SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, Recognized by UGC & Affiliated to Anna University
Accredited by NBA-AICTE, NAAC-UGC with 'A+' Grade

Saravanampatti, Coimbatore-641035

CURRICULA AND SYLLABI

REGULATION 2016

CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF

AERONAUTICAL ENGINEERING

B.E. – AERONAUTICAL ENGINEERING

SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)
COIMBATORE-35

DEPARTMENT OF AERONAUTICAL ENGINEERING

REGULATION – 2016

CHOICE BASED CREDIT SYSTEM

SUGGESTED CURRICULUM AND SYLLABI

B. E. AERONAUTICAL ENGINEERING

SEMESTER I

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16EN101	Technical English – I	HS	3	3	0	0	3	-
2.	16MA101	Engineering Mathematics – I	BS	4	3	1	0	4	-
3.	16PY101	Engineering Physics	BS	3	3	0	0	3	-
4.	16CH101	Engineering Chemistry	BS	3	3	0	0	3	-
5.	16CS101	Fundamentals of Computing and Programming	ES	3	3	0	0	3	-
6.	16ME101	Engineering Drawing	ES	5	3	0	2	4	-
7.	16GE111/ 16GE113	Career Development Program -I	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16CS102	Fundamentals of Computing and Programming Laboratory	ES	4	0	0	4	2	-
9.	16CH103	Chemistry Laboratory	BS	2	0	0	2	1	-
10.	16EN103	Communication Skills Laboratory	HS	4	0	0	4	2	-
			TOTAL	**34**	**19**	**1**	**14**	**25+2***	

SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16EN102	Technical English – II	HS	3	3	0	0	3	16EN101
2.	16MA102	Engineering Mathematics-II	BS	4	4	0	0	4	16MA101
3.	16PY102	Physics of Materials	BS	3	3	0	0	3	-
4.	16CH102	Environmental Science and Engineering	BS	3	3	0	0	3	-
5.	16EE101	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3	-
6.	16ME102	Engineering Mechanics	ES	4	3	2	0	4	-
7.	16GE112 / 16CS103	Career Development Program –II / Programming in Python.	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16PY103	Physics Laboratory	BS	2	0	0	2	1	-
9.	16GE102	Engineering Practices Laboratory	ES	4	0	0	4	2	-
10.	16ME103	Computer Aided Drafting Laboratory	EEC	2	0	0	2	1	-
				31	**20**	**2**	**10**	**24+2***	

SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MA201	Transforms And Partial Differential Equations	BS	4	4	0	0	4	16MA102
2.	16ME207	Strength of materials	ES	3	3	0	0	3	16ME102
3.	16AE201	Aero Engineering	PC	5	3	2	0	4	-

		Thermodynamics							
4.	16ME202	Fluid Mechanics And Machinery	ES	3	3	0	0	3	-
5.	16AE202	Elements of Aeronautics	PC	3	3	0	0	3	-
6.	16MC201	Manufacturing Technology	PC	3	3	0	0	3	-
7.	16GE211 / 16GE213	Career Development Programme III	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16MC202	Manufacturing Technology Laboratory	PC	2	0	0	2	1	-
9.	16AE203	Strength of materials Laboratory	ES	2	0	0	2	1	-
10.	16AE204	Thermodynamics and Fluid Mechanics Laboratory	ES	4	0	0	4	2	-
			TOTAL	**32**	**20**	**2**	**10**	**24+2***	

SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MA202	Statistics and Numerical Methods	BS	4	4	0	0	4	16MA201
2.	16AE213	Mechanics of Machines	ES	4	4	0	0	4	16ME207
3.	16AE206	Aircraft Systems and Instruments	PC	3	3	0	0	3	16AE202
4.	16AE207	Aircraft Structures – I	PC	4	3	1	0	4	16ME207
5.	16AE208	Aerodynamics – I	PC	3	3	0	0	3	16ME202
6.	16AE209	Propulsion – I	PC	4	4	0	0	4	16AE201
7.	16GE212 / 16GE214	Career Development Programme IV	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16AE210	Aircraft Structures - I	PC	2	0	0	2	1	-

		Laboratory							
9.	16AE211	Aerodynamics Laboratory	PC	2	0	0	2	1	-
10.	16AE212	Aircraft Component Drawing Laboratory	EEC	4	0	0	4	2	-
			TOTAL	**33**	**22**	**1**	**10**	**26+2***	

SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16AE301	Aircraft Structures – II	PC	3	3	0	0	3	16AE207
2.	16AE302	Aerodynamics – II	PC	4	4	0	0	4	16AE208
3.	16AE303	Propulsion – II	PC	3	3	0	0	3	16AE209
4.	16AE304	Aircraft Performance	PC	3	3	0	0	3	16AE208
5.		Professional Elective – I	PE	3	3	0	0	3	-
6.		Open Electives – I**	OE	3	3	0	0	3	-
7.	16AE329 / 16GE313	Career Development Programme V	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16AE305	Aircraft Structures - II Laboratory	PC	2	0	0	2	1	-
9.	16AE306	Propulsion Laboratory	PC	2	0	0	2	1	-
10.	16AE307	Aero Engineering CAD Laboratory	EEC	4	0	0	4	2	-
			TOTAL	**30**	**20**	**0**	**10**	**23+2***	

SEMESTER VI

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									

1.	16GE301	Professional Ethics	HS	3	3	0	0	3	-
2.	16AE308	Finite Element Method for Aeronautical Applications	PC	4	3	0	0	3	16AE303
3.	16AE309	Airplane Stability and Control	PC	4	3	0	0	3	16AE304
4.		Professional Elective – II	PE	3	3	0	0	3	-
5.		Professional Elective – III	PE	3	3	0	0	3	-
6.		Open Electives - II**	OE	3	3	0	0	3	-
7.	16GE312 / 16GE314	Career Development Programme - VI	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16AE310	Aircraft Structures Repair Laboratory	PC	2	0	0	2	1	-
9.	16AE311	Aero Engine Maintenance Laboratory	PC	2	0	0	2	1	-
10.	16AE312	Aircraft Systems Laboratory	PC	2	0	0	2	1	-
TOTAL				**29**	**19**	**0**	**8**	**21+2***	

SEMESTER VII

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16GE302	Engineering Economics and Cost Analysis	HS	3	3	0	0	3	-
2.	16AE401	Composite Materials and Structures	PC	3	3	0	0	3	16AE207
3.	16AE402	Avionics	PC	3	3	0	0	3	16EE101
4.		Professional Elective – IV	PE	3	3	0	0	3	-
5.		Professional Elective – V	PE	3	3	0	0	3	-

6.		Open Electives – III**	OE	3	3	0	0	3	-
PRACTICAL									
7.	16AE403	Avionics Laboratory	PC	2	0	0	2	1	-
8.	16AE404	Aircraft Design Project	EEC	4	0	0	4	2	-
9.	16AE405	Project Phase – I	EEC	4	0	0	4	2	-
TOTAL				**28**	**18**	**0**	**10**	**23**	

SEMESTER VIII

S.NO	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16AE406	Computational Fluid Dynamics for Aeronautical Applications	PC	3	3	0	0	3	16ME202
2.		Professional Elective – VI	PE	3	3	0	0	3	-
PRACTICAL									
3.	16AE407	Project Phase – II	EEC	20	0	0	20	10	-
TOTAL				**26**	**6**	**0**	**20**	**16**	

TOTAL NO. OF CREDITS: 182

***Not included in the calculation of CGPA**

**** Courses from the curriculum of other programmes.**

1. HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S.No	Course Code	Courses Offered	L	T	P	C	Sem
1	16EN101	Technical English – I	3	0	0	3	I
2	16EN103	Communication Skills Laboratory	0	0	4	2	I
3	16EN102	Technical English – II	3	0	0	3	II
4	16GE301	Professional Ethics	3	0	0	3	VI
5	16GE302	Engineering Economics and Cost Analysis	3	0	0	3	VII
TOTAL			12	0	4	14	

2. BASIC SCIENCE COURSES (BSC)

S.No	Course Code	Courses Offered	L	T	P	C	Sem
1	16MA101	Engineering Mathematics – I	4	0	0	4	I
2	16PY101	Engineering Physics	3	0	0	3	I
3	16CH101	Engineering Chemistry	3	0	0	3	I
4	16CH103	Chemistry Laboratory	0	0	2	1	I
5	16MA102	Engineering Mathematics-II	4	0	0	4	II
6	16PY102	Physics of Materials	3	0	0	3	II
7	16CH102	Environmental Science and Engineering	3	0	0	3	II
8	16PY103	Physics Laboratory	0	0	2	1	II
9	16MA201	Transforms And Partial Differential Equations	4	0	0	4	II
TOTAL			24	0	4	26	

3. ENGINEERING SCIENCE COURSES (ESC)

S.No	Course Code	Courses Offered	L	T	P	C	Sem
1	16CS101	Fundamentals of Computing and Programming	3	0	0	3	I
2	16ME101	Engineering Drawing	3	0	2	4	I
3	16CS102	Fundamentals of Computing and Programming Laboratory	0	0	4	2	I
4	16EE101	Basic Electrical and Electronics Engineering	3	0	0	3	II
5	16ME102	Engineering Mechanics	3	2	0	4	II
6	16GE102	Engineering Practices Laboratory	0	0	4	2	II
7	16ME207	Strength of materials	3	0	0	3	III
8	16ME202	Fluid Mechanics And Machinery	3	0	0	3	III

9	16AE203	Strength of materials Laboratory	0	0	2	1	III
10	16AE204	Thermodynamics and Fluid Mechanics Laboratory	0	0	4	2	III
11	16AE213	Mechanics of Machines	4	0	0	4	IV
TOTAL			**22**	**2**	**16**	**31**	

4. PROFESSIONAL CORE COURSES (PCC)

S.No	Course Code	Courses Offered	L	T	P	C	Sem
1	16AE201	Aero Engineering Thermodynamics	3	2	0	4	III
2	16AE202	Elements of Aeronautics	3	0	0	3	III
3	16MC201	Manufacturing Technology	3	0	0	3	III
4	16MC202	Manufacturing Technology Laboratory	0	0	2	1	III
5	16AE206	Aircraft Systems and Instruments	3	0	0	3	IV
6	16AE207	Aircraft Structures – I	4	0	0	4	IV
7	16AE208	Aerodynamics – I	3	0	0	3	IV
8	16AE209	Propulsion – I	4	0	0	4	IV
9	16AE210	Aircraft Structures - I Laboratory	0	0	2	1	IV
10	16AE211	Aerodynamics Laboratory	0	0	2	1	IV
11	16AE301	Aircraft Structures – II	3	0	0	3	V
12	16AE302	Aerodynamics – II	4	0	0	4	V
13	16AE303	Propulsion – II	3	0	0	3	V
14	16AE304	Aircraft Performance	3	0	0	3	V
15	16AE305	Aircraft Structures - II Laboratory	0	0	2	1	V
16	16AE306	Propulsion Laboratory	0	0	2	1	V
17	16AE308	Finite Element Method for	3	0	0	3	VI

		Aeronautical Applications					
18	16AE309	Airplane Stability and Control	3	0	0	3	VI
19	16AE310	Aircraft Structures Repair Laboratory	0	0	2	1	VI
20	16AE311	Aero Engine Maintenance Laboratory	0	0	2	1	VI
21	16AE312	Aircraft Systems Laboratory	0	0	2	1	VI
22	16AE401	Composite Materials and Structures	3	0	0	3	VII
23	16AE402	Avionics	3	0	0	3	VII
24	16AE403	Avionics Laboratory	0	0	2	1	VII
25	16AE406	Computational Fluid Dynamics for Aeronautical Applications	3	0	0	3	VIII
TOTAL			**53**	**2**	**18**	**63**	

5. PROFESSIONAL ELECTIVE COURSES (PEC)

S.No	COURSE CODE	COURSE	L	T	P	C	CAT	PRE-REQUISITES
1	16AE313	Theory of Elasticity	3	0	0	3	PE	16AE207
2	16AE314	Experimental Techniques	3	0	0	3	PE	16AE208
3	16AE315	Theory Of Vibrations	3	0	0	3	PE	16AE207
4	16AE316	Advanced Propulsion Systems	3	0	0	3	PE	16AE209
5	16AE317	Theory Of Plates and Shells	3	0	0	3	PE	16AE207
6	16AE318	Heat Transfer	3	0	0	3	PE	16AE201
7	16AE319	Cryogenics Engineering	3	0	0	3	PE	16AE303
8	16AE320	Hypersonic Aerodynamics	3	0	0	3	PE	16AE302
9	16AE321	Control engineering	3	0	0	3	PE	16EE101
10	16AE322	Introduction To V/STOL and Ground Effect Machines	3	0	0	3	PE	16AE302

11	16AE323	Fatigue and Fracture Mechanics	3	0	0	3	PE	16AE301
12	16AE324	Aircraft Microprocessor and Applications	3	0	0	3	PE	16EE101
13	16AE325	Rocketry and Space Mechanics	3	0	0	3	PE	16AE303
14	16AE326	Combustion Engineering	3	0	0	3	PE	16AE303
15	16AE327	Industrial Aerodynamics	3	0	0	3	PE	16AE302
16	16AE328	Helicopter Aerodynamics	3	0	0	3	PE	16AE302
17	16AE408	Space Mechanics	3	0	0	3	PE	16AE302
18	16AE409	Rockets and Missiles	3	0	0	3	PE	16AE303
19	16AE410	Introduction to Turbulent Flows	3	0	0	3	PE	16AE302
20	16AE411	Advanced Flight Dynamics	3	0	0	3	PE	16AE305
21	16AE412	Aircraft Structural Dynamics	3	0	0	3	PE	16AE207
22	16AE413	Boundary Layer Theory	3	0	0	3	PE	16AE302
23	16AE414	Aircraft Rules and Regulation	3	0	0	3	PE	-
24	16AE415	Aircraft General Engineering and Maintenance	3	0	0	3	PE	-
25	16AE416	Air traffic control and planning	3	0	0	3	PE	-
26	16AE417	Helicopter Maintenance	3	0	0	3	PE	-
27	16AE418	Aero Engine Maintenance And Repair	3	0	0	3	PE	-
28	16AE419	Airframe Repair and Maintenance	3	0	0	3	PE	-
29	16AE420	Air Transportation and Aircraft Maintenance	3	0	0	3	PE	-
30	16GE303	Total Quality Management	3	0	0	3	PE	-
31	16GE304	Principles of Management	3	0	0	3	PE	-
32	16GE307	Nano Technology	3	0	0	3	PE	-
33	16ME411	Human Resource Management	3	0	0	3	PE	-
34	16ME415	Entrepreneurship Development	3	0	0	3	PE	-

6. OPEN ELECTIVE COURSES (OEC)

COURSE CODE	COURSE	L	T	P	C	CAT	PRE-REQUISITES
16AEOE1	Basic Aeronautical Engineering	3	0	0	3	OE	-
16AEOE2	Aircraft Systems And Engines	3	0	0	3	OE	-
16AEOE3	Rockets And Space Technology	3	0	0	3	OE	-
16AEOE4	Aircraft Materials and Applications	3	0	0	3	OE	-
16AEOE5	Aircraft Communication and Navigation System	3	0	0	3	OE	-
16AEOE6	Fundamentals of UAV	3	0	0	3	OE	-

7. EMPLOYABILITY ENHANCEMENT COURSES(EEC)

S.No	Course Code	Courses Offered	L	T	P	C	Sem
1	16GE111 / 16GE113	Career Development Program -I	1	0	2	2*	I
2	16GE112 / 16CS103	Career Development Program –II / Programming in Python	1	0	2	2*	II
3	16ME103	Computer Aided Drafting Laboratory	0	0	2	1	II
5	16GE211 / 16GE213	Career Development Programme III	1	0	2	2*	III
7	16GE212/ 16GE214	Career Development Programme IV	1	0	2	2*	IV
8	16AE212	Aircraft Component Drawing Laboratory	0	0	4	2	IV
9	16AE329/ 16GE313	Career Development Programme V	1	0	2	2*	V
10	16AE307	Aero Engineering CAD Laboratory	0	0	4	2	V
11	16GE312/ 16GE314	Career Development Programme - VI	1	0	2	2*	VI
12	16AE404	Aircraft Design Project	0	0	4	2	VII
13	16AE405	Project Phase – I	0	0	4	2	VII
14	16AE407	Project Phase – II	0	0	20	10	VIII

TOTAL	1	0	0	24	

ONE CREDIT COURSES

COURSE CODE	COURSE	L	T	P	C	CAT	PRE-REQUISITES
16AEOC1	Aerospace colloquium	1	0	0	1	OC	-
16AEOC2	Computing for Aerospace Engineers	1	0	0	1	OC	-
16AEOC3	Non - Destructive Testing	1	0	0	1	OC	-
16AEOC4	Wind Turbine Design and Testing	1	0	0	1	OC	-
16AEOC5	Real Time Industrial Applications in CFD	1	0	0	1	OC	-
16AEOC6	Failure Analysis of Advanced Composites	1	0	0	1	OC	-

S.NO.	SUBJECT AREA	CREDITS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	**HS**	5	3				3	3		14
2	**BS**	11	11	4	4					30
3	**ES**	9	9	9	4					31
4	**PC**			11	16	15	9	7	3	63
5	**PE**					3	6	6	3	18
6	**OE**					3	3	3		9
7	**EEC**		1		2	2		4	10	19
	TOTAL	**25**	**24**	**24**	**26**	**23**	**21**	**23**	**16**	**182**
8.	**Non-Credit / Mandatory**	2*	2*	2*	2*	2*	2*			12*

SEMESTER - I

16EN101	TECHNICAL ENGLISH I	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I **9**

General Vocabulary (Word–formation - prefixes & suffixes, root words) – Tenses – Adjectives forms – Adverb forms - Compound nouns - Abbreviations and Acronyms –Techniques of reading – Autobiographical writing.

UNIT II **9**

Active and Passive voice – Impersonal passive voice - Articles - Prepositions –Spelling and Punctuation –'WH' Question forms – Yes / No question form – Reading & note-making – Paragraph writing - comparison and contrast.

UNIT III **9**

Uses of Modal auxiliaries – Instructions– Definitions - Single line & Extended - Reading and understanding through Context –Transfer of information – bar chart, flowchart- Crafting advertisements.

UNIT IV **9**

Concord (subject & verb agreement) – Cause and effect expressions – One word substitution - Letter writing-letter to the editor & permission letter (for Industrial Visit & In-plant training) - Paragraph writing-descriptive.

UNIT V **9**

Empty verbs - 'If' conditionals – Gerund & Infinitive - Formal Letter writing – invitation, accepting & declining - Paragraph writing – analytical.

L :45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Dhanavel.S.P. English and Communication Skills for Students of Science and Engineering, Orient Blackswan, Chennai, 2011.

2. Gunasekaran.S , ' Technical English I' Third Edition, Vishnu Prints Media, Chennai, 2016.

REFERENCES

1 Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2011. .

2 Regional Institute of English. English for Engineers, Cambridge University Press, New Delhi, 2006.

3 Rizvi, Ashraf. M. Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.

4 Department of English, Anna University, Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012.

5 Mitra K. Barun, "Effective Technical Communication – A Guide for Scientists and Engineers", Oxford University Press, New Delhi, 2006.

COURSE OUTCOMES

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

CO1 Employ their active and passive vocabulary and construct basic sentence structures.

CO2 Become active readers who appreciate ambiguity and complexity, and who can articulate their own interpretations.

CO3 Write effectively and flawlessly avoiding grammatical errors for a variety of professional and social settings.

CO4 Demonstrate the usage of language effectively, creatively and successfully in both general and specific contexts.

CO5 Exhibit letter writing skills for effective communication both in formal and informal situations.

16MA101	ENGINEERING MATHEMATICS- I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	1	0	4

UNIT I MATRICES 9+3

Characteristic equation – Eigen values and Eigen vectors of a real matrix –Properties–Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form –Reduction of quadratic form to canonical form by orthogonal transformation – Cayley– Hamilton theorem (excluding proof).

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 9+3

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

UNIT III DIFFERENTIAL CALCULUS 9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Jacobians – Taylor's expansion– Maxima and Minima – Method of Lagrangian multipliers.

UNIT V DIFFERENTIAL EQUATIONS OF HIGHER ORDER 9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear differential equations.

L :45 T:15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1 Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", 4th Edition, University Science Press, 2014.

2. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCES

1 Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.

2 Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", Volume I., S. Chand & Co., New Delhi, 2012.

3 Veerarajan, T., "Engineering Mathematics for First Year", Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2014.

4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.

5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

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

CO1 Know Eigen values and Eigen vectors and its role in the system of equations.

CO2 Explore the knowledge to solving problems involving Sphere, Cone and Cylinder.

CO3 Discover the radius, centre and circle of curvature of any curves.

CO4 Identify the maximum and minimum values of surfaces.

CO5 Solve the ordinary differential equations of certain types.

16PY 101 **ENGINEERING PHYSICS** **L T P C**

(Common to All B.E. / B. Tech. Courses) **3 0 0 3**

UNIT I CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three moduli of elasticity– stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever Young's modulus by uniform bending- I-shaped girders Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow -Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel).

UNIT III QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment- Physical significance of wave function -Schrödinger's wave equation – Time independent and time dependent equations– Particle in a one dimensional box –Electron microscope- Scanning electron microscope

UNIT IV ACOUSTICS AND ULTRASONICS 9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies. Production of Ultrasonic's by magnetostriction and piezoelectric methods - acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications – Sonogram.

UNIT V PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO , Semiconductor lasers –applications. Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Losses in optical fibre- attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram)

L :45 T: 0 P: 0 T: 45 PERIODS

TEXT BOOKS

1 Naresh Kumar. P and Balasubramanian. V, Engineering Physics I, Gems Publishers,2015

2 Avadhanalu.M.N and Kshirsagar.P.G, A textbook of Engineering Physics,S.Chand & company Ltd, 2013.

REFERENCES

1 Searls and Zemansky, University Physics, 2009.

2 Gaur R.K. And Gupta S.L, Engineering Physics, Dhanpat Rai publishers, 2009.

3 Palanisamy P.K, Engineering Physics, SCITECH Publications, 2011.

4 Rajendran.V, Engineering Physics, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.2009.

5 Dr.G.Senthil kumar, Engineering Physics-I, VRB Publishers Pvt. Ltd. Chennai.(2013).

COURSE OUTCOMES :

At the end of the course student should be able to

CO1 Understand the properties of the crystalline materials.

CO2 Analyze the elastic and thermal properties of the materials.

CO3 Understand the basics of quantum mechanics.

CO4 Identify the applications of acoustics and ultrasonic waves.

CO5 Understand the basics and applications of photonics and fibre optics technology.

16CH101 **ENGINEERING CHEMISTRY** **L T P C**

(Common to All B.E. / B. Tech. Courses) **3 0 0 3**

UNIT I ELECTRO CHEMISTRY **9**

Electrochemical - EMF – Electrode potential – Nernst equation — problem – electrochemical series – significance– reference electrodes –Standard Hydrogen electrode - Calomel electrode – Ion selective electrode – glass electrode and measurement of pH and Fuel cells – hydrogen – oxygen fuel cell – batteries – Primary — Leclanche cell – secondary – Lead – acid battery – Lithium batteries (Li-TiS_2 and Li - S battery).

UNIT II CORROSION AND ITS CONTROL **9**

Chemical corrosion – oxidation corrosion – mechanism – Pilling – Bed worth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Gold plating).

UNIT III SPECTROSCOPY **9**

Beer-Lambert's law – problem – UV-visible spectroscopy and IR spectroscopy (principle –instrumentation) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principle – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy

UNIT IV SURFACE CHEMISTRY & WATER TECHNOLOGY **9**

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms – – role of adsorbents in ion-exchange adsorption (Demineralization only). Water – hardness – problems – Domestic water treatment – disinfection methods (Chlorination, Ozonation, UV treatment) – break point chlorination – salinity – desalination by reverse osmosis

UNIT V ENGINEERING MATERIALS **9**

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrication - properties – viscosity index, flash and fire points, cloud and pour points, oiliness) – solid lubricants – graphite and molybdenum sulphide.

L :45 T: 0 P: 0 T:45 PERIODS

TEXT BOOKS

1 M.Manjuladevi, R.Anitha "Engineering Chemistry" Gem Pub. Coimbatore. 2013.

2. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi 2008.

REFERENCES

1 B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2009).

2 R. Sivakumar and N Sivakumar, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd. New Delhi.2009.

3 Dr.Gourkrishna and Dasmohapatra, "Engineering Chemistry" Vikas Pub. House Pvt.Ltd. 2011.

4 O.Gpalanna, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi.2009.

5 B.R.Puri,L.R.Sharma&M.S.Pathania,"Principles of Physical Chemistry" Vishalpublishing Co. Jalandhar, Punjab. 2013.

COURSE OUTCOMES :

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

CO1 Assemble a battery and illustrate the phenomenon of production of electric current

CO2 Know the technical information about corrosion, corrosion control by galvanization and electroplating

CO3 Gain knowledge on the principles and instrumentation of spectroscopic techniques

CO4 Apply the theory of adsorption in real life situations

CO5 Acquire sound knowledge on different types of Engineering materials

16CS101	FUNDAMENTALS OF COMPUTING AND PROGRAMMING	L	T	P	C
	(Common to All B.E. / B. Tech.)	3	0	0	3

UNIT I INTRODUCTION TO COMPUTERS **8**

Introduction – Characteristics of Computers –Computer Generations – Classification of Computers – Basic Computer organization – Number Systems- Algorithm –Pseudo code –Flow Chart- Computer Software –Types of Software– Internet Terminology

UNIT II C PROGRAMMING BASICS **10**

Introduction to 'C' programming –fundamental Rules–structure of a 'C' program –compilation and linking processes –Constants, Variables, keywords, Identifier, Delimiters –Declaring and Initializing variables–Data Types –Operators and Expressions–Managing Input and Output operations –Decision Making and Branching – Looping statements –solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS **10**

Arrays – Characteristics, Initialization – Declaration – One dimensional and two dimensional arrays. String-String operations – String Arrays. Simple programs-sorting-searching –matrix operations (Addition, subtraction and Multiplication).

UNIT IV FUNCTIONS AND POINTERS **9**

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

UNIT V STRUCTURES AND UNIONS **8**

Defining Structures and Unions–Structure declaration –need for structure data type - Structure within a structure-Union -Programs using structures and Unions- Pre-processor directives.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. E.Balagurusamy, "Fundamentals of Computing and Computer Programming", Tata McGRaw-Hill Publishing Company Limited, (2011).
2. Ashok.N.Kamthane," Computer Programming", Pearson Education (India) (2010).

REFERENCES

1. Byron Gottfried, "Programming with C", 2nd Edition, (Indian Adapted Edition), TMH Publications, (2006).
2. Stephan G kochan, "Programming in C" Pearson Education (2010).
3. P.Sudharson, "Computer Programming", RBA Publications (2008).
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

COURSE OUTCOMES

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

CO1 Distinguish the differences among the various generation and classification of computers and solve problems in number system

CO2 Understand the basic concepts of C programming and write programs using various control statements

CO3 Implement programs using arrays and apply the concepts to solve basic problems

CO4 Write C programs to solve problems using functions and pointers

CO5 Understand the concepts structures and unions and apply them

16ME101	ENGINEERING DRAWING	L	T	P	C
	(Common to Aero, Agri, Auto, Civil, Civil & Planning, Mech, MEA and MCT)	3	0	2	4

Concepts and conventions (Not for Examination)

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

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES 12+8

Projection of points - Projection of straight lines located in the first quadrant -Determination of true lengths and true inclinations - Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II PROJECTION OF SOLIDS 9+6

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

UNIT III SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9+6

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other -Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids -Prisms, pyramids, cylinders and cones.

UNIT IV PICTORIAL PROJECTIONS AND FREE HAND SKETCHING 9+6

Principles of isometric projection -isometric scale -isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method. Free hand sketching: Representation of Three Dimensional objects -Need for importance of multiple views and their placement -First angle projection -layout views -Developing visualization skills through free hand sketching of multiple views from pictorial drawing.

UNIT V BUILDING DRAWING 6+4

Drawing of a plan, Elevation and sectioning of security room and residential building (Two bed rooms, kitchen, hall,etc.)

L: 45 T:0 P: 30 TOTAL : 75 PERIODS

TEXT BOOKS

1. N.D. Bhatt and V.M. Panchal, "Engineering Drawing", Charotar Publishing House, 53rd Edition, (2016).
2. K. R. Gopalakrishnan, "Engineering Drawing" (Vol.I & II), Subhas Publications (2014).

REFERENCES

1. K. V. Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2015).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2011),
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2014).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2011),
5. K.L. Narayanan and P. Kannaiah, "Engineering Drawing" SciTech Publications, 2nd edition, (2012).

COURSE OUTCOMES

CO1 Sketch the projections of a points, straight lines and plane surfaces.

CO2 Illustrate top view and front view of the solids.

CO3 Sketch sectioned views and develop area required.

CO4 Demonstrate knowledge about isometric, perspective and orthographic projections.

CO5 Design simple buildings with detailed plan and sectional elevation.

16GE111	CAREER DEVELOPMENT PROGRAMME - I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I TRAINING FUNDAMENTALS **3+6**

Goal Settings – Insights into pre-placement requisites – SWOT Analysis – LSRW Skills.

UNIT II LINGUISTIC SKILLS I **3+6**

Parts of Speech – Noun, Verb, Participle, Articles, Pronoun, Preposition, Adverb, Conjunction – Logical sequence of words –Tense & Voice – Comparison – Comprehension – comprehend and understand a paragraph

UNIT III QUANTITATIVE ABILITY I **3+6**

Number theory – Percentage – Profit, loss and discount – Simple and compound interest.

UNIT IV QUANTITATIVE ABILITY II **3+6**

Ratio & Proportions – Partnership – Problems on Average & Ages – Clocks – Time sequence test.

UNIT V COMMUNICATION SKILLS **3+6**

Impromptu Speech – Group Discussion – Questioning Technique.

L:15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1 John Eastwood, "Oxford Practice Grammar", Oxford, 2006.
2. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications, 2010.

REFERENCES

1 Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.
2 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.
3 R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited, 2016.
4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.
5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

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

CO1 Set their career goals through SWOT analysis.
CO2 Form sentences through logical sequence of words and understand passage through Comprehension
CO3 Apply the shortcut methods in quantitative aptitude.
CO4 Solve application orientated concepts in quantitative aptitude.
CO5 Communicate well and familiarize with the questioning techniques.

16GE113	CAREER DEVELOPMENT PROGRAMME - I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I TRAINING FUNDAMENTALS **8**

Goal Settings – Insights into pre-placement requisites – SWOT Analysis – LSRW Skills.

UNIT II LINGUISTIC SKILLS I **12**

Parts of Speech – Error spotting, Logical sequence of words, Tense & Voice, Comparison, Paragraph completion.

UNIT III LINGUISTIC SKILLS II **8**

Comprehend – comprehend and understand a paragraph, Sentences - Simple, Compound & Complex sentences, Jumbled sentence, Idioms & Phrases.

UNIT IV PERSONALITY DEVELOPMENT **9**

Personality, Presentation Skills – stages, selection of topic, content & aids, Minutes of meeting, Public speaking.

UNIT V COMMUNICATION SKILLS **8**

Impromptu Speech – Group Discussion – Questioning Technique.

L:15 T:0 P: 30 Total: 45 PERIODS

TEXT BOOKS

1 John Eastwood, "Oxford Practice Grammar", Oxford.

2. Barun K. Mithra, "Personality Development & Soft Skills", Oxford.

REFERENCES

1 Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.

2 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

3 R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited, 2016.

4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.

5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

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

CO1 Understand language structures and functioning of the language.

CO2 Analyse the parts of speech.

CO3 Demonstrate knowledge of personal beliefs and values.

CO4 Understand language attitudes.

CO5 Raise the basic language skills.

16CS102	FUNDAMENTALS OF COMPUTING AND PROGRAMMINGLABORATORY	L	T	P	C
	(Common to All B.E. / B. Tech.)	0	0	4	2

LIST OF EXPERIMENTS

A) Word Processing

1. Document creation, Text manipulation with Scientific notations
2. Table creation, Table formatting and Conversion
3. Mail merge and Letter preparation
4. Drawing Flow Chart

B) Spread Sheet

1. Chart - Line, XY, Bar and Pie.
2. Formula - formula editor.
3. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
4. Sorting and Import / Export features.

C) Simple C Programming

1. Data types, Expression Evaluation, Condition Statements.
2. Arrays , Looping Statement
3. Functions , Pointers
4. Structures and Unions

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Hardware

- LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
- Printers – 3 Nos.

Software

- OS – Windows / UNIX Clone
- Application Package – Office suite
- Compiler – C

L : 0 T: 0 P:60 Total:60 PERIODS

COURSE OUTCOMES

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

CO1	Create a document, insert formulas and pictures and prepare letters using MS office
CO2	Create tables and charts, use formula in calculations and protect worksheets in MS Excel
CO3	Write simple programs using basic C Concepts
CO4	Write C programs using concepts in control statements
CO5	Write C programs to solve problems using Arrays, Functions, Pointers, Unions, and Structures

16CH103	CHEMISTRY LABORATORY	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	0	0	2	1

LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA.
2. Determination of DO in water (Winkler's method)
3. Estimation of Chloride in Water sample (Argentometric).
4. Conductometric titration (Simple acid base).
5. Conductometric titration (Mixture of weak and strong acids vs strong base).
6. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$).
7. pH titration (acid & base).
8. Determination of inhibitor efficiency on the corrosion rate of steel in acid media by weight loss method.
9. Anodizing of aluminum and determination of thickness of anodic film.
10. Determination of cathode efficiency of nickel plating.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Electronic balance
- pH meter
- Potentiometer
- Conductivity bridge
- Spectro Photometer
- Colorimeter
- IC regulated power supply
- Hot air oven

L : 30 T: 0 P: 0 C: 1 Total:30 PERIODS

COURSE OUTCOMES

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

CO1 Gain the experimental knowledge of testing the water.

CO2 Carry out titration using conductivity meter, potentiometer and pH meter.

CO3 Estimate the metal ions in industrial effluents.

CO4 Set up mini electroplating unit.

CO5 Determine the inhibitor efficiency on the corrosion rate of steel.

16EN103 COMMUNICATION SKILLS LABORATORY L T P C

(Common to all B.E. / B. Tech. Courses) **0 0 4 2**

UNIT I LISTENING 15

Introduction to Business communication-Listening to Monologues-Listening for general content-Listening to dialogues-Listening to telephonic Conversation-Listening to conversation among three or more people-Listening to business conversations.

UNITII SPEAKING 15

Greetings, Formal and in formal introduction of self and others – Establishing business relationships and negotiating- Tongue twisters/pronunciation drills – Describing an object or event-Describing a working mechanism- Phrases for positive feedback, agreeing/disagreeing Group Discussion-Conversation techniques –Presentation skills-Interview techniques.

UNIT III READING 10

Reading Techniques-Reading to understand –Facts, Inference, Main idea, Authors opinion and tone – Newspaper reading, Reading brochures- Reading and reviewing books, articles -Cloze exercises-Reading Comprehension- Reading a Technical Report-Critical Reading(Editorial):Creative and Critical Thinking.

UNIT IV WRITING 15

Business Itinerary – Business Letters – Calling for Quotation-Placing Orders-Letter Seeking clarification-Letter requesting Information, explaining a situation- Resume & cover letter, Short prepared compositions on current affairs – Leaflets, Instruction Manual- Picture Perception-Encoding and decoding advertisements-Perceiving Visual Information-E-mail Etiquette and Correspondence-Expression indicating frequency/responding to situations and Providing solutions.

UNIT V SOFT SKILLS 5

Emotional Intelligence- Inter & Intrapersonal skills-Teamwork/ Leadership skills -Decision making and Problem solving skills -Time & Stress management- Professional Ethics.

L :0 T: 0 P:60 Total: 60 PERIODS

TEXT BOOKS

1 Norman Whitby, Business Benchmark, Cambridge English, Second Edition, South Asian Edition 2014

2. Guy Brook-Hart, Business Benchmark, Cambridge English, Second Edition, South Asian Edition 2014

REFERENCES

1 Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, "Empower English", Cambridge University Press, NY, USA. Updated Edition, 2016.

2 Rizvi, Ashraf. M. "Effective Technical Communication". Tata McGraw-Hill, New Delhi. Updated Edition, 2015.

3 Department of English, Anna University,"Mindscapes: English for Technologists and Engineers",Chennai, Updated Edition, 2015.

4 Leo Jones, Richard Alexander, "New International Business English", Cambridge University Press, NY, USA. Updated Edition, 2009.

5 Jeff Butterfield, "Soft skills for everyone", Cengage Learning, New Delhi, 2011.

COURSE OUTCOMES

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

CO1 Face the challenges of the globalized world with confidence and with the best communicative skills.

CO2 Make learners imbibe listening and speaking skills in both formal and informal contexts.

CO3 Help them develop their reading skills by familiarizing them with different types of reading strategies.

CO4 Make them acquire language skills at their own pace by using e-materials and language lab components.

CO5 Enrich their creative and critical thinking and get through interviews successfully.

SEMESTER - II

16EN102	TECHNICAL ENGLISH II	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I **9**

Technical Vocabulary – meanings in context – Sentence pattern - Process description - Sequencing words - Uses of Pronouns - Paragraph writing – narrative.

UNIT II **9**

Numerical adjective - Phrasal verbs - Phrases / Structures indicating use / purpose – Introduction to communication & Barriers to communication - Non-verbal communication – Different grammatical forms of the same word.

UNIT III **9**

Stress and Intonation – Word stress & Sentence stress – Formal Letter writing- quotations, clarification, placing orders, complaint letter – Writing – Using connectives (discourse makers) - Recommendations -Report writing – types of report, report format, recommendations/suggestions- (Fire Accident & Road Accident).

UNIT IV **9**

Direct & Indirect speech – Argumentative paragraphs – Letter of application – content, format (CV / Resume) – Checklist– E-mail communication – Blog writing.

UNIT V **9**

Auxiliary verbs - Preparing Agenda, Notices and Minutes – Proposal writing – project/business proposal- Technical essay – Conversational skills – four types of speeches – extempore, manuscript, impromptu, memorized.

L :45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Gunasekaran.S , ‘ Technical English II’ Third Edition, Vishnu Prints Media, Chennai, 2016.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011.

REFERENCES

1. Muralikrishna & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007.
3. Rizvi, Ashraf. M, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
4. Mitra K. Barun, “Effective Technical Communication – A Guide for Scientists and Engineers”, Oxford University Press, New Delhi, 2006.
5. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008

COURSE OUTCOMES

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

- **CO1** Apply knowledge about the various principles of communication and its various stages.
- **CO2** Imply the importance of verbal and non-verbal communication in the professional world along with its uses.
- **CO3** Review the grammar – verbs and its different forms and application of the different forms of advanced grammar.
- **CO4** Apply grammatical knowledge which enhances speaking and writing skills to prepare reports and resume in a professional manner.
- **CO5** Speak clearly, confidently, comprehensively, and communicate with one or many listeners using appropriate communicative strategies.

16MA102 ENGINEERING MATHEMATICS II L T P C

(Common to all B.E. / B. Tech. Courses) **3 1 0 4**

UNIT I MULTIPLE INTEGRALS 9+3

Double integration in Cartesian co-ordinates – Change of order of integration – Triple Integrals – Simple problems – Area and volume by multiple integrals.

UNIT II VECTOR CALCULUS 9+3

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple problems involving cubes and rectangular parallelepipeds.

UNIT III COMPLEX DIFFERENTIATION 9+3

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions using Milne Thomson's method – Conformal mapping : w= z + c, cz, 1/z, and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Complex integration – Statement and Problems of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's expansion – Singular points – Residues – Residue theorem – Problems only.

UNIT V LAPLACE TRANSFORMS 9+3

Laplace transform – Conditions for existence (statement only) – Transforms of standard functions – Properties (statement only) – Transforms of derivatives and integrals – Initial and Final value theorems (statement only) – Periodic functions - Inverse transforms – Convolution theorems (statement only) – Applications of Laplace transforms for solving the ordinary differential equations up to second order with constant co-efficient.

L :45 T:15 P:0 Total: 60 PERIODS

TEXT BOOKS

1 Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", 4th Edition, University Science Press, 2014.

2. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCES

1 Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.

2 Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", Volume I., S. Chand & Co., New Delhi, 2012.

3 Jain, R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House Pvt. Ltd., 2015.

4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.

5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

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

CO1 Evaluate double integral and triple integral to compute area, volume for two dimensional and three dimensional solid structure.

CO2 Know the gradient, divergence and curl, related theorems useful for engineering applications.

CO3 Test the analyticity and to construct the analytic function and transform complex functions from one plane to another plane graphically.

CO4 Evaluate real and complex integrals over suitable closed paths or contours.

CO5 Know the Applications of Laplace transform and its properties & to solve certain linear differential equations using Laplace transform technique.

16PY102	PHYSICS OF MATERIALS	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	0	0	3

UNIT I CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classification of materials based on conductivity- Conductors –Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals. Superconductors – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) –High T_c superconductors – Application of superconductors –SQUID, Magnetic levitation.

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination –direct and indirect band gap semiconductors-derivation of carrier concentration in n-type and p-type semiconductors – variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC MATERIALS 9

Basic concepts – magnetic moment, susceptibility, permeability. Origin of magnetic moment – Bohr magneton – Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – ant ferromagnetic materials – Ferrites and its applications. Magnetic storage devices- magnetic hard disc, bubble memory.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, applications – Nano materials: Properties –Top-down process: Ball milling method-Bottom –up process: Chemical vapour deposition method- Carbon Nanotubes- Preparation by pulsed laser deposition method, properties and applications.

L :45 T: 0 P: 30 T: 45 PERIODS

TEXT BOOKS

1 Charles Kittel, Introduction to Solid State Physics, Wiley Publications, 2006.
2 Ragavan V, "Materials Science and Engineering:, PHI Learning Private, 2012.

REFERENCES

1 Rajendran.V, Engineering Physics, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.2009.
2 Neil W.Ashcroft, N.David Mermin, Solid state physics, Cengage Publication, 2011.
3 S.O.Pillai, Solid State Physics, New Age International, New Delhi, 2005.
4 William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
5 Dr.G.Senthil kumar, Engineering Physics-II, VRB Publishers Pvt.Ltd.Chennai.(2013).

COURSE OUTCOMES :

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

CO1 Understand the properties and applications of conducting, super conducting materials
CO2 Identify the electrical properties of semiconducting materials.
CO3 Classify the magnetic materials based on the properties and employ it to act as an memory storage device.
CO4 Understand the various types of polarisation and applications of dielectric materials.
CO5 Comprehend the preparation and properties of advanced engineering materials for industrial applications.

16CH102 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

(Common to All B.E. / B. Tech. Courses) **3 0 0 3**

UNIT I ENVIRONMENT & BIODIVERSITY 9

Definition, scope and introduction –planet earth (atmosphere, lithosphere & hydrosphere) of environment. Introduction to biodiversity definition: genetic, species and ecosystem diversity –Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values–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.

UNIT II AIR &NOISE POLLUTION 9

Air pollution - Atmospheric chemistry - Chemical composition of the atmosphere-Definition- causes, effects and control measures. Control of particulate and gaseous emission - Electrostatic precipitator – automobile emission - catalytic convertor - Acid rain- Green house effect - Global warming- -Air (Prevention & control of pollution act) - Noise pollution – Definition, effects & control of noise pollution.

UNIT III WATER & SOIL POLLUTION 9

Water and their environment significance-Water quality parameters-Physical, chemical and biological parameters-Dissolved Oxygen-Biological Oxygen demand – Chemical Oxygen Demand (Definition only) - Water pollution- causes, effect & control measures-Sewage water treatment – Water (prevention & control of pollution act) - Soil pollution-Definition, causes, effects of soil pollution

UNIT IV CONVENTIONAL & NON CONVENTIONAL ENERGY RESOURCES 9

Conventional – Coal – Gross net calorific value (Definition only) – Coke – Manufacture of coke – Otto Hoffmann method **–** Petroleum- Fractional distillation - Natural gas - LPG and CNG-Need for alternative energy resources –Nuclear energy- Fission and fusion reactions- Light water nuclear reactor for power generation (block diagram only) – Solar energy – Wind energy-H_2O_2 fuel cell. Role of an individual in conservation of energy resources

UNIT V GREEN CHEMISTRY & ENVIRONMENTAL MANAGEMENT 9

Green chemistry- Principles of green chemistry – Water conservation – Rain water harvesting - Solid waste management: causes, effects and control measures of municipal solid wastes. Disaster management – Floods, Earthquake – Population growth – Population explosion and its consequences - Role of information technology in environment and human health.

L :45 T: 0 P: 0 T: 45 PERIODS

TEXT BOOKS

1 Dr.A.Ravikrishnan, "Environmental Science & Engineering"Sri Krishna Hitech Pub.Co.Pvt.Ltd.2013

2 Benny Joseph, "Environmental Science & Engineering" Tate McGraw-Hill Pub.Co.Ltd, New Delhi.2009.

REFERENCES

1 G.Tyler Miller, "Environmental Science" Cengage Learning India Pvt. Ltd.New Delhi.2011

2 Dr. Debang Solanki, "Principles of Environmental Chemistry" Prateeksha Pub.Jaipur.2011.

3 Gilbert M. Masters and Wendell. P.Ela, "Introduction to Environmental Engineering and Science" PHI Learning Pvt. Ltd. New Delhi.2010

4 Deeksha Dave and S.S. Katewa, "Environmental Science & Engineering" Learning India Pvt. Ltd.New Delhi.2011

5 Benny Joseph "Environmental Science & Engineering" Tata McGraw-Hill Pub.Co.Ltd, New Delhi. 2009.

COURSE OUTCOMES :

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

CO1 Understand the importance of fossil fuels as energy sources, development of alternative sources of energy like solar, wind etc

CO2 Aware on green house effect, various types of pollutions and global warming

CO3 Know about the effects of automobile emission and its control measures

CO4 Gain knowledge about the protection of environment

CO5 Conscious on water conservation, rapid growth of population and advantages of green chemistry

16EE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C

(Common to all Non circuit branches) 3 0 0 3

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 9

Ohm's Law – Kirchoff's Laws – Power and Power factor – Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters) and Energy meters.

UNIT II ELECTRICAL MACHINES 9

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

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 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 – ElementaryTreatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 9

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

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 9

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

L:45 T: 0 P:0 Total: 45 PERIODS

TEXT BOOKS

1 Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill, New Delhi (2012)

2. Bhattacharya. S.K, "Basic Electrical and Electronics Engineering", Pearson Education , First Edition, (2011)

REFERENCES

1 N. Mittle "Basic Electrical Engineering", Second Edition, Tata McGraw Hill Edition, New Delhi, (2005)

2 Mehta V K, Mehta Rohit, "Principles of Electrical Engineering and Electronics", S.Chand & Company Ltd, (2010)

3 Mehta V K, Mehta Rohit, "Principles of Electronics", S.Chand & Company Ltd, (2005)

4 Anokh singh, Chhabra .A. K, "Principles of Communication Engineering", S.Chand & Company Ltd, (1999)

5 Vincent Deltoro, " Electrical Engineering Fundamentals", Second Edition, Pearson Education, (2015)

COURSE OUTCOMES

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

CO1 Apply the elementary concept of electric sources, elements and their properties in the circuits

CO2 Familiarize in the concepts of measuring instruments

CO3 Understand the construction and operation of electrical machines

CO4 Gain knowledge on the theory and applications of analog and digital electronics

CO5 Acquire the knowledge on basics of communication engineering

16ME102	ENGINEERING MECHANICS (Common to Aero, Agri, Auto, Civil, CEP, MEA and MCT)	L	T	P	C
		3	2	0	4

UNIT I BASICS & STATICS OF PARTICLES **9+6**

Introduction - Units and Dimensions - Vectorial representation of forces and moments – Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces -Resolution and Composition of forces -Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility -Single equivalent force - Free body diagram

UNIT II EQUILIBRIUM OF RIGID BODIES **9+6**

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

UNIT III PROPERTIES OF SURFACES AND SOLIDS **10+6**

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

UNIT IV DYNAMICS OF PARTICLES **8+6**

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

UNIT V ELEMENTS OF RIGID BODY DYNAMICS **9+6**

Translation and Rotation of Rigid Bodies -Velocity and acceleration -General Plane motion. Analysis of structures -Plane Trusses -simple trusses -Analysis by Method of joints - Method of sections -Frames -Analysis of a structure containing multi -force members

L:45 T:30 P:0 TOTAL : 75 PERIODS

TEXT BOOKS

1. Arthur P.Boresi and Richard J.Schmidt, "Engineering Mechanics: Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.
2. Beer, F.P and Johnston Jr. E.R. "Vector Mechanics for Engineers", McGraw-Hill Education 10th Edition (India) Pvt Ltd. (2013).

REFERENCES

1. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)
2. D.P.Sharma "Engineering Mechanics", Dorling Kindersley (India) Pvt. Ltd, New Delhi 2010.
3. Dr.I.S Gujral "Engineering Mechanical" second edition, 2011, Lakshmi Publication (P).Ltd.
4. J.L. MEriam & L.G. Karidge, Engineering Volume I) and engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Hibbeller, R.C., "Engineering Mechanics", 13th edition, Prentice hall (2013).

COURSE OUTCOMES

CO1 Recognize the basics of equilibrium of particles in 2D and 3D
CO2 Review the requirements of equilibrium of rigid bodies in 2D and 3D
CO3 Compute the center of mass and moment of inertia of surfaces and solids
CO4 Predict displacement, velocity and acceleration of dynamic particles
CO5 Solve for equilibrium and internal forces acting in a rigid body

16GE112	CAREER DEVELOPMENT PROGRAMME - II	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I LINGUISTIC SKILLS II **15**

Goal Settings, Insights into pre-placement requisites, SWOT Analysis, LSRW Skills

UNIT II QUANTITATIVE ABILITY III **8**

Time, speed and distance -Train problems-Boats and streams, Time and work – Pipes and cisterns, Calendars, Venn diagram.

UNIT III QUANTITATIVE ABILITY IV **7**

Probability, Permutation &Combination, Mixtures & Allegation, Mensuration, Data Interpretation.

UNIT IV PERSONALITY DEVELOPMENT **8**

Personality, Presentation Skills – stages, selection of topic, content & aids, Minutes of meeting, Public speaking.

UNIT V COMMUNICATION SKILLS **7**

Power point presentation, Speak for three minutes, Online typing, Passage reading.

L :15 T: 0 P: 30 T: 45 PERIODS

TEXT BOOKS

1 John Eastwood, “Oxford Practice Grammar”, Oxford, 2006.

2 Rajesh Varma, “Fast Track Objective Arithmetic”, Arihant Publications, 2010.

3 Barun K. Mithra, 2016, “Personality Development & Soft Skills”, Oxford.

REFERENCES

1 R.V.Praveen, “Quantitative Aptitude and Reasoning” PHI Publication, 2012.

2 R.S.Agarwal, “Quantitative Aptitude for Competitive Examinations”, S.Chand & Company Pvt Limited, 2016.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Understand the field Linguistic techniques.

CO2 Communicate at the basic level in public speaking and write reports.

CO3 Solve time related problems.

CO4 Get the critical concepts through the mixture & allegation & data interpretation sums.

CO5 Write minutes of meeting and versatile presentations.

16CS103	CAREER DEVELOPMENT PROGRAMME II – PROGRAMMING IN PYTHON	L	T	P	C
		1	0	2	2*

UNIT I INTRODUCTION TO PYTHON 9

Introduction - Features of Python - Fundamentals of Python - Installation and Working with Python - Python interpreter and interactive mode - Understanding Python variables - Python basic Operators - Understanding python blocks.

UNIT II DATA, EXPRESSIONS,STATEMENTS & STRINGS 9

Declaring and using data types: int, float, boolean, string, and list - variables - expressions - statements, tuple assignment - precedence of operators - comments - Illustrative programs.

UNIT III CONTROL FLOW, STRINGS 9

Conditionals: Boolean values and operators - conditional (if), alternative (if-else), chained conditional (if-elif-else) - Iteration: state, while, for, break, continue, pass - Strings: string slices, immutability - Illustrative programs.

UNIT IV FUNCTIONS 9

Modules and functions - function definition and use, flow of execution, parameters and arguments - Fruitful functions: return values, parameters, local and global scope, function composition, recursion - string functions and methods - string module - Illustrative programs

UNIT V COMPOUND DATA: LISTS, TUPLES, DICTIONARIES 9

Lists as arrays - 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

L : 15 T: 0 P: 30 Total: 45 PERIODS

TEXT BOOKS

1 Y.Daniel Liang,"Introduction to Programming using Python", 1st Edition, Pearson Education,(2017)

REFERENCES

1 Eric Matthes," Python Crash Course: A Hands-On, Project-Based Introduction to Programming", 2016.

2 Mark Lutz," Learning Python", O'Reilly Media, 2013.

COURSE OUTCOMES

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

CO1 Install and work with Python

CO2 Read and write simple Python programs

CO3 Develop Python programs with conditionals and loops

CO4 Define Python functions and call them.

CO5 Use Python data structures –lists, tuples, dictionaries

16PY 103	PHYSICS LABORATORY	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	0	0	2	1

LIST OF EXPERIMENTS

1. Determination of wavelength of mercury spectrum – Spectrometer grating
2. Determination of Young's modulus of the material – uniform bending.
3. Determination of viscosity of liquid – Poiseuille's method.

(a) Particle size determination using Diode Laser.

(b) Determination of Laser parameters – Wavelength.

4. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
5. Determination of thickness of a thin wire – Air wedge method.
6. Determination of dispersive power of a prism using spectrometer.
7. Determination of Young's modulus of the material – non uniform bending.
8. Torsional Pendulum - determination of rigidity modulus of wire and moment of inertia of disc.
9. Determination of Band gap of semiconductor material.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Spectrometer
- Young's modulus apparatus
- Poiseuille's method apparatus
- Diode Laser
- Ultrasonic Interferrometer
- Air Wedge apparatus
- Torisional Pendulum Apparatus
- Bandgap determination kit

L : 0 T: 0 P: 45 Total:30 PERIODS

COURSE OUTCOMES

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

CO1 Experiment the concept of stress, strain for the given material.

CO2 Utilize the concept of interference and diffraction in optical measuring instruments.

CO3 Experiment the concept of diffraction in determining the wavelength, velocity of ultrasonic waves.

CO4 Grasp the knowledge of dependency of viscosity of a liquid on its density and velocity of liquid motion.

CO5 Apply the concept of temperature dependence of resistance of a semiconducting

16GE102 **ENGINEERING PRACTICES LABORATORY** **L T P C**
0 0 4 2

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL) (36)

CIVIL ENGINEERING (18)

1. Study of plumbing tools and Components
2. Preparation of threads in pipes
3. Preparation of single and multi tap connections for domestic
4. Study of carpentry tools and its applications
5. Preparation of Cross Lap and Dove Tail Joints.

MECHANICAL ENGINEERING (18)

1. Study of different types of Welding and its applications
2. Preparation of Butt, Lap and Tee joints
3. Study of sheet metal and its applications
4. Preparation of Rectangular, Square Trays and Funnel
5. Demonstration of Lathe and Drilling Operations
6. Demonstration of Smithy and Foundry tools.

GROUP B (ELECTRICAL AND ELECTRONICS) (30)

ELECTRICAL ENGINEERING PRACTICE (18)

1. Residential house wiring using switches, fuse, miniature circuit breaker, 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 insulation resistance to earth of electrical equipment.
7. Measurement of single and three phase voltages.
8. Study of Iron Box, Emergency Lamp and Fan.

ELECTRONICS ENGINEERING PRACTICE (18)

1. Study of Electronic components and equipments –Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Verification 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. Characteristics of a PN Junction diode

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

CIVIL

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

MECHANICAL

1 Arc welding transformer with cables and holders
2 Welding booth with exhaust facility
3 Welding accessories like welding shield, chipping hammer, wire brush, etc.

4 Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.
5 Centre lathe
6 Hearth furnace, anvil and smithy tools
7 Moulding table, foundry tools
8 Power Tool: Angle Grinder
9 Study-purpose items: centrifugal pump, air-conditioner

ELECTRICAL

1 Assorted electrical components for house wiring
2 Electrical measuring instruments
3 Study purpose items: Iron box, fan and regulator, emergency lamp
4 Megger (250V/500V)
5 Power Tools:
(a) Range Finder
(b) Digital Live-wire detector

ELECTRONICS

1 Soldering guns
2 Assorted electronic components for making circuits
3 Small PCBs
4 Multi Meters
5 Study purpose items: Telephone, FM radio, low-voltage power supply
6 Bread Board
7 CRO

L : 0 T: 0 P: 60 Total:60 PERIODS

COURSE OUTCOMES

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

CO1 Demonstrate plumbing system and Carpentry for the required applications.

CO2 Relate the basic machining operations with engineering problems.

CO3 Apply different types of Welding processes and Sheet metal processes for the Industrial applications

CO4 Illustrate Residential House wiring and simple wiring circuits.

CO5 Employ knowledge on measuring electrical quantities and usage of energy meters.

16ME103	COMPUTER AIDED DRAFTING LABORATORY	L	T	P	C
	(Common to Aero, Agri, Auto, Civil, CEP, Mech, MAE and MCT)	0	0	2	1

LIST OF EXPERIMENTS

1. Study of capabilities of software for Drafting and Modeling -Coordinate systems (Absolute, relative, polar, etc.) -Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like ellipse, parabola, Hyperbola, Cycloid and Involutes.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc
9. Creation of 3-D models of simple objects by using Revolve and Extrude option and also Convert 3D to 2D
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from3-D model.

L:0 T:0 P:30 TOTAL: 30 PERIODS

LIST OF EQUIPMENTS REQUIRED

1.Pentium IV computer or better hardware, with suitable graphics facility -30 Nos.
2. Licensed software for Drafting and Modeling. -30 Licenses
3. Laser Printer or Plotter to print / plot drawings -1 Nos.

COURSE OUTCOMES

At the end of the course the student will be able to

CO1 Use the concept of drafting and modeling with help of software.
CO2 Display various views of engineering objects.
CO3 Develop an idea in drawing truss like structures
CO4 Create 3D drawings of simple models.
CO5 Convert 3D to 2D views

16MA201 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C

(Common to all B.E. / B. Tech. Courses) **3 1 0 4**

UNIT I FOURIER SERIES 9+3

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

UNIT II FOURIER TRANSFORMS 9+3

Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem– Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Lagrange's linear equation –Solution of standard types of first order partial differential equations – Linear partial differential equations of second order with constant coefficients (Homogeneous Problems).

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Solutions of one dimensional wave equation – One dimensional equation of heat Conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z- Transforms – Elementary properties – Inverse Z - Transform – Convolution theorem – Formation of difference equation – Solution of difference equations using Z - Transform.

L:45 T:15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1 Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

2. Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.

REFERENCES

1 Bali, N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", Fifth Edition, Laxmi Publications (P) Ltd., 2014.

2 Glyn James, "Advanced Modern Engineering Mathematics", Fourth Edition, Pearson Education, 2013.

3 Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth Edition, Wiley India, 2015.

4 Ronald Bracewell, "The Fourier transforms & its Applications" 3rd Edition, 2012.

5 Zachmanoglou, E.C., "Introduction to partial differential Equations with Application", 2012.

COURSE OUTCOMES

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

CO1 Know how to find the Fourier Series and half range Fourier Series of a function given explicitly or to find Fourier Series of numerical data using harmonic analysis.

CO2 Find the Fourier transform, sine and cosine transform of certain functions and use Parseval's identity to evaluate integrals.

CO3 Form partial differential equations and solve certain types of partial differential equations.

CO4 Solve one dimensional wave equation, one dimensional heat equation and two dimensional heat equation in steady state using Fourier Series.

CO5 Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

16ME207	STRENGTH OF MATERIALS	L	T	P	C
	(Common to Mech, MAE, Auto & MCT)	3	0	0	3

UNIT I STRESS STRAIN DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies -Strength, Stiffness and Stability - Stresses; Tensile, Compressive and Shear - Deformation of simple and compound bars under axial load - Elastic constants and their relationship - Stresses in Stepped shafts and varying sections.

UNIT II BEAMS -SHEAR FORCE, BENDING MOMENT AND THEORY OF BENDING 9

Types of beams: Supports and Loads - Shear force and Bending Moment in beams - Cantilever, simply supported and Overhanging beams -Point of contra Flexure - Stresses in beams: Bending and shear stress.

UNIT III TORSION AND SPRINGS 9

Analysis of torsion of circular bars - Shear stress distribution - Bars of Solid and hollow circular section - Stepped shaft - Twist and torsion stiffness - Compound shafts - Fixed and simply supported shafts - Application to close - coiled helical springs - Maximum shear stress in spring section including Wahl Factor - Deflection of helical coil springs under axial loads - Design of helical coil springs - stresses in helical coil springs under torsion loads. Strain energy in Torsion.

UNIT IV DEFLECTION OF BEAMS AND BUCKLING OF COLUMNS 9

Elastic curve of Neutral axis of the beam under normal loads - Evaluation of beam deflection and slope: Double integration method, Macaulay Method - Columns- End conditions - equivalent length of a column -Euler equation -Slenderness ratio -Rankine formula for columns.

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses - Thin cylindrical and spherical shells - Deformation in thin cylindrical and spherical shells -Biaxial stresses at a point - Stresses on inclined plane -Principal Planes Hoop stress and stresses - Mohr's circle for biaxial stresses - Maximum shear stress.

L:45 T:0 P:0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Popov E.P, "Engineering Mechanics of Solids", Prentice - Hall of India, New Delhi,2012.
2. R.K.Rajput, "Strength of Materials", S.Chand and Company Ltd., New Delhi 2015,

REFERENCES

1. R.S.Khurmi, "Strength of Materials", S.Chand and Company Ltd. New Delhi 2015.
2. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2012.
3. Ryder G.H, "Strength of Materials, Macmillan India Ltd"., Third Edition, 2010
4. Kazimi S.M.A, "Solid Mechanics", Tata McGraw - Hill Publishing Co., New Delhi, 2006.
5. Singh D.K "Mechanics of Solids" Pearson Education 2014.

COURSE OUTCOMES

At the end of the course the student will be able to

CO1 Describe the fundamentals about the simple stresses, strains and deformation in components due to external loads.

CO2 Draw the shear force and bending moment diagrams for various beams.

CO3 Explain the effect of torsion on shaft and springs.

CO4 Determine the deflection of the beams and buckling of columns.

CO5 Evaluate the 2D stresses.

16AE201 AERO ENGINEERING THERMODYNAMICS L T P C

3 2 0 4

UNIT I BASIC CONCEPT AND FIRST LAW OF THERMODYNAMICS 9+6

Definition of thermodynamics – concept of continuum – Macroscopic vs. Microscopic aspects – 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 equipment.

UNIT II PROPERTIES OF PURE SUBSTANCE 9+6

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, and thermodynamic properties of steam.

UNIT III SECOND LAW OF THERMODYNAMICS AND ENTROPY 9+6

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 IV GAS AND VAPOUR POWER CYCLES 9+6

Otto, Diesel, Dual and Brayton cycles – air standard efficiency – mean effective pressure, Standard Rankine cycle, reheat and regeneration cycles.

UNIT V IDEAL AND REAL GASES, THERMODYNAMICS RELATIONS 9+6

Properties of Ideal gas – Ideal and real gas comparison – Equations of state for ideal and real gases – Reduced properties – compressibility factor – Principle of corresponding states – Generalized Compressibility chart and its use – Maxwell relations – Tds equations – Difference and ratio of heat capacities – Energy equation – Joule-Thomson Coefficient – Clausius-Claypeyron equation – Phase change process – Simple calculations

L : 45 T: 30 P: 0 Total: 75 PERIODS

TEXT BOOKS

1. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hills Co., Ltd., 5th Edition, 2013.
2. Rathakrishnan.E, "Fundamentals of Engineering Thermodynamics", 2nd Edition Prentice Hall, India 2005.

REFERENCES

1. Robert Balmer., "Modern Engineering Thermodynamics", 1st edition, Academic Press Publication, 2011.
2. Van Wylen, G.J. and Sonntag, R.E., "Fundamentals of Classical Thermodynamics (S.I.Version)", 7th Edition, Wiley Publications 2012.
3. Mayhew, A. and Rogers, B., "Engineering Thermodynamics", 4th Edition Longman Green & Co. Ltd., London, E.L.B.S. Edition, 1992.
4. Yunus A Cengel, "Introduction to Thermodynamics and Heat Transfer", Tata McGraw-Hill Co. Ltd., 2nd Edition, 2008.

COURSE OUTCOMES

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

CO1 Describe the fundamental concepts of thermodynamics.

CO2 Describe the basics of pure substance and diagram

CO3 Understand the thermodynamics laws and various cycles.

CO4 Solve the problem in thermodynamics laws and various cycles

CO5 Analyse and difference between ideal and real cycle

16ME202	FLUID MECHANICS AND MACHINERY	L	T	P	C
	(Common to Mech, Agri, Auto & MAE)	3	0	0	3

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Flow characteristics -concept of control volume - application of control volume to continuity equation, energy equation and momentum equation

UNIT II DIMENSIONAL ANALYSIS AND SIMILITUDE 9

Need for dimensional analysis –methods of dimensional analysis -Similitude –types of similitude - Dimensionless parameters - Reynold's Number - Froude's Number - Euler's Number - Weber's Number - Mach's Number - application of dimensionless Parameters- Model analysis

UNIT III FLOW OVER FLAT PLATE AND FLOW THROUGH CIRCULAR CONDUITS 9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli - Boundary layer concepts -types of boundary layer thickness -Darcy Weisbach equation – friction factor - Moody diagram - commercial pipes - minor losses -Flow through pipes in series and parallel.

UNIT IV TURBINES 9

Classification of turbines -heads and efficiencies -velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines - working principles - work done by water on the runner -draft tube. Specific speed - unit quantities.

UNIT V PUMPS 9

Impact of jets -Euler's equation - Theory of roto - dynamic machines- various efficiencies- velocity components at entry and exit of the rotor - velocity triangles -Centrifugal pumps- working principle - work done by the impeller - Reciprocating pump - working principle.

L:45 T:0 P:0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Yunus A. Çengel, John M. Cimbala., Fluid Mechanics: Fundamentals and Applications, McGraw - Hill Higher Education, 2010, 10thedition
2. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd.,New Delhi. 2011. 9th Editon

REFERENCES

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, New Delhi 2013. 19thEditon
2. Robert W.Fox,alant. mcdonald, PhilipJ. Pritchard, "Fluid Mechanics and Machinery", 2011.
3. Kumar. K.L.,Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd., NewDelhi, 2010. 8th Edison
4. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2010. 9th Edition
5. Rajput. R. K, "A text book of Fluid Mechanics and Hydraulic Machines",S. Chand & Company Ltd., New Delhi, Fourth edition, 2010

COURSE OUTCOMES

CO1 Paraphrase and apply the properties of fluids with mathematical knowledge
CO2 Apply the control volume approach to produce the continuity equation
CO3 Predict the behavior of the prototype/model by applying model laws
CO4 Examine the change of fluid properties during flow through circular conduits
CO5 Estimate the performance of the rotary machines and reciprocating pump.

16AE202 ELEMENTS OF AERONAUTICS L T P C

3 0 0 3

UNIT I INTRODUCTION AND HISTORY OF FLIGHT 9

Major components of an airplane and their functions – History and Types of Aircraft, Balloon, ornithopters - early airplanes by Wright brothers, biplanes and monoplanes - Developments in aerodynamics, materials, structures and propulsion over the years - basic control surfaces-basic instruments.

UNIT II BASICS OF FLIGHT MECHANICS 9

Physical properties and structure of the atmosphere, temperature, pressure and altitude relationships, and Newton's law of motions applied to aeronautics –Aircraft Axis system-Motions of Aircraft with respect to the axis system - evolution of lift, drag and moment. Nomenclature of aerofoil, classification of Aerofoils-NACA aerofoil, Mach number, maneuvers.

UNIT III AIRPLANE STRUCTURES AND MATERIALS 9

General types of construction, monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials, use of aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains diagrams for aero materials – Hooke's law – elastic constants.

UNIT IV POWER PLANTS 9

Basic ideas about piston, turboprop and jet engines - use of propeller and jets for thrust production - comparative merits, principles of operation of rocket, types of rockets and typical applications, exploration into space.

UNIT V INTRODUCTION TO ORBITAL MECHANICS 9

Keplar's laws of planetary motion, Conic Sections, Orbital Elements, Types of Orbits, Uniform Circular Motion, Motions of Planets and Satellites, Launch of a Space Vehicle, Position in an Elliptical Orbit, Recent developments of space applications in India.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Anderson, J.D., "Introduction to Flight", 7th edition, McGraw-Hill, 2012.
2. Kermode, A.C., "Mechanics of Flight", 11th Edition, Prentice Hall Publisher, 2006

REFERENCES

1. Stephen. A. Brandt, John J. Bertin, Randall J. Stiles, "Introduction to Aeronautics: A design perspective" 2nd edition American Institute of Aeronautics & Astronautics, 2004.
2. Kermode, A.C., "Flight without Formulae", Pearson Education Publisher, 2004
3. Richard S. Shevel, Fundamentals of flight Prentice Hall, 2010.

COURSE OUTCOMES

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

CO1 Know about the history of aircraft

CO2 Identify the components of aircraft and describe their functions.

CO3

Describe and Analyze the structure of the atmosphere and the geometry of the Aerofoil.

CO4 Describe various components of aircraft structure and power plants.

CO5 Describe the basics of orbital mechanics

Describe the basics of orbital mechanics

16MC201	MANUFACTURING TECHNOLOGY	L	T	P	C
	(Common to Aero & Mechatronics)	3	0	0	3

UNIT I THEORY OF METAL CUTTING 9

Orthogonal and oblique cutting– Classification of cutting tools: Single, Multipoint – Tool signature for single point cutting tool – Mechanics of orthogonal cutting – Shear angle and its significance – Chip formation– Cutting tool materials– Tool wear and tool life – Machinability – Cutting Fluids– Simple problems.

UNIT II MACHINING 9

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. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining.

UNIT III CASTING AND WELDING 9

CASTING-Pattern and Core making – Moulding sand – Melting furnaces Cupola and Induction furnaces. Special casting processes – Shell, Investment, Die casting – Defects in casting. WELDING-Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron
– Beam Welding, Laser – Beam Welding- Plasma Arc. Solid State Welding: Ultrasonic Welding, Friction Welding.

UNIT IV METAL FORMING AND POWDER METALLURGY 9

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning. Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy- Case Studies.

UNIT V FORMING AND SHAPING OF PLASTICS 9

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson education India, 4th edition, 2001(ISBN 81 78081 571)
2. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005

REFERENCES

1. P. N. Rao, "Manufacturing Technology Vol I", Tata-McGraw-Hill Publishing Ltd, 2010.
2. Chua, C K., Leong, K F and Lim, C S., "Rapid Prototyping: Principles and Applications", John Wiley, New York, 2003
3. Rao P.N., "Manufacturing Technology, Metal cutting and Machine Tools", Tata McGraw Hill, 2000.
4. Sharma, P.C., "A textbook of Production Technology – Vol I and II", S. Chand & Company Ltd., New Delhi, 1996.
5. Jain. R. K., "Production Technology", Khanna Publishers, New Delhi, 2001.

COURSE OUTCOMES

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

- **CO1** Understand the basics of cutting, cutting tools, and tool wear.
- **CO2** Gather knowledge about the conventional and unconventional machining processes.
- **CO3** Characterize the major machining operations of turning, milling and drilling.
- **CO4** Gather knowledge about the casting and welding.
- **CO5** Have an exposure to powder metallurgy and plastics

16GE211	CAREER DEVELOPMENT PROGRAMME - III	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	**1**	**0**	**2**	**2***

UNIT I PERSONALITY DEVELOPMENT & SOFT SKILLS 8

Body Language – Introduction, Grooming, Postures and Gestures, Dressing Etiquettes, Hygiene & Cleanliness, Time Management. Resume Building – Introduction, difference between Resume and CV, Strategy of resume writing Body of the resume, Clarity and Crispness, Format and Content, Code of Conduct.

UNIT II LINGUISTIC SKILLS III 15

Synonyms & Antonyms, Error Spotting , Paragraph Writing ,Word Substitution, Jumbled words, Spellings, Dialogue Writing, Presentation.

UNIT III VERBAL REASONING I 8

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems.

UNIT IV VERBAL REASONING II 7

Logical reasoning – Number and Alpha series, Odd man out, Element series, Logical series, Coding and decoding, Syllogisms, Alphabets.

UNIT V PRACTICALS 7

Extempore speech, Online typing, Mock Interview, Case based interview, Passage writing.

L :15 T: 0 P: 30 T: 45 PERIODS

TEXT BOOKS

1 Barun K. Mithra, "Personality Development & Soft Skills", Oxford, 2006.

2 S.P.Bakshi, "Objective English" Arihant Publications, 2014.

3 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

REFERENCES

1 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2013.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Improves their personality through non-verbal communication and write good resume.

CO2 Write sentences and dialogues through paragraph & dialogue writing.

CO3 Apply their analytical thinking.

CO4 Think logically in critical situations.

CO5 Face the interviews confidently through attending the mock interview sessions.

16GE213	CAREER DEVELOPMENT PROGRAMME - III	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	**1**	**0**	**2**	**2***

UNIT I LINGUISTIC SKILLS I **8**

Parts of speech, Transformation of sentences-simple, complex, compound, Homonyms, Question tags.

UNIT II LINGUISTIC SKILLS II **15**

Synonyms, Antonyms, Cloze Test, Voice, Idioms & Phrases. Verbal Analogies.

UNIT III VERBAL ABILITY I **8**

Logical sequence of words, Jumbled Words, Spellings, One word substitution.

UNIT IV VERBAL ABILITY II **7**

Comparison, Paragraph formation, Error spotting

UNIT V VERBAL ABILITY III **7**

Comprehension-comprehend and understand a passage, Dialogue Writing, Power point Presentation.

L :15 T: 0 P: 30 Total: 45 PERIODS

TEXT BOOKS

1 Dr. Aggarwal R.S and Monika Agarwal, "Objective General English", New Delhi, Sultan Chand and Company Ltd., 1999.

2 Arun Sharma & Meenakshi Upadhay," Verbal ability and Reading comprehension". Mc Graw Hill Education.

REFERENCES

1 Aptimithra , McGraw Hill Publications, 2012.

2 Ajaysingh, Verbal ability and Reading comprehension", Arihant publication.

3 Hedge, T. (2000). Teaching and learning in the language classroom. Oxford, Oxford University Press.

4 Dutt Kiranmai.P, Rajeevan Geethe & Prakash C.L.N 'A course in Communication Skills ,First publications Cambridge University Press India Pvt.Ltd , 2008.

5 Brown, D. (1995). Teaching by Principles-An Interactive Approach to Language Pedagogy. Prentice Hall.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Understand the importance & fundamentals of communication.

CO2 Start speaking and writing in English without making any mistakes.

CO3 Develop presentation skills.

CO4 Think logically in critical situations.

CO5 Prepare the questionnaire.

16MC202	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
	(Common to Aero & Mechatronics)	0	0	2	1

LIST OF EXPERIMENTS

Study of Lathe

Exercise on Three-Jaw Chuck Lathe – Plain Turning
Exercise on Three-Jaw Chuck Lathe – Taper Turning
Exercise on Three-Jaw Chuck Lathe – Thread Cutting

Study of Drilling

Exercise on Drilling &Tapping
Exercise on Shallow hole Drilling &Reaming

Study of Milling Machine

Exercise on Surface Milling
Exercise on Gear Cutting
Exercise on Contour Milling

Study of Planning Machine

Exercise on Planning Machine – Cutting Key Ways

Study of Shaping Machine

Exercise on Shaping Machine – Cutting Key Ways

Study of Grinding Machines

Machining a work piece using a Surface Grinding
Machining a work piece using a Cylindrical Grinding

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Lathe	-15
Drilling Machine	-1
Milling Machine	-2
Planning Machine	-1
Shaping Machine	-2
Grinding Machine	-1
Surface Grinding Machine	-1
Cylindrical Grinding Machine	-1

L : 0 T: 0 P:30 C: 0 Total:30 PERIODS

COURSE OUTCOMES

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

CO1	gather the practical knowledge of the machines and various machining operations
CO2	have the exposure on hands-on training to the students on various conventional machines.
CO3	know the manufacturing of the components through machining process.
CO4	get ideas about various parameters of machining tools.
CO5	understand the working of special machines like Shaper, Planer, Milling, and Grinding Machines

16AE203	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Tension test on mild steel.
2. Compression test on wood.
3. Double shear test on metal.
4. Torsion test on mild steel.
5. Impact test on metal specimen (Izod and Charpy).
6. Rockwel Hardness test on metals.
7. Brinell Hardness Test on metals.
8. Compression test on helical spring.
9. Deflection test on beam.
10. Construction of Southwell plot.

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Universal Testing Machine
2.	Torsion Testing Machine
3.	Hardness Testing Machine
4.	Impact Testing Machine
5.	Spring Testing Machine

COURSE OUTCOMES

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

CO1 Analyse experimentally the compressive and tensile strength on the given specimen.
CO2 Determine the deflection test on beams with various end and load conditions.
CO3 Determine the column test by using southwell plot.
CO4 Understand the different metals and its hardness value.
CO5 Analysis the experimental data with theoretical calculation.

16AE204 THERMODYNAMICS AND FLUID MECHANICS LABORATORY

L	T	P	C
0	0	4	2

LIST OF EXPERIMENTS

THERMODYNAMICS

1. Performance test on a 4-stroke Diesel engine.
2. Valve timing of a 4-stroke engine and port timing of a 2-stroke engine.
3. Conduction heat transfer in a composite wall.
4. Experiment on natural convection heat transfer.
5. Experiment on forced convection heat transfer.

FLUID MECHANICS

6. Determination of the Coefficient of discharge of given Venturimeter.
7. Determination of friction factor for a given set of pipes.
8. Conducting experiments and drawing the characteristic curves of reciprocating pump.
9. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump.
10. Conducting experiments and drawing the characteristics curves of Pelton/Francis turbine.

L : 0 T: 0 P: 60 Total: 60 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Four - stroke Diesel engine
2.	Composite wall Setup
3.	Free & Forced Convective apparatus
4.	Venturimeter setup
5.	Centrifugal pump/ submergible pump

COURSE OUTCOMES

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

CO1 Use the instruments for measuring flow parameters.
CO2 Determine experimentally the heat transfer characteristics.
CO3 Conduct the experiment to determine the performance of the hydraulic machines.
CO4 Conduct the experiment and describe the performance of the diesel engine.
CO5 Design and conduct experiments as well as Analyse and interpret experimental data

16MA202	STATISTICS AND NUMERICAL METHODS	L	T	P	C
	(Common to AERO, AUTO, CIVIL, C&P, EEE, E&I, IT, MECH, MCT, MAE, BME)	3	1	0	4

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions – Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit-Independence of attributes.

UNIT II DESIGNS OF EXPERIMENTS 9+3

Completely Randomized Design – Randomized block design – Latin square Design – 2^2 factorial design.

UNIT III SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3

Newton Raphson method – Gauss Elimination method – Pivoting Gauss Jordan methods – Iterative methods of Gauss - Jacobi and Gauss - Seidal – Matrix Inversion by Gauss - Jordan method – Eigen values of a matrix by power method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's $1/3^{rd}$ rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method – Euler's method – Modified Euler's Method – Fourth order Runge-Kutta method for solving first and second order equations – Milne's Predictor – corrector methods for solving first order equations.

L:45 T:15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., and Gupta,C.B., Miller and Freund's, "Probability and statistics for Engineers", Pearson Education Asia,8th Edition, 2011.
2. Grewal, B.S and Grewal, J.S, "Numerical methods in Engineering and Science", 9^{th} Edition, Khanna Publishers, New Delhi, 2012 .

REFERENCES

1. Spiegel,M.R., Schiller, J. and Srinivasan,R.A., "Schaum's Outlines Probabilty and Statistics", Tata McGraw Hill edition, 3^{rd} Edition, 2011.
2. Chapra, S.C and Canale, R.P., "Numerical Methods for Engineers", 6^{th} Edition, Tata McGraw Hill Edition, 2014 .
3. Gerald, C.F. and Wheatley, P.O. "Applied Numerical Analysis", 8^{th} Edition, Pearson Education, Asia, New Delhi, 2014.
4. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8^{th} Edition, Pearson Education, Asia, 2007.
5. Kandasamy, P., Thilagavathy. K and Gunavathy, K., "Numerical Methods", 3^{rd} Edition, S.Chand & Company Pvt. Ltd, 2013.

COURSE OUTCOMES

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

CO1 Apply the statistical concepts and tools for engineering applications and to use different types of research methodology techniques for decision making under uncertainty.

CO2 Perform the ANOVA calculation which is needed for engineering research and project management.

CO3 Solve a set of algebraic equations representing steady state models formed in engineering problems

CO4 Find the trend information from discrete data set through numerical differentiation and summary information through numerical integration.

CO5 Predict the system dynamic behaviour through solution of ODEs modeling the system.

16AE213	MECHANICS OF MACHINES	L	T	P	C
	(Common To Aero, Auto, MCT and MAE)	4	0	0	4

UNIT I KINEMATICS OF MECHANICS 12

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons (Velocity, Acceleration and Displacement diagram only graphical method)

UNIT II FORCE ANALYSIS 12

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 III GEARS AND GEAR TRAINS 12

Spur gear – law of toothed gearing – Involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclical gear trains – automotive transmission gear trains.

UNIT IV CAMS AND FOLLOWERS 12

Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller followers with and without offsets for various types of follower motions.

UNIT V BALANCING 12

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – Governors: Introduction – Types – Watt, Porter, Proell Governors.

L : 60 T: 0 P: 0 Total: 60 PERIODS

TEXT BOOKS

1 Rattan.S.S, “Theory of Machines”, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2009.
2. Thomas Bevan, “The Theory of Machines” 3rd Edition, CBS Publisher, 2005.

REFERENCES

1 Rao, J.S and Dukkipati, R.V, “Mechanism and Machine Theory”, Second Edition, New Age International (P) Ltd. Reprint, 2006.
2 Ballaney.P.L, “Theory of Machines”, Khanna Book Publishing Co. (P) Ltd, New Delhi, 2008.
3 Gosh, A. and Mallick, A.K., “Theory of Machines and Mechanisms”, East West Press, 3rd Edition, 2006.
4 R.S.Khurmi & J.K.Gupta, Theory of Machines - S.Chand and company Pvt Ltd, 14th Edition, 2005.

COURSE OUTCOMES

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

CO1 Describe different mechanisms and Linkages.
CO2 Analyze the contribution of force equilibrium in the machines.
CO3 Understand the gear and Cam profile with follower motion.
CO4 Describe the methods of balancing the moving parts of the machines.
CO5 Determine the phenomenon of direction of rotation, speed and torque systems for simple, compound and planetary gear

16AE206 AIRCRAFT SYSTEMS AND INSTRUMENTS L T P C

3 0 0 3

UNIT I AIRCRAFT SYSTEMS 9

Hydraulic systems - Study of typical workable system - components - Hydraulic system Controllers - Modes of operation - Pneumatic systems - Advantages - Working principles –Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification – Shock absorbers - Retractive mechanism.

UNIT II AIRCRAFT CONTROL SYSTEMS 9

Conventional Systems – power assisted and fully powered flight controls – power actuated systems – engine control systems – push pull rod system – operating principles. Modern control systems – digital fly by wire systems – auto pilot system, active control technology. Communication and Navigation systems, Instrument landing systems.

UNIT III ENGINE SYSTEMS 9

Fuel systems for Piston and jet engines, - Components of multi engines. Lubricating systems For piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet Engines.

UNIT IV AUXILIARY SYSTEM 9

Basic air cycle systems – vapour cycle systems, boot-strap air cycle system – evaporative vapour cycle systems – evaporation air cycle systems – oxygen systems – fire protection systems, deicing and anti-icing system.

UNIT V AIRCRAFT INSTRUMENTS 9

Flight instruments and navigation instruments – accelerometers, air speed indicators – mach meters – altimeters - gyroscopic instruments– principles and operation – study of various types of engine instruments – tachometers – temperature gauges – pressure gauge – operation and principles.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1995.
2. "General Hand Books of Airframe and Powerplant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi, 1995.

REFERENCES

1. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1992.
3. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.Reprint 2008.
4. James Ephraim Johnson, "Electro hydraulic Servo Systems" Published by Editors of Hydraulics & pneumatics magazine, 1984.

COURSE OUTCOMES

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

CO1 Identify the various instruments used in aircraft.

CO2 Describe working principles of Aircraft Control Systems.

CO3 Describe working principles of Engine Systems.

CO4 Describe the working principles Aircraft Auxiliary Systems.

CO5 Describe the working principles Aircraft instruments.

16AE207 AIRCRAFT STRUCTURES – I

L	T	P	C
3	1	0	4

UNIT I STATICALLY DETERMINATE AND INDETERMINATE STRUCTURE **12+3**

Plane Truss Analysis - method of joints - method of sections - Propped cantilever beam, fixed – fixed beam, Principle of Super position, Clapeyron's three moment equation and moment distribution method for indeterminate beams.

UNIT II ENERGY METHODS **12+3**

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 and trusses.

UNIT III COLUMNS **9+3**

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

UNIT IV FAILURE THEORIES **6+3**

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

UNIT V STRUCTURAL ANALYSIS **6+3**

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

L : 45 T: 15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1. Timoshenko.S and Gere.J, "Mechanics of Materials", Tata McGraw Hill, 2004.
2. Megson T M G, "Aircraft Structures for Engineering students" Elsevier Science and Technology, 2007.

REFERENCES

1. Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", Cambridge university press, 2012.
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.
4. William A Nash, "Strength of Materials". Tata McGraw Hill, 2008.
5. James Gere "Mechanics of Materials", Nelson Engg., 2008.

COURSE OUTCOMES

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

CO1 Analyse the statically determinate and indeterminate structures.

CO2 Analyse the columns with different end conditions.

CO3 Describe the stresses and possible modes of failure of the structures subjected to external loads.

CO4 Apply knowledge of science and engineering principles to solve aeronautical engineering problems.

CO5 Design and conduct experiments as well as Analysis and interpret experimental data

16AE208 AERODYNAMICS - I

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO LOW SPEED FLOW **9**

Euler equation(3d), Incompressible Bernoulli equation, Circulation and vorticity, Green's lemma and stoke's theorem, barotropic flow, Kelvin's theorem, streamlines, stream function, irrotational flow, potential function, equipotential function, flownet, elementary flows and their combinations. Example problems on conservation equations

UNIT II TWO DIMENSIONAL INCOMPRESSIBLE AND IRROTATIONAL FLOW **9**

Ideal flow over a circular cylinder, coefficient of static pressure, pressure distribution for the ideal and real flow over a circular cylinder, D'Alembert paradox, magnus effect, Kuttajoukowski's theorem, Streamline pattern over symmetrical and unsymmetrical airfoil, Kutta condition.

UNIT III AIRFOIL THEORY **9**

Cauchy-Rhemann relations, complex potential, methodology of conformal transformation. KuttaJoukovsky transformation and its applications, thin airfoil theory and its applications.

UNIT IV SUBSONIC THEORY **9**

Vortex filament, Biotsavart law, bound vortex, horse shoe vortex, lifting line theory and its limitations

UNIT V INTRODUCTION TO BOUNDARY LAYER THEORY **9**

Navier-Stokes equation, boundary layer equations for a steady incompressible flow, boundary layer growth over a flat plate, boundary layer growth over a flat plate, critical Reynolds number, Blasius solution, Basics of turbulent flow.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 2010.
2. Clancey, L J.," Aerodynamics", Pitman, 1986.

REFERENCES

1. Karamcheti K., (1966), Principles of Ideal-Fluid Aerodynamics, John Wiley & Sons Inc.
2. BertinJ.J., "Aerodynamics for Engineers", Prentice Hall; 6th edition, 2013.
3. E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
4. Kuethe A. M. and Chow C.-Y., "Foundations of Aerodynamics", John Wiley & Sons Inc. ., 5th Edition, 1997.
5. KunduP.K. & Cohen I.M., (2008), Fluid Mechanics, Elsevier Inc.

COURSE OUTCOMES

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

CO1 Analyze the governing equations for the fluid flow and basics in ideal air flow.
CO2 Apply the governing equations for the incompressible flow over aerodynamic bodies.
CO3 Describe the flow pattern over airfoils at various angles.
CO4 Describe airfoil theories and their applications.
CO5 Analyze the incompressible viscous flow over flat plate

16AE209	PROPULSION – I	L	T	P	C
		4	0	0	4

UNIT I FUNDAMENTALS OF AIR BREATHING ENGINES 12

Operating principles of piston engines – thermal efficiency calculations – classification of piston engines – illustration of working of gas turbine engine – the thrust equation – Factors affecting thrust – effect of pressure, velocity and temperature changes of air entering compressor – methods of thrust augmentation – characteristics of turboprop, turbofan and turbojet – performance characteristics

UNIT II INLETS, NOZZLES AND COMBUSTION CHAMBERS FOR JET ENGINES 12

Internal flow and Stall in subsonic inlets – relation between minimum area ratio and external deceleration ratio – diffuser performance – Overview of normal and oblique shock waves – supersonic inlets – starting problem on supersonic inlets – shock swallowing by area variation – Real flow in nozzles and nozzle efficiency – losses in nozzles – equilibrium flow and frozen flow in nozzles – two phase flow in nozzles – ejector and variable area nozzles – interaction of nozzle flow with adjacent surfaces – thrust reversal – classification of combustion chambers – combustion chamber performance – effect of operating variables on performance – flame stabilization.

UNIT III COMPRESSORS FOR JET ENGINES 12

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 12

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

UNIT V RAMJET PROPULSION 12

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.

L : 60 T: 0 P: 0 Total: 60 PERIODS

TEXT BOOKS

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" 2nd Edition Pearson publishers, 2008.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Prentice Hall; 6th Edition, 2008.

REFERENCES

1. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", 2iiu Edition, Standard Publishers Distributors, Delhi, 2008.
2. Rolls Royce, "Jet Engine", 5th Edition, Rolls Royce Technical Publications, 2005.
3. KlauseHunecke, "Jet Engines – Fundamentals of theory, design and operation", 1st Edition, the Crowood Press Ltd, 2010.

COURSE OUTCOMES

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

CO1 Describe the working principles of components of gas turbine engines.

CO2 Analyse the performance of the compressible flow through ducts and combustion chambers.

CO3 Analyse the performance of the nozzle.

CO4 Analyse the performance of the compressors and turbines of a gas turbine engine.

CO5 Describe and analyse the performance of the Ramjet engine.

16GE212	CAREER DEVELOPMENT PROGRAMME IV	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I COMMUNICATION & SOFT SKILLS 7

Group Discussion – Types, guidelines, roles, Do's and Don'ts during GD, Mock GD. Interview Etiquettes – Meaning, Purpose, Interview Process and Types, Checklist – Do's and Don'ts, Preparation of Self Introduction.

UNIT II LINGUISTIC SKILLS IV 15

Cloze test, Direct & Indirect speech, Question Tags, Homonyms, HIGH LEVEL- Synonyms, Antonyms, Idioms and Phrases.

UNIT III VERBAL REASONING - III 7

Logical reasoning - Machine Input & Output, Coded Inequalities, Puzzles, Cubes, Data sufficiency, Analogy.

UNIT IV VERBAL &NON VERBAL REASONING - IV 8

Critical reasoning- Statement – Argument & Assumption, Courses of Action, Inferences.

Non Verbal reasoning- Insert the missing character, Figure series, Odd man out, Cubes & Dices, Logical Venn diagram.

UNIT V PRACTICALS 8

Group Discussion, Online typing, Mock Interview, Company website references.

L:15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1 Barun K. Mithra, "Personality Development & Soft Skills", Oxford, 2006.
2 S.P.Bakshi, "Objective English" Arihant Publications, 2014.

REFERENCES

1 Dr. R.S.Agarwal, "A modern approach to Verbal & Non-verbal Reasoning", S.Chand & Company Pvt Limited, 2013.
2 S.P.Bakshi, "Objective English" Arihant Publications, 2014.
3 Dr. Aggarwal R.S and Monika Agarwal, "Objective General English", New Delhi, Sultan Chand and Company Ltd., 1999.
4 Arun Sharma & Meenakshi Upadhay,"Verbal ability and Reading comprehension".Mc Graw Hill Education.
5 Dutt Kiranmai.P, Rajeevan Geethe & Prakash C.L.N 'A course in Communication Skills ,First publications Cambridge University Press India Pvt.Ltd , 2008.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Bring behavioral changes through interview etiquettes & communicate well.
CO2 Improve their thinking ability.
CO3 Solve the puzzles through their lateral thinking ability.
CO4 Think critically and attain solutions for the problems.
CO5 Speak better in GD and thorough with the company details.

16GE214	CAREER DEVELOPMENT PROGRAMME IV	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I BODY LANGUAGE **9**

Body Language – Introduction, Elements, Grooming, Body Language –Postures and Gestures, Dressing Etiquette, Hygiene and Cleanliness, Time Management, Body Language - Positive and Negative, Importance of body language in Communication.

UNIT II INTERVIEW ETIQUETTE **9**

Interview Etiquettes – Meaning, Purpose, Process, Types, Do's and Dont's, Dress Code, Self Introduction, Code of Conduct for Interviews, Mock Interview

UNIT III RESUME BUILDING **9**

Resume Building –Introduction, difference between Resume and CV, Strategy of resume writing, Body of the resume, clarity and crispness, format and content, Resume Etiquettes – Do's and Dont's, model resume writing.

UNIT IV GROUP DISCUSSION **9**

Group Discussion – Types, Key steps to succeed in GD, Skills required for GD, Importance of GD, Guidelines – Do's and Dont's during GD, the technique of Summing up, Mock GD.

UNIT V PRACTICALS **9**

Extempore Speech, Company website References, Short speech.

L:15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1 John Eastwood, "Oxford Practice Grammar", Oxford.
2 Barun K. Mithra, "Personality Development & Soft Skills", Oxford.

REFERENCES

1 Sanjay Kumar "Communication Skills", Oxford University 2015.
2 Sanjay Kumar "Communication Skills", Oxford University 2015.
3 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.
4 Dr. Aggarwal R.S and Monika Agarwal, "Objective General English", New Delhi, Sultan Chand and Company Ltd., 1999.
5 Arun Sharma & Meenakshi Upadhay,"Verbal ability and Reading comprehension". Mc Graw Hill Education.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Exhibit appropriate body language and interview skills.
CO2 Speak effectively in group discussion and acquire interpersonal skills.
CO3 Acquire the professional skills of Group discussion and Resume writing.
CO4 Improve thinking, listening and speaking skills.
CO5 Demonstrate an understanding of the principles of active listening.

16AE210	AIRCRAFT STRUCTURES - I LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Determination of Young's modulus of aluminum using electrical extensometers.
2. Determination of flexural strength of metallic materials.
3. Deflection of a simply-supported beam.
4. Deflection of a cantilever beam.
5. Verification of Maxwell's Reciprocal theorem.
6. Verification of principle of superposition theorem.
7. Buckling load estimation of slender eccentric columns.
8. Determination of flexural rigidity of composite beams.
9. Determination of membrane stresses in a thin cylinder under internal pressure.
10. Study of non-destructive testing procedures.

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Electrical Extensometer
2.	Universal Testing Machine
3.	Beam Test set up with various end conditions
4.	Column Test Apparatus
5.	NDT Setup

COURSE OUTCOMES

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

CO1 Learn the deflection of various beams.

CO2 Determine experimentally the material properties of a given specimen.

CO3 Determine the behavior of the beams, columns and cylinders subjected to external load`s.

CO4 Prove the theories of structures conducting experimental studies.

CO5 Learn the material testing procedures.

16AE211	AERODYNAMICS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Generation of lift and tip vortices.
2. Flow visualization in water flow channel
3. Flow visualization in smoke tunnel
4. Calibration of a subsonic Wind tunnel.
5. Determination of lift for the given airfoil section.
6. Pressure distribution over a smooth circular cylinder.
7. Pressure distribution over a rough circular cylinder.
8. Pressure distribution over a symmetric aerofoil.
9. Pressure distribution over a cambered aerofoil.
10. Flow visualization studies in subsonic flows

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Small Aspect Model- blower & weighing machine
2.	Water flow channel
3.	Smoke tunnel apparatus
4.	Subsonic Wind tunnel and its models

COURSE OUTCOMES

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

CO1 Calibrate the wind tunnel.

CO2 Describe the various wind tunnel techniques (subsonic) and the methods of measuring flow parameters.

CO3 Determine experimentally the aerodynamic characteristics of the streamlined and bluff bodies.

CO4 Understand the various flow patterns of objects and flow visualization techniques.

CO5 Examine the difference of lift and tip vortices created in various objects.

16AE212	AIRCRAFT COMPONENT DRAWING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTs

1. Design and drafting of riveted joints.
2. Design and drafting of welded joints.
3. Design and drafting of control components cam.
4. Design and drafting of control components bell crank.
5. Design and drafting of control components gear.
6. Design and drafting of control components push-pull rod.
7. Three view diagram of a typical aircraft.
8. Layout of typical wing structure.
9. Layout of typical fuselage structure.
10. Layout of control system.

L : 0 T: 0 P: 60 Total: 60 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Drawing Boards and Drafting Machines
2.	Computer Systems
3.	Modelling Packages
4.	CAD Software
5.	UPS

COURSE OUTCOMES

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

CO1 Design and draw the various types of riveted and welded joints used in aircraft.

CO2 Design and draw the various control components of aircraft.

CO3 Design and draw 3D view of an aircraft.

CO4 Design and draw the typical wing and typical structure of aircraft.

CO5 Design and draw the control system of aircraft.

SEMESTER V

16AE301	AIRCRAFT STRUCTURES – II	L	T	P	C
		3	0	0	3

UNIT I UNSYMMETRICAL BENDING **9**

General, Principal axis and neutral axis methods – Bending of symmetric beams subject to skew loads – Bending stresses in beams of unsymmetrical sections.

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 and torsion – with walls effective and ineffective in bending – Shear centre of closed sections.

UNIT IV BUCKLING OF PLATES **9**

Bending of thin plates – Rectangular sheets under compression – Local buckling stress of thin walled sections – Crippling strength estimation – Needham and Gerard methods – Thin-walled column strength – Sheet stiffener panels – Load carrying capacity of sheet stiffener panels –Inter rivet buckling and sheet wrinkling failures – Effective width.

UNIT V STRESS ANALYSIS IN WING AND FUSELAGE **9**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Megson T H G, "Aircraft Structures for Engineering Students", 4th Edition, Elsevier Ltd, 2007.
2. Bruhn E.F., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985.

REFERENCES

1. Peery D. J., and Azar J.J., "Aircraft Structures", 2nd edition, McGraw-Hill, N.Y., 1993.
2. Timoshenko S., and Goodier T.N., "Theory of Elasticity", Third edition McGraw – Hill (India) Ltd.,
3. Donaldson B.K., "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993.
4. J.P Den Hartog, "Advanced Strength of Materials", Dover Publications Inc, 1988.
5. Lakshmi Narasaiah G, "Aircraft Structures" BSP Books pvt ltd.,2010.

COURSE OUTCOMES

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

CO1 Analyze the structures subjected to unsymmetrical bending
CO2 Understand the behavior of open sections.
CO3 Solve the problems on unsymmetrical closed sections.
CO4 Analyze the stiffened plates subjected to buckling.
CO5 Describe the stresses induced in various aircraft components.

16AE302	AERODYNAMICS – II	L	T	P	C
		4	0	0	4

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW **12**

Compressibility, continuity, momentum and energy equations for steady one dimensional flow, compressible Bernoulli's equation, area – mach number – velocity relation, mach cone, mach angle, one dimensional isentropic flow through variable area duct, critical conditions, characteristic mach number, maximum discharge velocity – operating characteristics of nozzles- introduction to hypersonic flows

UNIT II SHOCK AND EXPANSION WAVES **12**

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

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW **12**

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

UNIT IV HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION **12**

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

UNIT V EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS **12**

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

L : 60 T: 0 P: 0 Total: 60 PERIODS

TEXT BOOKS

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

REFERENCES

1. Shapiro, A. H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., "Elements of Gas Dynamics", McGraw- Hill & Co., 1989.
3. Oosthuizen. P.H,& Carscallen. W. E., "Compressible Fluid Flow", McGraw- Hill & Co.,1997.
4. L.J.Clancy "Aerodynamics" Pitman, Himalaya Publishing House , 3rd edition, 2006.
5. J.J. Bertin, "Aerodynamics for engineers" Prentice-hall, 6th edition, 2013.

COURSE OUTCOMES

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

CO1 Describe the fundamental aspects and behaviours of compressible flow.

CO2 Understand the phenomenon of normal and oblique shock characteristics.

CO3 Demonstrate the functions of two dimensional compressible flows.

CO4 Illustrate the physical behaviour of high speed flows.

CO5 Examine the principle and operations of flow visualisation techniques.

16AE303 **PROPULSION – II** **L T P C**

3 0 0 3

UNIT I HYPERSONIC AIR-BREATHING 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 combustors – One dimensional models for supersonic combustion using method of influence coefficients.

UNIT II FUNDAMENTALS OF CHEMICAL ROCKET PROPULSION 9

Operating principle – Specific impulse of a rocket – Internal ballistics – Performance considerations of rockets – Types of Igniters - Staging of Rockets –Types of Solid Propellant Igniters and Liquid Propellant Igniters – Hypergolic Ignition – 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

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

UNIT IV LIQUID AND HYBRID ROCKET PROPULSION 9

Salient features of liquid propellant rockets – Selection of liquid propellants – Various feed systems and injectors for liquid propellant rockets – Thrust control and cooling in liquid propellant rockets and the associated heat transfer problems – Combustion instability in liquid propellant rockets – Peculiar problems associated with operation of cryogenic engines - Introduction to hybrid rocket propulsion – Standard and reverse hybrid systems – Combustion mechanism in hybrid propellant rockets – Applications and limitations.

UNIT V ADVANCED PROPULSION TECHNIQUES 9

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.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", 2nd Edition, Standard Publishers and Distributors, Delhi, 2008.
2. Sutton, G.P., "Rocket Propulsion Elements", 8th Edition, John Wiley & Sons Inc., New York, 2010.

REFERENCES

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" 2nd Edition Pearson India, 2009.
2. Ramamurthi. K, "Rocket Propulsion", Macmillan Publishers, India, 1st Edition, 2010.
3. V.M. Domkundwar, "Gas Turbines and Jet Rocket Propulsion", 2nd Edition,DhanpatRai& Co., 2013.
4. Martin Tajmar, "Advanced Space propulsion Systems", 1st Edition, Springer, 2003.
5. Ganesan.V, "Gas Turbines" 3rd edition, Tata McGrew Hill Education (India) Private Limited, 2010.

COURSE OUTCOMES

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

CO1 Analyse the hypersonic air breathing propulsion.

CO2 Understand the fundamental of chemical rocket propulsion.

CO3 Performance analysis of propulsion system of Rockets.

CO4 Analysis of different types of propellants.

CO5 Explain the advanced propulsion techniques.

16AE304	AIRCRAFT PERFORMANCE	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

Streamlined and bluff bodies - Aerofoil classification - Aerofoil characteristics - Pressure distribution around aerofoil - Types of drag - Effects of Reynolds number on skin friction and pressure drag - Drag reduction of airplanes - Induced drag - Chord wise and span wise pressure distribution - Aspect ratio, Camber and plan form characteristics - Drag polar.

UNIT II STEADY FLIGHT **9**

Steady level flight - Thrust/power available and required with altitude - Estimation of Maximum level flight speed - Conditions for minimum drag and minimum power required.

UNIT III GLIDING, CLIMBINGAND TURING PERFORMANCE **9**

Maximum range - Minimum rate of skin a glide - Shallow angle of climb - Rate of climb - Time to climb and ceiling - Glide hodograph - Bank angle and load factor - Limitations on turn - Pull up and push over - The v-n diagram.

UNIT IV SPECIAL PERFORMANCE **9**

Range and Endurance of jet and propeller type of airplanes - Estimation of take-off and landing distance - High lift devices.

UNIT V PROPELLERS **9**

Froude momentum and blade element theories - Propeller coefficients –static thrust estimation – in flight thrust and power estimation and flight estimation - use of propeller charts - Performance of fixed and variable pitch propeller - Propeller noise – Propeller noise chart.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Anderson J. D., Jr. "Airplane Performance and Design", McGraw Hill Publishing Co., 3rd Rev Ed edition 2011.
2. L.J.Clancy, "Aerodynamics", Pitman, Himalaya Publishing House, 3rd edition 2006 .

REFERENCES

1. Perkins, C. D., and Hage, R, E., "Airplane Performance, Stability and Control", Wiley, Reprint 2011.
2. J.J. Bertin, "Aerodynamics for Engineers" Prentice-hall, 6th edition 2013.
3. Stengel, R.F. "Flight dynamics" Princeton University Press, Princeton, N.J., USA, 2004.
4. A.C.Kermode., "Mechanics of Flight" Prentice Hall,11th edition, 2006
5. Houghton, E.L., and Carruthers, N.B., "Aerodynamics for Engineering students", Hodder Arnold; 3rd Revised edition, 1988.

COURSE OUTCOMES

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

CO1 Describe the aerodynamic performance parameters.

CO2 Solve the problems on steady level flight condition.

CO3 Solve the problems on unsteady level flight condition.

CO4 Explain the various special performance of aircraft

CO5 Describe the basics of propeller theory.

16AE329	CAREER DEVELOPMENT PROGRAMME – V	L	T	P	C
		1	0	2	2

UNIT I EVALUATION OF AIRCRAFT AND DEVELOPMENT **9**

Early Airplanes – Biplanes and Monoplanes – Development in Aerodynamics – Materials, Structures and Propulsion over the Year

UNIT II AERODYNAMICS **9**

Introduction – Airflow and Aerofoil – Airfoil and its applications – Forces acting in the flight – Performance – Conformal transformations – Viscous flow – Compressible flow dynamics – Hypersonic aerodynamics.

UNIT III PROPULSION **9**

Fundamentals of gas turbine engines – Subsonic and Supersonic inlets for jet engines – Combustion chamber – Nozzles – Compressors – Propellers – Hypersonic air breathing engines – Rocket Propulsion.

UNIT IV AIRCRAFT STRUCTURES **9**

Load distribution on wings – Statically determinate structures – Statically indeterminate structures – Energy methods – Columns – Failure theory – Composite materials and structures.

UNIT V AVIONICS **9**

Digital electronics – Microprocessors – Avionics Data Buses – Microcontroller – I/O Interfacing – Applications.

L : 15 T: 0 P: 30 Total: 45 PERIODS

TEXT BOOKS

1. Anderson, J.D., "Introduction to Flight", 7th edition, McGraw-Hill, 2012.
2. Kermode, A.C., "Mechanics of Flight", 11th Edition, Prentice Hall Publisher, 2006

REFERENCES

1. L.J.Clancy, "Aerodynamics", Pitman, Himalaya Publishing House, 3rd edition 2006.
2. J.J. Bertin, "Aerodynamics for engineers" Prentice-hall, 6th edition 2013.
3. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", 2nd Edition, Standard Publishers and Distributors, Delhi, 2008.
4. Peery, D. J., and Azar, J. J., "Aircraft Structures", 2nd edition, McGraw-Hill, N.Y., 1993.
5. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004.

COURSE OUTCOMES

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

CO1 Explain the basic function and developments of Airplane.

CO2 Detail the fundamentals of Aerodynamics Engineering.

CO3 Describe about the working of various air breathing engines.

CO4 Analyse the statically determinate and indeterminate structures.

CO5 Integrate avionics systems using data buses.

16GE313	CAREER DEVELOPMENT PROGRAMME V	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I QUANTITATIVE ABILITY I 9

Number theory- Shortcuts, Divisibility criteria- Unit place deduction-LCM &HCF, Square root and Cube Root, Decimal & Fraction, Percentage.

UNIT II QUANTITATIVE ABILITY II 9

Profit, loss and discount, Simple and compound interest, Ratio & Proportions, Mixtures & Allegation, Partnership.

UNIT III QUANTITATIVE ABILITY III 9

Problems on Ages, Average, Venn diagram, Clocks, Calendar, Data Interpretation- Bar chart- Pie chart- Line chart-Tables chart.

UNIT IV VERBAL REASONING I 9

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems, Puzzle.

UNIT V VERBAL REASONING II 9

Logical reasoning - Number and Alpha series, Odd man out, Element series, Logical series, Coding and decoding, Analogy, Alphabets, Logical sequence of words.

L : 15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
2. BS Sijwali- Indu Sijwali, A New Approach to "Reasoning Verbal, Non-Verbal & Analytical", Arihant Publications.

REFERENCES

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.
2. R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited
3. M.K.Panday, "Analytical Reasoning", Magical Series.
4. Wiley's Quantitative Aptitude Book - P.A. Anand.
5. The Pearson Guide To Quantitative Aptitude For Competitive – Arun Sharma.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Know the both analytical and logical reasoning
CO2 Apply the shortcut methods in quantitative aptitude.
CO3 Solve application orientated concepts in quantitative aptitude.
CO4 Improve the quality of the student as a finished product for their corporate life.
CO5 Understand and practice Logical reasoning.

16AE305 AIRCRAFT STRUCTURES - II LABORATORY

L	T	P	C
0	0	2	1

LIST OF EXPERIMENTs

1. Unsymmetrical Bending of a Cantilever Beam
2. Shear Centre of a Channel Section
3. Shear Centre of a closed Section
4. Constant strength Beam
5. Material Fringe Constant of Photo-elastic Models
6. Free Vibration of a Cantilever Beam
7. Forced Vibration of a Cantilever Beam
8. Flexibility matrix for Cantilever Beam
9. Determination of Elastic constants for a Composite specimen
10. Tension field beam
11. Fabrication of a Composite Laminate
12. Combined bending and Torsion of a Hollow Circular Tube

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Photo elasticity set-up
2.	Vibration set-up with accessories
3.	Wagner beam set-up
4.	Unsymmetrical bending set-up
5.	Set-up for combined bending and torsion

COURSE OUTCOMES

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

CO1 Analyze Bending test, Torsion test, Shear test on metallic and composite specimen
CO2 Conduct experiment on vibration on the cantilever beam.
CO3 Describe the performance and behavior of the tension field beam.
CO4 Examine material fringe constant on photo elasticity set-up
CO5 Conduct experiment on combined bending and torsion on beam set-up.

16AE306	PROPULSION LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Study of aircraft piston and gas turbine engines.
2. Velocity profiles of free jets.
3. Velocity profiles of Wall jets.
4. Study of Ram jet.
5. Study of performance of propeller.
6. Flame stabilization studies using conical flame holders.
7. Cascade testing of compressor blades.
8. Study of secondary injection in a supersonic cross flow.
9. Wall pressure distribution in subsonic diffuser.
10. Wall pressure measurements in subsonic nozzle.

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Turbojet & Piston Engine
2.	Turboprop Engine
3.	Cascade Wind Tunnel
4.	Propeller test rig
5.	Measurement of Burning velocity

COURSE OUTCOMES

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

CO1 Understand the details of piston and gas turbine engine.
CO2 Conduct performance test on Free and Wall Jet.
CO3 Determine the thrust force using propeller test.
CO4 Understand the pressure distribution over a Compressor and Turbine Blade.
CO5 Determine the pressure variation in Diffuser and Nozzle.

16AE307	AERO ENGINEERING CAD LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTs

1. Numerical Simulation of flow through a C-D nozzle.
2. Numerical Simulation of subsonic flow over an airfoil.
3. Numerical Simulation of supersonic flow over an airfoil.
4. Numerical Simulation of flow through compressor/ turbine blade passage.
5. Numerical Structural analysis of a tapered wing.
6. Numerical Structural analysis of a fuselage structure.
7. Numerical Analysis of a composite laminate structure.
8. Numerical Structural analysis of a landing gear.
9. Numerical analysis of composite structure subjected to thermal and external loads.
10. Numerical Analysis of flow through subsonic and supersonic diffusers.

L : 0 T: 0 P: 60 Total: 60 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Computers with suitable software

COURSE OUTCOMES

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

CO1 Describe the results obtained in the numerical study.
CO2 Understand the design of aircraft components.
CO3 Use the available software for analyzing types of structures
CO4 Use the available software for analyzing internal and external fluid flows.
CO5 Solve the composite structural problem for aircraft components.

SEMESTER - VI

16GE301	PROFESSIONAL ETHICS	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I ENGINEERING ETHICS **9**

Senses of Engineering ethics – Variety of moral issues – Types of inquiry- Moral dilemmas. Moral autonomy – Kolberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideals and virtues – theories about right action – self-interest – customs and religion – use of ethical theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as social experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – Case studies.

UNIT III ENGINEERS RESPONSIBILITY FOR SAFETY **9**

Safety and risk – assessment of safety and risk – risk benefit analysis – reducing risk – Case studies.

UNIT IV RESPONSIBILITIES AND RIGHTS **9**

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights –employee right – discrimination – intellectual property rights, Case studies.

UNIT V GLOBAL ISSUE **9**

Multinational corporations – environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – sample code of conduct, Case studies.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Mike Martin and Roland Schinzinger, "Ethics in Engineering" McGraw hill, NewYork, 2004.
2. Govindarajan. M, Natarajan. S,Senthilkumar. V.S, "Engineering Ethics" Prentice Hall, New Delhi, 2004.

REFERENCES

1 Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics– Concepts and Cases", Cengage Learning, 2009 .
2 Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt.Ltd., New Delhi 2013 .
3 Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4 Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004).
5 David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

COURSE OUTCOMES

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

CO1 Understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories.

CO2 Identify various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO3 Realize the responsibilities of an engineer for safety and risk benefit analysis.

CO4 Recognize the professional rights and responsibilities of an engineer.

CO5 Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional career.

16AE308 FINITE ELEMENT METHOD FOR AERONAUTICAL APPLICATIONS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Basic Steps in FEM Formulation – 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 **9**

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

Not for Examination: Program: Simple case on 1-D static problem related to Aeronautics (using C/C++ language or MATLAB)

UNIT III CONTINUUM ELEMENTS **9**

Plane stress, plane strain and Axi-symmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axi-symmetric element.

UNIT IV ISOPARAMETRIC ELEMENTS **9**

Introduction to iso-parametric elements - 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 **9**

Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. Gaussian elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Tirupathi.R. Chandrupatla and Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, Pearson Higher Education Publication, 4th Revised Edition,2012.
2. Singiresu S. Rao, “The Finite Element Method in Engineering”, Elsevier Publication, 5th Edition, 2012.

REFERENCES

1. Robert D Cook, David S Malkus, Michael E Plesha, “Concepts and applications of finite element analysis”, 4th Edition, John Wiley and Sons, Inc., 2001.
2. Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, Inc. 2nd Edition, 1985.
3. Krishnamurthy, C.S., "Finite Element Analysis: Theory and Programming", Tata McGraw Hill, 2001.
4. Young W. Kwon, Hyochoong Bang, “The Finite Element Method Using MATLAB”, CRC Press; 2nd Edition, 1996.
5. NitinS.Gokhale Sanjay S.Deshpande and SanjeevV.Bedekar, “Practical Finite Element Analysis”, Finite To Infinite Publisher, First Edition, 2008.

COURSE OUTCOMES

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

CO1 Understand the basic finite element formulation techniques

CO2 Able to develop the fundamental equations required for solving solid mechanics and thermal engineering problems

CO3 Solve the axisymmetric problems

CO4 Understand the isoparametric elements

CO5 Solve the one, two and three dimensional problems applying FEM

16AE309 AIRPLANE STABILITY AND CONTROL L T P C

3 0 0 3

UNIT I STICK FIXED STATIC LONGITUDINAL STABILITY AND CONTROL 9

Introduction: Degrees of freedom of a system – Static and dynamic stability – Need for stability in an airplane – purpose of controls – Inherently and marginally stable airplanes.

Stick fixed: Basic equations of equilibrium – Stability criterion – Wing and tail moments – Effect of fuselage and nacelles – Effect of C.G. location – Power effects – Stabilizer setting and C.G. location – Elevator effects – Stick fixed neutral point.

UNIT II STICK FREE STATIC LONGITUDINAL STABILITY AND CONTROL 9

Stick free: Hinge moment coefficients – Stick free neutral point symmetric maneuvers – Stick force gradients and stick force per cg – Aerodynamic balancing of control surfaces.

Maneuvering flight: Introduction – elevator angle per 'g'– limits on airplane's CG.

UNIT III DIHEDRAL EFFECT AND LATERAL STABILITY 9

Dihedral effect –Lateral Control – Aileron power – Coupling between rolling moment and yawing moment – Adverse yaw – Aileron reversal.

UNIT IV DIRECTIONAL STABILITY AND CONTROL 9

Static directional stability rudder fixed – Weather cocking effect – Rudder requirements – One engine inoperative conditions – static free directional stability – Rudder lock.

UNIT V DYNAMIC STABILITY 9

Equation of motion – Stability derivatives – Routh's discriminant – Solving the stability quadratic – Phugoid motion – factors affecting the period and damping – Dutch roll and spiral instability – Auto rotation and spin – Two control airplane.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Perkins, C. D., and Hage, R, E., "Airplane Performance, Stability and Control", Wiley Toppan, Reprint edition, 2011.
2. L.J.Clancy, "Aerodynamics", Pitman, Himalaya Publishing House, 3rd edition, 2006.

REFERENCES

1. Nelson, R.C. "Flight Stability and Automatic Control", McGraw Hill Education (India) Pvt Ltd, 8th Reprint Edition, 2011.
2. Etkin B., "Dynamics of Flight Stability and Control", Wiley, New York, 3rd edition, 1995.
3. A.C Kermode., "Mechanics of Flight" Prentice Hall, 11th edition, 2006.
4. Stengel, R.F. "Flight dynamics" Princeton University Press, Princeton, N.J., USA, 2004.
5. J.J. Bertin, "Aerodynamics for engineers" Prentice-hall, 6th edition, 2013.

COURSE OUTCOMES

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

CO1 Describe the need for stability and purpose of controls in aircraft.

CO2 Identify the longitudinal modes and relate the important physical influences of aircraft properties on these modes.

CO3 Understand the dihedral effect and lateral stability.

CO4 Calculate static directional stability characteristics.

CO5 Describe the dynamic stability of the aircraft from the literalized equations of motion.

16GE312	CAREER DEVELOPMENT PROGRAMME VI	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I LINGUISTIC SKILLS **10**

Parts of Speech, Sentences - Simple, Compound & Complex sentences, Logical sequence of words, Reading Comprehension, Paragraph writing, Jumbled words, Jumbled sentences, Error Spotting, Idioms & Phrases, Word Substitution, Synonyms & Antonyms.

UNIT II QUANTITATIVE ABILITY **10**

Number theory, Percentage, Profit loss and discount, Simple and compound interest, Problems on Average & Ages, Ratio & Proportions, Partnership, Mixtures and allegation, Time speed and distance, Time and work, Probability, Permutation and combination, Mensuration, Clocks, Calendars.

UNIT III VERBAL & NON-VERBAL REASONING **10**

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems, Decision making.

Logical reasoning - Number and Alpha series, Odd man out, Element series, Logical series, Coding and decoding, Syllogisms, Alphabets Machine Input & Output Coded Inequalities, Puzzles, Cubes, Data sufficiency, Analogy.

Critical reasoning - Statement – Argument & Assumption, Causes & effects, Courses of Action, Inferences.

Non-Verbal reasoning - Insert the missing character, Figure series, Cubes & Dices, Logical Venn diagram.

UNIT IV PERSONALITY DEVELOPMENT & SOFT SKILLS **8**

Body Language – Introduction, Grooming, Body Language - Postures and Gestures, Dressing Etiquettes, Hygiene & Cleanliness, Time Management

Interview Etiquettes – Meaning, Purpose, Interview process and types, checklist – do's and don'ts, Dress code, Self-Introduction.

Resume Building – Introduction, transformation between Resume and CV, Strategy of Resume Writing, Body of the resume, clarity and crispness, format and content.

Group Discussion – Types, Key steps to succeed in Group Discussion, Guidelines – Do's and Don'ts during Group Discussion, the technique of summing up.

UNIT V COMPANY SPECIFIC TRAINING **7**

Company specific training.

L:15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1. John Eastwood, "Oxford Practice Grammar", Oxford.
2. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
3. M.K.Panday, "Analytical Reasoning", Magical Series.

REFERENCES

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.
2. R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited.
3. S.P.Bakshi, "Objective English" Arihant Publications.
4. Edgar Thorpe & Showick Thorpe, "Winning Interviews", Pearson Publications.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Communicate well both in oral and written English.
CO2 Solve the complicated problems with the thorough knowledge on the basics.
CO3 Think both critical and logical to solve the problems.
CO4 Be a better personality in their professional and social life.
CO5 Face the recruitment challenges.

16GE314	CAREER DEVELOPMENT PROGRAMME VI	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I QUANTITATIVE ABILITY IV **9**

Time, speed & distance-Average speed- Relative speed- Train problems- Boats and streams- Races, Chain rule, Time and work -Pipes and cisterns.

UNIT II QUANTITATIVE ABILITY V **9**

Permutation & Combination, Probability, Mensuration, Data sufficiency (Quants).

UNIT III VERBAL REASONING III **9**

Machine Input and Output, Coded Inequalities, syllogisms, Problems on Cubes, Data sufficiency (Reasoning).

UNIT IV CRITICAL REASONING **9**

Statement and Argument, Statement and Assumption, Statement and Conclusion, Course of action, Inference, Decision Making.

UNIT V NON- VERBAL REASONING **9**

Figure series, Odd man out, Mirror Image, Water image, Embedded Image, Cubes and Dices, shape construction, Insert the Missing Characters, Analytical reasoning, Logical venn diagram.

L:15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
2. BS Sijwali- Indu Sijwali, A New Approach to "Reasoning Verbal, Non-Verbal & Analytical", Arihant Publications.

REFERENCES

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.
2. R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited.
3. M.K.Panday, "Analytical Reasoning", Magical Series.
4. Wiley's Quantitative Aptitude Book - P.A. Anand.
5. The Pearson Guide To Quantitative Aptitude For Competitive – Arun Sharma.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Increase the students knowledge in both analytical and logical reasoning
CO2 Apply the shortcut methods in quantitative Aptitude
CO3 Solve application orientated concepts in quantitative aptitude.
CO4 Improve the quality of the student as a finished product for their corporate life
CO5 Use their logical thinking and analytical abilities to solve Quantitative aptitude questions.

16AE310 AIRCRAFT STRUCTURES REPAIR LABORATORY L T P C

0 0 2 1

LIST OF EXPERIMENTs

1. Aircraft wood gluing.
2. Patch repair welding using TIG.
3. Patch repair welding using MIG.
4. Patch repair welding using Plasma Arc.
5. Exercise on pipe bending
6. Exercise on Riveted joints & repair work.
7. Exercise on composites & repair work.
8. Repair of Sandwich panels.
9. Sheet metal forming.
10. Control cable inspection and repair

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Shear cutter pedestal type
2.	Drilling Machine
3.	Pipe Flaring Tools / Pipe Bending Tools
4.	Carbide Gas Plant
5.	MIG, TIG, Plasma Weld Plant

COURSE OUTCOMES

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

CO1 Inspect the aircraft structures and perform the repair work.
CO2 Analyze the aircraft systems and components
CO3 Inspect the control cables and perform the repair work.
CO4 Determine the different types of welding process
CO5 Explain the riveted joints on aircraft structures.

16AE311	AERO ENGINE MAINTENANCE LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Dismantling of a Piston Engine.
2. Piston Engine - Cleaning, Visual Inspection, NDT checks.
3. Piston Engine Components - Dimensional Checks.
4. Study of Carburetor.
5. Piston Engine Reassembly.
6. Dismantling of a Jet Engine.
7. Jet Engine – Identification of components & defects.
8. Jet Engine – NDT Checks and Dimensional Checks.
9. Jet Engine – Reassembly.
10. Engine starting procedures.

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Piston Engines
2.	Aero Jet Engines
3.	Standard tools for Dismantling and assembly
4.	Precision instruments Vernier Caliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector and DTI
5.	NDT Equipment

COURSE OUTCOMES

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

CO1 Dismantling the aircraft piston engines and jet engines for inspection

CO2 Identify the defects in Aircraft piston and jet engines by NDT Checks.

CO3 Check the dimension for Aircraft engines using Precision Instruments.

CO4 Reassemble of engines after NDT and Dimensional Checks.

CO5 Demonstrate the Engine Starting procedures.

16AE312	AIRCRAFT SYSTEMS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

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

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Serviceable aircraft with all above systems
2.	Hydraulic Jacks (Screw Jack)
3.	Trestle adjustable, Cable Tensometer
4.	Spirit Level, Plumb bob
5.	Leveling Boards, Adjustable Spirit Level

COURSE OUTCOMES

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

CO1 Conduct aircraft Jacking and Leveling procedure

CO2 Demonstrate the control system assembly and symmetry check procedure.

CO3 Examine the fuel filter element clogging by Flow test.

CO4 Understand the performance characteristics of fuel system components

CO5 Illustrate the maintenance procedure to be carried during the aircraft operations.

SEMESTER – VII

16GE302	ENGINEERING ECONOMICS AND COST ANALYSIS	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I BASIC ECONOMICS **9**

Definition of economics - nature and scope of economic science - nature and scope of managerial economics - basic terms and concepts - goods - utility - value - wealth - factors of production - land - its peculiarities - labour - economies of large and small scale - consumption -wants - its characteristics and classification - law of diminishing marginal utility – relation between economic decision and technical decision.

UNIT II DEMAND AND SCHEDULE **9**

Demand - demand schedule - demand curve - law of demand - elasticity of demand - types of elasticity - factors determining elasticity - measurement – its significance - supply – supply schedule - supply curve - law of supply - elasticity of supply - time element in the determination of value - market price and normal price - perfect competition - monopoly – monopolistic competition.

UNIT III ORGANISATION **9**

Forms of business - proprietorship - partnership - joint stock company - cooperative organization - state enterprise - mixed economy - money and banking - banking - kinds - commercial banks - central banking functions - control of credit - monetary policy - credit instrument.

UNIT IV FINANCING **9**

Types of financing - Short term borrowing - Long term borrowing – Internal generation of funds -External commercial borrowings - Assistance from government budgeting support and international finance corporations - analysis of financial statement – Balance Sheet - Profit and Loss account - Funds flow statement.

UNIT V COST AND BREAK EVEN ANALYSES **9**

Types of costing – traditional costing approach - activity base costing - Fixed Cost – variable cost – marginal cost – cost output relationship in the short run and in long run – pricing practice– full cost pricing – marginal cost pricing – going rate pricing – bid pricing – pricing for a rate of return – appraising project profitability –internal rate of return – pay back period – net present value – cost benefit analysis – feasibility reports – appraisal process – technical feasibility economic feasibility – financial feasibility. Break even analysis - basic assumptions – break even chart – managerial uses of break even analysis.

L:45 T: 0 P:0 Total: 45 PERIODS

TEXT BOOKS

1 Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand & Co., 2006.
2. Sharma JC "Construction Management and Accounts" Satya Prakashan, New Delhi, 2006.

REFERENCES

1 Barthwal R.R., Industrial Economics - An Introductory Text Book, New Age, 2007.
2 Jhingan M.L., Micro Economic Theory, Konark,1989.
3 Samuelson P.A., Economics - An Introductory Analysis, McGraw Hill.

COURSE OUTCOMES

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

CO1 Know the basic terms and concepts of economic.
CO2 Understand the major capability and limitations of cash flow analysis for proposed capital investment.
CO3 Recognize, formulate, analyze and solve cash flow models in practical situations.
CO4 Develop the ability to account for time value of money using engineering economy factors and formulas, as well as implication and importance of considering taxes, depreciation and inflation.
CO5 Evaluate engineering alternatives by economic analysis techniques and models.

16AE401	COMPOSITE MATERIALS AND STRUCTURES	L	T	P	C
		3	0	0	3

UNIT I MICROMECHANICS **9**

Introduction– Advantages and applications of composite materials – Types of reinforcements and matrices – Micro mechanics – Mechanics of materials approach, elasticity approach– Bounding techniques – Fiber volume ratio – Mass fraction – Density of composites–Effect of voids in composites.

UNIT II MACRO MECHANICS **9**

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

UNIT III LAMINATED PLATE THEORY **9**

Governing differential equation for a laminate – Stress-strain relations for a laminate – Different types of laminates – In plane and flexural constants of a laminate –Hydrothermal stresses and strains in a laminate – Failure analysis of a laminate – Impact resistance and interlaminar stresses – Netting analysis – Uses of composite structures in aerospace engineering.

UNIT IV FABRICATION PROCESS AND REPAIR METHODS **9**

Various open and closed mould processes manufacture of fibers – Importance of repair and different types of repair techniques in composites – Autoclave and non-autoclave methods

UNIT V SANDWICH CONSTRUCTIONS **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.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Robert M.Jones, "Mechanics of Composite Materials", BS Publication-Hyderabad, 2nd Edition, 1998.
2. Madhujit Mukhopadhyay, "Mechanics Of Composite Materials and Structures", Orient Blackswan Pvt. Ltd - New Delhi, 1st Edition, 2010.

REFERENCES

1. Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, 2nd Edition, 2005.
2. Dam Ishai., "Engineering Mechanics of Composite Materials", Oxford University Press New Delhi, 2013.
3. P.K.Mallick, "Fiber-Reinforced Composites: Materials, Manufacturing and Design", CRC Press, 3rd Revised Edition, 2007.
4. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, 2nd Revised Edition, 2004.
5. R.C. Prasad, "Composite Science and Technology", New Age International Publishers, New Delhi, 2009.

COURSE OUTCOMES

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

CO1 Describe the mechanism of composite materials.

CO2 Determine the structural properties of composite materials

CO3 Apply the suitable manufacturing techniques to prepare laminated composites

CO4 Explore the possibilities of using composite materials for manufacturing aircraft components.

CO5 Acquire basic knowledge in sandwich constructions.

16AE402	AVIONICS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION TO AVIONICS **9**

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

UNIT II PRINCIPLES OF DIGITAL AVIONICS **9**

Digital computers – Application of digital computers - Microprocessors – Memories – Avionics system architecture – Data buses – MIL-STD-1553B – ARINC 420 – ARINC 629.

UNIT III FLIGHT DECKS AND COCKPITS **9**

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

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS **9**

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

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

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

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

REFERENCES

1. Spitzer, C.R. “Digital Avionics Systems”, Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
2. E.H.J. Pallett, “Aircraft Instruments and Integrated Systems”, Longman Scientific.1992
3. Brain Kendal, “Manual of Avionics”, the English Book House, 3rd Edition, New Delhi, 1993.
4. D H Middleton, Ed., “Avionics Systems, Longman Scientific and Technical”, Longman Group UK Ltd., England, 1989.
5. Malvino A.P. and Leach, D.P., “Digital Principles and Application”, Tata McGraw- Hill, 1990.

COURSE OUTCOMES

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

CO1 Prepare the preliminary design requirements for avionics systems.

CO2 Integrate avionics systems using data buses.

CO3 Analyze the performance of various cockpit display technologies.

CO4 Design suitable navigation algorithms for Aerospace vehicles.

CO5 Acquire basic knowledge in air data system and auto pilot.

16AE403	AVIONICS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Addition/Subtraction of binary numbers.
2. Multiplexer/Demultiplexer Circuits.
3. Encoder/Decoder Circuits.

MICROPROCESSORS

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

AVIONICS DATA BUSES

10. Study of Different Avionics Data Buses.
11. MIL-STD – 1553 Data Buses Configuration with Message transfer.
12. MIL-STD – 1553 Remote Terminal Configuration.

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Adder/Subtractor Binary bits Kit
2.	Encoder & Decoder Kit
3.	MIL-STD 1553B Setup with Remote Terminal
4.	Multiplexer & Demultiplexer Kit
5.	Digital to Analog Converter

COURSE OUTCOMES

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

CO1 Design and analyze complex digital circuits.

CO2 Write assembly language programs using 8085 for any applications.

CO3 Integrate avionic systems using MIL-STD-1553B data bus.

CO4 Understand the different of digital and analog converter.

CO5 Analysis the different avionics data buses.

16AE404	AIRCRAFT DESIGN PROJECT	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTs

1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Preliminary weight estimation, Selection of design parameters.
3. Power plant selection, aerofoil selection, Landing gear selection.
4. Drag estimation
5. Performance calculations and stability analysis.
6. Final V-n diagram - Gust and maneuverability envelopes.
7. Preliminary design of an aircraft wing – lift load distribution - Shrenck's curve, shear force, bending moment and torque diagrams.
8. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage.
9. Preparation of a detailed design report with CAD drawings

L : 0 T: 0 P: 30 Total: 30 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	LIST OF EQUIPMENTS
1.	Computers with suitable software

COURSE OUTCOMES

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

CO1 Select an aircraft and its design parameters and specifications with a survey.

CO2 Estimate the aerodynamic design characteristics of aircraft.

CO3 Understand the performance analysis and stability characteristics.

CO4 Examine the gust and maneuverability envelopes.

CO5 Illustrate the detailed report with aircraft wing design and load distribution

16AE405 **PROJECT PHASE – I** **L T P C**

0 0 4 2

The students in a group of maximum four Members work on a topic approved by the Head of the department under the guidance of an internal faculty member and prepare a detailed literature study and preliminary outline of the project work. The progress of the project phase – I 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 comprehensive examination by internal review committee constituted by the Head of the Department.

L : 0 T: 0 P: 60 Total: 60 PERIODS

MAJOR EQUIPMENTS / SOFTWARE REQUIRED (for a batch of 30 students)

S. No	**LIST OF EQUIPMENTS**
1.	Computers with suitable software

COURSE OUTCOMES

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

CO1 Identify the project and explain the objectives.

CO2 Examine the literature relevant to the project.

CO3 Conclude the methodology to be adopted to carry out the project.

CO4 Identify the tools used for the project

CO5 Identify the basic equation and data for the project

SEMESTER – VIII

16AE406	COMPUTATIONAL FLUID DYNAMICS FOR AERONAUTICAL APPLICATIONS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION TO NUMERICAL METHODS IN FLUID DYNAMICS 9

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

UNIT II GRID GENERATION 9

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

UNIT III SOLUTION OF FLUID FLOW EQUATIONS 9

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

UNIT IV TIME DEPENDENT METHODS 9

Introduction to time dependent methods - Explicit time dependent methods – Euler, Backward Euler, One step trapezoidal, Backward differencing, two-step trapezoidal, Leap Frog and Adams-Bashforth Methods - Description of Lax-Wendroff Scheme and MacCormack's two step predictor – corrector method - Description of time split methods. Introduction to implicit methods and respective stability properties of explicit and implicit methods - Construction of implicit methods for time dependent problems - Linearization, choice of explicit operator and numerical dissipation aspects.

UNIT V FINITE VOLUME METHOD 9

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics volume I & II" Springer Verlag,1995.
2. Klaus. A. Hoffmann, "Computational Fluid Dynamics for Engineer Volume I and II", Engineering education system, 1993.

REFERENCES

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

1994
5. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.

COURSE OUTCOMES

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

CO1 Understand the various approaches of fluid modeling and various methods of discretization.

CO2 Analyze the detail components of fluid governing equations

CO3 Apply the concept of numerical dissipation and components of boundary layer equations.

CO4 Solve the advanced turbulent models.

CO5 Apply the concept ofFinite Volume Method for 1-D and 2-D problems.

16AE407	PROJECT PHASE – II	L	T	P	C
		0	0	20	10

The students in a group of maximum four Members work on a topic approved by the head of the department and Review Committee constituted by the Head of the Department(Project Phase – I). The group 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 by a review committee constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Controller of Examination based on oral presentation and the project report. Students are also encouraged to present/publish their Project Work in National Conferences and Journals.

L : 0 T: 0 P: 300 Total: 300 PERIODS

COURSE OUTCOMES

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

CO1 Devise the method of analysis of a project.

CO2 Describe the validation methods of a project.

CO3 Find the proper designing and analyzing tools.

CO4 Comparison of results.

CO5 Write a detailed report of a project carried out and publish the papers.

PROFESSIONAL ELECTIVE

16AE313	THEORY OF ELASTICITY	L	T	P	C
		3	0	0	3

UNIT I HISTORY OF FLIGHT **9**

Definition, notations and sign convection for stress and strain – Stress and strain relations – Strain displacements – Lame's constant – Cubical dilation – Compressibility of materials – Bulk modulus– Shear modulus.

UNIT II BASIC EQUATIONS OF ELASTICITY **9**

Equations of equilibrium– Transformation equations for stresses and strains– Compatibility equation – Boundary conditions – Saint-Venant's Principle – principal stresses, stress ellipsoid – Stress invariants.

UNIT III 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– Computational solutions for simple 2-D problems.

UNIT IV POLAR COORDINATES **9**

Equations of equilibrium, strain displacement relations, Airy's functions – Axi-symmetric problems – Introduction to Dunder's table, curved beam analysis, Lame's, Kirsch's, Michell'sand Boussinesq's problems – Rotating discs.

UNIT V TORSION **9**

Navier's theory, Saint Venant's theory and Prandtl's theory on torsion – Semi-inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections– Fuselage structure – Membrane Analogy.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", 3rd edition, McGraw Hill Education (India) Pvt. Ltd., 2010.
2. Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity an Introductory Primer", Ane Books.

REFERENCES

1. Sadhu Singh.S "Theory of Elasticity" Khanna Publishers, New Delhi, 2002.
2. Landau "Theory of Elasticity" volume 7, 3rd edition CBS Publishers and Distributers, 2005.
3. R. J. Atkin, N "An Introduction to the Theory of Elasticity" Dover Publications Inc. 2005.
4. L. S. Srinath., "Advance Mechanics of Solids", 3rd edition, McGraw Hill Education (India) Private Limited.
5. Gere and Timoshenko "Mechanics of Materials" 2nd edition, CBS Publishers, 2004.

COURSE OUTCOMES

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

CO1 Describe the fundamental concepts and basic elasticity equation in Cartesian coordinate and polar coordinate.

CO2 Compute the elasticity concepts to plane stress and plane strain problems.

CO3 Apply the elasticity theories to torsion problems.

CO4 Acquire knowledge in polar coordinates and its application.

CO5 Acquire basic knowledge in elasticity torsion.

16AE314	EXPERIMENTAL TECHNIQUES	L	T	P	C
		3	0	0	3

UNIT I MEASUREMENT AND EXTENSOMETERS **9**

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

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGE **9**

Principle of operation and requirements of Electrical resistance strain gauge, Types and their uses, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges.

UNIT III PHOTOELASTICITY **9**

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

UNIT IV WIND TUNNELS MEASUREMENTS **9**

Pressure transducer, velocity measurements, hot wire anemometry and temperature measurements - Force measurements - types of balances-Three component and six component balances - calibration of measuring instruments.

UNIT V FLOW VISUALIZATION AND ANALOGUE METHODS **9**

Principles of Flow Visualization - Intrusive and Non-Intrusive methods of flow diagnosation -Hele-Shaw apparatus. Laser - Doppler anemometry - Particle image velocimetry - Laser induced fluorescence

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2012.
2. Pope. A andGoin. L., “High Speed Wind Tunnel Testing”, John Wiley, 1985.

REFERENCES

1. Dally, J.W., and Riley, W.F., “Experimental Stress Analysis”, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghavan, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "Experimental Stress Analysis", Tata McGraw Hill, New Delhi, 1984.
3. Robert B Northrop, “Introduction to Instrumentation and Measurements”, Second Edition, CRC Press, Taylor & Francis, 2006.
4. Hetenyi.M., “Hand book of Experimental Stress Analysis”, John Wiley and Sons Inc., New York, 1972.
5. Lecture course on “Advanced Flow Diagnostic Techniques”, 17-19 September 2008 NAL, Bangalore.

COURSE OUTCOMES

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

CO1 Demonstrate the fundamental working principle of Extensometers.

CO2 Diagnose the operation of Electrical Resistance type strain gauges.

CO3 Understand the concept of Photo elasticity.

CO4 Describe the basics of Measurement techniques and wind tunnel characteristics.

CO5 Explain the flow visualization techniques and the special flows.

16AE315	THEORY OF VIBRATIONS	L	T	P	C
		3	0	0	3

UNIT I BASIC NOTATIONS **9**

Introduction to vibration problems – terminologies – simple harmonic motions – equation of motion of a vibrating system – Newton's laws of motion – Energy methods – Rayleigh's method – D'Alembert's principle.

UNIT II SINGLE DEGREE OF FREEDOM SYSTEM **9**

Free and forced vibrations with and without damping – support excitations – transmissibility – vibration measuring instruments.

UNIT III MULTI DEGREE OF FREEDOM SYSTEM **9**

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

UNIT IV APPROXIMATE METHODS **9**

Approximate methods – Rayleigh's method –Dunkerlay's method, Holzer Method – matrix iteration method – Computational solutions of approximate methods.

UNIT V ELEMENTS OF AEROELASTICITY **9**

Aeroelastic problems – Collar'saeroelastic triangle – wing divergence – aileron control reversal – flutter – buffeting – elements of Servo elasticity.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Grover. G.K., "Mechanical Vibrations", 8th Edition, Nem Chand Brothers, Roorkee, India, 2009.
2. Thomson W T, "Theory of Vibration with Application" – 3rd editions, CBS Publishers, 2002.

REFERENCES

1. Bisplinghoff R.L., Ashely H and Hogman R.L. "Aero-elasticity", 4th edition, Dover Publications Inc., New Tork, 1996.
2. V.P.Singh, "Mechanical Vibrations", Dhanpat and Co, 2014.
3. S.Graham Kelly, S.K.Kudari "Mechanical Vibrations", McGraw Hill Education (India) Private Limited, 2010.
4. Francis S.Tse, I.E.Morse and H.T.Hinkle, "Mechanical Vibrations: Theory and Applications", Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
5. Sadhu Singh.S, "Mechanical Engineering and Noise Control", Khanna Publishers, New Delhi, 2003.

COURSE OUTCOMES

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

CO1 Describe the basic concepts and notations, terminologies of vibrations.

CO2 Compute the equations of motion of the single degree of freedom systems.

CO3 Gain knowledge about the equations of motion of the multi-degree of freedom systems.

CO4 Solve problems based on approximation methods.

CO5 Explain the elements of aero elasticity concepts.

16AE316	ADVANCED PROPULSION SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I THERMODYNAMIC CYCLE ANALYSIS OF AIR-BREATHING PROPULSION SYSTEMS **9**

Air breathing propulsion systems like Turbojet, Turboprop, Ducted fan, Ramjet, Scramjet and Air augmented rockets – Thermodynamic cycles – Pulse propulsion – Combustion process in pulse jet engines – Inlet charging process – Supercritical charging and subcritical discharging – Subcritical charging and subcritical discharging – Subcritical charging and supercritical discharging.

UNIT II RAMJETS AND AIR AUGMENTED ROCKETS **9**

Preliminary performance calculations – Diffuser design and hypersonic inlets – Combustor and nozzle design – Air augmented rockets – Engines with supersonic combustion

UNIT III SCRAMJET PROPULSION SYSTEM **9**

Fundamental considerations of hypersonic air breathing vehicles – Preliminary concepts in engine airframe integration – Calculation of propulsion flow path – Flow path integration – Various types of supersonic combustors – Fundamental requirements of supersonic combustors – Mixing of fuel jets in supersonic cross flow – Performance estimation of supersonic combustors.

UNIT IV NUCLEAR PROPULSION **9**

Nuclear rocket engine design and performance – Nuclear rocket reactors – Nuclear rocket nozzles – Nuclear rocket engine control – Radioisotope propulsion – Basic thruster configurations – Thruster technology – Heat source development – Nozzle development – Nozzle performance of radioisotope propulsion systems.

UNIT V ELECTRIC AND ION PROPULSION AND ROCKET TESTING **9**

Basic concepts in electric propulsion – Power requirements and rocket efficiency – Electro thermal thrusters – Electrostatic thrusters – Plasma thruster of the art and future trends – Fundamentals of ion propulsion – Performance analysis – Electrical thrust devices – Ion rocket - Rocket Testing Types of test – Test Facilities – Flight testing – Post accident procedures.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. G.P. Sutton, “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York,1998.
2. William H. Heiser and David T. Pratt, “Hypersonic Air Breathing Propulsion”, AIAA Education Series, 2001.

REFERENCES

1. Fortescue and Stark, “SpacecraftSystems Engineering”, 2nd Edition, John Wiley and sons, 1999.
2. Cumpsty, “Jet propulsion”, 2nd Edition Cambridge UniversityPress, 2003.
3. Mathur M L, “Gas Turbine & Jet Rocket Propulsion”, 2nd Edition, Standard Publications, New Delhi, 2011.
4. ZoebHusain, “Air Breathing Engines.” I.K. International Group, 2010.
5. David Buden, “Nuclear Thermal Propulsion system”, Polaris Books, 2011.

COURSE OUTCOMES

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

CO1 Solve problems involving thermodynamic cycles of propulsion system.

CO2 Design and analyze various components of the propulsion systems.

CO3 Summarize the concept of Ramjet and Scramjet.

CO4 Distinguish between electrical, Nuclear and ion propulsion.

CO5 Describe the testing of rockets.

16AE317	THEORY OF PLATES AND SHELLS	L	T	P	C
		3	0	0	3

UNIT I CLASSICAL PLATE THEORY **8**

Classical plate theory – Assumptions – Differential equation – Boundary conditions.

UNIT II PLATES OF VARIOUS SHAPES **10**

Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions. Governing equation – Solution for Axi-symmetric loading – Annular plates – Plates of other shapes.

UNIT III EIGEN VALUE ANALYSIS **9**

Stability and free vibration analysis of rectangular plates - Introduction of forced vibration analysis of rectangular plates and cut-out plates.

UNIT IV APPROXIMATE METHODS **9**

Rayleigh – Ritz, Galerkin Methods– Finite difference method – Application to rectangular plates for static, stability analysis – unstable and dynamic analysis.

UNIT V SHELLS **9**

Basic concepts of shell type of structures – Membrane and bending theories for circular cylindrical shells. Applications of bending theory to aircraft fuselage structures.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Timoshenko, S.P. Winowsky. S., and Kreger, "Theory of Plates and Shells", 2nd edition, McGraw Hill Education (India) Private Limited, 2010.
2. Varadan. T. K. and Bhaskar. K., "Analysis of Plates and Shells", 1999, Narosa.

REFERENCES

1. A.C.Ugural, "Stresses in Plates and Shells " McGraw Hill Higher Education; 2nd Revised edition , 1998.
2. Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw Hill Education (India) Private Limited,2010.
3. A.C.Ugural, "Stresses in Beams, Plates, and Shells", Third Edition, CRC Press,2009.
4. L.S.Srinath "Advanced Mechanics of Solids" 3rd edition, McGraw Hill Education (India) Private Limited.
5. Gere and Timoshenko "Mechanics of Materials" 2nd edition, CBS Publishers, 2004.

COURSE OUTCOMES

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

CO1 Compare the behavior of the plates with different geometry under various types of loads.

CO2 Solve the approximate methods application in plate's theory.

CO3 Explain the behavior of the shells subjected to load.

CO4 Analyze the rectangular plates for Static, Stability Analysis

CO5 Explain the application of bending theory to aircraft fuselage structures

16AE318	HEAT TRANSFER	L	T	P	C
		3	0	0	3

UNIT I CONDUCTION **9**

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

UNIT II CONVECTION **9**

Review of basic equations of fluid flow – Dimensional analysis- Forced convection – Laminar flow over flat plate and flow through pipes– Flow across tube banks–Turbulent flow over flat plate and flow through pipes – Free convection – Heat transfer from vertical plate using integral method – Empirical relations– Types of heat exchangers – Overall heat transfer coefficient –Logarithmic Mean Temperature Difference and Number of Transfer Units methods of analysis –Gas turbine blade cooling.

UNIT III RADIATION **9**

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

UNIT IV NUMERICAL METHODS IN HEAT TRANSFER **9**

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

UNIT V HEAT TRANSFER APPLIED TO AEROSPACE ENGINEERING **9**

Heat transfer problems in gas turbines–Rocket thrust chambers– Combustion chamber wall cooling techniques– Aerodynamic heating – Ablative heat transfer– Thermal Analysis of multilayer insulation for reentry aerodynamic heating.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Holman, J. P., “Heat Transfer”, McGraw Hill Book Co., Inc., New York, 6th Edition. 1991.
2. R. C.Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern. Ltd., New Delhi, 1981.

REFERENCES

1. R.K Rajput, “Heat Transfer and Mass Transfer” S ChantPublisher 2008.
2. Sutton,G.P., “Rocket Propulsion Elements”, John Wiley and Sons, Fifth Edition, 1986.
3. Mathur, M., and Sharma,R.P., “Gas Turbine and Jet and Rocket Propulsion”, Standard Publishers, New Delhi.
4. C.P. Kothandaraman “Heat and Mass Transfer”, New age Publishers 2006.
5. Yunus A Cengel, "Heat Transfer- Practical Approach", Tata McGraw Hill, Second edition, 2003.

COURSE OUTCOMES

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

CO1 Describe the fundamental concepts of heat transfer.

CO2 Solve problems on three modes of heat transfer

CO3 Analyze simple heat exchanger.

CO4 Apply numerical methods of solve heat transfer problems.

CO5 Describe the heat transfer concepts applied to aerospace engineering.

16AE319 CRYOGENIC ENGINEERING

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Historical Background – Introduction to cryogenic propellants – Liquid hydrogen, liquid helium, liquid nitrogen and liquid oxygen, their properties.

UNIT II PRODUCTION OF LOW TEMPERATURE **9**

Theory behind the production of low temperature – Expansion engine heat exchangers – Cascade process Joule Thompson Effect – Magnetic effect – Ortho and H2 – Helium4 and Helium 3.

UNIT III EFFICIENCY OF CRYOGENIC SYSTEMS **9**

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

UNIT IV CYCLES OF CRYOGENIC PLANTS **9**

Classification of cryogenic cycles – Structure of cycles–Throttle expansion cycles –Expander cycles – Thermodynamic analysis – Numerical problems.

UNIT V CRYOGENIC IN AEROSPACE APPLICATIONS **9**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Haseldom, G., "Cryogenic Fundamentals", Academic Press, 1971.
2. Barron, R. F., Cryogenic Systems, Oxford University, 1985.

REFERENCES

1. Zoeb Husain, "Air Breathing Engines", I.K. International Group, 2010.
2. David Buden, "Nuclear Thermal Propulsion system.", Polaris Books, 2011.
3. Cumpsty, "Jet propulsion", 2nd Edition Cambridge UniversityPress, 2003.
4. William H. Heiser and David T. Pratt, "Hypersonic Air Breathing Propulsion", AIAA Education Series, 2001.
5. D.T. Harrje and Reardon F.H., "Liquid Propellant Rocket Combustion Instability", NASA SP-194, NASA Washington, 1972.

COURSE OUTCOMES

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

CO1 Describe the need and importance of cryogenic propellants.

CO2 Describe the different phases and temperatures of propellants.

CO3 Analyze the efficiency and performance of cryogenic propellants.

CO4 Analyze the cycles of cryogenic plants.

CO5 Understand the concepts and applications of cryogenic propellants.

16AE320	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 and entropy layers - Hypersonic flight paths - Shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9

Local surface inclination methods - Newtonian theory - Modified Newtonian law - Newtonian-Busemann theory - Tangent wedge and tangent cone and shock expansion methods - Approximate methods - Hypersonic small disturbance theory - Thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equations for hypersonic flow - Hypersonic boundary layers - Self similar and non-self-similar boundary layers - Solution methods for non-self-similar boundary layers - Aerodynamic heating and its adverse effects on airframe.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

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

UNIT V HIGH TEMPERATURE EFFECTS IN HYPERSONIC FLOWS 9

Nature of high temperature flows - Chemical effects in air - Real and perfect gases - Gibb's free energy and entropy - Chemically reacting boundary layers - Recombination and dissociation.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", McGraw hill Series, New York, 1996.
2. Hayes, W.D, and R.F Probstein, "Hypersonic flow theory", 2nd Edn. Academic Press, New York, 1966.

REFERENCES

1. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", McGraw Hill Publishing Company, New York, 1996.
2. John T. Bertin., "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington. D.C., 1994.
3. Davidson P.A., "Turbulence: An Introduction for Scientists and Engineers", OUP Oxford Publishers, 2004.
4. Leif N. Persen., "Pragmatic Approach to Turbulence, A: A Short Course in Fluid Mechanics", PHI Learning Private Limited, 2013
5. White, F. M., "Viscous Fluid Flow", McGraw-Hill & Co., Inc., New York., 3rd edition 2011.

COURSE OUTCOMES

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

CO1 Apply knowledge in basics of hypersonic aerodynamics.

CO2 Explain the theory of simple solution methods used in inviscid flows.

CO3 Calculate the boundary layers of hypersonic flow and its viscous interaction

CO4 Enumerate the physical behaviour of viscous interaction in high speed flows.

CO5 Solve the high temperature effects in hypersonic flow applications

16AE321	CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

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 **10**

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 **10**

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 **8**

Necessary and sufficient conditions – Routh-Hurwitz criteria of stability – Root locus and Bode techniques – Concept and construction – Frequency response - Frequency Analysis

UNIT V SAMPLED DATA SYSTEMS **8**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Ogata, “Modern Control Engineering”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.
2. Kuo, B.C. "Automatic control systems", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES

1. Houpis, C.H. and Lamont, G.B. "Digital control Systems", McGraw Hill Book co., New York, U.S.A. 2014.
2. Naresh K Sinha, "Control Systems", 3rd Edition New Age International Publishers, New Delhi, 1998.
3. Joseph J.Distefano, Allen.RStubberud and Ivan.J. Williams “Feed back and control system”, McGraw-Hill international 2nd Edition 2007.
4. Norman S. Nise “ Control Systems Engineering”, Wiley India Private Limited. Paper back – 5th Edition 2009
5. Robert C. Nelson., “Flight Stability & Automatic Control” Tata McGraw Hill Publishers 2005.

COURSE OUTCOMES

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

CO1 Understand the basics of control systems

CO2 Differentiate the open and closed loop systems

CO3 Analyse the characteristic equation and functions of transformation.

CO4 Explain the basic concept of stability of control systems

CO5 Describe the basics of data systems.

16AE322	INTRODUCTION TO V/STOL AND GROUND EFFECT MACHINES	L	T	P	C
		3	0	0	3

UNIT I ELEMENTS OF HELICOPTER AERODYNAMICS 9

Configurations based on torque reactions – Jet rotors and compound helicopters –Methods of control – Cyclic and collective pitch changes – Lead-lag and flapping hinges - Take off techniques – Role of helicopters in IAF – Case study on HAL Light Combat Helicopter.

UNIT II IDEAL ROTOR THEORY 9

Hovering performance – Momentum and simple blade element theories – Figure of merit – profile and induced power estimation – Constant chord and ideal twist rotors.

UNIT III POWER ESTIMATES 9

Induced, profile and parasite power requirements in forward flight curves with effect of altitude – Preliminary ideas on helicopter stability.

UNIT IV LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT 9

Various configurations – Propeller, rotor, ducted fan and jet lift – Tilt wing and vectored thrust – Performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT V GROUND EFFECT MACHINES 9

Types – Hover height – Lift augmentation – Power calculations for plenum chamber and peripheral jet machine –Drag of hovercraft on land and water.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. McCormick B.W., "Aerodynamics of V/STOL Flight", Dover Publications, 1998
2. Simon Newman, "Foundation of Helicopter Flight", Butterworth India, New Delhi, 2012.

REFERENCES

1. Prouty R.W., "Helicopter Aerodynamics", Shroff, 2004.
2. Lalit Gupta, "Helicopter Engineering", Himalayan Books, New Delhi, 1996.
3. John M. Seddon, "Basic Helicopter Aerodynamics", 3rd Edition, John Wiley & Sons, 2011.
4. Gessow, Myres, C.G., "Aerodynamics of Helicopter", Macmillan & Co., New York, 1987.
5. John Fay, "The Helicopter", Himalayan Books, 1995.

COURSE OUTCOMES

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

CO1 Understand the basics of elements of helicopter aerodynamics
CO2 Describe configurations of helicopter and ideal rotor theory.
CO3 Explain the power estimates of helicopter stability
CO4 Determine the characteristics of helicopter and V/STOL aircraft
CO5 Describe the basics of ground effect machines.

16AE323	FATIGUE AND FRACTURE MECHANICS	L	T	P	C
		3	0	0	3

UNIT I FATIGUE OF STRUCTURES **9**

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

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOR **9**

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 **9**

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

UNIT IV FRACTURE MECHANICS **9**

Strength of cracked bodies –Potential energy and surface energy – Griffith's theory – Irwin-Orwin extension of Griffith's theory to ductile materials – Stress analysis of cracked bodies –Effect of thickness on fracture toughness – Stress intensity factors for typical geometries

UNIT V FATIGUE DESIGN AND TESTING **9**

Safe life and Fail-safe design philosophies – Importance of fracture mechanics in aerospace structures – Application to composite materials and structures– Failure analysis Process.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Prashant Kumar, "Elements of fracture mechanics", McGraw Hill Education (India) Pvt. Ltd, 2009.
2. JaapSchijve,"Fatigue of Structures and Materials," Springer Publication, 2nd Edition, 2009.

REFERENCES

1. SubraSuresh, "Fatigue of Materials", Cambridge University Press, 2nd Edition, 1998.
2. V. Raghavan, "Materials Science and Engineering", Phi Learning Publisher, 5th Edition, 2009.
3. Broke D, "Elementary Engineering Fracture Mechanics", Springer India Pvt. Ltd - New Delhi, 4th Edition, 1986.
4. Dam Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press New Delhi, 2013.
5. John Frederick Knott, "Fundamentals of Fracture Mechanics," Butterworth& Co., Ltd., London, 1983.

COURSE OUTCOMES

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

CO1 Describe the need and importance of fatigue analysis.

CO2 Describe the different phases and mechanism of fatigue life.

CO3 Analyze the fatigue life a component based on its S-N data.

CO4 Analyze the fracture due to fatigue.

CO5 Evaluate the fatigue design and testing.

16AE324 AIRCRAFT MICROPROCESSOR AND APPLICATIONS

L	T	P	C
3	0	0	3

UNIT I 8085 MICROPROCESSOR **9**

Basics of microprocessor – 8085 block diagram –Architecture – Addressing modes–Instruction set – Timing diagrams – Assembly language programming – Memory interfacing – Interrupts.

UNIT II 8086 MICROPROCESSOR **9**

8086 signals – Basic configurations –8086 Architecture – Addressing modes– instruction set – System bus timing– IO programming –Counter – Memory interfacing – Interrupts.

UNIT III MICROCONTROLLER **9**

Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes –Assembly language programming.

UNIT IV INTERFACING **9**

Memory Interfacing and I/O interfacing –Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications.

UNIT V APPLICATIONS **9**

Electronic Flight Systems – Automatic Flight Control Systems – Automatic Flight & Landing Systems – Flight Management System - Ring Laser Gyro.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Gaonkar R.S., "Microprocessors Architecture, Programming and Applications" Penram Intl. Publishing (India) Pvt. Ltd.-Mumbai, 6th edition.
2. Thomas K. Eismin, "Aircraft Electricity & Electronics", Fifth Edition, 1994, McGraw Hill International Editions.

REFERENCES

1. Aditya P Mathur -"Introduction to Microprocessors", Third Edition, Tata McGraw Hill.
2. EHJ Pallet, "Aircraft Instruments & Integrated Systems", Indian Reprint 1996- Longman Scientific & Technical.
3. EHJ Pallet, "Aircraft Electrical Systems", Longman Scientific & Technical,
4. Brain Kendal, "Manual of Avionics", the English Book House, 3rd Edition, New Delhi, 1993.
5. Spitzer, C.R., "Digital Avionic Systems", Prentice Hall, Englewood Cliffs, N.J., USA, 1987.

COURSE OUTCOMES

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

CO1 Design and implement programs on 8085 microprocessors.

CO2 Understand the implement programs on 8086 microprocessors

CO3 Gain knowledge about8051 microcontroller and Memory Interfacing circuits.

CO4 Describe the basic concepts of aircraft systems are control by the microprocessor.

CO5 Understand the application of microprocessors in aircraft.

16AE325	ROCKETRY AND SPACE MECHANICS	L	T	P	C
		3	0	0	3

UNIT I ORBITAL MECHANICS **9**

Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points - Estimation of orbital and escape velocities

UNIT II SATELLITE DYNAMICS **9**

Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – methods to calculate perturbations- Hohmann orbits – calculation of orbit parameters – Determination of satellite rectangular coordinates from orbital elements

UNIT III ROCKET MOTION **9**

Principle of operation of rocket motor - thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories determinations of range and altitude – simple approximations to burnout velocity.

UNIT IV ROCKET AERODYNAMICS **9**

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – rocket dispersion – launching problems.

UNIT V STAGING AND CONTROL OF ROCKET VEHICLES **9**

Need for multi-staging of rocket vehicles – multi-stage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles - SITVC.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.
2. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.

REFERENCES

1. Howard D. Curtis., "Orbital Mechanics for Engineering Students", Elsevier Publishers, 3rd Edition, 2012.
2. Willian E. Wiesel, "Space Flight Dynamics", 3rd Edition, Create Space Independent Publishing Platform, 2010.
3. Cornelisse, J.W., Schoyer, H.F.R. and Wakker, K.F., "Rocket Propulsion and Spaceflight Dynamics", Pitman Publishing Limited, 1979.
4. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.
5. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

COURSE OUTCOMES

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

CO1 Achieve basic knowledge in solar system.

CO2 Explain the basic concepts of orbital mechanics with particular emphasis interplanetary trajectories.

CO3 Describe the concept of satellite injection and satellite perturbations

CO4 Estimate the trajectory/orbit of space vehicles and satellites.

CO5 Define space coordinate systems and space environment

16AE326 **COMBUSTION ENGINEERING** **L T P C**

3 0 0 3

UNIT I REVIEW OF CHEMICAL THERMODYNAMICS 9

General Objectives of Combustion Modeling – Classification of Combustion Problems – General Structure of a theoretical model – Governing equations for combustion modeling (Conservation & transport equations) – Some common assumptions made in combustion models – Criteria for thermodynamics equilibrium – Conservation of atomic species – Mole and mass fractions – Equivalence ratio - Thermo chemical laws – Relationship between bond energies and heats of formation – Heats of reaction for Constant-Pressure and Constant-Volume Combustion – Energy balance considerations for flame temperature calculations – Equilibrium constants – Clausius-Clapeyron equation for phase equilibrium.

UNIT II CHEMICAL KINETICS AND REACTION MECHANISMS 9

Rates of reactions and their functional dependence – Total collision frequency – Equation of arrhenius – Rates of reaction – Methods for measurement of gas-phase reaction rates – One step chemical reactions of various orders – Chain reactions – Surface reactions – Reaction flow analysis – Gas phase reaction mechanisms of aliphatic hydrocarbon and oxygen system – Formation mechanism of nitrogen oxides – Formation and control of CO and Particulates.

UNIT III MULTI COMPONENT REACTING SYSTEMS 9

Conservation equations for multi component reacting systems – Definitions of concentrations, velocities, and mass fluxes – Fick's law of diffusion – Theory of ordinary diffusion in gases at low density – Continuity equation and species mass conservation equations – Conservation of momentum, Momentum equation derivation by infinitesimal control volume approach, Navier–Stokes equations, Conservationof energy – physical derivation of the multi component diffusion equation – Solution of a multi component species system – Shvab-Zel'dovich formulation – Dimensionless ratios of transport coefficients – Boundary conditions at an interface 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 PHYSICS OF FLAMES 9

Detonation and deflagration waves of premixed gases – Qualitative differences between detonation and deflagration – Brief description about the Hugonoit curve – Determination of Chapman-Jouguet , Detonation-Wave velocity, Detonation-Wave structure – Mechanism of Deflagration-to-Detonation transition (DDT) in gaseous mixtures – Spontaneous Detonation initiation – Functional form of distribution of ignition delay – Premixed laminar flames – Flame speed measurement methods - Diagnostic method for flame structure measurements – Classical laminar flame theories – Effect of chemical and physical variables on flame speed – Flame quenching – Flammability limits of premixed laminar flames – Spalding's theory of flammability limits and flame quenching – Gaseous diffusion flames and combustion of a single liquid fuel droplet – Burke and Schumann's theory of laminar diffusion flames – Laminar jet with chemical reactions – Numerical solution of 2-D Axisymmetric laminar diffusion flames – Evaporation of a single fuel droplet – Droplet combustion in quiescent environments.

UNIT V COMBUSTION CHARACTERISTICS OF PROPELLANTS 9

Basic understanding on solid propellants and their combustion characteristics – Thermal decomposition and combustion of nitramine – Burning behavior of homogeneous solid propellants – Chemically reacting boundary layer flows – Ignition and combustion of single energetic solid particles – Combustion of solid particles in multiphase flows – Basic understanding on the burning characteristics of liquid and cryogenic propellants – Applications of turbulent and multi-phase combustion.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kenneth Kuan-yunKuo, "Principles of Combustion", 2nd Edition, ISBN: 978-0-471- 04689-9, January 2005.
2. Irvin Glassman Richard A. Yetter, "Combustion", 4th Edition, Academic Press, Elsevier Publication, 2009.

REFERENCES

1. Kenneth Kuan-yunKuo, RaginiAcharya, "Fundamentals of Turbulent and Multi-Phase Combustion", ISBN: 978-0-470-22622-3, March 2012.
2. D.T Harrje, and Reardon F.H., "Liquid Propellant Rocket Combustion Instability", NASA SP-194, NASA Washington, 1972.
3. Yang Vigor, Anderson William, "Liquid Rocket Engine Combustion Instability, Progress in Astronautics and Aeronautics", Vol.169, AIAA Inc., Washington, 1995.
4. Kenneth Kuan-yunKuo, RaginiAcharya, "Applications of Turbulent and Multi-Phase Combustion", ISBN: 978-1-118-12756-8, April 2012.
5. William H. Heiser, David T. Pratt, "Hypersonic Air Breathing Propulsion", AIAA Education Series, 2001.

COURSE OUTCOMES

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

CO1 Understand the basic concepts of chemical kinetics of combustion.

CO2 Identify the combustion factors of premixed and diffusion flames.

CO3 Analyze the operations of reciprocating engines, gas-turbine engines and rocket engines.

CO4 Understand the basic concepts in physics of flames.

CO5 Acquire basic knowledge in propellant combustion.

16AE327	INDUSTRIAL AERODYNAMICS	L	T	P	C
		3	0	0	3

UNIT I ATMOSPHERE **9**

Types of winds – Causes of variation of winds – Atmospheric boundary layer – Terrain and their types – Effect of terrain on gradient height – Structure of turbulent flows.

UNIT II WIND ENERGY COLLECTORS **9**

Wind Turbines – Classification – Working principle – Horizontal axis and vertical axis machines – Application of wind turbines – Power coefficient – Betz coefficient by momentum theory.

UNIT III VEHICLE AERODYNAMICS **9**

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

UNIT IV BUILDING AERODYNAMICS **9**

Pressure distribution on low rise buildings – Wind forces on buildings – Environmental winds in city blocks – Special problems of tall buildings – Building codes – Building ventilation and Architectural aerodynamics.

UNIT V FLOW INDUCED VIBRATIONS **9**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

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

REFERENCES

1. Blevins. R.D., "Flow Induced Vibrations", Van Nostrand, 1990.
2. Calvert. N.G., "Wind Power Principles", Charles Griffin & Co., London, 1979.
3. Scorer,R.S., "Environmental Aerodynamics", Ellis Harwood Ltd., England,1998.
4. Ahmed Siraj., "Wind Energy Theory and Practice", Prentice Hall India Learning Private Limited; 2 edition, 2011.
5. Tom Lawson, "Building Aerodynamics", Icp, 1st edition, 2001.

COURSE OUTCOMES

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

CO1 Determine the atmospheric conditions.

CO2 Describe the concept of wind energy collectors.

CO3 Analyse the flow over the vehicles Aerodynamics.

CO4 Understand the pressure distribution over a Various Building.

CO5 Describe the flow induced vibrations**.**

16AE328 HELICOPTER AERODYNAMICS L T P C

0 0 0 3

UNIT I DEVELOPMENT OF ROTATING WING AIRCRAFT 9

Helicopter configurations - Helicopter as an aircraft – Basic features – Layout – Generation of lift – Main rotor –Gearbox –Tail rotor –Power plant – Considerations on blade flapping and feathering – Rotor controls and various types of rotors – Role of Helicopters in IAF.

UNIT II DYNAMICS OF HOVERING AND VERTICAL FLIGHT 9

Airfoil characteristics in hovering and vortex ring state – Actuator disc theory – Blade element theory – Blade loading –Effect of solidity –Profile drag – Blade area required – Number of blades –Blade form – Power losses –Rotor efficiency – Flow patterns surrounding the rotor –Ceiling in vertical climb – Power required in climb and descent – Ground effect.

UNIT III DYNAMICS OF FORWARD FLIGHT 9

Forward flight performance – Parasite drag and power – Blade stall – Flapping – Cyclic pitch – Autorotation in hover and in forward flight – Dead man's curve.

UNIT IV HELICOPTER STABILITY AND CONTROL 9

Physical description of effects of disturbances, stick fixed longitudinal and lateral dynamic stability –Lateral stability characteristics –Control response – Difference between stability and control of airplane and helicopter.

UNIT V ROTOR VIBRATIONS 9

Dynamic model of the rotor –Motion of the rigid bodies – Flapping motion –Lagging motion –Feathering motion – Properties of vibrating system – Phenomenon of vibration – Fuselage response –Vibration absorbers –Measurement of vibration in flight – Rotor blade design – General considerations – Airfoil selection – Blade construction and materials – Factors affecting weight and cost – Design conditions – Stress analysis.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Simon Newman, "Foundation of Helicopter Flight", Butterworthis India, New Delhi, 2012.
2. John Fay, "The Helicopter", Himalayan Books, 1995.

REFERENCES

1. Lalit Gupta, "Helicopter Engineering", Himalayan Books, New Delhi, 1996**.**
2. R. W. Prouty, "Helicopter Aerodynamics", Shroff, 2004.
3. John M. Seddon, "Basic Helicopter Aerodynamics", 3rd Edition, John Wiley & Sons, 2011.
4. McCormick B.W., "Aerodynamics of V/STOL Flight", Dover Publications, 1998.
5. Gessow, Myers, C.G., "Aerodynamics of Helicopter", Macmillan & Co., New York., 1987.

COURSE OUTCOMES

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

CO1 Describe the basic concepts on helicopter aerodynamics.

CO2 Analyze the performance of helicopter rotor blades of hover flight.

CO3 Analyze the performance of forward flight and vertical flight.

CO4 Solve problems on helicopter stability and control.

CO5 Describe the basic concepts of rotor vibrations.

16AE408	SPACE MECHANICS	L	T	P	C
		3	0	0	3

UNIT I SPACE ENVIRONMENT 9

Peculiarities of space environment and its description – Effect of space environment on materials of spacecraft structure and astronauts – Effect on satellite life time – Manned space missions – Sidereal time – Solar time – Standard time – The earth's atmosphere – Indian human space flight programme – ISRO orbital vehicle.

UNIT II BASIC CONCEPTS ANDTHE GENERAL N- BODY PROBLEM 9

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

UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS 9

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

UNIT IV INTERPLANETARY TRAJECTORIES 9

Two dimensional interplanetary trajectories –Fast interplanetary trajectories – Three dimensional interplanetary trajectories – Launch of interplanetary spacecraft –Trajectory about the target planet – Concept of sphere of influence – Lambert's theorem.

UNIT V BALLISTIC MISSILE TRAJECTORIES 9

Introduction to ballistic missile trajectories – The boost phase – The ballistic phase –Trajectory geometry – Optimal flights – Time of flight – Reentry phase – The position of the impact point – Influence coefficients – Indian Ballistic Missile Defense programme.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. William E. Wiesel, "Spaceflight Dynamics", 3rd Edition, Create Space Independent Publishing Platform, 2010.
2. J.W. Cornelisse H.F.R. Schoyer& K.F. Wakker,"Rocket Propulsion and Spaceflight Dynamics", Pitman Publishing Ltd. 1979.

REFERENCES

1. Howard D. Curtis., "Orbital Mechanics for Engineering Students", Elsevier Publishers, 3rd Edition, 2012.
2. George P. Sutton and Oscar Biblarz, "Rocket Propulsion Elements", 8th edition, John Wiley and Sons, 2000.
3. Roger R. Bate, Donald D. Mueller, and Jerry E. White, "Fundamentals of Astrodynamics", Dover Publications Inc., New York, 1972.
4. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw Hill Book Co. Inc., 1982.
5. Martin Tajmar, "Advanced Space propulsion Systems", 1st Edition, Springer, 2003.

COURSE OUTCOMES

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

CO1 Describe the basic concepts of space, coordinate systems and space environment.

CO2 Estimate the trajectory/orbit of space vehicles and satellites.

CO3 Gain knowledge about concepts of Satellite Injection.

CO4 Design a trajectory for interplanetary mission's missiles.

CO5 Understand a trajectory for ballistic missiles.

16AE409	ROCKETS AND MISSILES	L	T	P	C
		3	0	0	3

UNIT I BASICS OF LAUNCH VEHICLES AND MISSILES 9

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

UNIT II AERODYNAMICS OF ROCKETS AND MISSILES 9

Airframe components of rockets and missiles – Forces acting on a missile while passing through atmosphere – Slender body aerodynamics – Method of describing forces and moments – Lift force and lateral moment – Drag estimation – Upwash and downwash in missile bodies – Rocket dispersion.

UNIT III ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 9

One dimensional and two dimensional rocket motion in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – Determination and range and altitude – Simple approximations to determine burn out velocity and altitude – Estimation of culmination time altitude.

UNIT IV STAGING OF ROCKETS AND MISSILES 9

Design philosophy behind multi-staging of launch vehicles and ballistic missiles – Optimization of multi-stage vehicles – Stage separation techniques in atmosphere and in space – Stage separation dynamics and lateral separation characteristics - Case study on GSLV

UNIT V CONTROL OF ROCKETS AND MISSILES 9

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 for launch vehicles and ballistic missiles.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. George P. Sutton and Oscar Biblarz, "Rocket Propulsion Elements", 8th edition, John Wiley and Sons, 2000.
2. Cornelisse, J.W., Schoyer, H.F.R. and Wakker, K.F., "Rocket Propulsion and Spaceflight Dynamics", Pitman Publishing Limited, 1979**.**

REFERENCES

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.
3. Willian E. Wiesel, "Space Flight Dynamics", 3rd Edition, Create Space Independent Publishing Platform, 2010.
4. Martin Tajmar, "Advanced Space propulsion Systems", 1st Edition, Springer, 2003.
5. Parker, E.R., "Materials for Missiles and Spacecraft", Mc.Graw Hill Book Co. Inc., 1982.

COURSE OUTCOMES

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

CO1 Classify the rockets and missiles.

CO2 Describe the components of rockets and missiles and the forces acting on it.

CO3 Design and estimate trajectory of launch vehicles.

CO4 Describe the concepts of single and multistage rockets.

CO5 Solve the problems on launch vehicle performance, stability and control.

16AE410 INTRODUCTION TO TURBULENT FLOWS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Definition of turbulence; Features of turbulence - irregularity-diffusivity -high Reynolds number- rotational-dissipative - continuum phenomenon - Characterisation of turbulent flows - statistical averages-moments-probability density function-correlation-spectrum-scales - intermittency-quadrant analysis.

UNIT II EQUATIONS GOVERNING TURBULENT FLOW **9**

Reynolds averaged Navier - Stokes Equations- Equations for Reynolds stresses-mean and turbulent kinetic energy - Energy transfer in turbulent flows - Closure problem - Boundary layer equations for turbulent flows - Momentum integral equation for turbulent boundary layer.

UNIT III EXPERIMENTAL TECHNIQUES, BENCH MARK DATA AND FEATURES OF BASIC TURBULENT FLOWS. **9**

Need for special techniques -Hot-wire anemometry - LASER Doppler Velocimetry - Particle Image Velocimetry - Validation of CFD codes and need for benchmark data - Characteristics of good Data - reliability and consistency -Test cases for turbulent flows - homogeneous flows - thin shear flows - sources of benchmark data.

UNIT IV TURBULENCE MODELLING **9**

Outline of approaches to prediction of turbulent flows - statistical theory of turbulence - integral methods for thin shear flows - Direct numerical simulation (DNS) -Modelling of turbulent stresses and numerical solution of resulting equations - Need for models of turbulence-zero - one-half and two equation models of turbulence - Reynolds stress model - three-equation model -Modelling for compressible flows - Role of DNS data in turbulence modelling.

UNIT V NUMERICAL SCHEME FOR PREDICTING THIN SHEAR FLOWS AND SEPARATED FLOWS **9**

Thin shear flow equations; Elements of Patankar - Spalding scheme; Examples of computations. Reynolds average Navier - Stokes equations; Finite volume discretization - Solution procedure-Inlet, exit and wall boundary conditions - Modification to models of turbulence for flow with separation and swirl - Examples of computation of separated flow.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Biswas, G. and Eswaran, V. C. "Turbulent flows" Narosa Publishing House New Delhi, India, 2002.
2. Pope Stephen B., “Turbulent Flows”, Cambridge University Press, 2009.

REFERENCES

1. **Davidson** P.A., “Turbulence: An Introduction for Scientists and Engineers”, OUP Oxford Publishers, 2004.
2. **Leif N. Persen**, “Pragmatic Approach to Turbulence, A: A Short Course in Fluid Mechanics”, PHI Learning Private Limited, 2013
3. Anderson, J. D, "Modern Compressible Flow", McGraw-Hill & Co., 2002.
4. Rathakrishnan.E,"Gas Dynamics", Prentice Hall of India, 2004.
5. White, F. M., “Viscous Fluid Flow”, McGraw-Hill & Co., Inc., New York., 3rd edition 2011.

COURSE OUTCOMES

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

CO1 Understand the features and characteristics of turbulent flows.

CO2 Illustrate the governing equations for boundary layer and turbulent flows.

CO3 Demonstrate the experimental techniques to analyse the turbulent flows.

CO4 Enumerate the applications in modeling of turbulent flows.

CO5 Compile the applications in thin layer turbulent flows and separated flows.

16AE411	ADVANCED FLIGHT DYNAMICS	L	T	P	C
		3	0	0	3

UNIT I ATMOSPHERIC AND SPACE FLIGHT **10**

Atmospheric and space flight – Modeling and simulation - Attitude and kinematics of coordinate frames – Basic definitions and vector operations - Coordinate systems and rotation matrix - Euler axis and principal angle - Euler angles - Euler symmetric parameters (quaternion) - Rodrigues parameters – Gibbs vectors - Attitude kinematics - Overview of the space flight programme

UNIT II GRAVITY AND MOTION **8**

Newton's law of gravitation – Gravity of an asymmetric planet - Gravitational anomalies -Particle kinematics in moving plane - Newton's law of motion – Energy, movements and angular movements – Two body problem.

UNIT III CELESTIAL FRAME AND ELEMENTS **10**

Celestial frame and orbital elements – Planet fixed frame – Lambert's problem - Perturbation acceleration - Effects of planetary oblateness - Effects of atmospheric drag - Numerical solution to perturbed problem - Three body problem - Equations of motion -Langrage solution - Restricted three body problem.

UNIT IV INTERPLANETARY TRAJECTORIES **7**

Two-dimensional interplanetary trajectories – Fast interplanetary trajectories – Three dimensional interplanetary trajectories – Launch of interplanetary spacecraft – Trajectory estimation about the target planet – Concept of sphere of influence – Lambert's theorem.

UNIT V ROTATIONAL MOTION AND CONTROL SYSTEMS **10**

Euler equation for a rotational motion - Rotational kinematic energy - Principal body frame –Torque free rotation of spacecraft – Attitude motion in atmospheric flight – Implementation of control system elements - Single axis closed loop attitude control - Multi axis closed loop attitude control - Six-degrees of freedom simulation - Wing rock motion of a aircraft simulation.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Wiesel, William E., "Spaceflight Dynamics", Createspace Independent Publishing Platform, 3rd edition,2010.
2. AshishTewari, "Atmospheric and Space Flight Dynamics - modeling and simulation with Matlab and Simulink", Birkhauser, Springer international edition, 2007.

REFERENCES

1. Stengel, Robert F. "Flight Dynamics", Princeton University Press, Princeton, N.J., USA, 2004.
2. Etkin, B. and Reid L.D. "Dynamics of Flight-Stability and Control" 3rd edition, John Wiley, 1995.
3. Kaplan, Marshall H., "Modern Spacecraft Dynamics and Control", John Wiley& Sons, New York. 1976
4. John D. Anderson, "Airplane Performance and Design", Tata McGraw - Hill Education, 3rd Rev Ed edition 2011.
5. Perkins, C. D., and Hage, R, E., "Airplane Performance, Stability and Control", Wiley, Reprint edition 2011.

COURSE OUTCOMES

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

CO1 Differentiate atmospheric and space flight conditions.

CO2 Describe concepts of gravity and motion.

CO3 Analyse the celestial frame and elements.

CO4 Explain the two dimensional and three dimensional trajectories.

CO5 Describe the rotational motion and control systems.

16AE412	AIRCRAFT STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

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.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Francis S.Tse, "Mechanical Vibrations: Theory and Applications", 2nd Edition, CBS Publisher, 2004.
2. Patrick Paultre, "Dynamics of Structure", Wiley Publishers,2011.

REFERENCES

1. Thomson W T, "Theory of Vibration with Application" – 3rd edition, CBS Publishers, 2002.
2. V.P.Singh, "Mechanical Vibrations", Dhanpat and Co, 2014.
3. S.Graham Kelly, S.K.Kudari "Mechanical Vibrations", McGraw Hill Education (India) Private Limited,2010.
4. Grover. G.K., "Mechanical Vibrations", 8th Edition, Nem Chand Brothers, Roorkee, India, 2009.
5. Sadhu Singh.S, "Mechanical Engineering and Noise Control", Khanna Publishers, New Delhi, 2003.

COURSE OUTCOMES

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

CO1 Determine the Force Deflection Properties of Structures.

CO2 Explain deflection properties and the principles of dynamics.

CO3 Solve the problems on natural modes of vibration.

CO4 Apply the energy methods to study the structural dynamic conditions.

CO5 Understand the approximate methods to study the structural dynamic conditions.

16AE413	BOUNDARY LAYER THEORY	L	T	P	C
		3	0	0	3

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW **9**

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

UNIT II SOLUTIONS OF VISCOUS FLOW EQUATIONS **9**

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

UNIT III VISCOUS HYPERSONIC FLOW THEORY **9**

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

UNIT IV TURBULENT BOUNDARY LAYER **9**

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

UNIT V COMPRESSIBLE BOUNDARY LAYERS **9**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Schlichting, H., "Boundary Layer Theory", McGraw-Hill, New York, 7th Edition 2014.
2. White, F. M., "Viscous Fluid Flow", McGraw-Hill & Co., Inc., New York., 3rd edition 2011.

REFERENCES

1. Reynolds, A, J., "Turbulent Flows Engineering", John Wiley and Sons, 1980.
2. Anderson, J. D, "Modern Compressible Flow", McGraw-Hill & Co., 2002.
3. Rathakrishnan. E, "Gas Dynamics", Prentice Hall of India, 2004.
4. Biswas. G. and Eswaran. V. C. "Turbulent flows"Narosa Publishing House New Delhi, India, 2002.
5. Pope Stephen. B., "Turbulent Flows", Cambridge University Press, 2009.

COURSE OUTCOMES

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

CO1 Describe the features of viscous flow and the governing equations applied.

CO2 Develop solutions for viscous flow analysis.

CO3 Calculate the boundary layers of hypersonic flow and its viscous interaction.

CO4 Illustrate the applications of laminar and turbulent boundary layers.

CO5 Explain about the compressible flow boundary layer.

16AE414	AIRCRAFT RULES AND REGULATION	L	T	P	C
		3	0	0	3

UNIT I C.A.R. SERIES 'A' & 'B' **9**

C.A.R. Series 'A' –Procedure For Civil Air Worthiness Requirements And Responsibility Operators Vis-A-Vis Air Worthiness Directorate - Responsibilities of operators / owners – Procedure of CAR issue, amendments etc., - Objectives and targets of airworthiness directorate – Airworthiness regulations and safety oversight of engineering activities of operators.

C.A.R. Series 'B' – Issue Approval of Cockpit Check List, MEL, CDL - Deficiency list (MEL and CDL) – Preparation and use of cockpit checklist and emergency list.

UNIT II C.A.R. SERIES 'C'& 'D' **9**

C.A.R. Series 'C' Defect recording, reporting, investigation, rectification and analysis – Flight report – Reporting and rectification of defects observed on aircraft – Analytical study of in-flight readings and recordings – Maintenance control by reliability method.

C.A.R. Series 'D' – Aircraft Maintenance Programme - Reliability Programmes (Engines) – Aircraft maintenance programme and their approval – On condition maintenance of reciprocating engines – TBO – Revision programme – Maintenance of fuel and oil uplift and consumption records – Light aircraft engines – Fixing routine maintenance periods and component TBOs – Initial and revisions.

UNIT III C.A.R. SERIES 'E' & 'F' **9**

C.A.R. Series 'E' Approval of organizations in categories A, B, C, D, E, F, and G – Requirements of infrastructure at stations other than parent base.

C.A.R. Series 'F' – Air Worthiness and Continued Air Worthiness - Procedure relating to registration of aircraft – Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of certificate of airworthiness – Requirements for renewal of certificate of airworthiness.

UNIT IV C.A.R. SERIES 'I','L', 'M' , 'S' AND 'R' **9**

Issue of AME License – Classification and experience requirements – Mandatory modifications/inspections

UNIT V C.A.R. SERIES 'T' & 'X' **9**

Flight testing of (Series) aircraft for issue of C of A – Flight testing of aircraft for which C of A had been previously issued –Registration Markings of aircraft – Weight and balance control of an aircraft – Provision of first aid kits and physician's kit in an aircraft – Use of furnishing materials in an aircraft – Concessions – Aircraft log books –Document to be carried on board on Indian registered aircraft – Procedure for issue of tax permit – Procedure for issue of type approval of aircraft components and equipment including instruments - Technical Standard Orders – Introduction to EASA-CAAS-FAA-JAA regulations

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)" – Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi, 2000.
2. "Aeronautical Information Circulars" (related to Airworthiness) from DGCA 2000.

REFERENCES

1. "Aircraft Manual (India) Volume" – Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. "Advisory Circulars from DGCA", 2003.
3. R3.Pilots Handbook of Aeronautical Knowledge, Federal Aviation Authority, 2007.
4. Rotorcraft Flying Handbook, Federal Aviation Authority, 2007.
5. Llyold Dongle and Mike Tooley., "Aircraft Engineering Principles" CBS Publishers and Distributors – Paperback 2005

COURSE OUTCOMES

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

CO1 Describe the basic civil aviation requirements for safety measures to operate an aircraft.

CO2 Define the minimum airworthiness requirements on aircraft engine maintenance and its inspection.

CO3 Prepare aircraft maintenance documents based on DGCA regulations.

CO4 Explain the requirement of mandatory modifications and inspections on aircraft.

CO5 Describe the certificate of airworthiness on miscellaneous requirements.

16AE415 AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE

L	T	P	C
3	0	0	3

UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT **9**

Mooring, jacking, leveling and towing operations – Preparation – Equipment – Precautions – Engine starting procedures – Piston engine, turboprops and turbojets - Engine fire extinguishing – Hand signals. Ground power unit.

UNIT II GROUND SERVICING OF VARIOUS SUB SYSTEMS **9**

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

UNIT III MAINTENANCE OF SAFETY **9**

Shop safety – Environmental cleanliness – Precautions- Maintenance of lead & cadmium Batteries and their components.

UNIT IV INSPECTION **9**

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 **9**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kroes.M, W.A.Watkins, F. Delp and R. Sterkenburg, "Aircraft Maintenance and Repair", 7th Edition, McGraw Hill, New York, 2013.
2. Larry Reithmaier and Ron Sterkenburg" Standard Aircraft Handbook for Mechanics and Technicians", McGraw-Hill Professional Publishing,2013.

REFERENCES

1. A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996.
2. A&P Mechanics, "General Hand Book", F A A Himalayan Bok House, New Delhi, 1996.
3. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons Inc.
4. George Titterton, "Aircraft materials & processes", 5th Edition, Sterling Book House, 1998.
5. Kroes.M and T.Wild, "Aircraft Basic Science", 7th Edition, Tata-McGraw Hill, New Delhi, 2010.

COURSE OUTCOMES

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

CO1 Operate the various ground support systems for aircraft operations.

CO2 Carry out the ground servicing and maintenance works on critical aircraft systems.

CO3 Carry out the maintenance for Aircraft.

CO4 Carry out the inspection for Aircraft components.

CO5 Know the specification standards of aircraft hardware systems.

16AE416 AIR TRAFFIC CONTROL AND PLANNING

L	T	P	C
3	0	0	3

UNIT I BASIC CONCEPTS **9**

Airports in India – Objectives of ATS - Parts of ATC service – Scope and provision of ATCS – VFR & IFR operations – Classification of ATS air spaces – Varies kinds of separation – Altimeter setting procedures – Establishment – Designation and identification of units providing ATS – Division of responsibility of control.

UNIT II AIR TRAFFIC SERVICES **9**

Area control service – assignment of cruising levels minimum flight altitude ATS routes and significant points – RNAV And RNP – Vertical – Lateral and longitudinal separations based on time / distance – ATC Clearances – Flight plans – Position report.

UNIT III FLIGHT INFORMATION SYSTEMS **9**

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 co-ordination 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 – Data handling equipment – 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 **9**

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.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. "AIP (India) Vol. I & II", the English book store, 17-1, Connaught Circus, New Delhi.
2. "Aircraft Manual (India) Volume I", latest Edition – The English Book Store, 17-1, Connaught Circus, New Delhi

REFERENCES

1. "PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. Kazda, "Airport Design and Operation", Elsevier Science, New York, 2nd Edition, 2007.
3. Michael S.Nolan, "Fundamentals of Air Traffic Control", 5th Edition, Delmar Publishing, 2010.
4. **Not credited**, "Aerodrome Runway and Obstruction Data/Planning, Section 5", AIDU (RAF) 1980.
5. Nagabhushana.S, Sudha L.K. , "Aircraft Instrumentation and Systems" I.K. International Publishing House Pvt. Ltd.

COURSE OUTCOMES

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

CO1 Understand the basic concepts of air traffic controls and planning

CO2 Explain the concepts of air traffic controls and services.

CO3 Explain the various flight information systems

CO4 Describe the characteristics of aerodrome.

CO5 Differentiate the various navigation and lighting systems.

16AE417	HELICOPTER MAINTENANCE	L	T	P	C
		3	0	0	3

UNIT I HELICOPTER FUNDAMENTAL 9

Basic directions – Ground handling, bearing – Gears- Construction of fuselage and tail boom.

UNIT II MAIN ROTOR SYSTEM 9

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

UNIT III MAIN ROTOR TRANSMISSIONS 9

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

UNIT IV POWER PLANTS & TAIL ROTORS 9

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

UNIT V AIRFRAMES AND RELATED SYSTEMS 9

Fuselage maintenance – Airframe Systems – Special purpose equipment-Types of undercarriages and their operations.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Joe Schafer, “Helicopter Maintenance”, 2nd Edition Publisher Jeppesen,2002.
2. Kroes.M, W.A.Watkins, F. Delp and R. Sterkenburg, "Aircraft Maintenance and Repair", 7th Edition, McGraw Hill, New York, 2013.

REFERENCES

1. “Civil Aircraft Inspection Procedures”, Part I and II, CAA, English Book House, New Delhi, 1986.
2. Larry Reithmaier, “Aircraft Repair Manual”, Palamar Books Marquette, 1992.
3. Delp. Bent and McKinley “Aircraft Maintenance Repair”, McGraw Hill, New York, 1987.
4. “General Hand Book of Airframe and Power Plant” US Department of Transportation, FAA, English Book Stores, New Delhi.
5. Gupta. L, “Helicopter Engineering”, Himalayan Books, 1996.

COURSE OUTCOMES

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

CO1 Understand the fundamental of Helicopter.

CO2 Gain knowledge about the function of main rotor system.

CO3 Maintenance of Helicopter main rotor transmission.

CO4 Distinguish Helicopter rotor and power plants.

CO5 Describe the concepts of Airframes.

16AE418	AERO ENGINE MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3

UNIT I PISTON ENGINES **9**

Carburetion and fuel injection systems for small and large engines – Ignition system components – spark plug detail – Engine starting procedure - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system – Maintenance and inspection check to be carried out – Inspection and maintenance and troubleshooting – Inspection of all engine components - Daily and routine checks – Overhaul procedures – Compression testing of cylinders – Special inspection schedules – Engine fuel, control and exhaust systems – Engine mount and super charger – Checks and inspection procedures.

UNIT II PROPELLERS **9**

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

UNIT III CLASSIFICATION OF JET ENGINES AND COMPONENTS **9**

Types of jet engines – Fundamental principles – Bearings and seals – Inlets – Compressors – Turbines – Exhaust section – Classification and types of lubrication and fuels – Materials used – Details of control, starting around, running and operating procedures – Inspection and Maintenance – Permissible limits of damage and repair criteria of engine components - Internal inspection of engines – Compressor washing – Field balancing of compressor fans- Component maintenance procedures – Systems maintenance procedures – Use of instruments for online maintenance – Special inspection procedures – Foreign Object Damage – Blade damage.

UNIT IV TESTING AND INSPECTION **9**

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

UNIT V OVERHAUL PROCEDURES **9**

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

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kroes.M, W.A.Watkins, F. Delp and R. Sterkenburg, "Aircraft Maintenance and Repair", 7th Edition,

McGraw Hill, New York, 2013.

2. Larry Reithmaierand Ron Sterkenburg“Standard Aircraft Handbook for Mechanics and Technicians”, McGraw-Hill Professional Publishing,2013.

REFERENCES

1. Turbomeca, “Gas Turbine Engines”, the English Book Store ", New Delhi, 1993.
2. United Technologies’ Pratt & Whitney, "The Aircraft Gas turbine Engine and its Operation”, The English Book Store, New Delhi, 2005.
3. Mathur, M., and Sharma, R.P., “Gas Turbines and Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1998.
4. Vinayak and Srinivasan, “Aircraft materials”, 2008**.**
5. Bent, R.D. Mickinely., “Aircraft Maintenance and Repair”, 2nd Edition - McGraw Hill Inc., Now York, 1978.

COURSE OUTCOMES

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

CO1 Identify the various minor and major components of the piston engines.

CO2 Define the aircraft propellers and its operations

CO3 Describe the various gas turbine engines and its components.

CO4 Apply NDT procedures to identify the defects.

CO5 Explain the overhaul procedures to the gas turbine engines.

16AE419 AIRFRAME REPAIR AND MAINTENANCE

L	T	P	C
3	0	0	3

UNIT I MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS **9**

Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding. Sheet metal repair and maintenance-Selection of materials-Repair schemes-Fabrication of replacement patches-Tools - power/hand-Repair techniques- Peening - Close tolerance fasteners-Sealing compounds-forming/shaping-Calculation of weight of completed repair- Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing- Riveted repair design - Damage investigation - Reverse engineering.

UNIT II MAINTENANCE OF AIRCRAFT SYSTEM AND INSTRUMENTS **9**

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems - Inspection and maintenance of air-conditioning and pressurization system, water and waste system - Installation and maintenance of Instruments - Handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).

UNIT III 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., and various repairs schemes - Scopes. Cleaning of fiber reinforced plastic (FRP) materials prior to repair- Break test - Repair Schemes-FRP/honeycomb sandwich materials-Laminated FRP structural members and skin panels-Tools/equipment -Vacuum-bag process- Special precautions – Autoclaves

UNIT IV AIRCRAFT JACKING, ASSEMBLY AND RIGGING **9**

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

UNIT V SAFETY PRACTICES **9**

Hazardous materials storage and handling - Aircraft furnishing practices -Aircraft painting and finishing - Equipments- Trouble shooting-Theory and practices-Human Factors in Hangar Maintenance

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kroes.M, W.A.Watkins, F. Delp and R. Sterkenburg, "Aircraft Maintenance and Repair", 7th Edition, McGraw Hill, New York, 2013.
2. A & P MECHANICS, "Aircraft hand Book" – F. A. A. Himalayan Book House, New Delhi,1996.

REFERENCES

1. Larry Reithmaier, "Aircraft Repair Manual", Palomar Books, Marquette, 1992.
2. Delp. Bent and Mckinley "Aircraft Maintenance Repair", McGraw Hill, New York, 1987
3. Brimm, D. J., Bogges R. E., "Aircraft Maintenance", Pitman Publishing corp., New York,
4. "Civil Aircraft Inspection Procedures", Part I and II, CAA, English Book House, New Delhi, 1986.
5. Gupta. L "Helicopter Engineering", Himalayan Books, 1996.

COURSE OUTCOMES

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

CO1 Understand the fundamental aircraft structural maintenance components.

CO2 Outline the maintenance procedure to be followed in aircraft systems and instruments.

CO3 Describe the importance of plastics and composites in aircraft.

CO4 Summarize the inspection techniques in aircraft jacking and control surfaces.

CO5 Understand human safety practices while handling equipments.

16AE420 AIR TRANSPORTATION AND AIRCRAFT MAINTENANCE

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Development of air transportation – Comparison with other modes of transport – Role of IATA – ICAO – The general aviation industry airline – Factors affecting general aviation – Use of aircraft – Airport: airline management and organization – Levels of management – Functions of management – Principles of organization planning the organization – Chart – Staff departments & line departments.

UNIT II AIRLINE ECONOMICS **10**

Forecasting – Fleet size – Fleet planning – The aircraft selection process – Operating cost – Passenger capacity – Load factor etc. – Passenger fare and tariffs – Influence of geographical – Economic & political factors on routes and route selection.

Fleet Planning -The aircraft selection process – Fleet commonality – Factors affecting choice of fleet – Route selection and capital acquisition – Valuation & depreciation – Budgeting – Cost planning – Aircrew evaluation – Route analysis – Aircraft evaluation.

UNIT III PRINCIPLES OF AIRLINES SCHEDULING **9**

Equipment maintenance – Flight operations and crew scheduling – Ground operations and facility limitations - Equipments and types of schedule – Hub & spoke scheduling – Advantages / disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

UNIT IV AIRCRAFT RELIABILITY **7**

Aircraft reliability – The maintenance schedule & its determinations – Condition monitoring maintenance – Extended range operations (EROPS) & ETOPS – Safety precautions in aircraft maintenance.

UNIT V TECHNOLOGY IN AIRCRAFT MAINTENANCE **9**

Airlines scheduling (with reference to engineering) – Product support and spares – Maintenance sharing equipments and tools for aircraft maintenance – Aircraft weight control – Budgetary control – On board maintenance systems – Engine monitoring – Turbine engine oil maintenance – Turbine engine vibration monitoring in aircraft – Life usage monitoring – Current capabilities of NDT – Helicopter maintenance.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Frederick J.H., "Airport Management", 2000.
2. C.H. Friend, "Aircraft Maintenance Management", 2000.

REFERENCES

1. Gene Kropf, "Airline Traffic Procedures", McGraw-Hill, 1949.
2. Wilson & Bryon, "Air Transportation", Prentice-Hall,1949.
3. Philip Locklin D, "Economics of Transportation", Irwin(Richard D),1974.
4. "Indian Aircraft manual" – DGCA Pub.
5. P S Senguttuvan "Principle of Airport Economics", Excel books, 2012.

COURSE OUTCOMES

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

CO1 Get knowledge about basic air transportation and aircraft maintenance procedures.
CO2 Apply the methods of accessing airlines economics
CO3 Understand the principles of airlines scheduling.
CO4 Interpret the aircraft reliability conditions.
CO5 Apply the aircraft maintenance technology.

16GE303	TOTAL QUALITY MANAGEMENT	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I INTRODUCTION **9**

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

UNITII 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 STATISTICAL PROCESS CONTROL (SPC) **9**

Statistical fundamentals – Measures of central Tendency and Dispersion - Population and Sample, Control Charts for variables and attributes, Industrial Examples. Process capability. Concept of six sigma – New seven Management tools.

UNIT IV TQM TOOLS **9**

Bench marking -Reason to bench mark, Bench marking process - FMEA - Stages, Types. Quality Function Deployment (QFD) - House of Quality - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems - ISO 9001-2015 Quality System - Elements, Implementation of Quality System Documentation, Quality Auditing - QS 9000 – BS-OHSAS 18001: 2007, ISO 20000, ISO 22000 IATF 16949: 2016, ISO 14001:2015, AS9100– Concept, Requirements and Benefits- Case studies.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Dale H. Besterfiled, "Total Quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2016.

2. SubburajRamasamy“ Total Quality Management” Tata Mcg raw hill edition, 2015.

REFERENCES

1 Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2010.

2 James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012. .

3 Dr S. Kumar, “Total Quality Management”, Laxmi Publications Ltd., New Delhi 2006.

4 P. N. Muherjee, “Total Quality Management”, Prentice Hall of India, New Delhi, 2015.

5 Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2010.

COURSE OUTCOMES

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

CO1 State about the recent techniques followed in quality approach.

CO2 Improve Leadership Skills.

CO3 Implement the Concepts of SPC Tools in Industrial Activity.

CO4 Examine the TQM Tools in Several Engineering fields.

CO5 Explain about the ISO and QS certification process and its need for the industries.

16GE304	PRINCIPLES OF MANAGEMENT	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Definition - Evolution of Management Studies –Nature, Functions, Levels and role of management - Basic Principles and Process of Management - Management vs. Administration – Taylor & Fayol's contribution to Management - Role of Managers.

UNIT II PLANNING 9

Planning: Basic types of planning – Characteristics of a good plan- Features - Planning process- Obstacles in planning - MBO, Policy - Policy formulation - Types of policies - Forecasting, Process, Importance – Decision making process.

UNIT III ORGANISING 9

Organization: Need - forms of organization - features of a good organization. Departmentation –- manuals - span of management, factors affecting span of management – delegation of authority and responsibility - centralization and decentralization.

UNIT IV STAFFING & DIRECTING 9

Staffing: Meaning, Nature, Need, and Process. Directing - Characteristics, Importance and Techniques of directing. Event & Time Management - Scope, Importance - Coordination - Need for coordination.

UNIT V CONTROLING 9

Concept of Control – Importance of control- Essentials of control system - Process of control – Communication - Process of Communication - Types - Barriers - Management Information Systems.

L:45 T:0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Harold Koontz, and Weihrich, 'Essential of Management' 8th Edition, Tata Mc Graw Hill Education, Delhi, (2010) .

2. Tripathy.P.C and Reddy.P.N., 'Higher Principles of Management' Tata Mc-Graw Hill Publishing Company limited, New Delhi (2011).

REFERENCES

1 Stephen.P.Robbins, Mary coulter, NeharikaVohra 'Management', 10th Edition, Tata Mc-Graw Hill Publishing Company limited, New Delhi (2010).

2 Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2011).

3 VSP Rao, V.Hari Krishna, 'Management, Excel Books (2010).

4 Dr.Kumkum Mukherjee, 'Principles of Management, 2nd Edition, Tata Mc Graw Hill, (2009).

COURSE OUTCOMES

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

CO1 Discuss and communicate the management evolution and how it will affect future managers.

CO2 Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.

CO3 Practice the process of management's four functions: planning, organizing, leading, and controlling.

CO4 Use appropriate methods of communication in the Business Environment.

CO5 Gather and analyze both qualitative and quantitative information to isolate issues and formulate best control methods.

16GE307	NANO TECHNOLOGY	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I NANO SCALE MATERIALS **9**

Introduction – Classification of nanostructures, nano scale architecture – effects of the nanometre length scale – Nano composites- Nano Tubes and Nano wires- effect of nanoscale dimensions on various properties – structural, thermal, chemical, mechanical,magnetic, optical and electronic properties.

UNITII NANO MATERIALS SYNTHESIS METHODS **9**

Fabrication methods – top down processes –Ball milling- synthesis using solvents and plant extracts litho graphics, machining process –bottom up process – vapour phase deposition methods, plasma assisted deposition process, colloidal and solgel methods – methods of templating the growth of nano materials –ordering of nano systems.

UNIT III NANO CHARECTERIZATION TECHNIQUES **9**

General classification of characterization methods – analytical techniques – microscopy techniques – Principles of Fourier Transform Infra-red spectroscopy- Scanning electron microscopy- Transmission Electron Microscopy-atomic force microscopy – diffraction techniques –X-Ray diffraction spectroscopy

UNIT IV NANO DEVICES AND INORGANIC SEMICONDUCTORS **9**

Quantum confinement in semiconductor nanostructures – quantum wells, quantum wires, quantum dots, super lattices –Organic FET – principle, description, requirements, integrated circuits – organic LEDs – basic processes, organic photovoltaic cells – carbon nano tubes – structure, synthesis and electronic properties.

UNIT V APPLICATIONS OF NANOMATERIALS **9**

Applications – fuel cells –as fuel in IC engines- nano motors – Solar Photovoltaic cells-aerospace- defence-bio medicines- Textile Technology- Electronic applications.

L:45 T:0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2005.
2. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw – Hill Education (India) Ltd, 2007.

REFERENCES

1. Michael Kohler, Wolfgang Fritzsche, Nanotechnology: An Introduction to Nano structuring Techniques, Wiley-VCH Verlag GmbH & Co.2004.
2. William Goddard, Donald .W.Brenner, Handbook of Nano Science Engineering and Technology, CRC Press, 2004.
3. Bharat Bhushan, Springer Handbook of Nanotechnology, 2004.
4. Charles P Poole, Frank J Owens, Introduction to Nanotechnology, John Wiley and Sons, 2003.
5. Mark Ratner, Daniel Ratner, Nanotechnology: A Gentle Introduction to the Next Big Idea, Prentice Hall, 2003.

COURSE OUTCOMES

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

CO1 Apply principles of basic science concepts in understanding, analysis and prediction of matter at Nano scale.

CO2 Analyze interdisciplinary subjects/concepts/ideas for interdisciplinary application of Science and engineering concepts.

CO3 Know advanced ideas and techniques required in emergent area of nanotechnology.

CO4 Develop human resource with specialization in theoretical and experimental techniques required for career in academia and Nano technology driven industry.

16ME411 HUMAN RESOURCE AND PERSONNEL MANAGEMENT L T P C
3 0 0 3

UNIT I PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT 9

Evolutions of Human Resource Management – Meaning and Definition of HRM- Objectives and Functions of HRM - Role of Human Resource Manager – Human Resource Policies -Computer Applications in Human Resource Management.

UNIT II HUMAN RESOURCE PLANNING AND WAGE ADMINISTRATION 9

Importance of Human Resource Planning - Forecasting - Human Resource requirement- Internal and External sources. Matching demand and supply-Principles and Techniques of Wage Fixation, Job Evaluation, Incentive Schemes.

UNIT III RECRUITMENT,TRAINING AND DEVELOPMENT 9

Job Analysis - Recruitment. Selection Process - Selection devices -Interview – Medical Examination. Induction - socialization benefits-Principles of Learning, Objectives, Types and Training Methods, Management Development: Its Meaning, Scope and Objectives

UNIT IV MORALE, MOTIVATION AND PERFORMANCE APPRAISAL 9

Morale - importance of Moral-employee Attitudes and Behaviour and their significance to Employee Productivity. Motivation Methods of Employees, Empowerment – Factors Affecting Empowerment – Process – Benefits- Compensation Plans - Rewards - Motivation – Theories of motivation. Methods of performance evaluation – Feedback-Industry practice – promotion, Demotion, Transfer – Implications in job change.

UNIT V WORK ENVIRONMENT AND TRENDS IN HR 9

Fatigue - Safety – Accident Prevention Accident Records – Industrial Relations.HR Outsourcing – HRIS – Management of Turnover and retention –Workforce Relationlization– Managing Separation – Trends in Employee Engagement and Retention.-International HRM

L: 45 T: 0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS

1. H.JohnBernardin. "Human Resource Management an Experimental Approach", Tata McGraw Hill, Sixth Edition 2012
2. Mamoria C B, "Personnel Management", Himalaya pub.house, New Delhi,2014

REFERENCES

1. K. Aswathappa, "Human Resource and Personnel Management – Text and Cases", Tata McGraw Hill, New Delhi, Eighth edition 2017
2. Gary Dessler "Human Resource Management", Prentice- Hall of India, Fifteenth Edition
3. Decenzo and Robbines, Human Resource Management, Wiley and Sons, Singapore, Eleventh edition 2015
4. Harry Alder, "Think Like a Leader", Magna Publishing Co. Ltd., Mumbai,2012
5. Harold Koontz and Heinz Weihrich, "Essentials of Management", TataMcGraw Hill, Tenth edition 2015

COURSE OUTCOMES

At the end of the course students should be able to

CO 1 Interpret the effectiveness of human resource management practices in organization
CO 2 Examine the role that human resource planning, organizational and job evaluation in planning process.
CO 3 Illustrate the role of competency and performance management in recruitment and selection
CO 4 Describe the steps needed to have an effective performance appraisal in organization
CO 5 Analyze the current trends in human resource and safety practices for employees.

16ME415	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
	(Common to Mech & Auto)	3	0	0	3

UNIT I ENTREPRENEURSHIP **9**

Entrepreneur–Definition–Characteristics and Functions of an Entrepreneur–Common Myths about entrepreneurs–Importance of Entrepreneurship-Types of Entrepreneurs– Difference between Entrepreneur and Intrapreneur- Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION **9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self- Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs– Needs and objectives.

UNIT III BUSINESS **9**

Small Enterprises–Definition, Classification–Characteristics, Ownership Structures- Types of Business– Project Formulation–Steps involved in setting up a Business– identifying, selecting a Good Business opportunity, Market Survey and Research, Preparation of Preliminary Project Reports–Project Appraisal–Sources of Information–Classification of Needs and Agencies.

UNIT IV FINANCING ACCOUNTING AND MARKETING **9**

Need-Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital ,Costing, Break Even Analysis, Taxation–Income Tax, Excise Duty, Sales Tax. Industry Analysis–Competitor Analysis–Marketing Research for the New Venture –Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analysing and Interpreting the Results –The Marketing Process – Bank Schemes.

UNIT V SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business–Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry–Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

L : 45 T: 0 P: 0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Khanka.S.S.,"EntrepreneurialDevelopment"S.ChandandCo.Ltd.,RamNagar,New Delhi,2013
2. DonaldFKuratko," Entreprenuership– Theory, Process and Practice", 9th Edition, Cengage Learning, 2014

REFERENCES

1. HisrichRD,PetersMP,"Entrepreneurship"9thEdition,TataMcGraw-Hill,2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech,2005
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University
4. S.AnillKumar, S.C Poomina, M.K Abraham "Entrepreneurship Development"NewagePublishers,2009
5. JAF Stoner, Freeman R.E and Daniel R Gilbert"Management",6th Edition, Pearson Education,2004

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Describe the strength of entrepreneurship
CO2 Gain knowledge about entrepreneur skills and motivation.
CO3 Evaluate the business efficiencies
CO4 Discover the financing source in Entrepreneurship.
CO5 Relate the scheme and support for the entrepreneurs.

OPEN ELECTIVE

16AEOE1	BASICS AERONAUTICAL ENGINEERING	L	T	P	C
		3	0	0	3

UNIT I HISTORY OF FLIGHT **9**

History and Types of Aircraft, Balloon, ornithopters - early airplanes by Wright brothers, biplanes and monoplanes - Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AERODYNAMICS **9**

Aerodynamic forces on aircraft – Drag types - classification of NACA airfoils, Mach number, center of pressure and aerodynamic center - Components of an Airplane and their functions - classifications.

UNIT III AIRPLANE STRUCTURES AND MATERIALS **9**

General types of construction, Monocoque, semi-monocoque. Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

UNIT IV AIRCRAFT POWER PLANTS **9**

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production, Principles of operation of rocket, types of rockets.

UNIT V AIRCRAFT INSTRUMENTS **9**

Study of Atmosphere – Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators – TAS, EAS- Mach Meters - Altimeters - Principles and operation.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Anderson, J.D., “Introduction to Flight”, McGraw-Hill, 1995.
2. Richard S. Shevel, “Fundamentals of flight” Prentice Hall, 2010.

REFERENCES

1. Kermode, A.C., “Mechanics of Flight”, Himalayan Book, 1997.
2. Kermode, A.C., “Flight without Formulae”, McGraw-Hill, 1997.
3. Stephen. A. Brandt, "Introduction to Aeronautics: A design perspective" American Institute of Aeronautics & Astronautics,1997.
4. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, 2nd Edition, Standard Publishers Distributors, Delhi, 2008.
5. Pallet, E.H.J., “Aircraft Instruments & Principles”, Pitman & Co., 1992.

COURSE OUTCOMES

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

CO1 Describe about the historical background of early Airplanes.

CO2 Identify the components of aircraft and describe their functions.

CO3 Describe various components of aircraft structure and Materials used.

CO4 Explain the function of various power plants.

CO5 Identify the various instruments and describe their function.

16AEOE2	AIRCRAFT SYSTEMS AND ENGINES	L	T	P	C
		3	0	0	3

UNIT I AIRCRAFT SYSTEMS **9**

Hydraulic systems- Pneumatic systems – Advantages - Shock absorbers - Retractive mechanism - Conventional Systems – power actuated systems – engine control systems – push pull rod system–lubrication systems.

UNIT II AVIONICS SYSTEMS **9**

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – flight management systems - fly by wire systems– auto pilot system.

UNIT III PISTONAND JET ENGINES **9**

Fundamental Principles and operations of piston engine – jet engines – classification of piston engine – jet engines – application – advantage – disadvantage.

UNIT IV TESTING AND INSPECTION **9**

Symptoms of failure –Rectification during testing equipment for overhaul: Tools and equipment requirements for various checks and alignment during overhauling – Tools for inspection – Tools for safety and for visual inspection – non-destructive testing techniques – Engine testing procedures and schedule preparation.

UNIT V OVERHAUL PROCEDURES **9**

Engine Overhaul – overhaul procedures – inspections and cleaning of components – repairs schedules for overhaul – troubleshooting – procedures for trouble shooting.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., “Aircraft Maintenance & Repair”, McGraw-Hill, 1995.
2. Kroes.M, W.A.Watkins, F. Delp and R. Sterkenburg, "Aircraft Maintenance and Repair", 7th Edition, McGraw Hill, New York, 2013

REFERENCES

1. Mckinley, J.L. and Bent, R.D., “Aircraft Power Plants”, McGraw-Hill, 1993.
2. Pallet, E.H.J., “Aircraft Instruments & Principles”, Pitman & Co., 1992.
3. Turbomeca, “Gas Turbine Engines", the English Book Store, New Delhi, 1993.
4. Anderson, J.D., “Introduction to Flight”, 7th edition, McGraw-Hill, 2012.
5. Kermode, A.C., “Flight without Formulae”, Pearson Education Publisher, 2004.

COURSE OUTCOMES

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

CO1 Describe working principles of Aircraft Control Systems.
CO2 Understand basic concept of aircraft instruments
CO3 Describe the working principles Aircraft engines and instruments.
CO4 Apply the procedures of testing and inspection of aircraft engines.
CO5 Apply the overhaul procedures to the gas turbine engines.

16AEOE3 ROCKETS AND SPACE TECHNOLOGY L T P C

3 0 0 3

UNIT I ROCKET PROPULSION AND FUNDAMENTALS 9

Review of fluid mechanics and rocket propulsion - Thrust from stationary rocket engine/motor, Specific impulse-Effect of gravity - Atmospheric drag - Ascent phase and trajectories.

UNIT II CHEMICAL ROCKETS, MULTIPLE STAGING AND OPTIMIZATION 9

Chemical rockets and Multi-staging - Limit of multi-staging- Parallel staging-Optimal Staging with non-identical stages- Electric rockets-Optimal payload in an electric rocket.

UNIT III FUNDAMENTALS OF ORBITAL MECHANICS 9

Fundamentals of orbital mechanics - Equilibrium motion for two body problem-Elliptic trajectory-Parabolic and hyperbolic trajectory- Orbital maneuver in earth satellite system

UNIT IV SPACE ENVIRONMENT AND MISSION 9

Atmosphere, radiation and magnetic field- Atmospheric entry- Flight mechanics - Introduction to re-entry - re-entry types - Re-entry heating.

UNIT V INTORDUCTION TO SPACE CRAFT ATTITUDE DYNAMICS 9

Space environment-Satellite Subsystems-Spherical geometry- Attitude dynamics- Altitude Stabilization control.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. B.A Campbell & S.W Mc.Candless Jr., "Introduction to Space Science and Spacecraft Application", Gulf 1996.
2. C.R Chetty "Satellite Technology and Its Applications"

REFERENCES

1. V.L Pisacane and R.C Moore., "Fundamentals of Space Systems, OxfordUniv Press,1994.
2. G.R Wood Cock, "Space stations and Platform",Orbit book, 1986
3. J.R Wertz and W.J Larson, "Space Mission Analysis and Design", Microcosm and Kluwer, Third Edition, 1999.
4. Cornelisse, J.W., Schoyer, H.F.R. and Wakker, K.F., "Rocket Propulsion and Spaceflight Dynamics", Pitman Publishing Limited, 1979**.**
5. Martin Tajmar, "Advanced Space propulsion Systems", 1st Edition, Springer, 2003.

COURSE OUTCOMES

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

CO1 Achieve basic knowledge in space technology.

CO2 Acquire knowledge in space orbits, satellite platform technology.

CO3 Define basic concept in space environment and effects of micro gravity.

CO4 Solve the problems on launch vehicle performance, stability and control.

CO5 Determine the stability control on space craft.

16AEOE4 AIRCRAFT MATERIALS AND APPLICATIONS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Ferrous – Materials and alloys, Non-ferrous – Materials and alloys – Superalloys Composites/Non-metallic – Properties of materials – Strength, Hardness, Fatigue and Creep.

UNIT II FERROUS ALLOYS **9**

Low, medium and high carbon steels Properties – Heat treatment and applications of carbon/alloy steels – Stainless steels, Maraging steel – Aging treatments.

UNIT III NON-FERROUS ALLOYS **9**

Aluminum alloys – Alloy designation and tempers Al-Cu alloys – Principles of age hardening, Hardening mechanisms – Al-Li alloys, Al-Mg alloys – Nano crystalline aluminum alloys – Titanium alloys – α-β alloys, Super plasticity – Structural titanium alloys –Intermetallics magnesium alloys – Mg-Al and Mg-Al-Zn alloys.

UNIT IV SUPER ALLOYS **9**

Processing and properties of superalloys – single-crystal superalloys – Environmental degradation and protective coatings – Detection of corrosion, special coating – chemical films, special paints – Abrasive resistant paint – Heat and corrosive resistive paints and electroplating.

UNIT V COMPOSITES / NON-METALLIC COMPOSITES **9**

Composites – Metal matrix composites Matrix material, system –Thermosets, thermoplastic, epoxy resin working with resin & catalysis – Adhesive pre-impregnated materials, fillers – Polymer based composites – Ceramic based composites – Carbon-carbon composites.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Roger C. Reed, The Super alloys- Fundamentals and Applications. Cambridge University Press.
2. Balram Gupta, "Aerospace Materials", S. Chant publications.

REFERENCES

1. Hazel Assender and Patrick Grant Cantor, B, "Aerospace Materials", Institute of Physics Publishing Ltd.
2. ASM Speciality Handbook, "Heat Resistant Materials".
3. Hazel Assender and Patrick Grant Cantor, B, "Aerospace Materials", Institute of Physics Publishing Ltd.
4. Karl U.Kainer, "Metal Matrix Composites", Wiley-VCH Publications.
5. Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, 2nd Edition, 2005.

COURSE OUTCOMES

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

CO1 Describe basic knowledge in Aircraft materials.

CO2 Acquire knowledge in alloys and its composition.

CO3 Understand basic knowledge in composite used in aircraft structures.

CO4 Apply knowledge in super alloys and its application.

CO5 Acquire basic knowledge in non-metallic and composites.

16AEOE5 AIRCRAFT COMMUNICATION AND NAVIGATION SYSTEM

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

The radio frequency spectrum – Electromagnetic waves – Frequency and wavelength – Radio wave propagation – Antennas – Transmitters and receivers: Modulation and demodulation – AM transmitters – FM transmitters.

UNIT II COMMUNICATION SYSTEMS **9**

VHF Communication: VHF range and propagation - DSB modulation - VHF radio equipment; HF communications: HF range and propagation - SSB modulation - HF radio equipment.

UNIT III FLIGHT-DECK AUDIO SYSTEMS **9**

Flight interphone system – Cockpit voice recorder – Emergency locator transmitters [ELT]: Types of ELT – Maintenance and testing of ELT.

UNIT IV AIRCRAFT NAVIGATION AND LANDING APPROACH **9**

The earth and navigation – Dead reckoning – Position fixing – Maps and charts –Navigation terminology: Automatic direction finder [ADF] –VHF omnidirectional range [VOR] – Distance measuring equipment [DME] – Instrument landing system [ILS] – Microwave landing system [MLS].

UNIT V SATELLITE NAVIGATION AND ATC **9**

Inertial navigation systems – Global navigation satellite system – Flight management systems – Weather radar – Air traffic control system – Air Traffic alert and collision avoidance system [TCAS].

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Aircraft Communications and Navigation Systems by David Wyatt , Mike Tooley . 2007 edition.
2. Aircraft Electrical and Electronic Systems Principles, operation and maintenance by Mike Tooley and David Wyatt. 2009 edition, Elsevier Publications.

REFERENCES

1. Malvino A. P., and Leach, D.P., "Digital Principles and Application, Tata McGraw Hill, 1980.
2. Spitzer. C.R., "Digital Avionics System", Chapman and Hall, 1996.(Unit: I & II)
3. Myron Kayton, Walter R. Fried, "Avionics Navigation Systems", 2nd Edition, Wiley publications, 2010.
4. Aditya P Mathur -"Introduction to Microprocessors"- Third Edition, Tata McGraw Hill.
5. EHJ Pallet "Aircraft Instruments & Integrated Systems", Indian Reprint 1996- Longman Scientific & Technical.

COURSE OUTCOMES

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

CO1 Understand the radio frequency spectrum and Electromagnetic waves
CO2 Explain the working principles of aircraft communications.
CO3 Understand the Flight interphone system.
CO4 Describe and analyze the various aircraft navigation system.
CO5 Apply knowledge on ATC.

16AEOE6	FUNDAMENTALS OF UAV	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS **9**

Systematic Basics of UAS - System composition - classification - basic terminology- models and prototypes - Design and selection of the system - conceptual- preliminary - detail design phase -applications.

UNIT II BASICS OF AIRFRAME **9**

Airframe - dynamics – modeling - structures and mechanisms - wing design - engines types - support equipment maintenance - control surfaces - specifications.

UNIT III AVIONICS HARDWARE **9**

Autopilot - AGL- pressure sensors - servos - accelerometer - gyros - ring laser - fiber optic - Electromechanical - actuators - power supply - installation, configuration and testing.

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payload Types - Telemetry - Tracking - Aerial photography - control and stability - radio controlfrequency range - SAS-flight director-commands and videos - sensors - displays - ground testing - analysis - system in flight testing.

UNIT V PATH PLANNING AND MAV **9**

Introduction - Trends in UAS - Micro Air Vehicle - Comparison of UAV and MAV - Applications - Way point navigation - Ground control software - Autonomy - Artificial intelligence - Future trends in UAS.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Unmanned Aircraft Systems (UAV's Design, Development and Deployment) by Reg Austin, John Wiley & Sons Ltd. 2010.
2. Skafidas, "Microcontroller Systems for a UAV", KTH, TRITA-FYS 2002:51 ISSN 0280-316 X. 34, 2002.

REFERENCES

1. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007.
2. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998,
3. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
4. P.J.Swatton, "Ground studies for pilots' flight planning", Sixth edition, 2002.
5. Kermode, A.C., "Flight without Formulae", Pearson Education Publisher, 2004.

COURSE OUTCOMES

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

CO1 Understand the features and systems of Unmanned Aerial Systems.

CO2 Interpret the detailed mechanism of airframe structure and maintenance.

CO3 Describe the installation, configurations of Avionics hardware systems.

CO4 Enumerate the applications of communication control systems.

CO5 Compile the future trends and advances in Unmanned Aerial Systems

ONE CREDIT COURSE

16AEOC1 AEROSPACE COLLOQUIUM

AEROSPACE COLLOQUIUM **10**

This is a required course for all aerospace engineering students. Topics of importance and new developments are discussed by leading aerospace industry persons from HAL, NAL, GTRE, VSSC, etc. Technical videos on aircraft manufacturing and testing are also included.

PRACTICAL TRAINING IN THE INDUSTRY **5**

Total: 15 PERIODS

References Books:

1. Collection of notes from visiting industry persons.

COURSE OUTCOMES

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

CO1 Understand the importance and new developments in aerospace

CO2 Interact with leading aerospace industry persons from HAL, NAL, GTRE, VSSC

16AEOC2 COMPUTING FOR AEROSPACE ENGINEERS

COMPUTING FOR AEROSPACE ENGINEERS **10**

MATLAB desktop – Numbers and formats – Variable names – Pre-defined variables – Data types – Suppressing the output – Matrix and array operation - Symbolic computation – Solving several algebraic equations – Solving single differential equation – Solving several differential equation - Line plots – Multiple data sets in one plot - Editing plot – 3D plot and subplots - Control flow – The "if… End" statement – The "switch" command – The "for… End" loop – M-files – application of MATLAB in Finite Element Method, Mechanical Vibrations, Aerodynamics, engine performance calculations.

PRACTICAL TRAINING IN THE INDUSTRY **5**

Total: 15 PERIODS

References Books:

1. Steven Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw-Hill Education; 4 edition, 2017.

COURSE OUTCOMES

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

CO1 Understand the MATLAB for Aerodynamics

CO2 Describe the application of MATLAB in Finite Element Method

16AE0C3 NON DESTRUCTIVE TESTING

NON DESTRUCTIVE TESTING **10**

NDT – NDT Methods – Inspections Intervals –Visual Testing (VT) – Liquid Penetrant Testing (PT) – Magnetic Particle Testing (MT) – Ultrasonic Testing (UT) – Radiographic Testing (RT) – Laser Testing Methods (LM) – Leak Testing (LT) –Electromagnetic Testing (ET) – Acoustic Emission Testing.

PRACTICAL TRAINING IN THE INDUSTRY **5**

Total: 15 PERIODS

References Books:

1. A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996.

COURSE OUTCOMES

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

CO1 Describe the features of non destructive testing.

CO2 Understand the behavior of Inspections and Testing.

16AE0C4 WIND TURBINE DESIGN AND TESTING

NON DESTRUCTIVE TESTING **10**

Wind turbine - Introduction, Developments & types with advantages & disadvantages, Wind turbine - general flow pattern, Blade profile selection and its comparison with conventional airfoil shape, Blade design, Integration of blade system, Noise reduction, power control and efficiency of wind turbines, testing of wind turbine blade.

PRACTICAL TRAINING IN THE INDUSTRY **5**

Total: 15 PERIODS

References Books:

1. A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996.

COURSE OUTCOMES

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

CO1 Understand the features and systems of Wind turbine.

CO2 Analyze the testing of wind turbine blades.

16AE0C5 REAL TIME INDUSTRIAL APPLICATIONS IN CFD

INDUSTRIAL CFD **10**

Basic introduction of CFD & its real-time industrial applications, 2D & 3D geometry creation using commercial CFD packages, Theoretical introduction of Grid generation, Grid generation technique using commercial CFD packages - 2D & 3D, Solver techniques & its implementation, Turbulence Modeling, Pre-processing & Post-processing techniques.

PRACTICAL TRAINING IN THE INDUSTRY **5**

Total: 15 PERIODS

References Books:

1. H. Versteeg, W. Malalasekera, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method" 2nd Edition, Pearson Publications, 2005.

COURSE OUTCOMES

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

CO1 Understand the its real-time industrial applications of CFD.

CO2 Create 2D & 3D geometry using commercial CFD packages

16AE0C6 FAILURE ANALYSIS OF ADVANCED COMPOSITES

FAILURE ANALYSIS **10**

Sources of failure and damage - failure investigation process - failure due to overload and design deficiency, material & manufacturing defects and due to in-service factors. Theoretical and experimental evaluation of mechanical properties and thermal properties of composites. Manufacturing defects - bonding mechanism - different modes of fracture - stress intensity factor, fracture toughness - methods to improve fracture toughness. Life prediction models – fracture morphologies under cyclic loading, inter-laminar failure, Trans laminar failure. Case studies-Aircraft structures - impact loading - crashworthiness - structural requirement - wind turbine materials and techniques - failure modes.

PRACTICAL TRAINING IN THE INDUSTRY **5**

Total: 15 PERIODS

References Books:

1. Dr Emile Greenhalgh,"Failure Analysis and Fractography of Polymer Composites", Woodhead Publishing,1st edition,2009.

COURSE OUTCOMES

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

CO1 Understand the failure investigation process of composite matrerials.

CO2 Describe and analyse the different modes of fracture and failure modes