering (Parts I, II & III), AMCP 706-203, 1974
4. Alastair K. Cooke, Eric W. H. Fitzpatrick, Helicopter Test and evaluation, , Blackwell Science, 2002.

		L	T	P	C
AE17E72	**COMBUSTION AND FLAMES**	**3**	**0**	**0**	**3**

OBJECTIVE

- To familiarize the learner chemical kinetics of different types of combustions.

UNIT I REVIEW OF THERMODYNAMICS RELATIONS 8

Review of Thermodynamics, Chemical kinetics, Mass transfer definitions: Fick's law.

UNIT II CONSERVATION OF MASS AND ENERGY 10

Equations of conservation of species mass, momentum and energy, Schvab-Zel'dovich formulation, Rankine-Hugoniot relations.

UNIT III LAMINAR PREMIXED FLAMES 8

Flame speed, Flammability limits, Flame stabilization, Ignition and quenching.

UNIT IV LAMINAR DIFFUSION FLAMES 9

Burke-Schumann problem, Droplet Burning, Partially premixed flames, Introduction to turbulent premixed and diffusion flames.

UNIT V PROPELLANT COMBUSTION 7

Solid propellant combustion, Spray combustion, Detonation: ZND model, Combustion instabilities.

TEXT BOOK

1. K. K. Kuo, Principles of Combustion, Second Edition.

REFERENCES

1. W. C. Strahle, Introduction to Combustion.
2. S. Mukunda, Understanding Combustion

AE17E73	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study ground handling and support equipment
- To understand aircraft logbooks and documentation
- To acquire knowledge of different agencies and documents
- To understand aircraft inspection
- To understand aircraft hardware materials

UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENTS 10

Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions – engine starting procedures – Piston engine, turboprops and turbojets – Ground power units.

UNIT II AIRCRAFT MATERIALS TESTING 7

Knowledge of various types of corrosion, its cause and protection- detailed knowledge of the hot oil and chalk, dye penetrant and fluorescent and magnetic particle techniques and the subsequent inspection of the parts, knowledge of the X-ray, ultrasonic and eddy current inspections.

UNIT III AIRCRAFT DOCUMENTATION 8

Roll of DGCA in Indian aviation-Categories of AME Licenses'-civil airworthiness requirements-various aircraft-logbooks- logbook maintenance and making entry-Advisory circulars-certificate of registration and certificate of airworthiness- modification, concession

UNIT IV INSPECTION 10

Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications,bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets– ATA Specifications

UNIT V AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES 10

Precision instruments – special tools and equipments in an airplane maintenance shop– specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets) – threads, gears, bearings-Identification of all types of fluid line fittings, materials, metallic and nonmetallic plumbing connectors – cables – swaging procedures, tests, advantages of swaging over splicing.

TOTAL: 45 PERIODS

OUTCOMES

- Understands ground handling and support equipment
- Understands aircraft documentation and logbook
- Acquires knowledge of different agencies and documents
- Understands aircraft inspection
- Understands aircraft hardware materials

TEXT BOOK

1. Airframe &Plant Mechanics," General Hand Book", Shroff publishers, 2007

REFERENCES

1. Kroes, Watkins and Delp, "Aircraft Maintenance and Repair", Tata McGraw Hill, 2010

AE17E74	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- 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

Introduction to Brittle Coating - 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

- Able to distinguish various types of principles in strain and stress measurement
- Able to analyze various electrical resistance strain gauges and its applications
- Able to acquire knowledge on photoelastic techniques
- Able to use brittle coating and moire fringe methods
- Familiarized to various techniques on non-destructive testing

- **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. Durelli. A.J., "Applied Stress Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1970
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

AE17E74	SPACE MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES

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

UNIT I SPACE ENVIRONMENT 8

Peculiarities of space environment and its description– effect of space environment on materials ofspacecraft 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 celestialsphere 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 – thecircular restricted three body problem libration points – the general N-body problem – two bodyproblem – 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 toinjection 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 dimensionalinterplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the targetplanet – 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. Parker, E.R., "Materials for Missiles and Spacecraft", Mc.Graw Hill Book Co. Inc., 1982.

REFERENCES

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

ELECTIVE – III & IV

AE17E81	BOUNDARY LAYER THEORY	L	T	P	C
		3	0	0	3

UNIT I VISCOUS FLOW EQUATIONS 9

Navier-Stokes Equations, Creeping motion, Couette flow, Poiseuille flow through ducts, Ekmandrift.

UNIT II LAMINAR BOUNDARY LAYER 9

Development of boundary layer – Estimation of boundary layer thickness, Displacement thickness- Momentum and energy thicknesses for two dimensional flow – Two dimensional boundary layerequations – Similarity solutions - Blasius solution.

UNIT III TURBULENT BOUNDARY LAYER 9

Physical and mathematical description of turbulence, two-dimensional turbulent boundary layerequations, Velocity profiles – Inner, outer and overlap layers, Transition from laminar to turbulentboundary layers, turbulent boundary layer on a flat plate, mixing length hypothesis.

UNIT IV APPROXIMATE SOLUTION TO BOUNDARY LAYER EQUATIONS 9

Approximate integral methods, digital computer solutions – Von Karman – Polhausen method.

UNIT V THERMAL BOUNDARY LAYER 9

Introduction to thermal boundary layer – Heat transfer in boundary layer - Convective heattransfer, importance of non dimensional numbers – Prandtl number, Nusselt number, Lewisnumber etc.

TOTAL: 45 PERIODS

OUTCOME

- Upon completion of the course, students will acquire knowledge on viscous fluid flow, development of boundary layer for 2D flows.

REFERENCES

1. H. Schlichting, “Boundary Layer Theory”, McGraw-Hill, New York, 1979.
2. Frank White – Viscous Fluid flow – McGraw Hill, 1998
3. A. J. Reynolds, “Turbulent flows in Engineering”, John Wiley & Sons, 1980.
4. Ronald L., Panton, “Incompressible fluid flow”, John Wiley & Sons, 1984.
5. Tuncer Cebeci and Peter Bradshaw, “Momentum transfer in boundary layers”, HemispherePublishing Corporation, 1977.

AE17E82	FATIGUE AND FRACTURE	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

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

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR 8

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 7

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

UNIT IV FRACTURE MECHANICS 13

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory – Energy Release Rate - Importance of R-curve in fracture mechanics – Critical Energy Release Rate – Stress Intensity Factor – Westergaard Approach – Relation between G_I and K_I - Irwin - Orwin extension of Griffith's theory to ductile materials -– Effective Crack Length - Effect of thickness on fracture toughness. Elastic – Plastic analysis through J-integral – CTOD.

UNIT V FATIGUE DESIGN,TESTING AND NUMERICAL ANALYSIS OF FRACTURE 10

Safe life and Fail-safe design philosophies –Test Methods-FEM- Direct and indirect method to determine fracture parameters-Importance of Fracture Mechanics in aerospace structures.

TOTAL: 45 PERIODS

OUTCOMES

- Ability to apply mathematical knowledge to define fatigue behaviors
- Ability to apply concept of various theories to define fatigue behaviors.
- Compute the physical aspects of fatigue.
- Ability to analyse the fracture due to fatigue.
- Ability to perform experimental and numerical analysis on fatigue and fracture and knowledge on fatigue design philosophies.

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
4. D.Brock, "Elementary Engineering Fracture Mechanics", Noordhoff International PublishingCo., London, 1994.

AE17E83	AIR TRAFFIC CONTROL AND PLANNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the procedure of the formation of aerodrome and its design and air traffic control.

UNIT I BASIC CONCEPTS 9

Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR& IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter settingprocedures – Establishment, designation and identification of units providing ATS – Division ofresponsibility of control.

UNIT II AIR TRAFFIC SYSTEMS 9

Area control service, assignment of cruising levels - minimum flight altitude - ATS routes andsignificant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time /distance –ATC clearances – Flight plans – position report

UNIT III FLIGHT INFORMATION SYSTEMS 10

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar –performance checks – use of radar in area and approach control services – assurance control and coordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

UNIT IV AERODROME DATA 9

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point –Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

UNIT V NAVIGATION AND OTHER SERVICES 8

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

TOTAL : 45 PERIODS

OUTCOMES

- Understanding the requirement of air traffic control systems and types of air traffic controlsystem.
- Knowledge in flight information systems and rules of air traffic systems.
- Knowledge indirection indicator systems for air navigation.

TEXT BOOK

1. AIP (India) Vol. I & II, “The English Book Store”, 17-1, Connaught Circus, New Delhi.

AE17E84	AERO ENGINE MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3

OBJECTIVES

- Apply maintenance procedure to piston engines
- Understand the propeller theory
- Identify the jet engine components and faults
- Apply non destructive testing procedures
- Apply overhauling procedure to engines

UNIT I PISTON ENGINES **9**

Engineoperating conditionsat variousaltitudes–Engine powermeasurements–Classificationofenginelubricantsandfuels–Induction,Exhaustandcoolingsystem-Maintenanceandinspectionchecktobecarriedout-inspectionandmaintenanceandtroubleshooting-Inspection ofallenginecomponents-Daily androutinechecks-Overhaulprocedures-Compressiontestingof cylinders-Specialinspectionschedules.

UNIT II PROPELLERS **9**

Propellertheory-operation,constructionassemblyandinstallation-Pitchchange mechanism- Propelleraxiallysystem-Damageand repaircriteria-General Inspectionprocedures-Checkson constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operatingconditions–Damage andrepair criteria.

UNIT III JET ENGINES **9**

Types of jet engines – Fundamental principles – Inspection and Maintenance- permissible limits ofdamage and repair criteria of engine components- internal inspection of engines- compressorwashing- 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 IV TESTING AND INSPECTION **9**

Symptoms of failure - Fault diagnostics -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 -Engine testing: Engine testing procedures and schedule preparation - Online maintenance.

UNITV OVERHAULING **9**

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.

TOTAL : 45 PERIODS

OUTCOMES

- Applymaintenance procedureto piston engines
- Understand the propeller theory
- Identify the jet enginecomponentsandfaults
- Apply non destructive testingprocedures
- Apply overhaulingprocedureto engines

TEXT BOOK

1. Kroes&Wild, “AircraftPowerplants",McGrawHill,NewYork,7th Edition

REFERENCES

1. Irving E Treager ,”Aircraft Gas Turbine Engine Technology” McGrawHill,NewYork,3rd Edition

AE17E85	HYPERSONIC AERODYNAMICS	L	T	P	C
		3	0	0	3

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics-differences between hypersonic aerodynamics and supersonic aerodynamics-concept of thin shock layers-hypersonic flight paths, hypersonic similarity parameters-shock wave and expansion wave relations of in viscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC IN VISCID FLOWS 9

Local surface inclination Methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self-similar boundary layers-solution methods for non self-similar boundary layers, aerodynamic heating.

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 INTRODUCTION TO HIGH TEMPERATURE EFFECTS 9

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

TOTAL: 45 PERIODS

TEXT BOOKS

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dyanmics", McGraw 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.

AE17E86	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

- To develop and strengthen entrepreneurial quality and motivation in students.
- To impart basicentrepreneurial skills and understandings to run a business efficiently and effectively.

UNIT I ENTREPRENEURAL COMPETENCE 6

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality -Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

UNIT II ENTREPRENEURAL ENVIRONMENT 12

Business Environment - Role of Family and Society - Entrepreneurship Development Training andOther Support Organisational Services - Central and State Government Industrial Policies andRegulations - International Business.

UNIT III BUSINESS PLAN PREPARATION 12

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product -Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with theProject - Feasibility Report Preparation and Evaluation Criteria.

UNIT IV LAUNCHING OF SMALL BUSINESS 10

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection -Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

UNIT V MANAGEMENT OF SMALL BUSINESS 5

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

TOTAL: 45 PERIODS

OUTCOMES

- To develop and strengthen entrepreneurial quality and motivation in students.
- To impart basic entrepreneurial skills
- To prepare business plan
- To understand to run a business efficiently and effectively.
- To know to run small business

TEXTBOOKS

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.

REFERENCES

1. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis,Biztrantra ,2nd Edition ,2005
2. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews,Tata McGraw-Hill, 1996.
3. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.Arya Kumar. Entrepreneurship. Pearson. 2012
4. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning.2012

AE17E87	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 SYSTEM 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
- The students will have an exposure on various topics such as Design and development of UAVs, payloads and design standards, concluding with case studies of different such unmanned systems and will be able to deploy these skills effectively in the solution of problems in avionics engineering

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 Martin Aeronautics Company, 2001.

AE17E88	STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the effect of periodic and a periodic 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 modelling 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 approximate methods of evaluating natural modes of vibration.

TEXT BOOKS

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

REFERENCES

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

AE17E89	SPRAY THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

- This course covers the theory necessary to understand spray formation and evolution, as well as a host of spray applications.

UNIT I INTRODUCTION TO SPRAYS AND ATOMIZATION 9

Basic spray processes, Factors controlling spray formation. Number distributions, Mass/volume distributions, Empirical distributions, Theoretical distributions.

UNIT II ATOMIZERS AND THEIR DESIGNS 9

Sheet and ligament breakup: Instability analyses for ligaments and sheets, Design models based on instability analyses.

Drop formation: Static and dynamic force balances, Continuity considerations, Secondary atomization, Collisions and coalescence.

UNIT III ATOMIZATION AND SPRAY THEORY 9

Drop motion and spray-surroundings interactions: Steady trajectories (gas turbines, spray cooling, paint sprays), Entrainment.

Drop evaporation: Steady evaporation, Unsteady evaporation, Convective effects.

UNIT IV INTERNAL AND EXTERNAL SPRAYS 9

Internal fluid mechanics: Swirl atomizers, Impinging jet atomizers. **External spray characteristics:** Cone angle, Radial circumferential mass flux distributions.and

UNIT V ATOMIZER PERFORMANCE AND MEASUREMENT TECHNIQUES 9

Atomizer performance: Modern design models for pressure-swirl atomizers, impinging jet atomizers,transient pressure (Diesel) atomizers.

Measurement techniques: Drop sizing by Malvern and P/DPA, Drop velocity by P/DPA, Mass flux distribution via patternators and P/DPA.

TOTAL: 45 PERIODS

OUTCOMES

- Ability to design and analyze atomizers for jet engine applications
- Ability to analyze spray characteristics

TEXT BOOKS

1. Atomization and Sprays, by A.H. Lefebvre (Hemisphere: New York, 1989. ISBN 0-89116-603-3) and
2. Liquid Atomization, by L. Bayvel and Z. Orzechowski (Taylor and Francis: Washington DC, 1993. ISBN 0-89116-959-8).

AE17E90 INTRODUCTION TO PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

UNIT I DESIGN PROCESS **9**

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research

UNIT II CUSTOMER NEEDS **9**

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking-quality function deployment- house of quality- product design specification-case studies

UNIT II DESIGN CONCEPTS **9**

Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition –functional representation – morphological methods-TRIZ- axiomatic design

UNIT IV DECISION MAKING **9**

Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture

UNIT V COST EVALUATION **9**

Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing.

TOTAL: 45 PERIODS

Note: Since the idea is to provide an overview of the design process, the questions in the examination should have more number of sub-divisions leading to not more than 4 or 5 marks each and need to be generic in the Part-B part.

OUTCOME

- Understand the design process
- Uunderstand customer needs
- Knowledge on design concepts
- Understand descision making process
- Know evaluation of cost

REFERENCES

1. George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9

2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9

3. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education,ISBN 9788177588217

4. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

5. Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

OPEN ELECTIVE - I

		L	T	P	C
OAE1701	INTRODUCTION TO AERONAUTICAL ENGINEERING	3	0	0	3

OBJECTIVES

- To introduce history and classification of aircraft
- To understand properties of atmosphere
- To study basic aerodynamics
- To introduce basic concepts of aircraft structure
- To introduce piston and jet engines

UNIT I AIRCRAFT CONFIGURATIONS 8

History of Flight-Wright brothers-Different types of flight vehicles, classification, components and functions of typical transport aircraft, Helicopter and UAV parts and functions,

UNIT II PROPERTIES OF ATMOSHPHERE 7

Physical properties and structure of the atmosphere, ISA, lapse rate –different layer of atmosphere-different types of altitudes-temperature, pressure and altitude relationships-calculations.

UNIT III BASICS OF AERODYNAMICS 12

Newton's law of motions applied to aeronautics - aerofoil and wing geometry, NACA series airfoils, generation of lift, Mach number and ranges, aerodynamic center, pressure coefs, aspect ratio, types of drag, induced drag, lift and drag curves, sweepback on wing, shock waves in supersonic flight-basics of Pitot tube.

UNIT IV AIRPLANE STRUCTURES AND MATERIALS 9

General types of construction, monocoque and semi-monocoque, typical wing and fuselage structure, metallic and non-metallic materials, use of aluminium alloy, titanium, stainless steel , plastics, composite materials and applications.

UNIT V POWER PLANTS 9

Basics about piston, turbojet, turboprop and turbofan - concept of propeller and jets for thrust production , principles of operation of rocket, types of rockets and typical applications, exploration into space- India

TOTAL: 45 PERIODS

OUTCOMES

- Identify the types and component of aircraft
- Understand properties of atmosphere
- Performs basic calculation on lift, drag and moment.
- Identifies suitable materials for aircraft structure
- Identifies types of jet and rocket engines

TEXT BOOKS

1. Anderson, J.D., "Introduction to Flight", Tata McGraw-Hill, 2010.

REFERENCES

1. Kermode, A.C., "Mechanics of Flight", Pearson Education; 11th edition.
2. Kermode, A.C., "Flight without Formula", Pearson Education; 5th edition .

OAE1702	FUNDAMENTALS OF JET PROPULSION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles of operation of jet and rocket propulsion.
- Also to understand about the types, operation and performance of various parts of the gas turbine engines.

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES 8

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 BASICS OF GAS TURBINE ENGINE COMPONENTS 9

Subsonic and supersonic inlets for gas turbine engines – inlet performance – axial flow and centrifugal flow compressors and their efficiencies & principle of operation – gas turbine combustion chambers & types – axial flow turbines and their performance – jet engine nozzles and their efficiency

UNIT III RAMJET PROPULSION 8

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.

UNIT IV HYPERSONIC AIRBREATHING PROPULSION 9

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

UNIT V ROCKET PROPULSION **10**

Operating principle – specific impulse of a rocket – internal ballistics –solid propellant rockets – selection criteria of solid propellants –liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets - thrust control in liquid rockets – cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion -.Electrical propulsion – Arcjet, resistojet – MPD thrusters, nuclear propulsion.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hill, P.G. & Peterson, C.R. “Mechanics & Thermodynamics of Propulsion” Pearson education (2009).

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Pearson Education Canada; 6th edition, 2008.
2. Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3. “Rolls Royce Jet Engine”, Rolls Royce; 4th revised edition, 986.
4. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition,2014.

OAE1703	INTRODUCTION TO SPACE FLIGHT	L	T	P	C
		3	0	0	3

UNIT I HISTORY OF INTERNATIONAL SPACE FLIGHT **8**

Manned space flight – Mercury, Gemini, Apollo, Skylab, Apollo-Soyuz, Space shuttle, Soviet manned spaceflights and International manned space flight. Unmanned space flight – Earth observation, space environment, planetary exploration, space exploration, commercial satellites, military satellites.

UNIT II INDIAN SPACE RESEARCH ORGANIZATION **8**

Organisation structure, Test facilities, Launch facilities, tracking and control facilities, Launch vehicles – SLV, ASLV, PSLV, GSLV, GSLV III and future launch vehicles. Satellite programmes, human space flight programme. Chandrayaan, Mangalyaan

UNIT III SKY COORDINATES AND MOTIONS **8**

Sky coordinates and motions - Earth Rotation - Sky coordinates - seasons - phases of the Moon - the Moon's orbit and eclipses - timekeeping (side real vs synodic period)

UNIT IV ORBITAL PRINCIPLES **12**

Kepler’s laws, Newton's laws - angular momentum, total energy, orbital velocities, orbital properties – field of view, ground track, maximum time in view, number of revolutions per day, and revisit time. Useful orbits – low earth orbits, polar orbits, geostationary orbits, sun-synchronous orbit. Orbit establishment, orbital maneuvers – simple impulse maneuver, Hoffmann transfer, simple plane changes

UNIT V SATELLITE DESIGN **9**

Mission, payload, launch vehicle and site selection, subsystems - attitude reference and control, power, thermal, orbital maintenance, data handling, TT&C, onboard computer, structure. Ground support systems.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Bruce A. Campbell and Samuel Walter McCandless, Jr., Introduction to Space Sciences and Spacecraft Applications, Gulf Professional Publishing (1996)

REFERENCES

1. 2. Brown, C. D., Spacecraft Mission Design , 2nd ed., AIAA Edu. Series (1998).

2. Escobal, P. R., Methods of Orbit Determination, 2nd ed., Krieger Pub. Co. (1976).

3. Web link: https://www.isro.gov.in/

OAE1704	INDUSTRIAL AERODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- 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 racing car, 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. Sachs. P., “Winds forces in Engineering”, Pergamum Press, 1978.

REFERENCES

1. Blevins. R.D., “Flow Induced Vibrations”, Van Nostrand, 1990.
2. Calvent. N.G., “Wind Power Principles”, Charles Griffin & Co., London, 1979.