COURSE STRUCTURE

I SEMESTER

S. No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE01	Professional Communication-I	3	-	-	3	3	40	60	100
2	17FE04	Differential Equations and Linear Algebra	3	2	-	5	4	40	60	100
3	17FE13	Engineering Physics	3	2	-	5	4	40	60	100
4	17CI01	Computer Programming	2	2	-	4	3	40	60	100
5	17ME01	Engineering Graphics	2	2	-	4	3	40	60	100
6	17FE60	English Communication Skills Lab	-	-	2	2	1	40	60	100
7	17FE63	Engineering Physics Lab	-	-	2	2	1	40	60	100
8	17CI60	Computer Programming Lab	-	-	2	2	1	40	60	100
9	17ME60	Engineering Workshop	1		2	3	2	40	60	100
		Total	**14**	**8**	**8**	**30**	**22**	**360**	**540**	**900**

II SEMESTER

S. No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE02	Professional Communication-II	3	-	-	3	3	40	60	100
2	17FE06	Transformation Techniques and Vector Calculus	3	2	-	5	4	40	60	100
3	17FE14	Applied Chemistry	4	-	-	4	4	40	60	100
4	17EE50	Basic Electrical and Electronics Engineering	2	2	-	4	3	40	60	100
5	17ME02	Engineering Mechanics	2	2	-	4	3	40	60	100
6	17FE64	Applied Chemistry Lab	-	-	2	2	1	40	60	100
7	17EE72	Basic Electrical and Electronics Engineering Lab	-	-	2	2	1	40	60	100
8	17ME61	Engineering Mechanics and Fuel Testing Lab	-	-	2	2	1	40	60	100
9	17ME62	Computer Aided Engineering Graphics Lab	1	-	2	3	2	40	60	100
		Total	**15**	**6**	**8**	**29**	**22**	**360**	**540**	**900**

III SEMESTER

S. No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE07	Numerical Methods and Fourier Analysis	3	2	-	5	4	40	60	100
2	17ME05	Metallurgy and Material Science	3	-	-	3	3	40	60	100
3	17AE01	Engineering Fluid Mechanics	3	-	-	3	3	40	60	100
4	17AE02	Engineering Thermodynamics	3	-	-	3	3	40	60	100
5	17AE03	Strength of Materials	3	-	-	3	3	40	60	100
6	17AE04	Elements of Aerospace Engineering	3	-	-	3	3	40	60	100
7	17AE60	Basic Simulation Lab	-	-	2	2	1	40	60	100
8	17ME67	Fluid Mechanics and Hydraulic Machinery Lab	-	-	2	2	1	40	60	100
9	17AE61	Strength of Materials Lab	-	-	2	2	1	40	60	100
10	17PD03	Professional Ethics and Human Values	3	-	-	3	0	40	60	100
11	17PD01	Problem Assisted Learning	-	-	1	1	0	100	-	100
		Total	**21**	**2**	**7**	**30**	**22**	**500**	**600**	**1100**

IV SEMESTER

S. No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE03	Environmental Science	3	-	-	3	3	40	60	100
2	17FE08	Probability and Statistics	3	2	-	5	4	40	60	100
3	17AE05	Thermal Engineering	2	2	-	4	3	40	60	100
4	17AE06	Manufacturing Technology	3		-	3	3	40	60	100
5	17AE07	Aerodynamics-I	2	2	-	4	3	40	60	100
6	17AE08	Aircraft Structures-I	2	2	-	4	3	40	60	100
7	17ME69	Thermal Engineering Lab	-	-	2	2	1	40	60	100
8	17AE62	Manufacturing Technology lab	-	-	2	2	1	40	60	100
9	17ME66	Computer Aided Machine Drawing Lab	-	-	2	2	1	40	60	100
10	17PD02	Problem Based Learning	-	-	1	1	0	100	-	100
		Total	**15**	**8**	**7**	**30**	**22**	**460**	**540**	**1000**

V SEMESTER

S.No.	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17HS01	Engineering Economics and Accountancy	3	-	-	3	3	40	60	100
2	17AE09	Elements of Heat Transfer	3	-	-	3	3	40	60	100
3	17AE10	Aerodynamics-II	2	2	-	4	3	40	60	100
4	17AE11	Propulsion – I	3	-	-	3	3	40	60	100
5	17AE12	Aircraft Systems and Instruments	3	-	-	3	3	40	60	100
6	**PROGRAM ELECTIVE – I**		3	-	-	3	3	40	60	100
	17AE13	Theory of Machines								
	17ME22	CAD/CAM								
	17AE14	Non-Destructive Testing								
	17AE15	UAV System Design								
7	17AE90	Aerospace Materials **(*Add on course – I)**	3	-	-	3	3	40	60	100
8	17FE61	Presentation Skills Lab	-	-	2	2	1	40	60	100
9	17ME71	Heat Transfer Lab	-	-	2	2	1	40	60	100
10	17AE63	Aerodynamics Lab	-	-	2	2	1	40	60	100
11	17PD07	Seminar	-	-	2	2	1	100	-	100
12	17PD05	Employability Enhancement Skills-I	1	-	-	1	0	100	-	100
13	17PD06	Industrial Training/ In-house Training	-	-	-	-	-	-	-	-
		Total	**21**	**2**	**8**	**31**	**22/25***	**600**	**600**	**1200**

VI SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17AE16	Propulsion –II	3	-	-	3	3	40	60	100
2	17AE17	Aircraft Structures – II	2	2	-	4	3	40	60	100
3	17AE18	Flight Dynamics	3	-	-	3	3	40	60	100
4	17AE19	Finite Element Methods in Engineering	3	-	-	3	3	40	60	100
5	**PROGRAM ELECTIVE – II**		3	-	-	3	3	40	60	100
	17AE20	Aerodynamics of Missiles and Launch Vehicles								
	17AE21	Combustion in Aerospace Vehicles								
	17AE22	Experimental Stress Analysis								
	17AE23	Space Mechanics								
6	**OPEN ELECTIVE – I**		3	-	-	3	3	40	60	100
7	17AE91	Industrial Aerodynamics (***Add on course – II)**	3	-	-	3	3	40	60	100
8	17AE64	Propulsion Lab	-	-	2	2	1	40	60	100
9	17AE65	Aircraft Structures Lab	-	-	2	2	1	40	60	100
10	17PD04	Mini Project	-	-	4	4	2	100	-	100
11	17PD08	Employability Enhancement Skills-II	1	-	-	1	0	100	-	100
		Total	**21**	**2**	**8**	**31**	**22/25***	**560**	**540**	**1100**

VII SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17AE24	Mechanics of Composites	2	2		4	3	40	60	100
2	17AE25	Computational Fluid Dynamics	3	-	-	3	3	40	60	100
3	17AE26	Instrumentation, Measurements and Experiments in Fluids	3	-	-	3	3	40	60	100
4	**PROGRAM ELECTIVE - III**		3	-	-	3	3	40	60	100
	17AE27	Applied Gas Dynamics								
	17AE28	Introduction to Space Technology								
	17AE29	Theory of Elasticity								
	17AE30	Introduction to Smart Structures								
5	**PROGRAM ELECTIVE – IV**		3	-	-	3	3	40	60	100
	17AE31	Hypersonic Aerodynamics								
	17AE32	Propellant Technology								
	17AE33	Theory of Vibrations								
	17AE34	Fatigue and Fracture Mechanics								
6	**OPEN ELECTIVE– II**		3	-	-	3	3	40	60	100
7	17AE92	Airport Design (***Add on course – III)**	3	-	-	3	3	40	60	100
8	17AE66	Aircraft Component Modeling and Analysis Lab	-	-	2	2	1	40	60	100
9	17AE67	Aircraft Design Lab	-	-	2	2	1	40	60	100
10	17PD09	Internship	-	-	1	1	2	100	-	100
11	17PD10	Extra-curricular/Co-curricular Activities	-	-	1	1	-	-	-	-
		Total	**20**	**2**	**6**	**28**	**22/25***	**460**	**540**	**1000**

VIII SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	**PROGRAM ELECTIVE – V**		3	-	-	3	3	40	60	100
	17AE35	Helicopter Engineering								
	17AE36	Wind Engineering								
	17AE37	Cryogenics								
	17AE38	Aero Elasticity								
2	**PROGRAM ELECTIVE -VI**		3	-	-	3	3	40	60	100
	17AE39	Boundary Layer Theory								
	17AE40	Advanced Propulsion Systems								
	17AE41	Theory of Plates and Shells								
	17AE42	Aero Engine Repair and Maintenance								
3	**OPEN ELECTIVE– III**		3	-	-	3	3	40	60	100
4	17PD11	Project Work	-	-	24	24	12	40	60	100
5	17PD12	Comprehensive Viva-Voce	-	-	2	2	1	100	-	100
		Total	**9**	**-**	**26**	**35**	**22**	**260**	**240**	**500**

OPEN ELECTIVE – I (VI Semester)

S.No.	Course Code	Title of the Course	Offered by	Chosen by
1	17MB80	Industrial Engineering and Management	MBA	AE, CE, CSE, ECE, EEE, EIE & IT
2	17MB81	Project Management	MBA	AE, CE, CSE, ECE, EEE, EIE, IT & ME
3	17MB82	Logistics and SupplyManagement	MBA	AE, CE, CSE, ECE, EEE, EIE, IT & ME
4	17MB83	Banking andInsuranceManagement	MBA	AE, CE, CSE, ECE, EEE, EIE, IT & ME

OPEN ELECTIVE – II (VII Semester)

S.No.	Course Code	Title of the Course	Offered by	Chosen by
1	17AE80	Principles of Flight	AE	CE, CSE, ECE, EEE, EIE, IT & ME
2	17CE80	Basic Civil Engineering	CE	AE, CSE, ECE, EEE, EIE, IT & ME
3	17CS80	Java Programming	CSE	AE, CE, ECE, EEE, EIE & ME
4	17CS81	Introduction to Operating Systems	CSE	AE, CE, ECE, EEE, EIE & ME
5	17EC80	Satellite Technology	ECE	AE, CE, CSE, EEE, EIE, IT & ME
6	17EC81	Analog and Digital Communications	ECE	AE, CE, CSE, EEE, IT & ME
7	17EE80	Basic Control Systems	EEE	AE, CE, CSE, IT & ME
8	17EE81	Utilization of Electrical Energy	EEE	AE, CE, CSE, ECE, EIE, IT & ME
9	17EI80	Instrumentation Technology	EIE	AE, CE, CSE, ECE, EEE, IT & ME
10	17IT80	Introduction to Database	IT	AE, CE, ECE, EEE, EIE & ME
11	17ME80	Optimization Techniques	ME	AE, CE, CSE, ECE, EIE & IT
12	17ME81	Elements of AutomobileEngineering	ME	AE, CE, CSE, ECE, EEE, EIE, & IT

OPEN ELECTIVE – III (VIII Semester)

S.No.	Course Code	Title of the Course	Offered by	Chosen by
1	17AE81	Space Technology	AE	CE, CSE, ECE, EEE, EIE, IT & ME
2	17CE81	Disaster Management	CE	AE, CSE, ECE, EEE, EIE, IT & ME
3	17CS82	Internet Technologies	CSE	AE, CE, ECE, EEE, EIE & ME
4	17CS83	Shell Programming	CSE	AE, CE, ECE, EEE, EIE & ME
5	17EC82	Elements of Communication Systems	ECE	AE, CE, CSE, IT & ME
6	17EC83	Systems and Signal Processing	ECE	AE, CE, CSE, IT & ME
7	17EE82	Energy Auditing	EEE	AE, CE, CSE, ECE, EIE, IT & ME
8	17EE83	Renewable Energy Sources	EEE	AE, CE, CSE, ECE, EIE & IT
9	17EI81	Nano Technology	EIE	AE, CE, CSE, ECE, EEE, IT & ME
10	17IT81	Computer Networks	IT	AE, CE, EEE & ME
11	17ME82	Robotics and Automation	ME	AE, CE, CSE, ECE, EEE & IT
12	17ME83	Mechanical Handling Systems and Equipments	ME	AE, CE, CSE, ECE, EEE, EIE & IT

B.Tech. (I Sem.)	17FE01 - PROFESSIONAL COMMUNICATION – I	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Basics in English Grammar & Vocabulary

Course Educational Objective:
To improve the proficiency of students in English with an emphasis on Vocabulary& Grammar for better communication in formal and informal situations;Develop listening skills required for thorough understanding and analysis to face interviews with confidence.

Course Outcomes: At the end of the course, the student will be able to
CO1: Use English vocabulary & grammar effectively while speaking and writing.
CO2: Comprehend the given text and Communicate confidently in formal and informal contexts.
CO3: Draft E-mails& Memos
CO4: Understand the written and spoken information thoroughly.
CO5: Face interviews with confidence.

UNIT – I
Presidential Address – Dr. A.P.J. Abdul Kalam
Vocabulary: Word formation: Prefixes, suffixes & Compound Collocations
Grammar: Punctuation; Parts of Speech
Reading: Double Angels, David Scott
Writing: Sentence structure; Paragraph writing& Dialogue writing

UNIT – II
SatyaNadella's E-Mail to his Employees
Vocabulary: Homonyms, Homophones, Homographs (Words often confused)
Grammar: Types of verbs; Types of sentences
Reading: The Road Not Taken – Robert Frost
Writing: Letter Writing: Official Letters

UNIT – III
Technology with a Human Face – E.F.Schumacher
Vocabulary: Synonyms & Antonyms, commonly misspelt words
Grammar: Tenses: Types & Uses
Reading: Extract from 'Preface' to Lyrical Ballads – William Wordsworth
Writing:E-mails; Memo drafting

UNIT – IV
Listening Skills: The boy who broke the bank – Ruskin Bond; Importance of active listening; understanding the people; understanding places &events;expanding the proverbs on listening& listening at work place.

UNIT – V
Interview Skills: The lighthouse keeper of Aspinwall – Henryk Sienkiewicz; Interview skills from the story; expanding proverbs on Interview skills; Tips for attending an Interview - Covering letters for job applications & Writing a CV/Résumé

TEXT BOOKS

1. Board of Editors, "Fluency in English – A Course book for Engineering Students", Orient Black Swan, Hyderabad, 2016
2. Dhanavel S.P, "English and Soft Skills", Orient Black Swan, Hyderabad, 2010.

REFERENCE

1. Murphy, "English Grammar with CD", Cambridge University Press, New Delhi, 2004.
2. Rizvi Ashraf M., "Effective Technical Communication", Tata McGraw Hill, New Delhi, 2008
3. BaradwajKumkum, "Professional Communication", I.K.International Publishing House Pvt.Lt., New Delhi, 2008.
4. Raman, Meenakshi and Sharma, Sangeeta, . "Technical Communication -Principles and Practice".Third Edition. New Delhi: Oxford University Press. 2015.

B.Tech.(ISem.) **17FE04- DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA**

L	T	P	Cr.
3	2	-	4

Pre-requisites : Basics of Differential Calculus and Matrix Algebra

Course Educational Objective :
The objective of this course is to introduce the first order and higher order differential equations, functions of several variables. The students will also learn Matrix Algebra.

Course Outcomes : At the end of the course, the student will be able to :
CO1: Apply first order and first degree differential equations to find Orthogonal trajectories and to calculate current flow in a simple LCR circuit.
CO2: Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients.
CO3: Developing continuous functions as an infinite series and compute the Jacobian to determine the functional dependence.
CO4: Distinguish among the pros and cons between the Row operation methods and Iterative methods in solving system of linear equations.
CO5: Compute the Eigen values and Eigen vectors and powers, Inverse of a square matrix through Cayley – Hamilton theorem.

UNIT –I
Differential Equations of First Order and First Degree
Differential equations of first order and first degree – Exact and Non Exact Differential Equations, Applications to Orthogonal trajectories, Newton's Law of Cooling and Law of Growth and Decay.

UNIT –II
Higher Order Differential Equations
Linear differential equations of second and higher order with constant coefficients, method of variation of parameters.

UNIT – III
Functions of Several variables
Generalized Mean Value Theorem (without proof), Maclaurin's series, Functions of several variables, Jacobians (polar, cylindrical, spherical coordinates), Functional dependence.
Partial Differential Equations.
Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions.Solution of first order and first degree linear partial differential equation – Lagrange's method.

UNIT –IV
System of Linear Equations.
Matrices - Rank- Echelon form, Normal form, PAQ form– Solution of Linear Systems – Homogeneous system of equations and Non Homogeneous system of equations

UNIT – V
Eigen Values and Eigen Vectors
Eigen values – Eigen Vectors – Properties – Cayley Hamilton Theorem – Inverse and Powers of a matrix by using Cayley Hamilton Theorem.

TEXT BOOKS

1. B.S. Grewal, "*Higher Engineering Mathematics*", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH Publications, New Delhi, 2010.

REFERENCE

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi, 2011.
2. Erwin Krezig, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley &Sons, New Delhi, 2011.
3. W. E. Boyce and R. C. Diprima, "*Elementary Differential equations*", 7th Edition, John Wiley and sons, New Delhi, 2001.

B.Tech. (I Sem.)	17FE13 - ENGINEERING PHYSICS	L	T	P	Cr.
		3	2	-	4

Pre-requisites: Basics in Light, Crystals, Magnetism, Conductivity etc.,

Course Educational Objective : To make students learn the basic concepts of Optics such as Interference, Diffraction, Polarization and Lasers; the principle of quantum mechanics, different types of crystals, magnetic materials and the concept of super conductivity.

Course Outcomes: At the end of the course, the student will be able to :
CO1:Define the nature of Interference and Diffraction.
CO2: Describe the polarization and LASER, types of lasers andtheirapplications.
CO3: Analyze the dual nature of matter waves and the crystal structures.
CO4: Identifythe different types of magnetic materials and their applications.
CO5: Propose the different superconducting materials.

UNIT – I
INTERFERENCE AND DIFFRACTION
INTERFERENCE: Introduction, coherence, Conditions for Interference, Interference in thin film by reflection, Newton's rings (reflection), Working principle of Interferometer.
DIFFRACTION: Introduction, Diffraction, Fraunhofer diffraction at single slit- Diffraction due to circular aperture–Diffraction due to N- slits- Diffraction Grating- Resolving power of Grating, Telescope.

UNIT – II
POLARIZATION AND LASERS
POLARIZATION: Introduction – Polarization of light, Brewster's law–Double refraction, Quarter wave plate – Half wave plate - Polarimeter.
LASERS: Introduction- Characteristics of Lasers – Principle of laser (Absorption, Spontaneous and stimulated emission of Radiation), Einstein Coefficients - Nd-YAG laser, Helium Neon Laser.

UNIT – III
PRINCIPLES OF QUANTUM MECHANICS , CRYSTALLOGRAPHY AND X-RAY DIFFRACTION
PRINCIPLES OF QUANTUM MECHANICS
De Broglie waves, Experimental verification- Schrodinger wave equation-time independent wave equation, physical significance of the wave function – particle in a box.
CRYSTALLOGRAPHY AND X-RAY DIFFRACTION

Fundamental terms of crystallography, Types of crystals, Miller Indices, Relation between Interplanar and atomic distance, simple cubic crystal structure, Body centred cubic structure, Face centred cubic structure, Bragg's law, Laue's method .

UNIT – IV
MAGNETIC MATERIALS
Magnetic parameters, Classification of magnetic materials-Diamagnetic materials, paramagnetic materials, ferromagnetic materials, Antiferromagnetic materials and Ferri magnetic materials, Weiss theory of ferro magnetism, soft and hard magnetic materials, Applications of magnetic materials.

UNIT – V

SUPER CONDUCTIVITY

Introduction- General properties of super conducting material, Meissner effect, Effect of electric current, Types of super conductors- Type I super conductors, Type II super conductors, DC and AC Josephson Effect, London Equations Applications of super conductors- SQUID , Cryotron, Magnetic levitation.

TEXT BOOKS

1. V. Rajendran, "*Engineering Physics*", TMH, New Delhi, 6th Edition ,2013.
2. D.K.Bhattacharya,PoonamTandon,"*Engineering Physics*", Oxford press, New Delhi, 5th Edition, 2015.

REFERENCE

1. 1.M. N. Avadhanulu , TVS Arun Murthy "*Engineering Physics*", S Chand & Co, New Delhi, 2017.
2. P K Palaniswamy, "*Engineering Physics*" Sci. Publ. Chennai, 2016.
3. P.Sreenivasa Rao, K. Muralidhar, "*Engineering Physics*", Himalaya Publishing House, Hyderabad, 2016.

B.Tech. (I Sem.)	17CI01 - COMPUTER PROGRAMMING	L	T	P	Cr.
		2	2	-	3

Pre-requisites : NIL

Course Educational Objective: In this course student will learn about
The basic elements of C programming structures like data types, expressions, control statements, various I/O functions and how to solve simple mathematical problems using control structures.The derived data types like arrays, strings, various operations on them. Modular programming using functions and Memory management using pointers.User defined structures and various operations on it.The basics of files and its I/O operations.

Course Outcomes: At the end of the course, the student shall be able to:
CO1: Identify basic elements of C programming structures like data types, expressions,control statements, various simple functions and inview of using them in problem solving.
CO2: Apply various operations on derived data types like arrays and strings in problem solving.
CO3: Design and Implement Modular Programming and memory management using pointers.
CO4: Implement user defined data structures used in specific applications.
CO5: Compare different file I/O operations on text andbinary files.

UNIT – I
Introduction to Problem solving through C-Programming: Problem Specification.
Algorithm / pseudo code, flowchart, examples.
C-Programming: Structure of C program, identifiers, basic data types and sizes, Constants, variables, Input-output statements, A sample C program, operators: arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.
Conditional statements: if, if else, else if ladder and switch statements, continue, goto. Loops: while, do-while and for statements, break, programming examples.

UNIT – II
Arrays- one dimensional arrays-concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.
Character Strings: declaration, initialization, reading, writing strings, arithmetic operations on characters, string handling functions, programming examples

UNIT – III
Functions: basics, category of functions, parameter passing techniques, recursive functions-comparison with Iteration, Functions with arrays, storage classes- extern, auto, and register, static, scope rules, Standard library functions, dynamic memory management functions, command line arguments, programing examples.
Pointers- concepts, declaring &initialization of pointer variables, pointer expressions, pointer arithmetic, pointers and arrays, pointers and character strings, pointer to pointer, Pre-processor Directives and macros.

UNIT –IV

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, array of structures, structures and functions, pointer to structure, self-referential structures, unions, typedef, programming examples.

UNIT – V

Files – concept of a file, text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling, and programming examples.

TEXT BOOKS

Jeri R.Hanly, Elliot B.Koffman, Problem Solving and Program Design in C, Pearson Publishers, 7th Edition, 2013

REFERENCE

1. N.B.Venkateswarlu and E.V.Prasad, C and Data Structures, S.Chand Publishing, 1st Edition, 2010,
2. ReemaThareja, Programming in C, Oxford University Press, 2nd Edition, 2015
3. Stephen G.Kochan, Programming in C, Pearson Education, 3rd Edition, 2005
4. PradeepDey, Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition, 2011
5. E Balagurusamy, Computer Programming, McGraw Hill Education, 1st Edition

B.Tech. (I Sem.) **17ME01 - ENGINEERING GRAPHICS**

L	T	P	Cr.
2	2	-	3

PRE-REQUISITES **:** Mathematics, Physics

COURSE EDUCATIONAL OBJECTIVE:
The main objective of the course is to recognize the BI Standards of Engineering Drawing and develop an ability to get familiarized with orthographic projections and isometric views

COURSE OUTCOMES: At the end of the course, the student will be able to:
CO 1: Represent the geometrical objects considering BIS standards.
CO2: Comprehend the basics of orthographic projections and deduce orthographic projections of a point and a line at different orientations.
CO3: Visualize geometrical planes of different positions in real life environment
CO4: Imagine orthographic views of various solid objects at different orientations
CO5: Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

UNIT – I
INTRODUCTION TO ENGINEERING DRAWING:
Introduction: Principles of Engineering Graphics and their significance - Drawing Instruments and their use-Conventions in Drawing- Lettering and Dimensioning – BIS conventions – Geometrical Constructions.
Engineering Curves: Conic Sections- Ellipse, Parabola, Hyperbola and rectangular hyperbola- General method and other methods; Cycloid, Epi-Cycloid and Hypo-Cycloid; Involutes.

UNIT – II
ORTHOGRAPHIC PROJECTIONS:
Principle of orthographic projection-Method of Projections – First and third angle projection methods- Projections of Points – Projections of straight lines of different orientations - True lengths and traces.

UNIT – III
PROJECTIONS OF PLANES: Planes parallel to one of the reference planes-Inclined to one reference plane and perpendicular to other-Oblique planes.

UNIT – IV
PROJECTIONS OF SOLIDS: Projection of solids in simple position - Axis inclined to one of the reference planes and parallel to the other-Axis inclined to both H.P and V.P.

UNIT – V
ISOMETRIC VIEWS: Introduction-theory of isometric projection, isometric views, isometric axes, scale, lines & planes-Isometric view of prism, pyramid, cylinder & cone-non isometric lines-methods to generate an isometric drawing
TRANSFORMATION OF PROJECTIONS: Conversion of Orthographic Projections to Isometric Views of composite objects, Conversion of Isometric Views to Orthographic Projections**.**

TEXT BOOK

N. D. Bhatt, Engineering Drawing, 51th Revised and Enlarged Edition, Charotar publishers, 2012

REFERENCE

1. Narayana K L, Kannaiah P, Textbook on Engineering Drawing, 2nd Edition, SciTech publishers.
2. R.K.Dhawan, Engineering Drawing, S.Chand Company LTD.
3. Venugopal, Engineering Drawing and Graphics, New Age publishers
4. Dhananjay A. Jolhe, Engineering Drawing, Tata McGraw Hill Publishers
5. N.S.Parthasarathy, Vela Murali, Engineering Drawing, Oxford Higher Education

B.Tech. (I Sem.) 17FE60 - ENGLISH COMMUNICATION SKILLS LAB

L	T	P	Cr.
-	-	2	1

Pre-requisites: Students should have fundamental knowledge in making sentences and be with readiness to speak

Course Educational Objective:
To improve the proficiency of students in English with an emphasis on better communication in formal and informal situations;Develop speaking skills required for expressing their knowledge and abilities and to face interviews with confidence.

Course Outcomes: At the end of the course, the student will be able to
CO1 : Articulate English with good pronunciation.
CO2 : Manage skilfully through group discussions.
CO3 : Communicate with the people effectively.
CO4 : Collect and interpret data aptly.

Syllabus: English Communication Skills Lab (ELCS) shall have two parts:
- **Computer Assisted Language Learning (CALL) Lab** for 60 students with 60 systems, LAN facility and English language software for self- study by learners.
- **Interactive Communication Skills (ICS) Lab.** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo – audio & video system and camcorder etc.

Exercise – I
CALL Lab:
Understand:Sentence structure, written language.
ICS Lab:
Practice: Introduction to English Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs - Phonetic Transcription.

Exercise – II
CALL Lab:
Understand:Usage of various words in different parts of speech.
ICS Lab:
Practice: Ice-Breaking Activity and JAM Session – Introducing Oneself.

Exercise – III
CALL Lab:
Understand:Features of Good Conversation – Strategies for Effective Communication
ICS Lab:
Practice: Situational Dialogues – Role-Play – Expressions in various situations – Making Requests and seeking permissions.

Exercise – IV
CALL Lab:
Understand:Data collection strategies – Interpretation of collected data.
ICS Lab:
Practice: Data interpretation – Information transfer from flow charts, pie charts, bar graphs, pictograms etc.

Exercise – V
CALL Lab:
Understand:Features of Good Conversation – Strategies for Effective Communication.
ICS Lab:
Practice: Introduction to Group Discussions

Lab Manual:
Board of Editors, "ELCS Lab Manual – A Workbook of CALL and ICS Lab Activities", Orient Black Swan Pvt. Ltd., Hyderabad, 2016.

SUGGESTED SOFTWARE:
1. Digital Mentor: Globarena, Hyderabad, 2005
2. Sky Pronunciation Suite: Young India Films, Chennai, 2009
3. Mastering English in Vocabulary, Grammar, Spelling, Composition, Dorling Kindersley,USA,2001
4. Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
5. Oxford Talking Dictionary, the Learning Company, USA, 2002
6. Learning to Speak English - 4 CDs. The Learning Company,USA,2002
7. Cambridge Advanced Learners English Dictionary (CD). Cambridge University Press, New Delhi, 2008.

L	T	P	Cr.
-	-	2	1

B.Tech. (I Sem.) **17FE63 – ENGINEERING PHYSICS LAB**

Pre-requisites : Awareness about the usage of Vernier callipers, Screw Gauge etc.,

Course Educational Objective:
To make students learn the theoretical concepts, Analytical techniques and graphical analysis through completing a host of experiments with the procedures and observational skills using simple and complex apparatus.

Course Outcomes: At the end of the course, the student will be able to :
CO1: Analyze the wave characteristics of light.
CO2: Estimate the wave length and width of the slit with Laser light source.
CO3: Evaluate the specific parameters in electrical circuits.
CO4: Analyze the characteristics of Torsional Pendulum, Thermister, Stewart and Gee's.

List of Experiments

(ANY 8 EXPERIMENTS)

GENERAL EXPERIMENTS:

1. Determine the frequency of AC supply by using Sonometer.
2. Determine the frequency of a tuning fork by using Melde's arrangement.
3. Study the characteristics of L.C.R Circuit.
4. Study the magnetic field along the axis of a current carrying circular coil using Stewart's &Gee'sapparatusand to verify Biot - Savart's law.
5. Determine the rigidity modulus of a given material using Torsional pendulum.
6. Study the characteristics of Thermister.
7. Determination of time constant of a RC Circuit.

OPTICS LAB EXPERIMENTS:

8. Determine the wavelength and divergence of a laser radiation.
9. Determine the width of a single slit by forming diffraction pattern.
10. Determine the Radius of Curvature of a Plano - Convex lens by forming Newton's Rings.
11. Find the specific rotation of sugar solution by using a polarimeter.
12. Determine the Refractive index of a material of the given prism.
13. Determine the Wavelengths of various spectral lines by using diffraction grating.
14. Determination of a thickness of thin wire by using wedge shaped film.

TEXT BOOKS
Lab Manual Prepared by the LBRCE.

B.Tech. (I Sem.)	17CI60 - COMPUTER PROGRAMMING LAB	L	T	P	Cr.
		0	0	2	1

Pre-requisites : NIL

Course Educational Objective: In this course student will learn about
Software development tools like algorithm, Pseudo codes and programming structure. Basic elements C programming structures like data types, expressions, Control statements, various I/O functions and how to solve simple mathematical Problems using control structures.Designand implementation ofvarious software components which solve real world problems.

Course Outcomes: At the end of the course the student will be able to
CO1: Apply and practice logical formulations to solve some simple problems leading to specific applications.
CO2: Demonstrate C programming development environment, compiling, debugging, linking and executing a program using the development environment.
CO3: Design effectively the required programming components that efficiently solve computing problems in real world.
Mandatory: All Programs must have Algorithms and Flow Charts

LAB CYCLESSYLLABUS

I) Exercise Programs on Basics of C-Program
Write a program in 'C' language to cover the following problems.
a) Example program which shows the usage of various preliminaryData types available in C Language.
b) Example program which shows the usage of various Operators available in C Language.
c) Example programs to illustrate the *order of evaluation.*

II) Exercise Programs on Control Structures:
a) To check whether the given year is leap year (or) not
b) Roots of Quadratic Equation.
c) Finding smallest& biggest number from the given set of 4 numbers using 'if' statement.
d) Calculate the student grade in the examination – assume suitable Constraints.
e) Prepare electricity bill for the consumed units – assume suitable Constraints.
f) Converting given two digit number into words using switch statement
g) To illustrate the usage of 'goto' statement.

III) Exercise Programs on Loops:
a) To Display first N natural numbers
b) To find whether the given number is Armstrong (or) not
c) To find reverse of the given number and to check whether it is palindrome (or) not.
d) To find whether given number is strong number (or) not.
e) To check whether given number is Prime (or) not
f) To display prime numbers with in the given range (Nesting of Loops).
g) To display the following structure (Nesting of Loops)

i)

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

ii)

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

IV) Exercise Programs on Arrays& Strings:

Write example programs in C Language to perform following operations:

a) Finding the sum and average of given numbers using Arrays.
b) To display elements of array in reverse order
c) To search whether the given element is in the array (or) not using linear search &binary search.
d) Write a C program to perform the following operations
   i) Addition, subtraction and multiplication of Matrices
   ii) Transpose of given matrix
   (The above operations are to be exercised using functions also bypassing arguments)
e) Write a C program to find whether the given string is palindrome (or) not.
f) To accept line of text and find the number of characters, number of vowels andnumber of blank spaces in it.
g) Write an example program to illustrate the use of any 5 stringhandling functions.

V) Exercise Programs on Functions &Pointers:

a) Example program to bring clarity on pointer declaration & initialization and Pointer arithmetic.
b) Write an example program to describe the usage of *call by reference*.
c) Write a program to find sum of the elements of the array using functions.

VI) Exercise Programs on Functions:

Write example programs in C Language:

a) To find factorial of a given number using functions.
b) Swap two numbers using functions.
c) To find GCD of two numbers using recursion
d) Write a recursive function to solve Towers of Hanoi problem.
e) Write an example program to illustrate use of external &static storage classes.
f) Write an example program to illustrate the usage of command line arguments.
g) Program to illustrate the usage of dynamic memory management functions.

VII) Exercise Programs on Derived data types:

a) Write an example program using structures to process the student record. Assume suitable fields for student structures (Different kinds of initialization of structure variables are to be exercised)
b) Write a program to read records of 10 employees and find their average salary (Exercise array of structures & Nested structures concepts through this program).
c) Write a program to handle a structure variable using pointers and implement self referential structure(i.e. A structure variable having a pointer to itself)

VIII) Exercise Programs on Files:

Write an example program on file to perform following operations:

a) Accessing content from files and writing content in to it.
(Exercise different file operation modes)
b) Copy the contents of one file into another.
(Exercise different file operation modes)

B.Tech. (I Sem.)	17ME60 - ENGINEERING WORKSHOP	L	T	P	Cr.
		1	-	2	2

PRE-REQUISITES: Knowledge in dimensions and units, Usage of geometrical instruments and analytical ability

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to get familiarized with various trades used in Engineering Workshop and learn the safety pre-cautions to be followed in the workshops, while working with the different tools.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1 : Design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint.
CO2 : Fabricate and model various basic prototypes in the trade of fitting such as Straight fit, V- fit.
CO3 : Produce various basic prototypes in the trade of Tin smithy such as rectangular tray, and open Cylinder.
CO4 : Perform various basic House Wiring techniques.

(Conduct at least 4 Trades with 2 exercises from each Trade and demonstrate about 2 Trades)

Trade –1: CARPENTRY SHOP

1.1. Introduction to various types of wood such as Teak, Mango, Sheesham, etc. (Demonstration and their identification).
1.2. Demonstration, function and use of commonly used hand tools.
1.3. Introduction to various types of wooden joints, their relative advantages and uses.
1.4. Care maintenance of tools and safety precautions in carpentry shop.

Job I- Marking, sawing, planning and chiselling & their practice
Job II -Preparation of half lap joint
Job III -Preparation of Mortise and Tenon Joint

Trade –2: FITTING SHOP

2.1. Introduction to fitting shop tools, common materials used in fitting shop.
2.2. Description and demonstration of simple operation of hack-sawing, various types of blades and their specifications, uses and method of fitting the blade.
2.3. Care and maintenance of tools & safety precautions in fitting shop.

Job I-Making a L-Fit from a rectangular piece of MS
Job II-Making a T-Fit from a rectangular piece of MS
Job III-Making a V-Fit from a rectangular piece of MS
Job IV-Making a Half round Fit from a rectangular piece of MS

Trade -3: TIN- SMITHY SHOP

3.1. Introduction to tin -smithy shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material and specifications.
3.2. Introduction and demonstration of various raw materials used in sheet metal shop e.g. M.S. sheet, galvanized-iron plain sheet, galvanized corrugated sheet, aluminium sheets etc.
3.3. Care and maintenance of tools & safety precautions in Tin-Smithy shop.

Job I - Preparation of a rectangular tray.
Job II- Preparation of a open scoop/ funnel.
Job III - Preparation of a Single Seam Joint and Double Seam Joint.
Job IV - Preparation of a Corner Seam Joint.

Trade –4: PLUMBING SHOP

4.1. Introduction to plumbing –use of hand tools and accessories e.g. pipe vice, Die sets, adjustable spanners, pipe wrench, pipe cutter and pipes and pipe fittings -various raw materials used in plumbing such as PVC Pipes, CI Pipes, MS pipes, Brass Pipes, Copper Pipes, Aluminium Pipes.

4.2. Demonstration of hand tools used in plumbing – preparation of pipe layout and pipe threading.

4.3. Care and maintenance of tools & safety precautions in Plumbing.

Job I – preparation of pipe layout.

Job II – Pipe threading.

Trade -5: BLACK SMITHY

5.1. Introduction to Black smithy –use of tools and equipments e.g.

5.2. Demonstration of forging operations.

5.3. Care and maintenance of tools & safety precautions in Black smithy.

Job I – preparation of S –Hook.

Job II – preparation of Chisel

Trade -6: HOUSE WIRING

6.1.Study, demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits.

6.2.Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthing.

Job I - Two lamps in series and parallel connection with one way switch
Job II – Florescent lamp and calling bell circuit.
Job III- One lamp connection with two 2- way switches(stair case connection).
Job IV – House wiring circuit.

REFERENCE

1. LBRCE Workshop Lab Manual
2. S.K.HajraChoudary&A.K.Choudary, “Workshop Technology-I”, Media Promoters and Publishers Pvt.Ltd., Mumbai, 2012.
3. B.S.Raghuvamsi, “Workshop Technology-I”, Dhanpatrai and company, New Delhi, 2014.
4. P.Khannaiah, K.L.Narayana, “Workshop Mnaual”, Scitech Publications India Pvt.Ltd, 2015.

B.Tech. (II Sem.)	17FE02 - PROFESSIONAL COMMUNICATION - II	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Students should have basics in English vocabulary andGrammar& they should write error free sentences

Course Educational Objective : To Improve vocabulary, Grammar, Verbal – Non verbal Communication; to develop adaptability, assertive skills and Team spirit for skillful management in work place; and to Interpret technical data given in the form of charts, graphs & pictograms for writing technical reports.

Course Outcomes: At the end of the course, the student will be able to

CO1 : Use appropriate vocabulary to interpret data thoroughly and to write reports effectively.
CO2 : Face any situation with confidence and voice opinions/decisions assertively.
CO3 : Use English Language effectively in spoken and written forms.
CO4 : Work effectively in teams for better result.
CO5 : Communicate effectively using verbal and non-verbal dimensions aptly.

UNIT – I
Good Manners – J.C. Hill
Vocabulary: Idioms; One-word substitutes
Grammar: Subject-Verb agreement (Concord)
Reading: If – Rudyard Kipling
Writing: Information transfer: Tables, Bar graphs, Line graphs, Pie charts, Flow charts, Tree Diagrams, Pictograms; Note-making& Abstract/Summary writing

UNIT – II
Assertive Skills: Verger – Somerset Maugham; Assertive skills from the story; Assertive skills at personal level & at workplace; Expanding proverbs & their Significance
Team work skills: White washing the fence – Mark Twain; Teamwork skills from the story; Teamwork at work place & its Importance

UNIT – III
Oh Father, Dear Father – Raj Kinger
Vocabulary: Foreign Languages and their Influence on English
Grammar: Conditional Sentences; Degrees of Comparison; Question Tags
Reading: Basic Education – M.K. Gandhi
Writing: Report Writing: Nature, Significance & Types of Reports

UNIT – IV
Adaptability: Sen˜or Payroll – W E Barrett; Understanding the Organizational Communication; Adaptability skills from the story; Expanding proverbs on Adaptability skills; Importance at work place & Real life - Active & Passive Voice; Direct & Indirect Speech.

UNIT – V

Non-Verbal Communication Skills: A real good smile – Bill Naughton; 'Wh' & 'Yes' or 'No' questions; Working on articulation and gestures; Non-Verbal Communication Skills from the story; Expanding the proverbs on Non-Verbal Communication; enhancing skills through real life experiences - Common Errors.

TEXT BOOKS

1. Board of Editors, "Fluency in English – A Course book for Engineering Students", Orient Black Swan, Hyderabad, 2016
2. Dhanavel S.P, "English and Soft Skills", Orient Black Swan, Hyderabad, 2010.

REFERENCES

1. Murphy, "English Grammar with CD", Cambridge University Press, New Delhi, 2004.
2. Rizvi Ashraf M., "Effective Technical Communication", Tata McGraw Hill, New Delhi, 2008
3. BaradwajKumkum, "Professional Communication", I.K.International Publishing House Pvt.Lt., New Delhi, 2008.
4. Raman, Meenakshi and Sharma, Sangeeta, . "Technical Communication -Principles and Practice".Third Edition. New Delhi: Oxford University Press. 2015.

B.Tech. (II Sem.)	17FE06 - TRANSFORMATION TECHNIQUES AND VECTOR CALCULUS	L	T	P	Cr.
		3	2	-	4

Pre-requisites: Basics of Integral Calculus and Vector Calculus

Course Educational Objective : In this course the students are introduced to Integral transformations which includes Laplace Transforms and Z – Transforms. They will also learn Multiple Integrals in different coordinate systems and Vector Calculus.

Course Outcomes : At the end of the course, the student will be able to :
CO1: Apply the concepts of Laplace Transforms to solve ordinary differential equations.
CO2: Apply Z - Transforms to solve difference equations
CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes.
CO4: Evaluate the directional derivative, divergence and angular velocity of a vector function.
CO5: Apply Vector Integration for curves, surfaces and volumes and relationship among themselves.

UNIT – I
Laplace Transforms
Laplace transforms of standard functions –Linear Property - Shifting Theorems, Change of Scale Property – Multiplication and Division by‘t’ - Transforms of derivatives and integrals – Unit step function –Dirac’s delta function..
Inverse Laplace Transforms
Inverse Laplace transforms– Linear Property - Shifting Properties - Convolution theorem, Applications of Laplace transforms to ordinary differential equations.

UNIT – II
Z-Transforms
Z-transform – properties – Damping rule – Shifting rule – Initial and final value theorems - Inverse Z –transform - Convolution theorem – Solution of difference equation by Z-transforms.

UNIT – III
Multiple Integrals
Multiple integrals - double and triple integrals (Cartesian, polar, spherical coordinates) – Changing of order of Integration and applications to areas and volumes.

UNIT – IV
Vector Differentiation
Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl – Irrotational fields-potential surfaces - Laplacian and second order operators and related properties of sums and products

UNIT – V
Vector Integration
Vector Integration - Line integral – work done –area - surface and volume integrals. Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems

TEXT BOOKS

1. Dr. B.S. Grewal, "*Higher Engineering Mathematics*", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. Dr. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH, New Delhi, 2010.

REFERNCES

1. Michael D. Greenberg , "*Advanced Engineering Mathematics*", 2nd Edition, TMH, New Delhi, 2011.
2. Erwin Krezig, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley & Sons, New Delhi, 2011.

B.Tech. (II Sem.)	17FE14 - APPLIED CHEMISTRY	L	T	P	Cr.
		4	-	-	4

Pre-requisites: Knowledge of atomic weights, molecular weights, equivalent weights, galvanic cell, working principle of battery, concept of polymerization.

Course Educational Objectives

In this course, students will learn the concepts and applications of chemistry in engineering. It aims at strengtheningthestudents with the fundamental concepts of chemistry. It provides them with the knowledge of water specification for different industries along with solutions to the problems that arise due to hardness of water.

It enables the students to know analysis of fuels and alternate fuels used in diverse fields. It makes the students to effectively use the knowledge of electrochemistry, battery technology, and corrosion science in engineering applicationsIt enables the students to identify the role of polymers and lubricants in various fields.

Course Outcomes: After completion of course, students will be able to

CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications.

CO2: Analyze issues related to conventional fuels and apply the concepts of advanced fuels like bio, nuclear and rocket fuels in energy production.

CO3: Analyze different types of electrodes and batteries for technological applications..

CO4: Apply principles of corrosion for design and effective maintenance of various equipments.

CO5: Identify the important applications of engineering materials like plastics, rubbers and lubricants.

UNIT – I :WATER TECHNOLOGY

Introduction: Sources of water and quality.

Hardness: Hardness of Water - Temporary and permanent hardness, units and their inter relation, problems on hardness and disadvantagesof hard water in industries.

Boiler troubles: Reasons, disadvantages and methods of prevention for scale and sludge formation, caustic embrittlement, boiler corrosion and carryover(priming and foaming).

Water softening: Ion- Exchange Process, merits and demerits.

Desalination of brackish water: Electro dialysis and reverse osmosis.

UNIT – II :CONVENTIONAL FUELS

Introduction: Definition and classification of fuels(solid,liquid and gaseoues fuels, merits and demerits) and characteristics of a good fuel.

Calorific value: Definition, gross and net calorific values (definition only).

Solid fuels: Coal – Origin, proximate analysis of coal and significance.

Liquid Fuels: Petroleum-origin, types of crude oil and refining of petroleum. Cracking – moving bed catalytic cracking and synthetic petrol –Fischer Tropsch's process.

Gaseous fuels: Natural gas composition and C.N.G - advantages.

ADVANCED FUELS

Bio fuels: Characteristics of bio fuels, sources of bio mass and advantages, - Production of bio diesel from rape seed oil.

Nuclear fuels: Nuclear fission, fusion, differences between chemical and nuclear fuel, Charecterstics of fuel elements.

Rocket propellants: Characteristics of good propellants, classification, examples and mechanism of propulsion.

UNIT – III :ELECTRO CHEMISTRY & BATTERIES

Introduction: Electrode potential, standard reduction and oxidation potentials (S.R.P and S.O.P), E.M.F/cell potential of a cell.

Nernst equation: Derivation and problems.

Reference Electrode: Standard hydrogen electrode (S.H.E), calomel electrode, measurement of electrode potential, electro chemical series and applications.

Types of batteries: Primary, secondary and reserve batteries, dry battery(Leclanche cell), Nickel-Cadmium battery, Magnesium - Copper reserve battery.

Fuel Cells: Hydrogen- Oxygen fuel cells.

UNIT – IV :SCIENCE OF CORROSION

Introduction: Definition, examples.

Dry Corrosion (Direct Chemical corrosion): Types of dry corrosion-oxidative corrosion, Pilling Bed worth rule, corrosion by other gases and liquid metal corrosion.

Wet Corrosion(Electro Chemical corrosion): Mechanism - Oxygen absorption, Hydrogen evolution, Types of wet corrosion, galvanic corrosion, concentration cell corrosion, passivity, galvanic series.

Factors Influencing Corrosion: Nature of metal (purity, position in galvanic series, relative area of cathode and anode, nature of surface film) and nature of environment (temperature, humidity, atmospheric pollution and nature of ions in the medium).

Control of Corrosion: Cathodic protection (sacrificial anode and impressed current methods), electro plating and metal cladding.

UNIT – V :CHEMISTRY OF ENGINEERING MATERIALS

Polymers: Definition, basic terminology, differences between thermosets &thermoplasts, types of polymerization(addition, condensation and co-polymerisation), preparation, properties and engineering applications of Teflon andbakelite, conducting polymers-extrensic and intrensic conducting polymers.

Rubbers: Definition, processing of natural rubber, draw backs, vulcanization and advantages, preparation, properties and applications of BUNA-S and thiokol.

Lubricants: Characteristicsofa good lubricant and properties of lubricants (viscosity, flash and fire points, cloud and pour points, aniline point) and applications.

TEXT BOOKS

1. Shashi Chawla, "A Text book of Engineering Chemistry", Dhanpat Rai PublishingCompany, New Delhi, 3rdEdition, 2003.
2. Jain, Jain, "A Text book of Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 16th Edition, 2015.

REFERENCES

1. Shikha Agarwal, "A text book of Engineering Chemistry", Cambridge University Press, New Delhi, 1st Edition, 2015.
2. S.S. Dara, S.S. Umare, "A Text book of Engineering Chemistry", S. Chand Publications, New Delhi, 12th Edition, 2010.
3. Y. BharathiKumari, JyotsnaCherukuri, "A Text book of Engineering Chemistry", VGS Publications, Vijayawada, 1st Edition, 2009.

B.Tech. (II Sem.)	17EE50 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	Cr.
		2	2	-	3

Pre-requisites :NIL

Course Educational Objective: This course enables student to illustrate the basics of applied electricity and electronics.

Course Outcomes: At the end of the course, the student will be able to :
CO1: Analyze the electrical circuits
CO2: Illustrate the performance of static and Rotating machines
CO3: Illustrate basic semiconductor devices and logic circuits.
CO4: Interpret the working of various electrical measuring instruments

UNIT – I
Electrical Circuit Analysis
Basic definitions, Types of elements-active and passive, Ohm's Law, Kirchhoff's Laws-Network reduction techniques- series, parallel, star to delta, delta to star transformations, source transformation (for resistive networks). Mesh Analysis, Nodal Analysis. Numerical problems.

UNIT – II
AC Fundamentals
Peak, R.M.S, average, instantaneous values, Form factor and Peak factor– periodic waveforms – Phase and Phase difference –Concepts of Reactance, Impedance, Susceptance and Admittance, Real, Reactive and apparent Powers, Power Factor- Resonance-Bandwidh-Quality Factor.

UNIT – III
Basic Rotating Machine Theory
Elementary concepts- introduction to AC and DC machines-MMF of Distributed Winding-Magnetic Fields in Rotating Machinery-Rotating MMF waves in AC machines –Generated Voltage.

UNIT–IV
Single Phase Transformers and Measuring Instruments
Principle of operation of single phase transformers-Emf equation-Losses- efficiency and regulation-O.C and S.C tests.
Measuring Instruments- Basic Principles of indicating instruments-permanent magnet moving coil and moving iron instruments.

UNIT – V
Basic Electronic Devices and Digital Logic circuits
Operation and V-I characteristics of PN Junction Diode, Zener Diode , Full wave , Half wave and bridge rectifiers, PNP and NPN junction transistor & configurations, application of transistor as amplifier.
Digital Logic circuits: Introduction, representation of data, digital techniques, number systems-decimal, binary, octal and hexadecimal systems, code conversion. Logic gates and truth tables-AND,OR, NOT operation; Flipflops-JK, SR.

TEXT BOOKS

1. A.Sudhakar and Shyammohan S Palli, "Electrical Circuits" Tata McGraw-Hill, 3rd Edition.
2. M.S.Sukhija, T.K.Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford University Press, 2016 Edition.

REFERENCES

1. Kothari and Nagarath, "Basic Electrical Engineering", TMH Publications, 3rd Edition.
2. Morris Mano, "Digital Design" ,PHI Publishers ,4th Edition.
3. G.S.N.Raju, "Electronic Devices and Circuits", I.K.International.

B.Tech. (II Sem.)	17ME02 - ENGINEERING MECHANICS	L	T	P	Cr.
		2	2	-	3

PRE-REQUISITES : Engineering Physics, Applied Mathematics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to develop the capacity to predict the behaviour of rigid bodies under the action of external forces in real world scenario.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1:Analyse the coplanar force systems using free body diagram.

CO2:Analyse the rigid bodies associated with frictional forces using conditions of equilibrium

CO3:Locate the centroid/center of gravity and determine the moment of inertia of plane sections/solids

CO4: Examine the behaviour of moving bodies in rectilinear and trajectory motion using kinematic equations or motion curves.

CO5:Examine the behaviour of moving bodies using dynamic equilibrium/workenergy methods

UNIT-I

INTRODUCTION TO ENGINEERING MECHANICS: Basic Concepts of mechanics .

RESULTANT OF SYSTEM OF FORCES: Resultant of Coplanar ConcurrentForceSystem - Moment of a Force,Couple,Varignon'sTheorem,Resultant of Coplanar Non-Concurrent Force System.

EQUILIBRIUM OF SYSTEM OF FORCES:Equilibrium of a Body Subjected toConcurrent Forces and Non-concurrent Forces, Free Body Diagrams,Lami's Theorem, Equilibrium of Connected Bodies.

UNIT-II

FRICTION: Introduction, Types of Friction, Laws of Friction, Angle of Friction, Angle of Repose, Problems on blocks resting on horizontal and inclined planes -Ladder friction.

UNIT - III

CENTROID AND CENTRE OF GRAVITY: Concept of Centroid and Centre of gravity, Centroid of simple figures from basic principles, Centre of gravity of simple bodies.

AREA MOMENT OF INERTIA: Theorems of Moment of Inertia, Determination of Moment of Inertia of Circle, Rectangle, Hollow Circle, Semi Circle, Triangle from basic principles.

MASS MOMENT OF INERTIA: Radius of gyration, Determination of Mass Moment of Inertia of Uniform Rod, Rectangular Plate, Circular Plate, Solid Cone, Solid Sphere, Solid Cylinder.

UNIT –IV

KINEMATICS:

Rectilinear Motion, Motion Curves, Motion with Uniform Velocity, Motion with Uniform Acceleration.

PROJECTILES: Definitions, Motion of a Body Projected Horizontally, Inclined projection on Level Ground, Inclined Projection with Point of Projection and Point of Strike at Different Levels.

UNIT – V

KINETICS:

Bodies in Rectilinear Translation, Bodies in Curvilinear Translation, Kinetics of Bodies Rotating about Fixed Axis.

WORK ENERGY METHOD:

Equation for Translation, Motion of Connected Bodies, Kinetic Energy of Bodies in Fixed Axis Rotation.

TEXT BOOKS

1. S.S. Bhavikatti, Engineering Mechanics, 4thedition, New Age International (P) Ltd, 2012.
2. N.H.Dubey, Engineering Mechanics, McGraw Hill, 2013.

REFERENCES

1 Ferdinand. L. Singer, Engineering Mechanics, 3rd edition, Harper – Collins, 1994
2. B.Bhattacharya, Engineering Mechanics, 1stedition, Oxford University Press, 2008
3. A.K.Tayal, Engineering Mechanics, 14thedition, 2ndreprint, Umesh Publications, 2012.
4. R.K.Bansal, Engineering Mechanics, 3rd edition, Laxmi Publications, 1996.
5. Manoj K Harbola, Engineering Mechanics, 2nd edition, CEng age Learning, 2012.

B.Tech. (II Sem.)	17FE64 - APPLIED CHEMISTRY LAB	L	T	P	Cr.
		-	-	2	1

Pre-requisites : Knowledge of volumetric titration.

Course Educational Objectives:

The primary objective of Applied Chemistry is to make the students analyze water sample for hardness and alkalinity. It makes the students to perform and distinguish different types of volumetric titrations. It also provides them with an overview of preparation of polymers. It makes the students to find important properties of fuels and lubricants for their effective use.

Course Outcomes: After completion of the course, the students will be able to

CO1: Assess quality of water based on the procedures given.
CO2: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus.
CO3: Acquire practical knowledge related to preparation of polymers.
CO4: Exhibit skills in performing experiments based on theoretical fundamentals.

Introduction

1. Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis, etc.
2. Preparation of standard solutions, concept of standardisation of solutions, dilution to get solution of required normality.
3. Model experiment - Determination of amount of HCl using standard Na_2CO_3 solution.

Water analysis

4. Determination of alkalinity of water sample**.**
5. Determination of total hardness of water by EDTA method.
6. Determination of permanent hardness of water by EDTA method.

Preparation of polymers

7. Preparation of Urea Formaldehyde resin.
8. Preparation of Phenol Formaldehyde resin.

Redox titrations

9. Estimation of Mohr's salt by using potassium permanganate.
10. Estimation of Mohr's salt by using potassium dichromate.
11. Estimation of $KMnO_4$ by using Oxalic acid.

Demonstration Experiments

12. Determination of pH of the given sample solution/ soil using pH meter.
13. Determination of turbidity of the given sample water.

Fuels

14. Determination of flash and fire points of a given fuel/lubricant.
15. Determination of cloud and pour point of a given fuel/lubricant.
16. Determination of Aniline point of a given lubricant.

REFERENCES

Lab manual

B.Tech. (II Sem.)	17EE72 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB	L	T	P	Cr.
		-	-	2	1

Pre-requisites: Basic Electrical and Electronics Engineering (17EE50).

Course Educational Objective : This lab course enables the student to demonstrate the knowledge of electrical and electronic equipment and analysis of electric circuits. It also deals with plotting characteristics of basic semiconductor devices and digital logic gates.

Course Outcomes: At the end of the course, the student will be able to :

CO1: Analyze electrical circuits for both DC and AC excitations

CO2: Demonstrate the usage of various electrical and electronic components

CO3: Operate BJT under different configurations and explore how it works as an amplifier and switch

LIST OF EXPERIMENTS

Cycle-1

1. Identify and test different types of passive elements (R, L, C).
2. Study of fluorescent lamp and determination of choke-coil parameters.
3. Verification of Kirchhoff's Laws (KCL and KVL.).
4. Verification of Maximum Power transfer theorem.
5. Measurement of active & reactive powers in a series R-L/R-C circuit.
6. Calculation of Resonant frequency, Bandwidth, Quality factor for parallel RLC resonant circuits (Series and Parallel).
7. Pre-determination of single phase transformer performance using O.C. and S.C. tests.

Cycle-II

1. Determine the peak value, frequency, time period of different alternating wave forms.
2. Plot the V-I characteristics of a p-n junction diode.
3. Plot the V-I characteristics of Zener diode.
4. Plot the input/output and transfer characteristics of a transistor in CE configuration.
4. Calculation of ripple factor for full wave rectifier.
5. Plot the input/output characteristics of a CE amplifier.
6. Verification of basic logic gates using truth tables.

Note: **Conduct any five experiments from each cycle.**

B.Tech. (II Sem.)	17ME61 - ENGINEERING MECHANICS AND FUEL TESTING LAB	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Engineering Mechanics, Applied Chemistry

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to demonstrate the concepts of engineering mechanics & fuels through experiments.

COURSE OUTCOMES: At the end of the course, the student will be able to :
CO1 : Verify the laws of Mechanics.

CO2 : Evaluate the force in the mechanical systems.

CO3 : Estimate the dynamic characteristics of fuel using Viscosity and Flash & Fire point data.

CO4 : Determinecalorific-value of fuels.

LIST OF EXPERIMENTS:

At least 10 experiments are to be conducted

1) Verification of polygon law of forces using Universal-Table apparatus.
2) Verification of Lami's Theorem.
3) Study of the equilibrium of parallel forces using Beam Reaction apparatus.
4) Verification of principle of moment with the help of Bell crank lever Apparatus.
5) Evaluation of the forces in the members of Truss Apparatus.
6) Determination of coefficient of friction between the two materials using Tilting-plane method.
7) Verification of Newton's second law.
8) Determination of viscosity of given oil using Saybolt Viscometer.
9) Determination of Calorific value of given fuel using Junkers Gas Calorimeter.
10) Determination of viscosity of given oil using Red-wood-II Viscometer.
11) Determination of viscosity of given oil using Englers Viscometer.
12) Determination of Flash and Fire point of given oil using ABELS Apparatus.
13) Determination of Calorific value of given fuel using BOMB Calorimeter.

REFERENCES:

Lab-Manual

COURSE ARTICULATION MATRIX (Correlation between COs and POs and PSOs)

B.Tech. (II Sem.)	17ME62 - COMPUTER AIDED ENGINEERING GRAPHICS LAB	L	T	P	Cr.
		1	-	2	2

PRE-REQUISITES : Engineering Graphics, Mathematics, Physics

COURSE EDUCATIONAL OBJECTIVE:

The main objectives of this course are to familiarize various commands used in Auto-CAD and to visualize the isometric and orthographic views of any solid object.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Understand the Auto-CAD basics and apply to solve practical problems used in industries where the speed and accuracy can be achieved.
CO2: Understand the principle of Orthographic projections of points, lines, planes and solids.
CO3: Familiarize with the sectioning of solids and development of surfaces.
CO4: Convert orthographic to isometric vice versa.

At least 10 Exercises are to be conducted using Auto Cad software:

BASIC AUTO CAD COMMANDS:

1. Basic drawing commands (line, circle, arc, ellipse, polygon, and rectangle).
2. Edit commands (copy, move, erase, zoom).
3. Array commands (polar array, rectangular array, P-edit, divide a line, offset).
4. Hatching &line commands (hatching with different angles& different types of lines).
5. Mirror & trim commands (mirror an object, trim, extend a line, chamfer& fillet, explode).
6. Dimensioning & text commands (linear, angular, radius, diameter& text).

PROJECTION OF POINTS AND LINES:

1. Projection of points (I, II, III, & IV quadrants).
2. Projection of lines parallel to both reference planes.
3. Projection of lines parallel to one reference plane & inclined to other reference plane.

PROJECTION OF PLANES AND SOLIDS:

1. Projection of planes parallel to one reference plane & perpendicular to other reference plane.
2. Projection of planes inclined to one reference plane& perpendicular to other reference plane.
3. Projection of solids in simple position.
4. Projection of solids with axes inclined to one reference plane & parallel to other.

SECTION OF SOLIDS & DEVELOPMENT OF SURFACES

1. Sectioning of simple solids like prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section
2. Development of lateral surfaces of simple solids – Prisms, pyramids, cylinders, cube and cones

ORTHOGRAPHIC PROJECTIONS:

1. Conversion of plane objects.
2. Conversion of circular objects.
3. Conversion of both combination of plane figures and circular objects.

ISOMETRIC PROJECTIONS:

- Conversion of plane objects.
- Conversion of circular objects.
- Conversion of both combination of plane figures and circular objects.

REFERENCES

1. M. Kulkarni, A.P Rastogi, and A.K. Sarkar, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, 2009.
2. Bethune, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, 2009.
3. N. D. Bhatt, Engineering Drawing, 51th Revised and Enlarged Edition, Charotar Publishers, 2012.

B.Tech. (III Sem.)	17FE07 - NUMERICAL METHODS AND FOURIER ANALYSIS	L	T	P	Cr.
		3	2	-	4

Pre-requisites : None

Course Educational Objective : The main objective of this course is to enable the students learnNumerical Techniques for solving the equations, interpolation, differential equations and fitting of various cuves. They will also learn about the Fourier analysis of single valued functions.

Course Outcomes : At the end of the course, the student will be able to :

CO1: Compare the rate of accuracy between various methods in approximating the root of theequation and Distinguish among the criteria ofselection and procedures of various Numerical Integration Rules.

CO2: Estimate the best fit polynomial for the given tabulataed data using the methods of Newton's Interpolation formulae and Lagrange's Interpolation.

CO3: Apply various Numerical methods in solving the initial value problem involving the ordinary differential equation.

CO4: Estimate the unknown dependent variables using curve fitting methods..

CO5: Generate the single valued functions in the form of Fourier series and obtain the Fourier Transforms

UNIT – I

Solution of Algebraic and Transcendental Equations and Numerical Integration

Solutions of Algebraic and Transcendental Equations – RegulaFalsi method and Newton Raphson Method in one variable.

Numerical Integration

Trapezoidal rule – Simpson's 1/3 Rule –Simpson's 3/8 Rule.

UNIT – II

Interpolation and Finite Differences

Interpolation: Introduction – Finite differences- Forward Differences- Backward Differences-Central differences – Symbolic relations and separation of symbols-Differences of a polynomial-Newton's formulae for interpolation – Lagrange's Interpolation formula.

UNIT – III

Numerical solution of Ordinary Differential Equations

Numerical solution of Ordinary Differential equations, Solution by Taylor's series - Picard's Method of successive approximations - Euler's Method - Runge- Kutta Methods.

UNIT – IV

CURVE FITTING

Curve fitting by the principle of Least Squares: Fitting of a straight line – Second degree parabola-other polynomial curves-Fitting of exponential curves –Fitting of a power curve

UNIT – V

Fourier Series and Fourier Transforms

Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval– Half-range sine and cosine series

Fourier Transforms

Fourier integral theorem (only statement) – Fourier transform – sine and cosine transforms – properties.

TEXT BOOKS

1. S. S. Sastry, "*Introductory Methods of Numerical Analysis*", 5th Edition, PHI, New Delhi, 2005.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH, New Delhi, 2010.

REFERENCES

1. B.S. Grewal , "*Higher Engineering Mathematics*", 42ndEdition, Khanna Publishers, New Delhi, 2012.
2. Steven. C. Chopra, Ra. P. Canale, "*Numerical Methods for Engineers with programming and software application*",4th Edition, TMH, New Delhi, 2002.
3. M. K. Jain, S. R. K. Iyengar, R.K. Jain, "*Numerical Methods for Scientific and Engineering Computation*", 5th Edition, New Age International Publishers, New Delhi, 2007.

B.Tech. (III Sem.) 17ME05 - METALLURGY AND MATERIAL SCIENCE

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Applied Mathematics, Engineering Physics, Engineering Chemistry

COURSE EDUCATIONAL OBJECTIVE: The objectives of this course are to acquire knowledge on structure of metals and alloys, understand the concept of alloys and equilibrium diagrams; demonstrate the concept of heat treatment process.

COURSE OUTCOMES: After completion of the course students will be able to:
CO1: Estimate the properties of the metals and alloys based on structures.
CO2: Classify, construct and analyze equilibrium diagrams.
CO3: Analyze and distinguish various ferrous, non-ferrous metals and alloys.
CO4: Identify the influence of mechanical working and heat treatment principles on materials.
CO5: Classify, analyze and suggest the suitable manufacturing method for composite materials.

UNIT – I
STRUCTURE OF METALS: Crystal structures-Body centred cubic, Face cantered cubic, closed packed hexagonal, crystallographic planes. Mechanism of crystallization of metals, grain and grain boundaries, Effect of grain boundaries on the properties of metal / alloys – Determination of grain size.
CONSTITUTION OF ALLOYS: Necessity of alloying, Solid solutions-Interstitial Solid Solution and Substitution Solid Solution, Hume Rothery rules.

UNIT – II
EQUILIBRIUM DIAGRAMS: Experimental methods of construction of equilibrium diagrams, Classification of equilibrium diagrams- isomorphous, eutectic, partial eutectic equilibrium diagrams.
EQUILIBRIUM DIAGRAMS FOR TRANSFORMATIONS: Equilibrium cooling and heating of alloys, lever rule, coring. Transformations in the solid state – allotropy, eutectic, eutectoid, peritectoid reactions. Study of Cu-Ni and Bi-Cd equilibrium diagrams.
FERROUS METALS AND ALLOYS: Study of Iron-Iron carbide equilibrium diagram.

UNIT – III
STEEL: Classification of steels, structure, properties and applications of plain carbon steel, low carbon steel, medium carbon steel and high carbon steel.
CAST IRONS: structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, spheroidal graphite cast iron.
NON-FERROUS METALS AND ALLOYS: structure, properties and applications of copper and its alloys, Aluminium and its alloys.

UNIT – IV
MECHANICAL WORKING: Hot working, Cold working, Strain hardening, Recovery, Recrystallisation and Grain growth. Comparison of properties of cold and hot worked parts.
HEAT TREATMENT OF ALLOYS: Annealing, normalizing and hardening. Construction of TTT diagram for eutectoid steel. Harden ability-determination of harden ability by jominy end quench test. Surface - hardening methods and age hardening treatment and application.

UNIT - V

COMPOSITE MATERIALS: Classification of composites, various methods of component manufacture of fiber reinforced composites-Hand layup process, Filament winding process, SMC processes, Continuous pultrusion processes, Resin transfer moulding.

METAL MATRIX COMPOSITES: Introduction to metal ceramic mixtures, Metal – Matrix composites and C – C composites and applications.

TEXT BOOKS:

1. V.D.Kotgire, S.V.Kotgire, Material Science and Metallurgy, Everest Publishing House, 24th Edition, 2008.
2. Sidney H. Avener, Introduction to Physical Metallurgy, Tata McGraw-Hill, 3rdEdition, 2011.

REFERENCES:

1. Richard A.Flinn, Paul K.Trojan, Engineering Materials and Their Applications, Jaico Publishing House, 4thEdition, 1999.
2. William and callister, Materials Science and engineering, Wiley India private Ltd., 2011.
3. U.C Jindal and AtishMozumber, Material since and metallurgy, Pearson education- 2012

B.Tech. (III Sem.)	17AE01 - ENGINEERING FLUID MECHANICS	L	T	P	Cr.
		3	-	-	3

Prerequisites: Nil

Course Educational Objectives: To demonstrate the properties of fluids and behavior of fluids under static conditions, differential relations for fluid flows, features of flow though pipes and to understand the working of Hydraulic turbines and Hydraulic pumps.

Course Outcomes: At the end of the course, the student will be able to

CO1: Analyze the forces acting on objects submerged in fluids under static conditions.
CO2: Apply differential relations to characterize the behavior of fluid flow.
CO3: Apply the conservation laws to solve elementary fluid flow problems**.**
CO4: Design simple pipe network for fluid transportation as per the requirements.
CO5: Examine the performance of various hydraulic turbines and pumps.

UNIT - I

INTRODUCTION: Fluids and Continuum, Classification of Fluids, Properties of Fluid – Pressure, Temperature, Density, Specific Weight, Specific Gravity, Viscosity-Newton's Law of Viscosity, Compressibility, Surface Tension, Capillarity, Vapour Pressure,

Fluid Statics: Pressure Acting at a Point in a Static Fluid-Pascal's Law, Basic Equation of Fluid Statics-Hydrostatic Pressure Distribution, Hydrostatic Forces on Submerged Plane Surfaces, Manometers, Buoyancy and Stability, Hydostatic pressure distribution in earth's atmosphere

UNIT - II

ANALYSIS OF FLUID FLOW: Eulerian and Lagrangian Approaches, Velocity Field, Flow Patterns- Pathline, Streamline, Streakline, Timeline, Stream Tube.

DIFFERENTIAL RELATIONS FOR FLUID FLOW: Acceleration Field of a Fluid, Differential Equation of Mass Conservation, Differential Equation of Linear Momentum, Euler's Equation, Stream Function, Rotationality and Irrotationality, Vorticity, Velocity Potential, Potential Flow, Bernoulli Equation and its Applications-Venturi Meter, Orifice Meter, Limitations on the Use of Bernoulli Equation.

UNIT - III

FLOW THROUGH PIPES: Introduction, Reynolds Experiment, Head Loss, Darcy-Wiesbach Equation, Hydraulic Gradient and Total Energy Lines, Laminar Fully Developed Pipe Flow-Hagen Poiseuille Law, Moody Chart, Pipes in Series, Equivalent Pipe, Pipes in Parallel, Minor Losses, Hydraulic Diameter.

DIMENSIONAL ANALYSIS AND SIMILARITY: Introduction, Principle of Dimensional Homogeneity, Buckingham's Pi Theorem, Dimensionless Groups, Similarity.

UNIT IV

HYDRAULIC TURBINES: Introduction, Classification of Turbines- Impulse and Reaction Turbines, Pelton Turbine, Francis Turbine and Kaplan Turbine-Working Principle, Velocity Triangles, Work Done and Efficiency, Draft Tube.

PERFORMANCE OF HYDRAULIC TURBINES: Geometric Similarity, Unit and Specific Quantities, Characteristic Curves, Governing of Turbines, Cavitation, Surge Tank, Water Hammer.

UNIT V

RECIPROCATING PUMPS: Classification, Working Principle, Co-Efficient of Discharge and Slip, Indicator Diagram.

CENTRIFUGAL PUMPS: Classification, Working Principle, Work Done, Head and Efficiencies, Losses, Specific Speed, Pumps in Series and Parallel, Performance Characteristics.

TEXT BOOK

1. White. F.M, Fluid Mechanics, Seventh Edition, McGraw-Hill Education 2011.
2. Balachandran P, Engineering Fluid Mechanics, Prentice Hall of India, 2012.

REFERENCES

1. Rathakrishnan. E, Fluid Mechanics an Introduction, Third Edition, Prentice Hall of India, 2012.
2. Fox. R.W, Mcdonald, A.J, Introduction of Fluid Mechanics, Fifth Edition, John Wiely, 1999.
3. Douglas. J.F, Gesiorek. J.M., Swaffield. J, A., Fluid Mechanics, Fourth Edition, Pearson Education, 2002.
4. Shames. I.H, Mechanics of Fluids, Third Edition, McGraw-Hill, 1992.

B.Tech. (III Sem.)	17AE02 - ENGINEERING THERMODYNAMICS	L	T	P	Cr.
		3	-	-	3

Prerequisites: Nil

Course Educational Objectives: To learn the basic concepts of energy conversions, laws of thermodynamics, concept of entropy, the properties of different gas mixtures and pure substances and basic aspects of ideal thermal cycles.

Course Outcomes: At the end of the course, the student will be able to

CO1: Describe the thermodynamic properties of various systems.
CO2: Apply the laws of thermodynamics to analyze various thermal systems.
CO3: Analyze the entropy change of various processes.
CO4: Analyze the properties of different gas mixtures and pure substances.
CO5: Analyze ideal gas power cycles and refrigeration cycle to estimate various performance parameters.

UNIT - I

BASIC CONCEPTS AND DEFINITIONS: Introduction, Macroscopic and Microscopic View Point, Continuum, System-Closed and Open, Control Volume, Properties of System, State, Path, Process, Cycle, Equilibrium-Thermodynamic Equilibrium, Quasi Static Process, Temperature-Temperature Scales, Zeroth Law of Thermodynamics, Energy-Forms of Energy, Heat, Work, Mechanical Forms of Work, Path and Point Functions.

UNIT - II

FIRST LAW OF THERMODYNAMICS: Introduction, Joule's Experiment, First Law Analysis Of Closed System, Different Forms of Stored Energy –Energy Balance, Internal Energy, Specific Heat, Enthalpy, Conservation of Mass, Conservation of Energy Principle-Flow Work.

FIRST LAW ANALYSIS OF CONTROL VOLUME- The Steady Flow Process-Steady Flow Energy Equation, Steady Flow Engineering Devices-Nozzles and Diffusers, Turbine, Compressors, Throttling Valves, Heat Exchangers.

UNIT - III

SECOND LAW OF THERMODYNAMICS: Introduction, Thermal Energy Reservoirs, Heat Engines, Kelvin-Plank &Clasius Statements of Second Law of Thermodynamics, Refrigerators, Heat Pumps, Equivalence of Kelvin-Plank and Clasius Statements, Perpetual Motion Machines, Reversible and Irreversible Processes, Carnot Cycle, Carnot Principles, Absolute Thermodynamic Temperature Scale, The Carnot Heat Engine, Heat Pump and Refrigerator.

ENTROPY: Introduction Entropy- The Property of a System,Clasius Inequality, Principle of Increase of Entropy, Tds-Relations, Entropy Change for Solids and Liquids, Entropy Change for Ideal Gases, Isentropic Relations for Ideal Gases, Maxwell Relation, Third Law of Thermodynamics.

UNIT – IV

NON REACTIVE GAS MIXTURES: Introduction, Composition of Gas Mixture, Mass Fraction, Mole Fraction, Daltons Law of Additive Pressures, Amagat`s Law of Additive Volumes, Ideal Gas Mixtures.

PROPERTIES OF PURE SUBSTANCES: Introduction, Phases of Pure Substance, Phase Change Processes-Saturated Liquid, Saturated Vapour, Super-Heated Vapour, Property Diagrams- Pressure-Volume, Pressure-Temperature, Temperature-Entropy, Enthalpy-Entropy, Pressure-Volume-Temperature Surface, Dryness Fraction-Saturated Liquid Vapour Mixture.

UNIT - V

GAS POWER CYCLES: Introduction, Analysis of Power Cycles- Carnot, Otto, Diesel, Dual, And Brayton Cycles.

REFRIGERATION CYCLES: Reversed Carnot Cycle, Bell-Coleman Cycle, SimpleVapour Compression Cycle.

TEXT BOOK

1. Rathakrishnan. E, Fundamentals of Engineering Thermodynamics, Second Edition, Prentice Hall of India, 2010.

REFERENCES

1. Nag. P.K, Engineering Thermodynamics- Fifth Edition, McGraw-Hill, 2013.
2. Cengel. Y.A and Boles, M.A, Thermodynamics: An Engineering Approach, Seventh Edition, McGraw-Hill, 2011.
3. Sonntag. R. E, Borgnakke. C, VanWylen. G. J, Fundamentals of Thermodynamics, Fifth Edition John Wiley & sons, publications Inc, 1998.

B.Tech. (III Sem.)	17AE03 - STRENGTH OF MATERIALS	L	T	P	Cr.
		3	-	-	3

Prerequisites: Engineering Mechanics

Course Educational Objectives: To learn the basic concepts of stress, strain and relations based on linear elasticity, shear force and bending moment diagrams on beams, theory of simple bending and torsion.

Course Outcomes: At the end of the course, the student will be able to

CO1: Analyze the stress and strain behavior in different types of members under various load conditions.

CO2: Evaluate stress, shear force, bending moment, deflection for beams and torsion for circular shafts under different loading conditions.

CO3: Evaluate shear stress distributions over different cross sections.

CO4: Design structural members by applying the failure theories and concepts of principle stresses.

CO5: Analyze internal stresses due to internal pressures in thin and thick cylindrical shells.

UNIT- I

SIMPLE STRESSES AND STRAINS: Stresses and Strains Due to Axial Force, Hooke's Law, Factor of Safety, Stepped Bars – Uniformly Varying Sections - Stresses in Composite Bars Due to Axial Force and Temperature - Strain Energy Due to Axial Force, Stresses Due to Sudden Loads and Impact. Lateral Strain: Poisson's Ratio - Change in Volume – Shear Stress - Shear Strain - Relationship Between Elastic Constants

UNIT - II

SHEAR FORCE AND BENDING MOMENT: Relationship Between Loading - Shear Force and Bending Moment - Shear Force and Bending Moment Diagrams for Cantilever, Simply Supported and Overhanging Beams Subjected to Concentrated Loads and Uniformly Distributed Loads Only - Maximum Bending Moment and Point of Contra Flexure.

UNIT - III

STRESSES IN BEAMS: THEORY OF SIMPLE BENDING: - Introduction-Pure Bending-Theory of Simple Bending with Assumptions - Derivation of The Bending Equation-Bending Stresses in Symmetric Sections – Section Modulus - Calculation of Normal Stresses Due to Flexure Application.

TORSION: Theory of Torsion and Assumptions - Derivation of the Torsion Equation, Polar Modulus, Power Transmitted by a Shaft, Stresses in Solid and Hollow Circular Shafts

UNIT – IV

SHEAR STRESSES: Introduction,Derivation of Shear Stress Distribution Formula – Shear Stress Distribution Across Various Beam Cross Sections Like Rectangular, Circular, Triangular, I and T Sections.

PRINCIPAL STRESSES: State of Stress at a Point-Principal Plane-Principal Stresses- Normal, Tangential and Resultant Stresses On Inclined Planes-Member Subjected to Direct Stress in One Plane, Two Mutually Perpendicular Planes- Two Mutually Perpendicular Planes with Simple Shear. Failure Theories**:** Maximum Stress Theory – Maximum Strain Theory – Maximum Shear Stress Theory –Distortion Energy Theory – Maximum Strain Energy Theory

UNIT – V

DEFLECTION OF BEAMS: Introduction to Deflection, Deflection and Slope of Beams Subjected to Point Load And Uniformly Distributed Load-Differential Equation of Elastic Line - Deflection of Statically Determinate Beams-Simply Supported Beam, Cantilever Beam, Overhang Beam with Point Load And Uniformly Distributed Load - Macaulay's Method for Prismatic Members - Area Moment Method for Stepped Beams with Concentrated Loads.

Thin, Thick Shells: Introduction- Thin Cylindrical Vessel Subjected to Internal Pressure- Stresses Due to Internal Pressure- Hoop and Longitudinal Stresses -Efficiency of Joint- Stresses in a Thick Cylindrical Shell-Lame's Equations.

TEXT BOOK

1. Ramamrutham. S, Narayanan R, Strength of Materials, Dhanpat Rai & Sons, 2017.

REFERENCES

1. Popov. E. P, Mechanics of Materials, Prentice Hall Inc, 1976.
2. Andrew. P, Singer F.L., Strength of Materials, Harper and Row Publishers, New York, 1987.
3. Gambhir. M. L, Fundamentals of Solid Mechanics, PHI Learning, 2009.
   Subramanian. R, Strength of Materials, Second Edition, Oxford University Press, 2010.

B.Tech. (III Sem.)	17AE04 - ELEMENTS OF AEROSPACE ENGINEERING	L	T	P	Cr.
		3	-	-	3

Prerequisites: Nil

Course Educational Objectives: To learn the components of airplane and different types of flight vehicles, the basic aspects of aerodynamics and airfoils, the elements of propulsive systems, function of structural components in wing and fundamental aspects of flight vehicle in space.

Course Outcomes: At the end of the semester, the student will be able to
CO1: Describe functions of various external and internal components of an airplane.
CO2: Classify the various forces and moments acting on an airfoil.
CO3: Describe the working principles of various aircraft engines systems.
CO4: Describe the basic aspects of space flight.

UNIT - I
BASIC ASPECTS: History-Early Planes, Components of Airplane and Their Functions, Types of Flight Vehicles, Classifications, Standard Atmosphere, Altitude, Hydrostatic Equation, Geopotential and Geometric Altitudes

UNIT - II
BASIC AERODYNAMICS: Introduction – Airfoils - Airfoil Nomenclature, Classifications of NACA Airfoils, Wing Geometry, Aerodynamic Forces, Lift, Drag and Moment Coefficients, Co-Efficient of Pressure, Centre of Pressure, Aerodynamics Centre, Pressure Distribution Over Aerofoil, Types of Drag.

UNIT - III
PROPULSION: Introduction, Propeller, Reciprocating Engine, Jet Propulsion-The Thrust Equation, Elements of Turbojet Engine-Turbofan Engine-Rocket Engine, Rocket Propellants-Liquid Propellants, Solid Propellants, Rocket Staging

UNIT - IV
FLIGHT VEHICLE STRUCTURES: Introduction, Fuselage-Monocoque, Semi-Monocoque Structures, Components of Wing-Spars, Ribs, Longerons, Stringers, Bulkheads, Aircraft Materials-Metallic and Non-Metallic Materials, Use of Aluminium Alloy, Titanium, Stainless Steel and Composite Materials.

UNIT - V
SPACE FLIGHT: Introduction, Orbit Equation, Basic Aspects of Space Vehicle Trajectories, Kepler's Laws, Earth and Planetary Entry,Space Explorations- Space Vehicles and Its Types, Reusable Space Vehicles, Space Shuttle, Satellites, Types of Satellites and Their Functions.

TEXT BOOK
1. Anderson. J. D, Introduction to Flight, Eighth Edition, McGraw-Hill Education, 2017.

REFERENCES
1. Houghton. E. L., Carpenter P.W., Aerodynamics for Engineering Students, Seventh Edition, Butterworth-Heinemann, 2017.
2. Kermode. A. C, Mechanics of Flight, Eleventh Edition, Pearson Education, 2007.

B.Tech. (III Sem.)	17AE60 - BASIC SIMULATION LAB	L	T	P	Cr.
		-	-	2	1

Prerequisites: Nil

Course Educational Objectives: To give overview on LabVIEW and National Instruments Software. A background on how the LabVIEW interface looks like. To learn how to navigate the graphical programming language environment and introduce some of its analysis capabilities

Course Outcomes: At the end of the semester, the student will be able to
CO1: Write the simple executable programs for a given engineering task.
CO2: Perform simple debugging techniques.
CO3: Make decisions in LabVIEW programming.
CO4: Create an executable file with LabVIEW.

LIST OF LAB PROGRAMS:

1. Perform basic arithmetic operations using LabVIEW.
2. Debugging a VI.
3. Converting a VI into a Sub VI
4. Creating an executable file from VI.
5. Performing Boolean operations using LabVIEW.
6. Finding the sum of ‘n’ numbers using for loop.
7. Performing the factorial of a given number using for loop.
8. Finding the sum of n natural numbers using while loop.
9. Performing the factorial of a given number using while loop.
10. Sorting even numbers using while loop in an array.
11. Searching and replacing a string.
12. Finding the maximum and minimum variable from an array.

B.Tech. (III Sem.)	17ME67 - FLUID MECHANICS AND HYDRAULIC MACHINERY LAB	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Engineering Mechanics Lab

COURSE EDUCATIONAL OBJECTIVE:
In this course student will learn about the insights of calculating the discharge in various flow measuring devices, performance parameters of hydraulic machines.

COURSE OUTCOMES: After completion of the course students are able to:
CO1: Tuning flow discharge measuring devices used in pipes channels and tanks.
CO2: Compute flow equations to solve control volume analysis problems in fluid mechanics.
CO3: Determine the laminar and turbulent boundary layer fundamentals in fluid flow problems.
CO4: Develop capability to apply conservation principles to hydraulic machines.

LIST OF EXPERIMENTS
At least 10 Experiments are required to be conducted
1. Verification of Bernoulli's Theorem
2. Calibration of Venturi meter
3. Calibration of Orifice meter.
4. Determination of friction factor for a given pipe line
5. Determination of loss of head due to sudden contraction in a pipeline
6. Determine Co-Efficient of Impact of jets on Vanes.
7. Performance Test on Pelton Wheel.
8. Performance Test on Kaplan Turbine.
9. Performance Test on Single Stage Centrifugal Pump.
10. Performance Test on Reciprocating Pump.
11. Determination Of Co-Efficient of flow using Turbine flow meter.
12. Flow visualization using Reynolds experiment.
13. Flow Visualization study using Water Flow Channel

REFERENCE: Lab Manual

L	T	P	Cr.
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B.Tech. (III Sem.) **17AE61 - STRENGTH OF MATERIALS LAB**

Prerequisites: Engineering Mechanics and Strength of Materials

Course Educational Objectives: To learn the methods to predict the response of a structure under loading and it susceptibility to various failure modes

Course Outcomes: At the end of the semester, the student will be able to
CO1: Analyze the various materials under different equilibrium loading conditions.
CO2: Perform tests and analyze materials subjected to tension, torsion, bending, and bucking.

Any of the ten experiments are required to be conducted

1. Tension test on mild steel rod.
2. Deflection test on Simply supported beam
3. Deflection test on Cantilever beam.
4. Deflection test on overhang beams.
5. Compression test on helical spring.
6. Torsion test on mild steel rod.
7. Impact test on metal specimen
   i) Izodii)Charpy.
8. Brinell hardness test on metals.
9. Rockwell Hardness test on metals
10. Shear test on metals
11. Bending test on solid metal specimen
12. Bending test on hollow metal specimen

B.Tech. (III Sem.)	17PD03 - PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	Cr.
		3	-	-	0

Pre requisite: Basic Sciences and Humanities

COURSE EDUCATIONAL OBJECTIVES:

1. To create an awareness on engineering ethics and human values.
2. To adumbrate the inevitability of different intellectual property rights like patents, copyrights, trademarks, and trade secret.
3. To give an impetus on achieving higher positions in profession, with ethical and human values as a base and support for the growth.
4. To explicate the professional and societal responsibilities of the engineers.
5. To make the student realize the sensitiveness associated with experimentation process

COURSE OUTCOMES: At the end of the course, the student

CO1 : Acquires the basic concepts of human values & also gain the connotations of ethical theories.

CO2: Knows the basic concepts of Professional ethics and handling Dilemma in decision making.

CO3: Knows the duties and rights towards the society in an engineering profession

CO4: Would realize the importance and necessity of intellectual property rights.

CO5: Can take all the necessary precautions while conducting the experiments, which may reduce the risk.

UNIT –I: **ETHICS**

Senses of 'Engineering Ethics' -Variety of moral issues - Types of inquiry -Moral dilemmas Moral autonomy -Kohlberg's theory Gilligan's theory -Consensus and controversy – Models of Professional Roles -Theories about right action- Self interest - Customs and religion -Uses of Ethical theories.

UNIT - II: HUMAN VALUES

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning - Civic Virtue –Respect for Others–Living Peacefully – Caring – Sharing - Honesty – Courage– Valuing Time - Cooperation – Commitment – Empathy – Self Confidence – Character – Spirituality

UNIT – III: ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation- Engineering Projects VS. Standard Experiments - Engineers as responsible experimenters – Codes of ethics - Industrial Standards - Abalanced outlook on law- The challenger case study.

UNIT – IV: SAFETYAND RESPONSIBILITIES

Safety and risk- Assessment of safety and risk- Risk benefit analysis and reducing risk- Three Mile Island and Chernobyl case study - Collegiality and loyalty -Respect for authority- Collective bargaining – Confidentiality- Conflicts of interest- Occupational crime-Professional Rights-Employee Rights –Intellectual Property Rights(IPR) discrimination.

UNIT – V: GLOBAL ISSUES

Multinational Corporation’s -Environmental ethics-computer ethics -weapons development Engineers as managers - consulting engineers-engineers as expert witnesses and advisors, Moral leadership - sample code of Ethics (Specific to a particular Engineering Discipline).

TEXT BOOKS

1. R.S.Nagarajan, a Textbook on "Professional Ethics and Human Values", New Age Publishers – 2016.
2. Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York 1996.
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M. Jayakumaran- Laxmi Publications.
4. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.

REFERENCES

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/ Prentice Hall, New Jersey,2004 (Indian Reprint now available)
3. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available).
4. John R Boatright, "Ethics and the conduct of business", Pearson Education, New Delhi,2003.
5. Edmund G Seebauer and Robert L Barry, "Fundamentals of ethics for scientists and engineers", Oxford University Press, Oxford, 2001.
6. "Fundamentals of ethics for scientists and engineers" Edmund G Cseebauer and Robert L Barey,Oxford University Press, 2001.
7. "Text book on Intellectual Property rights", N K Acahrya, Asian Law House, 7th edition,2014.
8. "An Introduction to Intellectual Property Rights", Dr.J.P.Mishra,Central law House, 3rd edition,2012.

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B.Tech. (IV Sem.) **17FE03 - ENVIRONMENTAL SCIENCE**

Pre-requisites : None

Course Educational Objective :

To provide a general background on developing an understanding of systems and cycles on the earth and how individual organisms live together in complex communities.

To enable the students in understanding how human activities influence our air, water and soil and it also helps in developing a right attitude about our use of fossil fuels and effect on climate and sustainable management of natural resources.

Course Outcomes: At the end of the course, the student will be able to :

CO1: Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions.

CO2: Evaluate local, regional and global environmental issues related to resources and their sustainable management.

CO3: Identify the importance of ecosystem and biodiversity for maintaining ecological balance.

CO4: Acknowledge and prevent the problems related to pollution of air, water and soil.

CO5: Interpret the significance of implementing environmental laws and abatement devices for environmental management.

UNIT – I

Nature and scope of Environmental Problems

- Introduction, components of Environment
- Scope and importance of environmental studies
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environment and human health
- HIV-AIDS
- Environmental ethics
- Role of Information Technology in environmental management and human health

UNIT – II

Natural Resources and Conservation

- Introduction and classification of Natural Resources
- Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people
- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, interlinking of rivers, dams-benefits and problems. Rain water harvesting, watershed management
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, soil salinity
- Energy resources: Growing energy needs renewable, non-renewable and alternate energy resources

UNIT – III

Ecology and Biodiversity

- Definition, structure and functions of an ecosystem
- Food chains and Food webs, Ecological succession, Ecological pyramids

- Biogeochemical cycles, Major Types of Ecosystems – Forest, Grassland, Desert Land & aquatic Ecosystem, Ecological Niche and Keystone Species
- Definition and levels of measuring biodiversity - genetic, species, community and ecosystem diversity
- Bio geographical classification of India
- India as a mega diversity nation
- Values of biodiversity- Direct and Indirect values
- Threats to biodiversity; Man and wild life conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation methods

UNIT – IV

Environmental Pollution

- Introduction to Environmental Pollution Causes, effects and control measures of:
- Air pollution
- Water pollution
- Soil pollution
- Noise pollution
- Nuclear hazards
- Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste
- Environmental Issues relating to Climate change, global warming, acid rain, ozone layer depletion
- Disaster Management- Floods, Cyclones, Earthquakes, Landslides and Tsunamis.

UNIT – V

Environmental Management

- Sustainable development and unsustainability
- Stockholm and Rio Summit
- Environmental Impact Assessment (EIA)
- Green building
- Consumerism and Waste products
- Carbon credits and carbon trading
- Environmental Law- Air, Water, Wild life, Forest, and Environmental protection act

TEXT BOOKS

1. Anubha Kaushik, C.P.Kaushik, "Perspectives in Environmental Studies", New age international publishers, Delhi, 5nd edition,2016.
2. MahuaBasu, S.Xavier, "Fundamentals of Environmental Studies", Cambridge University Press, Delhi, 1st edition, 2016.

REFERENCES

1. S.Deswal, A. Deswal, "A Basic course in Environmental Studies", Educational & Technical Publishers, Delhi, 2nd Edition, 2014.
2. R. Rajagopalan, "Environmental Studies (From Crisis to Cure)", Oxford University Press, New Delhi, 3rd Edition, 2012.
3. De, A.K, "Environmental Chemistry", New Age International (P) Limited, New Delhi,5th Edition, 2003.
4. Dr.K.V.S.G. Murali Krishna, "Environmental Studies", VGS Techno Series, Vijayawada, 1st Edition,2010.
5. G. Tyler Miller, Scott Spoolman, "Introduction to Environmental Studies", Cengage Learning, New Delhi,13th Edition, 2009.

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3	2	-	4

B.Tech. (IV Sem.) **17FE08 - PROBABILITY AND STATISTICS**

Pre-requisites : None

Course Educational Objective : The objective of this course is to intoduce the probability and its distributions, sampling methods and estimation. They also learn various tests of hypothesis and evaluation of correlation and regression analysis.

Course Outcomes : At the end of the course, the student will be able to :

CO1: Predict various probabilistic situations based on the laws of probability and random variables.

CO2: Distinguish among the criteria of selection and application of Binomial, Poisson, Normal and Exponential distributions.

CO3: Estimate the point and interval estimators of mean and proportion for the given Sample data.

CO4: Apply various sample tests like Z-test, t-test, F-test and $\chi 2$-test for decision making regarding the population based on sample data.

CO5: Estimate the level of correlation, the linear relationship using the regression lines for the given bivariate data.

UNIT - I :

PROBABILITY AND RANDOM VARIABLES

Conditional probability – Multiplication theorem-Baye's theorem.

Random variables – Discrete and continuous Random Variables, distribution function. Mathematical Expectation of Univariate Random Variable.

UNIT –II

PROBABILITY DISTRIBUTIONS

Discrete Probability Distributions: Binomial distribution and Poisson distribution. Continuous Probability Distributions: Normal distribution and Exponential distribution. Related properties, simple applications.

UNIT –III

SAMPLING DISRIBUTION AND ESTIMATION

Population and sample, Sampling distribution of mean (with known and unknown variance), and variances. Sampling distribution of sums and differences. Point estimation and interval estimation for mean and proportions.

UNIT –IV

TESTS OF HYPOTHESIS

Null and Alternative Hypothesis, One tail and two tailed tests,Type I and Type II errors. Testing of hypothesis concerning means, proportions and their differences using Z-test. Tests of hypothesis using Student's t-test, F-test and χ^2-test.

Applications of decision making using the above tests.

UNIT –V

CORRELATION AND REGRESSION

Simple Bivariate Correlation: Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient. Linear Regression: Regression lines, Regression coefficients, properties of Regression coefficients.

TEXT BOOKS

1. Miller, Freund, "*Probability and Statistics for Engineers*", 8th edition, PHI, New Delhi, 2011.
2. S.C.Gupta, V.K.Kapoor, "*Fundamentals of Mathematical Statistics*", 11th Edition, Sultan Chand and sons, New Delhi, , 2014.

REFERENCES

1. Jay L. Devore, "*Probability and Statistics for engineering and the sciences*", 8th Edition, Cengage Learning India, New Delhi, 2012.
2. William W. Hines, "*Probability and Statistics in Engineering*", 4th edition, John Wiley and Sons, New Delhi, 2003.
3. T.K.V. Iyangar, "*Probability and Statistics*", 4th revised Edition, S. Chand and Company, New Delhi, 2012.
4. B.V. Ramana, "*Higher Engineering Mathematics*", 1stEdition, TMH, New Delhi, 2010.

B.Tech. (IV Sem.)	17AE05 - THERMAL ENGINEERING	L	T	P	Cr.
		2	2	-	3

Pre-requisites: Engineering Thermodynamics

Course Educational Objectives: To learn the working of different components in I.C. engines, working of various air refrigeration systems, properties of moist air, various air conditioning systems, vapor power cycles and elements of steam power plant

Course Outcomes: At the end of the semester, the student will be able to
CO1: Describe the functions of various components and systems of I.C engines.
CO2: Describe the functions of air refrigeration systems.
CO3: Analyze the properties of moist air and methods to condition the air.
CO4: Differentiate the variousmethods to improve performance of vapour power cycle.
CO5: Describe the functions of various elements steam power plant.

UNIT - I
INTERNAL COMBUSTION ENGINES: Classification, Components of Spark Ignition and Compression Ignition Engines, Four Stroke and Two Stroke Engines, Valve and Port Timing Diagrams, Air-Fuel Mixture, Simple Carburettor, Fuel Injection System in Compression Ignition Engines, Ignition Systems, Engine Lubrication System, Performance of I.C Engines

UNIT – II
REFRIGERATION: Introduction, Types of Refrigeration Systems-Air Refrigeration System-Simple Air Cooling System-Simple Air Evaporative Cooling System - Boot-Strap Air Evaporative Cooling System -Reduced Ambient Air Cooling System -Regenerative Air Cooling System

UNIT – III
PSYCHROMETRICS: Introduction, Properties of Atmospheric Air, Humidity of Air, Properties of Moist Air, Psychometric Charts.
AIR-CONDITIONING: Air Conditioning Processes - Types of Air Conditioning Systems - Summer Air Conditioning-Winter Air-Conditioning-Year Round Air-Conditioning

UNIT – IV
VAPOUR POWER CYCLES: Introduction- Carnot Vapour Power Cycle, Simple Rankine Cycle, Actual Vapour Power Cycle, The Efficiency of Rankine Cycle- Lowering Condenser Pressure, Super Heating the Steam to High Temperature, Increasing Boiler Pressure, Ideal Reheat Rankine Cycle, Ideal Regenerative Rankine Cycle, Supercritical Rankine Cycle

UNIT – V
STEAM POWER PLANT:
Steam Boilers - Fire Tube Boilers- Water Tube Boilers, Draught, Steam Nozzles - Types of Steam Nozzles-Steam Flow Through a Nozzle, Steam Turbines:Introduction-Working Principle of a Steam Turbine – Classification - The Simple Impulse Turbine- Reaction Turbine - Velocity Triangles - Compounding of Impulse Turbine-Reaction Turbine, Steam Condensers - Introduction, Elements of Condensing Plant, Types of Condensers

TEXT BOOKS

1. Rathore. M. M,Thermal Engineering, Tata McGraw-Hill Education, 2010
2. Eastop. T.D, McConkey. A, Applied Thermodynamics, Fifth Edition, Pearson Education, 2009.

REFERENCES

1. Joel. R, Basic Engineering Thermodynamics, Fifth Edition, Pearson Education, 2008.
2. Choudhury. T. R, Basic Engineering Thermodynamics, 2nd Edition, Tata McGraw-Hill, 2000.
3. Nag. P. K, Power Plant Engineering, 3rd Edition, Tata McGraw-Hill, 2013.

B.Tech. (IV Sem.)	17AE06 - MANUFACTURING TECHNOLOGY	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Nil

Course Educational Objectives: To learn primary manufacturing processes, working of basic machines and various operations to be performed and also about unconventional machining processes

Course Outcomes:
CO1: To acquire knowledge of the basic aspects of casting process.
CO2: To know the various basic concepts of welding process.
CO3: To apply metal forming process and sheet metal operations in the manufacturing of products.
CO4: To apply various lathe operations to manufacture products.
CO5: To apply different types machining operations while manufacturing a product.
CO6: To Apply different unconventional machining processes while manufacturing a product.

UNIT - I
INTRODUCTION TO MANUFACTURING: Historical Perspective; Importance of Manufacturing; Classification of Manufacturing Processes; Engineering Materials.
CASTING: Steps Involved in Making a Casting- Advantages of Castings and Its Applications – Pattern Making- Types of Patterns- Materials Used for Patterns- Pattern Allowances and Their Constructions-Principles of Gating, Gating Ratio, Types of Raisers, Casting Defects, Special Casting Processes – Centrifugal – Die - Investment – Continuous.

UNIT - II
WELDING: Welding and Other Joining Processes: Classification of Welding Process- Types of Weld- Welded Joints and Their Characteristics- Principle and Applications- Gas Welding- Arc Welding- Welding Defects; Inert Gas Welding- TIG and MIG Welding; Friction Welding, Induction Welding, Soldering and Brazing.

UNIT - III
METAL FORMING PROCESSES: Rolling Fundamentals- Theory of Rolling, Types of Rolling Mills and Products; Principles of Forging - Tools and Dies – Types of Forging-Smith Forging, Drop Forging-Drawing and Its Types- Wire Drawing and Tube Drawing.
EXTRUSION OF METALS: Basic Extrusion Process and Its Characteristics, Hot Extrusion and Cold Extrusion –Forward Extrusion and Backward Extrusion, Impact Extrusion, Hydrostatic Extrusion.

UNIT - IV
MACHINING PROCESSES: Mechanism of Chip Formation; Tool Geometry; Cutting Tool & Tool Wear- Cutting Materials; Tool Life & Machinability - Cutting Fluids; Introduction to Lathe- Working Principle of Lathe and Operations

UNIT - V
SHAPING, PLANNING, MILLING AND DRILLING MACHINES: Principles of Working, Principle Parts, Specifications, Classification, Comparison and Operations Performed.
INTRODUCTION TO UNCONVENTIONAL MACHINING PROCESSES: Need for Unconventional Machining Methods, Classification of Unconventional Machining Processes. Abrasive Jet Machining, Ultrasonic Machining, Electrical Discharge Machining, Laser Beam Machining.

TEXT BOOK

1. Ghosh. A, Malik. A. K, Manufacturing Science, Second Edition, East West Publisher, 2010.
2. Kalpakjain. S, Schmid. S. R, Manufacturing Processes for Engineering Materials, 6th Edition, Pearson Education, 2017.

REFERENCES

1. Rao. P. N, Manufacturing Technology, Volume 1, Tata McGraw-Hill, 2013.
2. Jain. R. K, Production Technology, Khanna Publishers, 2001.
3. Lindberg. R. A, Process and materials of manufacturing, Allyn and Bacon, 1990.
4. Sarma P C., A Textbook of Production Technology, S. Chand & Company Ltd, 2009.
5. Raghuvamsi. B.S, Workshop Technology, Volume-I, Dhanpat Rai and Sons, Delhi, 2001.

B.Tech. (IV Sem.)	17AE07 - AERODYNAMICS - I	L	T	P	Cr.
		2	2	-	4

Pre-requisites: Engineering Fluid Mechanics

Course Educational Objective: To learn the theoretical methods to solve the potential flow problems, potential flow theory to solve for airfoil characteristics, the finite wing theory and properties of viscous flows and boundary layer development over flat plate.

Course Outcomes: At the end of the semester, the student will be able to
CO1: Apply Laplace equation for obtaining 2D and axisymmetric solutions.
CO2: Apply conformal transformation to from aerodynamic shapes.
CO3: Apply potential flow theory to solve for airfoil characteristics.
CO4: Apply the Prandtl's lifting line theory to predict finite wing properties.
CO5: Analyze the effect of boundary layer on flow over objects.

UNIT - I
POTENTIAL FLOW: Introduction,Laplace's Equation,Basic Flows – Uniform Parallel Flow, Source, Sink, Simple Vortex, Doublet, Combination of Simple Flows-Flow Past a Half Body, Rankine Oval, Flow Past a Circular Cylinder without Circulation and with Circulation, Kutta-Joukowsky Theorem

UNIT - II
CONFORMAL TRANSFORMATION: Introduction, Basic Principles, Methods for Performing Transformation, Kutta-Joukowski Transformation, Transformation of Circle to Straight Line, Transformation of Circle to Ellipse, Transformation of Circle to Symmetrical Aerofoil, Transformation of Circle to Cambered Aerofoil

UNIT - III
THIN AEROFOIL THEORY: Introduction, Aerofoil Characteristics, Vortex Sheet, Kutta Condition, Kelvin's Circulation Theorem, Starting Vortex, Thin Aerofoil Theory-Symmetrical Aerofoil and Cambered Aerofoil.

UNIT - IV
FINITE WING THEORY: Introduction, Down Wash, Induced Drag, Trailing Vortex,Vortex Filament, Biot-Savart Law and Helmholtz Theorems, Prandtl's Classical Lifting Line Theory-Elliptic Lift Distribution, General Lift Distribution.

UNIT - V
BOUNDARY LAYER: Introduction, Boundary Layer Development, Boundary Layer Thickness, Displacement Thickness, Momentum Thickness, Energy Thickness, Types of Boundary Layer, Momentum Integral Estimates- Karman Analysis of the Flat Plate, Boundary Layer Equations-2D Flow, Boundary Layer Growth On a Flat Plate-Blasius Solution, Boundary Layer with Pressure Gradient

TEXT BOOK
1. Anderson, J.D., Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York,1998.

REFERENCES
1. Rathakrishnan. E, Theoretical Aerodynamics, Wiley, 2013.
2. Houghton. E.L., Carpenter P. W, Collicott. C. H, Valentine. D. T, Aerodynamics for Engineering students, Seventh Edition, Elseveir, 2017.
3. Milne-Thomson. L. H., Theoretical aerodynamics, Courier Corporation, 2012.
4. Clancy. J. L, Aerodynamics, Sterling Book House, 2006.

B.Tech. (IV Sem.)	17AE08 - AIRCRAFT STRUCTURES - I	L	T	P	Cr.
		2	2	-	3

Pre-requisites: Engineering Mechanics and Strength of Materials

Course Educational Objectives: To learn the basic aspects of elasticity, characteristics of statically determinate and indeterminate structures, energy methods and theorem applicable to beams and trusses, behavior of columns under loading conditions

Course Outcomes: At the end of the semester, the student will be able to
CO1: Solve problems related to elastic members by applying stress-strain relations
CO2: Analyze the behavior of beams, frames and trusses under various loading conditions
CO3: Analyze the statically indeterminate structures under various loading conditions
CO4: Evaluate the strain energy stored in the structural members
CO5: Analyze the buckling of columns and compressive member under various loading conditions

UNIT - I
BASIC ELASTICITY: Concept of Principal Planes-Principal Stresses-Determination of Normal and Tangential Stresses-Mohr's Circle. Basic Elasticity Stresses and Strains, Equations of Equilibrium, Plane Stress and Plane Strain Problems, Compatibility Equations, Stress - Strain Relations, Airy's Stress Function.

UNIT - II
STATICALLY DETERMINATE STRUCTURES: Introduction,Principle of Superposition, Equations of Equilibrium,Determinacy and Stability, Beams, Frames, - Types of Frames-Reactions of Supports of a Frame- Analysis of Plane Truss - Method of Joints- Method of Sections- Plane Frames.

UNIT - III
STATICALLY INDETERMINATE STRUCTURES: Introduction**,** Methods for Indeterminate Beams, Double Integration Method, Propped Cantilever- Fixed-Fixed Beams-Continuous Beams Carrying Point Load And Uniformly Distributed Load- Shear Force and Bending Moment Diagrams, Clapeyron's Three Moment Equation – Moment Distribution Method-Relative Stiffness –Continuous Beams.

UNIT - IV
ENERGY METHODS: Strain Energy Due to Axial Loading, Strain Energy Due to Bending– Strain Energy Stored by A Beam Subjected to Uniform Bending Moment- Work Done by A Force On a Member-Law's of Reciprocal Deflections- Castigliano's First Theorem-Castigliano's Second Theorem -Maxwell's Reciprocal Theorem, Unit Load Method - Application to Beams and Trusses.

UNIT – V
Columns: Introduction- Axially Loaded Compression Members-Crushing Load- Buckling Load-Euler's Theory-Effective Length of Column-Expressions for Buckling Load With Different Column End Conditions- Limitations-Euler's Formula- Rankine's Formula –Column with Initial Curvature- Columns Subjected to Eccentric Loading – Euler's Method- Rankine's Method.

TEXT BOOKS

1. Timoshenko. S, Strength of Materials, Vol. I and II, Princeton D. Vonostrand Co, 1990.
2. Megson. T.M. G, Aircraft Structures for Engineering Students, Sixth Edition, Elsevier, 2007.

REFERENCES

1. Donaldson. B. K,Analysis of Aircraft Structures-An Introduction, McGraw-Hill, 1993.
2. Bruhn.E. F, Analysis and design of flight vehicle structures, Tri set of offset Company, USA, 1973
3. Punmia. B. C, Theory of Structures, Laxmi Publication.
4. Ramamrutham. S, Narayanan. R,Theory of Structures, Dhanpat Rai Publishing Co, 2003.

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B.Tech. (IV Sem.) **17ME69 - THERMAL ENGINEERING LAB**

Prerequisite: ICGT, Thermal Engineering

Course Objectives: The main objective of this course is to familiarize the principles and its evaluation of various performance parameters of mechanical systems and its impact on global environment.

Course Outcomes: After the completion of the course, students should be able to

CO1: Estimate various fuel characteristics through experimental testing.
CO2: Analyze the performance characteristics of Internal Combustion Engines
CO3: Evaluate the performance parameters of refrigeration and air conditioning systems
CO4: Draw the characteristic curves for the air compressors

LIST OF EXPERIMENTS (Any 10 experiments):

1. I.C. Engines Valve & Port Timing Diagrams
2. Performance Test on Variable Compression Ratio single cylinder 4-Stroke petrol Engine By using Eddy Current Dynamometer
3. Test on single cylinder 4 -Stroke Diesel Engine by using Mechanical Dynamometer
4. Evaluation of performance parameters of twin cylinder 4-stroke diesel engine.
5. Determination of performance characteristics of 2-Stroke Petrol Engine.
6. Evaluation of engine friction power by conducting Morse test on Multi cylinder 4-Stroke Petrol Engine.
7. Heat Balance of 4 stroke single cylinder diesel engine
8. Performance Test on Reciprocating Air – Compressor.
9. Determination of COP of Vapour Compression Refrigeration Unit.
10. Performance Test on Air Conditioning Unit.
11. Demonstration of automobile working components.
12. Measurement of exhaust emissions and smoke of I.C Engines.
13. Solar parabolic concentrator apparatus
14. Determination of calorific value of fuel using bomb calorimeter.

References:

Thermal engineering lab manuals.

B.Tech. (IV Sem.)	17AE62 - MANUFACTURING TECHNOLOGY LAB	L	T	P	Cr.
		-	-	2	1

Pre-requisites: Engineering workshop

Course Educational Objectives:
The objectives of the course are to provide hands-on laboratory experience to acquire basic knowledge in the area of casting, welding and its equipment, lathe machine and special machine operations.

COURSE OUTCOMES: After completion of the course students are able to:
CO1: Design and develop a product using casting.
CO2: Fabricate machine components with suitable welding, lathe and other machining operations.
CO3: Manufacture plastic components using various plastic processing techniques.

I. METAL CASTING LAB
1. Pattern Design and making - for one casting drawing.
2. Moulding, Melting and Casting - 1 Exercise

II. WELDING LAB
1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 2 Exercises

III PROCESSING OF PLASTICS
1. Injection Moulding
2. Blow Moulding

IV MACHINE TOOLS LAB
1. Lathe Operations
2. Special Machines: Drilling, Shaping, Milling Grinding (Surface Grinding).
3. Preparation of Single Point Cutting Tool

B.Tech. (IV Sem.)	17ME66 - COMPUTER AIDED MACHINE DRAWING LAB	L	T	P	Cr.
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PRE-REQUISITES: Engineering Graphics, CAEG.

COURSE EDUCATIONAL OBJECTIVE:
The main objectives of the course are to familiarize the basic conventions and various machine elements used in design and to understand the assembly drawings for engine parts, machine parts, valves etc.

COURSE OUTCOMES: After completion of the course students are able to:
CO1: Develop and/or comprehend basic conventions needed for machine drawing
CO2: Apply the conventions of machine elements while designing standardized parts
CO3: Apply the ideas and make design calculations correctly.
CO4: Design the drawings of mechanical components and their assemblies

I.MACHINE DRAWING CONVENTIONS
Need for drawing conventions – introduction to IS conventions
a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs and ribs.
b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views, Parts not usually sectioned.
c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centres, curved and tapered features.
d) Title boxes, their size, location and details - common abbreviations & their liberal usage e) Types of Drawings – working drawings for machine parts.

II.DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS
1. Sections of Solids: Introduction, Sections prisms, Pyramids, Cylinders and cones
2. Selection of views, additional views for the following machine elements and parts with every drawing proportion.
a) Popular forms of screw threads, bolts, nuts, stud bolts, tap bolts and set screws.
b) Keys, cottered joints and knuckle joint.
c) Riveted joints for plates
d) Shaft coupling, spigot and socket pipe joint.
e) Journal, pivot and collar and foot step bearings.

III.ASSEMBLY DRAWINGS
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.
a) Engine parts – Stuffing box, Cross head, Eccentric, Connecting rod, Piston assembly.
b) Other machine parts - Screws jack, Bench Vice, Pipe vice, Plummer block, Tailstock.

List of Tasks:

S. No	Name of the task	No. of Periods
1	Drawing commands	3
2	Editing commands	3
3	Dimensioning commands, Layers	3
4	Principles of Drawing: Title block, Borders, scales and their specifications	3
5	Lines and sections and Dimensioning principle	3
6	Conventional Representation of Materials	3
7	Conventional Representation of Machine components-I	3
8	Conventional Representation of Machine components-II	3
9	Thread Profiles	3
10	single and multi-start threads, left and right hand threads	3
11	Bolts and Nuts: Hexagonal and square headed nuts and bolts;	3
12	Flanged Nut, Dome Nut, Ring Nut, Washer, Lock Nut, Castle Nut, Eye Foundation Bolt	3
13	Cotter Joint with socket and Spigot Ends	3
14	Cotter Joint with Gib	3
15	Riveted Joints: Rivet heads; Double strap diamond butt Joint	3
16	Double riveted chain Lap joint; double riveted double strap zigzag butt joint	3
17	Keys: Taper Key, Sunk Taper Key, Round Key, Saddle Key, Feather Key, Splined Shaft, Woodruff Key	3
18	Shaft Couplings: Bushed pin type flange coupling	3
19	Universal Coupling	3
20	Assembly Drawings: Any four of the following: Stuffing Box of Steam Engine, Eccentric of Steam Engine, Connecting Rod of an IC Engine, Screw Jack, Plumber Block, Tool Post of Lathe Machine	12

TEXT BOOKS

1. K.L.Narayana, P.Kannaiah& K. Venkata Reddy, Machine Drawing, 4th Edition New Age Publishers. 2004
2. P.S Gill, Machine Drawing, 18th Edition Eastern Publisher, 2013.

REFERENCES

1. N.Sidheshwar, Machine Drawing, 4th Edition, Tata McGraw Hill, 2001
2. Dhawan, Machine Drawing, revised edition, S.Chand Publications, 2002
3. K. C. JOHN, Machine Drawing 6th Edition, Stronck publishers, 2007
4. N.D.Bhatt, V.M.Panchal Machine Drawing Charotar Publishing House, 2005

B.Tech. (V Sem.)	17HS01 - ENGINEERING ECONOMICS AND ACCOUNTANCY	L	T	P	Cr.
		3	-	-	3

Prerequisite: Basic Sciences and Humanities

Course Objective: The objective of this course is to inculcate basic knowledge to students relating to concepts of Engineering Economics and Accountancy to make them effective business decision makers.

Other course educational objectives of this course:

1. To know the concepts of engineering economics and to make them effective business decision makers.
2. To understand the concepts of production and cost for various business decision.
3. To understand the different types of market, market structures & pricing strategies and their applications in business decision making.
4. To explain the strategies of raising and utilization of business capital.
5. To understand the Fundamental of accounting and analysis of accounting statements for managerial decision making.

Course Outcomes: After completion of the course, students will be able to

CO1: Capable of analyzing fundamentals of economics concepts which helps in effective business administration.
CO2: Discuss cost- output relationship in business operations.
CO3: Analyze the features of market structures and present the pricing policies.
CO4: Identify the types of Business organization of the company and the implementation requirements of each one.
CO5: Financial position of the company can be analyzing with the help of financial statements.

UNIT - I

Introduction to Engineering Economics: Economics – Definitions- Nature and Scope - Branches economics – Engineering Economics-features & Scope

Demand Analysis: Demand- Types of demand- Determinants- Law of Demand -Elasticity of demand – significance -Types of Elasticity of Demand.

Demand Forecasting-Types- Factor governing - Methods of demand Forecasting.

UNIT - II

Theory of Production and Cost Analysis: Production Function – Isoquant and Isocost, MRTS, Least Cost Combination of Inputs. Laws of Returns, Internal and External Economies of Scale.

Cost Analysis: Cost concepts, Cost & output relationship in short run & long run, Break-even Analysis (BEA)-Determination of Break-Even Point - Significance and limitations.

UNIT – III

Markets & Pricing Policies:

Market structures: Markets-Types of markets - Features and price out determinations under Perfect competition, Monopoly, Monopolistic Competition, oligopoly markets.

Pricing –Pricing polices &its Objectives – Pricing Methods and its applications in business.

UNIT - IV

Capital and Capital Budgeting: Capital and its significance-Types of Capital-Estimation of Fixed and Working capital –working capital -Components of working capital & Factors determining the need of working capital.- Sources of raising capital

Capital budgeting-Significance –Process- Techniques of Capital Budgeting (non-discounted cash flow techniques and discounted cash flow of techniques).

UNIT - V

Financial Accounting and analysis: Accounting –significance -- Book Keeping-Double entry system –Journal- Ledger- Trial Balance- Final Accounts with simple adjustments.

Financial Statement Analysis through ratios: Ratio-analysis of financial statement using different ratios (Liquidity -Profitability- Solvency -Activity ratios).

TEXT BOOK

Aryasri: Managerial Economics and Financial Analysis, MHE, 2014.

REFERENCES

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2003.
2. AmbrishGupta,Financial Accounting for Management, Pearson Education, New Delhi.
3. Lipey&Chrystel, Economics, Oxford University Press.
4. Domnick Salvatore: Managerial Economics in a Global Economy,4th Edition,Thomson.

B.Tech. (V Sem.)	17AE09 - ELEMENTS OF HEAT TRANSFER	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Engineering Fluid Mechanics, Engineering Thermodynamics

Course Educational Objectives: To learn the basic differential equations of heat transfer in conduction, convection, radiation, and to understand the LMTD, NTU concepts used in heat exchangers.

Course Outcomes: At the end of the semester, the student will be able to
CO1: Formulate heat conduction phenomenon through plane, cylindrical, and spherical surfaces
CO2: Solve practical problems of steady and unsteady state heat transfer
CO3: Analyse the convective heat transfer phenomenon in both external and internal flows
CO4: Understand the thermal radiation concepts
CO5: Design simple heat exchanger units of moderate capacity

UNIT - I
CONDUCTIVE HEAT TRANSFER: Basic Modes of Heat Transfer- Basic Laws of Heat Transfer-Applications of Heat Transfer- Heat Conduction-Fourier Law of Heat Conductive-Thermal Conductivity-General Heat Conduction Equation in Cartesian, Cylindrical and Spherical Coordinates and Its Simplification.
ONE- DIMENSIONAL STEADY STATE CONDUCTION: Heat Flow Through Plane Wall and Cylinder and Sphere with Constant Thermal Conductivity- Electrical Analogy-Thermal Resistance-Heat Flow Through Composite Wall and Cylinder - Critical Radius of Insulation for Cylinder- Uniform Internal Heat Generation in Slabs.

UNIT – II
EXTENDED SURFACES: Extended Surfaces- Analysis of Long Fin, Short Fin with Insulated Tip - Fin Efficiency and Effectiveness.
TRANSIENT HEAT CONDUCTION: Systems with Negligible Internal Resistance-Lumped Heat Capacity Analysis–Significance of Biot and Fourier Numbers-Plane Wall with Finite Surface and Internal Resistance Using Heisler Chart.

UNIT - III
CONVECTIVE HEAT TRANSFER: Introduction-Types of Convection- Convective Heat Transfer Coefficient- Significance of Non Dimensional Numbers
FORCED CONVECTION: External Flow-Laminar and TurbulentFlow Over a Flat Plate – Internal Flow Through Circular Pipe-Laminar and Turbulent Flows- Reynolds and Colburn Analogy
Natural Convection: Development of Hydrodynamic and Thermal Boundary Layer Along Vertical Plate- Empirical Correlations for Vertical Plate, Vertical Cylinder, Horizontal Plate and Horizontal Cylinder.

UNIT - IV
THERMAL RADIATION: Introduction-Nature of Thermal Radiation-Concept of Black Body –Laws of Black Body Radiation- Radiation Heat Exchange Between Two Black Isothermal Surfaces- View Factor- Heat Exchange Between Non-Black Infinite Parallel Plates- Radiation Shields

UNIT - V

HEAT EXCHANGERS: Introduction-Classification of Heat Exchangers, Parallel and Counter Flow -Flow Arrangement, Overall Heat Transfer Coefficient- Fouling Factor- LMTD Method of Heat Exchanger Analysis-Correction for LMTD for Use with Multi Pass and Cross Flow Heat Exchangers, Effectiveness - NTU Method of Heat Exchanger Analysis.

NOTE: Heat and Mass Transfer Data Book By C.P. Kothandaramanand Subramanian- New Age Publications Is To Be Allowed In Examination.

TEXT BOOK

1. Sachdeva. R.C, Fundamentals of Engineering Heat and Mass Transfer, Second Edition, New Age Intl. Publishers, 2005.

REFERENCES

1. Rathakrishnan. E, Elements of Heat transfer CRC press, New York, 2012.
2. Cengel. Y. A,Heat Transfer: A Practical Approach, McGraw-Hill, 2007.
3. Holman. J.P, Heat transfer, McGraw-Hill Higher Education, 2010.
4. Ghoshdastidar. P.S, Heat Transfer, Oxford University Press, 2012.

B.Tech. (V Sem.)	17AE10 - AERODYNAMICS-II	L	T	P	Cr.
		2	2	-	3

Pre-requisites: Engineering Fluid Mechanics, Engineering Thermodynamics, Aerodynamics – I

Course Educational Objectives:
To learn the basic concepts of compressible fluid flows, steady one-dimensional flow properties discharging from a reservoir, the supersonic flow properties, the basic formulation for flow with friction and heat transfer and the theoretical aspects of compressible flow over wings

Course Outcomes: At the end of the semester, the student will be able
CO1:apply the of compressible fluid flow equations to solve flow problems
CO2: To apply the steady one-dimensional flow principles in designing the nozzles and diffusers
CO3: To analyze the supersonic flow behaviour over objects
CO4: To design ducts for fluid flows by considering friction and heat transfer affects
CO5: To apply compressible flow theory to analyze flow over wings

UNIT - I
BASICS OF COMPRESSIBLE FLOW: Introduction, Compressibility, Basic Equations of Compressible Flow- Energy Equation, Isentropic Flow Relations, Stagnation Properties, Speed of Sound, Mach Number, Mach Cone, Wave Propagation

UNIT - II
STEADY ONE-DIMENSIONAL FLOW: Introduction, Fundamental Equations, Discharge from A Reservoir, Critical Values, Stream Tube Area-Velocity Relation, Types of Nozzles, Applications of Nozzles, Area-Mach Number Relation, Isentropic Flow Through Nozzles, Diffusers, Dynamics Head Measurement in Compressible Flow, Compressibility Correction to Dynamics Pressure, Pressure Coefficient

UNIT - III
SHOCK AND EXPANSION WAVES: Introduction, Types of Waves, Normal Shock- Equations of Motion, The Normal Shock Relations for Perfect Gas, Hugoniot Equation, Oblique Shocks- Relation Between β-θ-M, Shock Polar, Detached Shocks, Expansion Waves, Prandtl-Meyer Flow, Simple and Non-Simple Regions, Flow with Shocks and Expansion Waves at the Exit of a Convergent- Divergent Nozzle, Mach Angle, Mach Wave.

UNIT - IV
FLOW WITH FRICTION AND HEAT TRANSFER: Introduction, Flow in Constant Area Duct with Friction, Adiabatic Constant Area Flow of a Perfect Gas, Fanno Line Flow, Flow with Heating and Cooling in Ducts, Rayleigh Line Relation.

UNIT - V
COMPRESSIBLE FLOW OVER WINGS: Introduction, Potential Equation for Compressible Flow, Linearization of Potential Equation, Prandtl-Glauert Rule, Critical Mach Number, Drag-Divergence Mach Number, Area-Rule, Supercritical Aerofoil, Forward Swept and Swept Back Wings, Delta Wings

TEXT BOOK
1. Rathakrishnan. E, Gas Dynamics, Sixth Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2017

REFERENCES

1. Ascher H. Shapiro, The dynamics and thermodynamics of compressible fluid flow Vol 1, The Ronald press Co. New York, 1953
2. Lipmann. H. W, Roshko. A, Elements of Gas Dynamics, John Wiley & Sons, New York
3. Thomson P.A., Compressible Fluid Dynamics, McGraw-Hill, New York, 1972
4. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998.

B.Tech. (V Sem.)	17AE11 - PROPULSION – I	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Engineering Thermodynamics, Elements of Aerospace Engineering

Course Educational Objectives: To learn engineering concepts of jet engines, flow through subsonic and supersonic inlets of a jet engine, principle of operation of aircraft jet engines, fundamentals of combustion process.

Course Outcomes: At the end of the semester, the student will be able,
CO1: To analyze the performance characteristics of various jet engines.
CO2: To design subsonic and supersonic inlets for jet engines.
CO3: To analyze the performance characteristics of aircraft compressor.
CO4: To identify the parameters governing the design of combustion chambers.
CO5: To analyze the performance of turbines of jet engines.

UNIT - I
FUNDAMENTALS OF GAS TURBINE ENGINE: Working of Gas Turbine Engine,Characteristics of Turboprop, Turbofan, And Turbojet Cycle Analysis, Performance Characteristics, Thrust Equation - Factors Affecting Thrust — Methods of Thrust Augmentation.

UNIT - II
SUBSONIC AND SUPERSONIC INLETS: Introduction, Subsonic Inlets - Internal Flows - External Flow, Supersonic Inlets – Starting Problem On Supersonic Inlets - Shock-Swallowing - Flow Stability Problem.

UNIT - III
COMPRESSORS: Principle of Operation of Centrifugal Compressor – Work Done and Pressure Rise – Velocity Diagrams – Diffuser Vane Design Considerations – Concept of Prewhirl, Stall and Surge, Elementary Theory of Axial Flow Compressor – Velocity Triangles – Degree of Reaction, Compressor Blade Design, Centrifugal and Axial Compressor Performance Characteristics.

UNIT - IV
COMBUSTION CHAMBERS: Classification of Combustion Chambers, Combustion Process, Important Factors Affecting Combustion Chamber Design– Combustion Chamber Performance – Effect of Operating Variables on Performance, Flame Tube Cooling, Flame Stabilization, Use of Flame Holders, Fuel Injection System.

UNIT - V
TURBINES: Elementary Theory of Turbines - Impulse and Reaction Turbines, Axial Flow Turbine, Radial Flow Turbine, Velocity Triangles and Power Output, Estimation of Stage Performance, Turbine Performance Characteristics, Methods of Blade Cooling, Matching of Turbine and Compressor.

TEXT BOOK
1. Ganesan. V, Gas Turbines, Third Edition, Tata McGraw-Hill, New Delhi, 2018
2. Saravanamuttoo. H.I.H, Rogers. G. F. C, Cohen. H,Straznicky. P. V, Nix. A. C, Gas Turbine Theory, Seventh EditionPearson Education, 2018.

REFERENCES

1. Hill, P.G., Peterson, C.R. Mechanics & Thermodynamics of Propulsion, Addison – Wesley. Longman INC, 1999.
2. Mattingly.J.D, Elements of propulsion: Gas Turbines and Rockets, AIAA Educational Series
3. Rolls Royce Jet Engine, Third Edition, 1983.

B.Tech. (V Sem.) 17AE12 - AIRCRAFT SYSTEMS AND INSTRUMENTS

L	T	P	Cr.
3	-	-	3

Pre-requisites: Elements of Aerospace Engineering

Course Educational Objectives: To learn the conventional and modern control systems and working principle of different types of hydraulic and pneumatic systems, engine systems, auxiliary systems, and flight and navigation instruments used in an aircraft.

Course Outcomes: At the end of the semester, the student will be able

CO1: To identify the various types of controls in the airplane design
CO2: To understand the performance of hydraulic and pneumatic systems in the aircraftoperation
CO3: To analyze the performance of various engine systems of an aircraft
CO4: To employ necessary auxiliary systems in the operation of an aircraft
CO5: To employ various instruments necessary of the aircraft operation

UNIT - I

AIRPLANE CONTROL SYSTEMS: Conventional Control Surfaces – Power Assisted and Fully Powered Flight Controls – Power Actuated Systems, Engine Control Systems (FADEC), Push Pull Rod System – Operating Principles, Modern Control Systems – Digital Fly by Wire Systems – Auto Pilot System, Active Control Technology.

UNIT - II

AIRCRAFT SYSTEMS: Hydraulic and Pneumatic Systems - Study of Typical Workable System – Components – Advantages, Working Principles - Typical Air Pressure System – Brake System - Typical Pneumatic Power System - Components, Landing Gear Systems – Classifications (Air Oleo).

UNIT - III

ENGINE SYSTEMS: 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: 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, De-icing and Anti-Icing System.

UNIT - V

AIRCRAFT INSTRUMENTS: Flight and Navigation Instruments Principles and Operation – Accelerometers, Air Speed Indicators – Mach Meters – Altimeters - Gyroscopic Instruments, Study of Various Types of Engine Instruments Operation and Principles – Tachometers – Temperature Gauges – Pressure Gauge –.

TEXT BOOKS

1. McKinley. J. L, Bent. R.D, Aircraft Maintenance and Repair, McGraw-Hill, 1993.
2. General Hand Books of Airframe and Power Plant Mechanics, U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi1995.

REFERENCES

1. Mekinley. J. L, Bent. R. D, Aircraft Power Plants, McGraw-Hill, 1993.
2. Pallet. E. H. J, Aircraft Instruments & Principles, Pitman & Co, 1993.
3. Treager. S, Gas Turbine Engine Technology, Third Edition, McGraw-Hill Education.

B.Tech. (V Sem.)	17AE13 - THEORY OF MACHINES	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To understand the concepts of simple mechanisms, the effect of friction in various machine parts, the gear profiles, kinematics of gear trains and design of cams, the stability of moving vehicles, the aspects in static and dynamic balancing of masses.

Course Outcomes: At the end of the semester, the student will be able

CO1: To analyze the kinematics of linkages to determine position, velocity and acceleration variation throughout the range of motion

CO2: To analyze the performance of various power transmission systems

CO3: To design cams and gear trains to produce a desired motion

CO4: To analyze the static and dynamics stability of motor vehicles

CO5: To analyze the mechanical systems for static and dynamics balancing

UNIT - I

MECHANISMS: Machine, Structure, Kinematic Link- Pair and Chain,GrueblersCriteria – Constrained Motion, Degrees of Freedom, Four Bar Mechanism - Single and Double Slider Crank Chains – Inversions, Applications, Kinematic Analysis of Simple Mechanisms, Determination of Velocity and Acceleration - Four Bar and Single Slider Crank Mechanism Only.

UNIT - II

FRICTION: Introduction toFriction in Screw and Nut, Pivot and Collar, Thrust Bearing, Plate and Disc Clutches, Belt (Flat and V Type) and Rope Drives, Ratio of Tensions – Effect of centrifugal and Initial Tension,Condition for Maximum Power Transmission – Open and Crossed Belt Drive.

UNIT - III

GEARING: Gear Profile and Geometry, Nomenclature of Spur and Helical Gears Only, Gear Trains – Simple - Compound– Epicylic, Determination of Speed and Torque of Gear Trains.

CAMS: Cams – Types of Cams, Design of Profiles – Knife Edged - Flat Faced - Roller Ended Followers with and Without Offsets, Follower Motions – Simple Harmonic Motion – Uniform Velocity – Uniform Acceleration.

UNIT - IV

PRECISION: Effect of Precision On Stability of Moving Vehicles - Motorcar - Motorcycle - Aero Planes, Static and Dynamic Forces Generated Due to Precision - Moving Mechanisms - Gyroscopic Motions.

UNIT-V

BALANCING OF ROTATING MASSES: Static and Dynamic Balancing – Single and Several Masses in Different Planes

BALANCING OF RECIPROCATING MASSES: Primary Balancing and Concepts of Secondary Balancing – Single and Multi-Cylinder Engines (Inline) – Balancing of Radial V Engine – Direct and Reverse Crank Method.

REFERENCES

1. Rattan. S. S, Theory of Machines, Tata McGraw–Hill Publishing Co, New Delhi,2004.
2. Ballaney. P. L, Theory of Machines, Khanna Publishers, New Delhi, 2002.
3. Rao J. S., Dukkipati. R.V, Mechanism and Machine Theory, Second Edition, Wiley Eastern Ltd, 1992.
4. Malhotra. D.R, Gupta. H.C, The Theory of Machines, Satya Prakasam, Tech. India Publications, 1989.
5. Gosh. A, Mallick. A. K, Theory of Machines and Mechanisms, Affiliated East West Press, 1989.
6. Shigley. J. E, Uicker, J. J, Theory of Machines and Mechanisms, McGraw-Hill, 1980.
7. Burton Paul, Kinematics and Dynamic of Planer Machinery, Prentice Hall, 1979.

B.Tech. (V Sem.)	17ME22 - CAD/CAM	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Machine Drawing, Machine Design, Machine Tools

COURSE EDUCATIONAL OBJECTIVES: The main objective of this course is to familiarize the principles of geometric modelling, numerical control and part programming.

COURSE OUTCOMES: After completion of the course students are able to:

CO1: Comprehend the principles of CAD/CAM for design and manufacturing
CO2: Formulate mathematical equations for geometrical entities like curves, surface, and solids.
CO3: Program for part profiles to accomplish numerical control machining
CO4: Develop a pseudo codes for different parts using GT codes and apply in automated manufacturing systems.
CO5: Become cognizant about CAQC techniques that are to be applied in manufacturing industry and able to comprehend the applications of Computer Integrated Manufacturing.

UNIT - I

FUNDAMENTALS OF CAD: Introduction – The design process – The application of Computers for design- Benefits of CAD.

COMPUTER GRAPHICS: Raster scan graphics-Transformation of geometry: Translation, scaling, reflection, rotation, homogeneous transformations - Concatenated transformations.

UNIT – II

GEOMETRIC MODELING: **REPRESENTATION OF CURVES**: Introduction, wireframe models, wireframe entities, curve representation, parametric representation of analytical curves, parametric representation of Bezier and B-Spline curves.

REPRESENTATION OF SURFACES AND SOLIDS: Introduction to surfaces, surface models surface entities. Introduction to solids, solid models, solid entities, Fundamentals of solid modeling, Boundary representation, CSG representation, sweep representation.

UNIT – III

COMPUTER NUMERICAL CONTROL: Introduction – NC modes – NC elements -NC Coordinate systems – Structure of CNC Machine Tools – Spindle design –Spindle drives – Feed drives – actuation systems.

PART PROGRAMMING: Part programming Fundamentals – Manual part programming computer aided part programming: APT Language.

UNIT - IV

GROUP TECHNOLOGY: Introduction – part families – part classifications and coding – OPITZ system – MICLASS system – CODE system – GT Machine cells – Benefits of GT – CAPP: Retrieval type and generative type

FLEXIBLE MANUFACTURING SYSTEM: Introduction – FMS components – Benefits of FMS

UNIT - V

COMPUTER AIDED QUALITY CONTROL: Introduction –computers in QC – Contact Inspection methods – Non contact inspection methods: optical, non optical – Computer Aided Testing-Integration of CAQC with CAD/CAM.

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Introduction–Integration of CIM – Benefits of CIM – Lean manufacturing.

TEXT BOOKS

1. MikelP.Groover and Emory W.Zimmers, CAD/CAM-prentice Hall of India private Ltd.New Delhi, 20thedition, May 2010.
2. Ibrahim Zeid, Mastering CAD/CAM, TATA McGraw-Hill publishing CO.Ltd, New Delhi2011.

REFERENCES

1. P.N Rao,CAD/CAM Principle and applications, Tata McGraw Hill Education Private Ltd,New Delhi,8th edition 2013.
2. P.Radhakrishnan,S.Subramanyam&V.Raju,CAD/CAM/CIM,New Age International Publishers,3rd edition 2010.
3. MikelP.Groover,Automaiton,Production Systems and Computer Integrated Manufacturing, Prentice Hall of India private Ltd.New Delhi, 3rd edition, May 2008.
4. Ibrahim Zeid and R. Sivasubramanian, CAD/CAM theory and practice, Tata McGraw Hill publishing Co. Ltd,New Delhi 2009.
5. Tien-Chienchang, Richard A.Wysk and HSU-Pin (Ben) Wang, "Computer Aided Manufacturing", 3rd Edition, 2006

B.Tech. (V Sem.)	17AE14 - NON-DESTRUCTIVE TESTING	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To impart knowledge about the non-destructive testing (NDT) methods and selection of NDT methods based on components and its application in engineeringindustries.

Course Outcomes: At the end of the semester, the student will be able

CO1: To describe the working principles of non-destructive techniques and standard sample specifications

CO2: To identify and apply the suitable non-destructive techniques to detect the defects in any component

CO3: To describe the various safety measures while performing inspections

CO4: To apply special techniques to detect the defects in any component

UNIT I

SURFACE TECHNIQUES: Introduction to Non-Destructive Testing - Importance of NDT Techniques - Types of NDT Techniques - ASME, ASTM, AWS, BIS, SAE Standard Sample Specifications, Visual Testing (Direct and Remote Visual Inspection) - Principle and Types of Liquid Penetrant Tests (LPT) - Properties of Liquid Penetrants and Developers - Advantages and Limitations of LPT - Applications of LPT.

UNIT II

MAGNETIC PARTICLE TESTING: Introduction to Magnetic Particle Testing (MPT) - Magnetization Methods - Dry Particle and Wet Fluorescent Particle Techniques - Demagnetization - Advantages and Limitations of MPT, Magnetic Flux Leakage Testing - Principle, Instrumentation and Applications of Electromagnetic Induction Techniques and Eddy Current Testing (ECT) Method.

UNIT III

ULTRASONIC TESTING: Introduction to Ultrasonic Testing (UT) - Characteristics of Ultrasonic Waves - Principle of UT – UT Probes - UT Inspection Methods (Pulse Echo, Transmission and Phased Array Techniques, PAUT) -Types of Scanning and Displays - Application of UT for Welded Parts.

UNIT IV

RADIOGRAPHY TESTING: Introduction to Radiography Testing (RT) - Sources of X-Rays and Gamma Rays - Characteristics of X-rays and Gamma Rays (Absorption, Scattering) - Filters and Screens - Film Radiography and Digital Radiography (Shadow Formation, Exposure Factors, Film Handling and Storage) - Inverse Square Law - Exposure Charts - Penetrometers - Safety Issues.

UNIT V

SPECIAL TECHNIQUES: Acoustic Emission Testing (AET) Principle - Advantages, Limitations - Instrumentation and Application of AET, Infra-Red Thermography (IRT) - Contact and Non-Contact Inspection Methods - Pressure and Leak Detection, Laser Shearography, Acoustic Holography.

REFERENCES

1. Baldev Raj. Jayakumar. T, Thavasimuthu. M, Practical Non-Destructive Testing, NarosaPublishing, India, 2012.
2. ASM Metals Handbook, Volume-17, Non-Destructive Evaluation and Quality Control, AmericanSociety of Metals, Metals Park, Ohio, USA, 2001.
3. McGonnagle. W. T, Non-Destructive Testing, McGraw Hill Book Co., USA, 2013.
4. Cartz. L, Non-Destructive Testing, ASM International, Metals Park Ohio, US, 2007.
5. Hull. B and John. V, Non Destructive Testing, ELBS/Macmillan, Hampshire, UK,2015.
6. Mix. P. E, Introduction to Non Destructive Testing, A Training Guide, Wiley- Interscience, New Jersey, USA, June 2005.

B.Tech. (V Sem.)	17AE15 - UAV SYSTEM DESIGN	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To study the basic terminologies,the integration methods and subsystems to construct the UAVs and MAVs and the flight performance parameters of UAVs and MAVs.

Course Outcomes (COs): At the end of the semester, the student will be able
CO1: To understand the basic needs to design UAV and MAV.
CO2: To acquire the knowledge and importance of payload integration with UAV airframe.
CO3: To understand the advanced concept of UAV and MAV system design to the engineers.
CO4: To analyze the Performance of UAVs and MAVs subsystems for stable fly.

UNIT I
INTRODUCTION TO UAV AND MAV: Historical Background of UAV and MAV - Classifications Based On Range and Endurance –Basic Terminology-Models and Prototypes - Preliminary, Conceptual and Detailed Design Stages.

UNIT II
AIRFRAME DESIGN: Fixed Wing -Rotor -VTOL-STOL- Blimb Wing Airframe - Flapping Wing - Dynamics –Modeling Fuselage Structures -Airfoil Selection - Propeller Selection- Empennage Design -Flight Control Surfaces Specifications- Airframe Maintenance.

UNIT III
HARDWARE SUPPORT: Propulsion Unit - Selection of Motors and Battery-UAV and MAV Airframe Weight Calculations - Payloads -Autopilot Sensors-Servos-Accelerometer -Gyros-Actuators- Power Supply Processor, Integration, Installation, Configuration.

UNIT IV
POWER PLANT: Introduction, Classifications of Power Plant (Reciprocating Piston Engines, Wankle Rotary Engines, Propeller Based Engines, Gas Turbine Engines, and Electric Motor Based) – Working Principle – Conceptual decomposition - Technical Issues – Advantages and Disadvantages.

UNIT V
ASSEMBLING-INTEGRATION: Introduction, Assembling the UAV Empennage, Wiring and Servo Motors - Problems in Wiring Installation, Wings, RC- CONTROL TECHNIQUES

References
1. Leszek. C,Adamski. M, Power units and power supply systems in UAV, Taylorand Francis Group publishers, 2014.
2. Austin. R, Unmanned Air Systems: UAV Design, Development and Deployment, Wiley Publishers, 2015.
3. Skafidas, Microcontroller Systems for a UAV- Auto Piloting and Camera Triggering System, KTH, TRITA-FYS 2002:51 ISSN 0280-316X. 34, 2002.
4. Droneprep, Unmanned Aircraft Systems Logbook for Drone Pilots & Operators,CreateSpace Independent Publishing Platform, 2015.
5. Griffis, C., Wilson, T., Schneider, J, Pierpont, P, Unmanned Aircraft System Propulsion Systems Technology Survey, 2009, Retrieved fromhttp://commons.erau.edu/publication/72

B.Tech. (V Sem.)	17AE90 - AEROSPACE MATERIALS (Add On Course – I)	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To impart basic knowledge of aircraft materials and testing, NDT tools to identify the problems, and an overview of the composites materials used in modern aircraft.

Course Outcomes: At the end of the semester, the student will be able
CO1: To identify the materials suitable for various aircraft components
CO2: To analyze and assess aircraft materials subject to various types of defects.
CO3: To characterize various materials used in aircraft.
CO4: To describe the mechanical behaviours of composite materials used in aircrafts.

UNIT-I
INTRODUCTION: Properties of Flight Vehicle Materials, Importance of Strength/Weight Ratio of Materials for Aerospace Vehicles Structures, Importance of Temperature Variations, Factors Affecting Choice of Material for Different Parts of Airplane.

UNIT - II
AEROSPACE MATERIALS: Classical of Alloys Steels, Effect of Alloying Elements, Carbon Steel Versus Alloys Steels. Magnesium Alloys and Their Properties, Heat Treatment, Aluminium Alloys, High Strength and High Corrosion Alloys. Refractory Materials, Ceramics, Titanium and Its Alloys, Properties of Inconel Monal& K-Monal, Nimonic and Super Alloys; Application of These Alloys Aerospace Vehicles.

UNIT – III
OVERVIEW OF NDT: NDT Versus Mechanical Testing, Overview of The Non Destructive Testing Methods for The Detection of Manufacturing Defects as Well as Material Characterisation. Relative Merits and Limitations, Various Physical Characteristics of Materials and Their Applications in NDT, Visual Inspection – Unaided and Aided.

UNIT – IV
AEROSPACE COMPOSITE MATERIALS: Definition, Classification and Characteristics of Composite Materials - Fibrous Composites, Laminated Composites, Particulate Composites. Properties and Types of Reinforcement and Matrix Materials.

UNIT – V
ADVANCED PROCESSING TECHNIQUES AND APPLICATION OF COMPOSITES: Filament Winding, Pultrusion, Pulforming, Thermo - Forming, Injection, Injection Molding, Liquid Molding, Blow Molding, Automobile, Aircrafts, Missiles, Space Hardware, Electrical and Electronics, Marine, Recreational and Sports Equipment, Future Potential of Composites.

TEXT BOOKS
1. Titterton. G. F, Aircraft Material and Processes, Fifth edition, Himalayan Books, New Delhi, 2015.
2. Gupta. L, Advanced Composite materials, Himalayan Books, New Delhi, 1998.

REFERENCES
1. Gibson. R.F, Principles of Composite Material Mechanics, Fourth Edition, CRRC press, 2016.
2. Prakash. R, Non-Destructive Testing Techniques, New Age Science, 2009.

L	T	P	Cr.
-	-	2	1

B.Tech. (V Sem.) **17FE61 - PRESENTATION SKILLS LAB**

Pre-requisites: Students should have fundamental knowledge in making Conversations in English and be with readiness to speak

Course Educational Objective: To help students make oral presentations, power point presentations, participate in group discussions and Write project/research reports/technical reports/ formal letters by gathering information and organizing ideas relevantly and coherently.

Course Outcomes: At the end of the course, the student will be able to
CO1: Make power point presentations and oral presentations.
CO2: Use standard vocabulary contextually.
CO3: Manage skilfully through group discussions.
CO4: Negotiate skilfully for better placement.

Syllabus: English Communication Skills Lab (ELCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab** for 60 students with 60 systems, LAN facility and English language software for self- study by learners.
- **Interactive Communication Skills (ICS) Lab.** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo – audio & video system and camcorder etc.

Exercise – I
CALL Lab:
Understand: synonyms and antonyms, one-word substitutes, analogy, idioms and phrases.
ICS Lab:
Practice: Ice-Breaking Activity and JAM Session – Introducing Oneself – Extempore - Public Speeches.

Exercise – II
CALL Lab:
Understand: Features of Good Conversation – Strategies for Effective Communication.
ICS Lab: Group Discussion

Exercise – III
CALL Lab:
Understand: Data collection – Organizing data - Making Poster – Making slides.
ICS Lab:
Practice: Poster Presentation – Power Point Presentations.

Exercise – IV
CALL Lab:
Understand: Types of Résumé – Letter Writing.
ICS Lab:
Practice: Writing Résumé & Letters

Exercise – V
CALL Lab:
Understand: Reading comprehension – Listening Comprehension – scanning, skimming, reading between lines and critical reading.

ICS Lab:
Practice: Reading comprehension - Listening Comprehension – scanning, skimming, reading between lines and critical reading.

Exercise - VI
CALL Lab:
Understand: Interview Skills
ICS Lab:
Practice: Mock Interviews

Lab Manual:
Board of Editors, "ELCS Lab Manual – A Workbook of CALL and ICS Lab Activities", Orient Black Swan Pvt. Ltd., Hyderabad, 2016.

SUGGESTED SOFTWARE:
1. Digital Mentor: Globarena, Hyderabad, 2005
2. Sky Pronunciation Suite: Young India Films, Chennai, 2009
3. Mastering English in Vocabulary, Grammar, Spelling, Composition, Dorling Kindersley, USA, 2001
4. Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
5. Oxford Talking Dictionary, The Learning Company, USA, 2002
6. Learning to Speak English - 4 CDs. The Learning Company, USA,2002
7. Cambridge Advanced Learners English Dictionary (CD). Cambridge University Press, New Delhi, 2008

L	T	P	Cr.
-	-	2	1

B.Tech. (V Sem.) **17ME71 - HEAT TRANSFER LAB**

Prerequisite: Heat Transfer

Course Educational Objectives The objective of this course is to understand the modes of heat transfer for different heat transfer equipments.

Course Outcomes: After completion of the lab students are able to:
CO1: Estimate the thermal conductivity of different materials and powders
CO2: Experiment both free and forced convection to predict heat transfer coefficient.
CO3: Validate the Stefan Boltzmann Constant and estimate emissivity of grey body.
CO4: Compare parallel and counter flow heat exchanger performance characteristics.

LIST OF EXPERIMENTS
At least 10 Experiments are required to be conducted
1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzmann Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

REFERENCES:
LAB MANUALS

B.Tech. (V Sem.)	17AE63 - AERODYNAMICS LAB	L	T	P	Cr.
		-	-	2	1

Course Educational Objectives:

1. To learn the basic experiments in wind tunnel
2. To learn the basic experiments in open jet facility
3. To learn the basic flow visualization techniques

Course Outcomes: At the end of the semester, the student will be able to

CO1: To analyze the flow characteristics over aerodynamic bodies

CO2: To design nozzle and analyze its flow characteristics

Any of the 10 Experiments are required to be conducted

1. Determination of lift and drag for the symmetrical aerofoil.
2. Determination of lift and drag for the cambered aerofoil.
3. Generation of potential flow pattern over objects using Hele-Shaw Apparatus.
4. Visualization of flow field around a flat plate using open channel.
5. Pressure Distribution over a smooth circular cylinder.
6. Pressure Distribution over a symmetrical aerofoil.
7. Pressure Distribution over a cambered aerofoil.
8. Flow visualization over objects using smoke tunnel.
9. Yaw effect on Pitot probe and Pitot-Static probe in incompressible and compressible flows
10. Flow thorough Convergent Nozzle
11. Calibration of Convergent- Divergent Nozzle
12. Supersonic Flow Visualization using Shadowgraph Technique.

B.Tech. (V Sem.)	17PD05 - EMPLOYABILITY ENHANCEMENT SKILLS-I	L	T	P	Cr.
		1	-	-	0

Prerequisite: NIL

Course Educational Objective (CEO): This course will make students proficient in Quantitative techniques, language & communication skills to qualify in placement tests, ,demonstrate industry-readiness skills by applying concepts and tools that will serve as building blocks for analytical thinking and professional development.

Course Outcomes (COs): After the completion of this course, student will be able to:

CO1: Apply Quantitative techniques and logical thinking to qualify in recruitment tests and other professional tasks.
CO2: Communicate effectively in various professional and social contexts.
CO3: Apply Verbal skills effectively in Job Interviews as well other professional contexts.
CO4: Demonstrate various principles involved in Quantitative problem solving, thereby reducing the time taken for performing job functions.
CO5: Practice lifelong learning through personal effectiveness as well as leadership.

UNIT – I
Quantitative Aptitude: Numbers, L.C.M &H.C.Fof numbers, Decimal Fractions,Simplification, Square root & cube root-Practice tests.
Verbal Ability: Introduction to Vocabulary-Root words (Prefixes, Suffixes) - Practice tests

UNIT – II
Quantitative Aptitude: Averages, Problems on Ages, Problems on Numbers, Surds and Indices- Practice tests.
Verbal Ability: Advanced vocabulary- Model tests for GRE/TOEFL/IELTS

UNIT – III
Quantitative Aptitude: Percentages, Profit and Loss- Practice tests
Verbal Ability: Synonyms & Antonyms, Idiomatic expressions-Practice tests

UNIT – IV
Quantitative Aptitude: Ratio And Proportion, Partnership, Chain rule- Practice tests
Verbal Ability: Words often confused & misused, One-word substitutes & Flash card activity-Practice tests

UNIT – V
Quantitative Aptitude: Number Series, Letter Series, Blood Relations, Coding and Decoding, Direction sense test- Practice tests
Verbal Ability: Phrasal verbs, Word analogies, Reading Comprehension-Practice tests

TEXT BOOKS

1. R.S.AGGARWAL, *Objective Arithmetic*, S. CHAND Publishers.
2. R.S.AGGARWAL, *Verbal & Non-Verbal Reasoning*, S. CHAND Publishers
3. Objective English. Edgar Thorpe, Pearson Education, New Delhi.2009
4. Sanjay kumar, PushpLata: Communication skills. Oxford, Delhi, 2012

REFERENCES

1. Meenakshi Raman, Sangeetha: Technical Communication, Oxford University Press, 2008
2. Baron's Guide on GRE
3. Dinesh Khattar, *The Pearson Guide to Quantitative Aptitude*, Pearson Education
4. M. Tyra, *Magical Book on Quicker Maths*, BSC Publishers
5. Quantitative Aptitude by Arun SharmaVocabulary Builder for Students of Engineering and Technology (A self – study manual for vocabulary Enhancement) Y.Saloman Raju, Maruthi Publishers

B.Tech. (VI Sem.)	17AE16 - PROPULSION –II	L	T	P	Cr.
		3	-	-	3

Pre-requisite: Propulsion – I

Course Educational Objectives: To learn the engineering concepts of ramjet and scram jet, the basic aspects of rocket propulsion, working principle of liquid, and solid propellant rocket systems, and advance propulsion techniques.

Course Outcomes: At the end of the semester, the student will be able

CO1: To analyze the performance parameters of ramjet and scram jet engine.

CO2: To evaluate the preliminary concepts

CO3: To analyze the performance of liquid propellant rocket systems

CO4: To analyze the performance of solid propellant rocket systems

CO5: To apply the advanced rocket propulsion techniques for a mission

UNIT - I

RAMJET PROPULSION: Operating principle, Sub critical, critical and supercritical operation, Combustion in ramjet engine, Ramjet performance, Need of Supersonic Combustion, Components and Working principle of Supersonic Ramjet Engine, Isolators, Types of Combustion Chambers for Scramjet Engine, Mixing Process in SCRAMJET Combustion

UNIT - II

ROCKET PROPULSION: Operating principle, Effective Exhaust Velocity, Thrust equation, Specific impulse, Rocket Propulsion Requirements, Equations of Motion for an Accelerating Rocket, Multistage Rocket

UNIT - III

LIQUID PROPELLANT ROCKET: Introduction, Liquid Propellants, Types of Fuels and Oxidizers,Propellant Tanks, Tank pressurization, Turbo pump Feed Systems, Gas pressure feed systems, injector configurations, Combustion Process, Combustion Instabilities.

UNIT - IV

SOLID PROPELLANT ROCKET: Solid propellant rockets, double base and composite propellants, Selection criteria of solid propellants, Combustion process, Propellant Burning Rate, Propellant grain and its configuration, Propellant Grain Stress and Strain, Hybrid Rockets.

UNIT - V

ADVANCED PROPULSION TECHNIQUES: Electric rocket propulsion- Electrothermal, Electrostatic – Ion Propulsion Techniques, Electro Magnetic Thrusters – Pulsed Plasma Thruster – Magneto Plasma Dynamic Thruster, Solar sail, Nozzleless propulsion, Energy Spike, Nuclear rockets.

TEXT BOOK

1. Sutton. G.P, “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York,5th Edn.,1993.

REFERENCES

1. Mattingly.J.D, Elements of Propulsion: Gas Turbines and Rockets, AIAA Educational Series
2. Gorden, C.V, Aero Thermodynamics of Gas Turbine and Rocket Propulsion, AIAA Education Series, New York, 1989.
3. Yahya. S. M, Fundamentals of Compressible Fluid Flow: SI Units with Aircraft and Rocket Propulsion, New Age International, 2003.

B.Tech. (VI Sem.)	17AE17 - AIRCRAFT STRUCTURES – II	L	T	P	Cr.
		2	2	-	3

Pre-requisites: Aircraft Structures – I

Course Educational Objectives: The objective of the course is to enable the students to apply standard methods to calculate the stress and displacement of thin walled symmetrical and unsymmetrical components located in fuselage, wing and landing gear are subjected to static loads.

Course Outcomes: At the end of the semester, the student will be able
CO1: To analyze the behavior of beam structures subjected to different loading conditions.
CO2: To analyze the shear flow distribution and location of shear centre for open sections.
CO3: To analyze the shear flow distribution in and location of shear centre.
CO4: To design elementary beam structures to withstand specified loads.
CO5: To analysis the stress distributions over aircraft components.

UNIT - I
BENDINGSTRESS: Introduction - Principal Axis and Neutral Axis Methods, Bending Stresses - Beams of Symmetric Sections with Symmetric and Skew Loads- Beams of Unsymmetrical Sections with Symmetric and Skew Loads.

UNIT - II
SHEAR FLOW IN OPEN SECTIONS: Thin Walled Beams, Concept of Shear Flow - Shear Centre, Shear Flow in Open-Section –Symmetrical - Unsymmetrical, Thin Wall Bending – Effective - Ineffective.

UNIT - III
SHEAR FLOW IN CLOSED SECTIONS: Bredt–BathoTheory, Single and Multi-Cell –Shear Flow - Shear Centre –Torsion, Thin Wall Bending – Effective – Ineffective.

UNIT - IV
BENDING OF THIN PLATES: Plates Subjected to – Pure Bending – Twisting – Distributed - Transverse Load, In-Plane Loading - Thin Rectangular Plate – Rectangular Plate with Small Initial Curvature.
BUCKLING OF THIN PLATES: Introduction to Inelastic buckling of plates, Determination of critical load for a flat plate, Local instability, Instability of stiffened panels, Failure stress in plates and stiffened panels.

UNIT - V
STRESS ANALYSIS IN WING AND FUSELAGE: Study of Wing Spars and Box Beams, Shear Resistant Web Beams, Tension Field Web Beams (Wagner's) – Procedures to Find Shear and Bending Moment Distribution for Cantilever Beam.

TEXT BOOKS
1. Peery. D.J, Azar. J. J, Aircraft Structures, SecondEdition, McGraw–Hill, New York, 2007.
2. Megson, T. H.G, Aircraft Structures for Engineering Students, Sixth Edition, Elsevier 2017.

REFERENCES
1. Bruhn. E. F. Analysis and Design of Flight Vehicles Structures, S. r. Jacobs, 1973.
2. Rivello. R. M, Theory and Analysis of Flight Structures, McGraw-Hill, 1993.

B.Tech. (VI Sem.)	17AE18 - FLIGHT DYNAMICS	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Aerodynamics

Course Educational Objectives: To learn the concepts of performance estimation on steady level flight at various altitudes and velocities, performance of maneuvering flight at unaccelerated and accelerated conditions, the concepts of static stability requirements during flight, the basic concepts of dynamic stability and control of an aircraft.

Course Outcomes: At the end of the semester, the student will be able
CO1. To analyse thrust and power requirement conditions for steady level flight
CO2: To analyze the performance of flight during manoeuvring
CO3. To apply the conditions in static longitudinal stability in the aircraft design
CO4: To apply the conditions in lateral and directional stability in the aircraft design
CO5: To apply the concepts and conditions of dynamic control methods during flight

UNIT - I
STEADY FLIGHT PERFORMANCE: Earth's Atmosphere, Concept of Drag, Equations of Motion in Steady Flight, Performance Design Parameters, Thrust Requiredand Thrust Available Conditions, Power Required and Power Available Conditions, Maximum Velocity, Effect of Drag Divergence

UNIT - II
MANOEUVERING FLIGHT PERFORMANCE: Rate of Climb, Range and Endurance for Propeller and Jet Aircrafts, Gliding Flight, Hodograph Diagram, Pull-Up and Pull-Down Manoeuvres, V-n Diagram, Take-off and Landing Performance.

UNIT - III
STATIC LONGITUDINAL STABILITY AND CONTROL: Introduction, Moments On the Airplane, Absolute Angle of Attack, Criteria for Longitudinal Static Stability, Neutral Point, Static Margin, Stick Fixed and Stick Free Stability, Elevator Hinge Moment, Stick-Free Longitudinal Static Stability, Power Effects

UNIT - IV
STATIC LATERAL-DIRECTIONAL STABILITY AND CONTROL: Lateral stability-Dihedral effect, criterion for lateral stability, contribution of wing, fuselage, tail, lateral control-strip theory estimation of aileron effectiveness, aileron reversal.
Directional stability-yaw and sideslip, Criterion of directional stability, contribution wing, fuselage, tail, Directional control- rudder control effectiveness, rudder requirements-adverse yaw, asymmetric power condition, spin recovery, Rudder lock and Dorsal fin,

UNIT - V
DYNAMIC STABILITY AND CONTROL:
Dynamic Longitudinal Stability: Modes of Stability,Aircraft Equations of motion, Small disturbance theory, Solving the stability quartic, Routh's discriminant, ,Phugoid motion, Short period of oscillation
Lateral and Directional Dynamic Stability- Spiral Divergence, Dutch Roll, Auto Rotation and Spin

TEXT BOOKS

1. Aircraft Performance and Design, J.D Anderson, Tata McGrawhill Edition
2. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2004.

REFERENCES

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:,Inc, NY, 1988.
2. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, NY, 1982.
3. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
4. Michael V. Cook, "Flight Dynamics Principles", Second Edition, Elsevier Aerospace Engineering Series, 2007.
5. Mc Cornick B. W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1995.

B.Tech. (VI Sem.)	17AE19 - FINITE ELEMENT METHODS IN ENGINEERING	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Numerical Methods, Strength of Materials

Course Educational Objectives: To understand the concepts such as discretization, natural co-ordinates, interpolation functions, stiffness matrix etc, the concepts of axisymmetric solids subjected to axisymmetric loading and the importance of isoparametric elements, the steady state heat transfer through plane walls and fin, the Eigen value and Eigen vectors for dynamic problems.

Course Outcomes: At the end of the semester, the student will be able to
CO1: Identify mathematical model for solution of common engineering problems
CO2: Determine the design quantities (deformation, strain, stress) for engineering structures under different loading conditions.
CO3: Formulate the design and heat transfer problems with application of FEM.
CO4: Create new solutions for the existing problems using FEM approaches.
CO5: Evaluate the natural frequencies of bar and beam structures

UNIT - I
INTRODUCTION TO FINITE ELEMENT METHODS: Stress and Equilibrium, Strain – Displacement relations, Stress – strain relations, Potential Energy and Equilibrium.
ONE DIMENSIONAL PROBLEMS
Finite element modeling coordinates and shape functions, Potential Energy approach, Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions.

UNIT - II
ANALYSIS OF BEAMS: Hermite shape functions, Element stiffness matrix, Load vector, Boundary conditions. 2-D Problems using Constant Strain Triangles (CST) – Shape functions, Stiffness matrix, Strain-Displacement matrix, Force terms.

UNIT - III
FINITE ELEMENT MODELING OF AXISYMMETRIC SOLIDS: Axisymmetric solids subjected to axisymmetric loading with triangular elements, Two dimensional four nodedisoparametric elements, problems on isoperimetric formulation of four nodes quadrilateral element, Numerical Integration-Gauss quadrature.

UNIT - IV
HEAT TRANSFER: Heat conduction in plane walls, convection heat transfers in fins. Two dimensional analysis of thin plate with triangular elements, Element conductivity matrix, Convection matrix, Heat rate vector

UNIT - V
DYNAMIC ANALYSIS: Formulation of finite element model, Lumped and consistent mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar.

TEXT BOOKS

1. Chandraputla, Ashok, Belegundu., Introduction to Finite Elements in Engineering, 3rd edition, 5th impress, Prentice – Hall, 2008.
2. Rao.S.S, The Finite Element Methods in Engineering, 4th edition, 6th reprint, B.H. Pergamon, 2010.

REFERENCES

1. Reddy.J.N, An introduction to Finite Element Method, 3rd edition, 13th reprint, McGraw Hill, 2011.
2. Kenneth H. Huebner, Donald L. Dewhirst, Douglas E Smith, Ted G. Byrom., The Finite Element Method for Engineers, 4th edition, John Wiley & sons (ASIA) Pvt Ltd, 2001.
3. David Hutton., Fundamentals of Finite Element Analysis, Tata McGraw Hill, 2005
4. George R Buchanan, R.RudraMoorthy., Finite Element Analysis, Tata McGraw Hill, 2006

B.Tech. (VI Sem.)	17AE20 - AERODYNAMICS OF MISSILES AND LAUNCH VEHICLES	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the various launch vehicle configurations, aerodynamics of slender and blunt bodies, the basic aspects of hypersonic aerodynamics, aerodynamic aspects of launching phase, and the issues in launching

Course Outcomes: At the end of the semester, the student will be able to
CO1: To analyze the forces acting on rockets and missile
CO2: To analyze the aerodynamic properties of slender and blunt bodies
CO3: To apply the hypersonic flow characteristics in designing the flight vehicles
CO4: To evaluate missile behavior during launching
CO5: To examine the problem during the launching

UNIT - I
LAUNCH VEHICLE CONFIGURATIONS AND DRAG ESTIMATION: Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT - II
AERODYNAMICS OF SLENDER AND BLUNT BODIES: Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding, determination of aeroelastic effects, Slender Bodies of Revolution**,** non-circular shapes, lifting surfaces- low Aspect Ratio characteristics, wing-body-tail interference

UNIT - III
HYPERSONIC AERODYNAMICS: Introduction to hypersonic aerodynamics, concept of thin shock layers-hypersonic flight paths-hypersonic similarity parameters-shock wave and expansion wave relations of in viscid hypersonic flows, Shock wave-boundary layer interactions, aerodynamic heating

UNIT - IV
AERODYNAMIC ASPECTS OF LAUNCHING PHASE: Booster separation-cross-wind effects-specific considerations in missile launching-missile integration and separation-methods of evaluation and determination- Stability and Control Characteristics of Launch Vehicle Configuration

UNIT - V
AERODYNAMIC LAUNCHING PROBLEMS: Introduction, Safety of parent Aircraft, Launch Boundaries-Launch-Aircraft Trajectory, Parent Aircraft Performance, Ground Launch

REFERENCES
1. Chin.S.S, Missile Configuration Design, Mc Graw Hill, New York, 1961.
2. Anderson, J.D., Hypersonic and High Temperature Gas Dynamics, AIAA Education Series.
3. Nielson, Jack N, Stever, Gutford, Missile Aerodynamics, Mc Graw Hill, New York, 1960.
4. Anderson Jr., D., Modern compressible flows, McGraw-Hill Book Co., New York 1999.
5. Charles D.Brown, Spacecraft Mission Design, AIAA Education Series, Published by AIAA, 1998.
6. Meyer Rudolph X, Elements of Space Technology for Aerospace Engineers, Academic Press, 1999

B.Tech. (VI Sem.) 17AE21 - COMBUSTION IN AEROSPACE VEHICLES

L	T	P	Cr.
3	-	-	3

Course Educational Objectives: To learn the combustion process in aircraft piston engine, gas turbine combustion chamber, solid and liquid propellant rockets, and the basics of supersonic combustion.

Course Outcomes: At the end of the semester, the student will be able to

CO1: To understand the basic concepts of propulsion unit

CO2: To analyze the various factors effecting the combustion process in aircraft engines-piston and jet engines

CO3: To analyze the various combustion models of rocket engines

CO4: To analyze the reaction and mixing process in supersonic combustion

UNIT - I

FUNDAMENTAL CONCEPTS: Thermo chemical equations, Heat of reaction - first order - second order - third order reactions, premixed flames, Diffusion flames, Measurement of burning velocity - Various methods - Effect of various parameters on burning velocity, Flame stability, Detonation – Deflagration, Rankine-Hugoniot curve, Radiation by flames.

UNIT - II

COMBUSTION IN AIRCRAFT PISTON ENGINE: Introduction to Combustion in Aircraft Piston Engines, Various Factors affecting the combustion Efficiency, Fuels used for Combustion in Aircraft Piston Engines – Selection Criteria, Detonation in Piston Engine Combustion - Methods to Prevent the Detonation.

UNIT - III

COMBUSTION IN GAS TURBINES ENGINES: Combustion in gas turbine combustion chambers - Re-circulation - Combustion efficiency - Factors affecting combustion efficiency - Fuels used for gas turbine combustion chambers - Combustion stability – Ramjet Combustion, Flame holder types

UNIT - IV

COMBUSTION IN ROCKETS: Solid propellant combustion - Double base and composite propellant combustion - Various combustion models -Combustion in liquid rocket engines - Single fuel droplet combustion model - Combustion in hybrid rockets.

UNIT - V

SUPERSONIC COMBUSTION: Introduction to Supersonic combustion, Need for supersonic combustion for hypersonic airbreathing propulsion, Supersonic combustion controlled by diffusion and heat convection - Analysis of reaction and mixing processes - Supersonic burning with detonation shocks.

REFERENCES

1. Sharma,S.P., Chandra Mohan, Fules and Combustion, Tata McGraw Hill Publishing Co., Ltd., New Delhi 1987.
2. Mathur, M., Sharma, R.P., Gas turbines and Jet and Rocket Propulsion, Standard Publishers, New Delhi, 1988.
3. Loh, W.H.T., Jet Rocket, Nuclear, Ion and Electric Propulsion Theory and Design, Springer Verlag, New York 1982
4. Beer, J.M., Chigier, N.A.Combustion Aerodynamics, Applied Science Publishers Ltd., London, 1981.
5. Chowdhury,R., Applied Engineering Thermodynamics, Khanna Publishers, New Delhi, 1986

B.Tech. (VI Sem.)	17AE22 - EXPERIMENTAL STRESS ANALYSIS	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To understand the stress transformation, various method such as strain gauges, Moire method, photoelasticity and birefringent coatings to measure the strain.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To formulate equations of stress under equilibrium conditions
CO2: To apply the strain gage system for strain measurement on bodies acted upon forces
CO3: To apply and analyze the moiré fringe method in a stress field
CO4: To analyze the fringe pattern of materials using polariscope

UNIT - I
STRESS: Stress - Stress Equations of Equilibrium - Laws of Stress Transformation - Principal Stresses – Maximum Shear Stress - Dimensional State of Stress.

UNIT - II
STRAIN MEASUREMENT: Strain - Experimental Determination, Strain Gauges - Properties of Strain Gauge Systems - Electrical Resistance Strain Gauges - Strain Gauge Circuits, Recording Instruments, Analysis of Strain Gauge Data.

UNIT - III
MOIRE METHODS: Mechanism of Formation of Moire Fringe - Geometrical Approach to Moire Fringe Analysis - Displacement Field Approach to Moire Fringe Analysis - Out of Plane Measurements Experimental Procedure.

UNIT - IV
PHOTO ELASTICITY METHODS: Temporary Double Refraction, Stress Optic Law, - Effects of Stressed Model inPlane Polariscope Fringe Multiplication - Isochromatic Fringe Patterns - Isoclinic Fringe Pattern Compensation Techniques, Calibration Methods, Separation Methods, Scaling Model to Prototype Stresses - Materials.

UNIT - V
BIREFRINGENT COATINGS: Coating Stresses and Strains - Sensitivity - Materials and Applications - Effect of Thickness - Stress Separation.

REFERENCES
1. J Srinivas, Stress Analysis and Experimental Techniques: An Introduction, Narosa Publishing House, New Delhi, 2012.
2. Dally, J. W., Riley, W. F. Experimental Stress Analysis, Third Edition, McGraw-Hill, 1991.
3. Dove, R. C., Adams, P. H. Experimental Stress Analysis and Motion Measurement: Theory, Instruments and Circuit, Techniques. Prentice-Hall of India, New Delhi, 1965.
4. Perry, C. C., Lissner, H. R. The Strain Gauge Primer, Second Edition, McGraw Hill, 192.
5. Durelli, A. J., Riley, W. F. Introduction to Photomechanics, Prentice Hall, 1965.
6. Sadhu Singh. Experimental Stress Analysis, Fourth Edition, Khanna Publisher, New Delhi, 2009.

B.Tech. (VI Sem.)	17AE23 - SPACE MECHANICS	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn basic aspects of space and solar system, Satellite injection and its orbit perturbations, an interplanetary trajectory issues, ballistic missile trajectories and material used of spacecraft.

Course Outcomes: At the end of the semester, the student will be able
CO1: To understand the basic aspects of space
CO2: To evaluate trajectory details of ballistic missiles
CO3: To apply N-body aspects in space exploration issues
CO4: To know the general aspects satellite injection and orbit perturbations
CO5: To evaluate interplanetary trajectories of spacecraft

UNIT - I
BASIC CONCEPTS: References Frames and Coordinate Systems – The celestial sphere,The ecliptic, Motion of Vernal Equinox:Time and calendar – Sidereal Time, Solar Time, Standard Time: The Earth's Atmosphere: Space Environment

UNIT - II
BALLISTIC MISSILE TRAJECTORIES: The Boost Phase: The Ballistic Phase –Trajectory Geometry, Optimal Flights, Time of Flight:The re-entry phase: The position of the impact point – Spherical earth, Oblate Earth, Influence Coefficients.

UNIT - III
THE MANY- BODY PROBLEM: General N-body problem: The Circular Restricted Three Body Problem – Jacobi's integral, Libration Points, Applications to space flight: Relative Motion in the N-body Problem – Satellite orbit perturbations: Two-Body Problem – circular, elliptic, parabolic and hyperbolic orbits: Orbital Elements.

UNIT - IV
SATELLITE LAUNCHING AND ORBIT PERTURBATIONS: Launch vehicle ascent trajectories: Satellite Injection- General Aspects: Launch vehicle performances: Orbit deviations: Special and General Perturbations – Cowell's Method, Encke's Method: Method of variation of Orbital Elements: General Perturbations Approach.

UNIT - V
INTERPLANETARY TRAJECTORIES: Two Dimensional Interplanetary trajectories – Hohmann trajectories, Fast Interplanetary Trajectories, Launch opportunities: Three Dimensional Interplanetary Trajectories: Launch if interplanetary Spacecraft: Trajectory about the Target Planet.

TEXT BOOKS
1. W.E. Wiesel, "Spaceflight Dynamics", McGraw-Hill, 1997
2. Cornelisse, Schoyer HFR, Wakker KF, "Rocket Propulsion and Space Flight Dynamics", Pitman publications, 1984

REFERENCES

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
2. Van de Kamp, P., "Elements of Astro-mechanics", Pitman, 1979.
3. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc.,1982.
4. Vladimir A. Chobotov, "Orbital Mechanics", AIAA Education Series, AIAA Education Series, Published by AIAA, 2002
5. David.A. Vellado, Microcosm, Kluwer, "Fundamentals of Astrodynamics and Applications", 2001

B.Tech. (VI Sem.)	17AE91 - INDUSTRIAL AERODYNAMICS (Add on course – II)	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: The course is intended to understand the aerodynamic aspects of wind generators, automobiles, buildings, bird, importance in recent industries etc, and the application of various aerodynamic aspects in vehicles and buildings.

Course Outcomes: At the end of the semester, the student will be able
CO1: To analyze the effects of aerodynamics in automobiles.
CO2: To analyze the aerodynamics effects on wind turbines, buildings and its ventilation.
CO3: To analyze the effects of wind and flow induced vibrations over objects
CO4: To apply the effects of aerodynamics in flapping wing vehicles

UNIT I
WIND ENERGY COLLECTORS: Types of Winds, Causes of Variation of Winds, Atmospheric Boundary Layer, Effect of Terrain On Gradient Height. Horizontal Axis and Vertical Axis Machines, Power Coefficient, Betz Coefficient by Momentum Theory.

UNIT II
GROUND VEHICLE AERODYNAMICS: Sources of Drag in Ground Vehicles**,** Power Requirement and Drag Coefficients of Automobiles, Aerodynamics of Passenger Cars, Race Cars, Motorcycles, Trains

UNIT III
BUILDING AERODYNAMICS: Pressure Distribution On Low Rise Buildings, Wind Forces On Buildings, Environmental Winds in City Blocks, Special Problems of Tall Buildings, Building Codes, Building Ventilation and Architectural Aerodynamics.

UNIT IV
FLOW INDUCED VIBRATIONS: Effect of Reynolds Number On Wake Formation of Bluff Shapes, Vortex Induced Vibrations, Buffeting, Vortex Shedding, Galloping and Flutter.

UNIT V
FLAPPING WING AERODYNAMICS: Bird Wing Parts, Unpowered Flight-Gliding and Soaring, Powered Flight-Flapping, Hovering, Take-Off and Landing, The Physics of Drag and Thrust Generation Due to Wing Flapping, Flapping Wing Kinematics

REFERENCES
1. T. Yomi Obidi, Ground Vehicle Aerodynamics with Applications, SAE International, 2014.
2. Lawson,Building Aerodynamics, Cambridge University Press, 2010.
3. Tomomichi Nakamura, Shigehiko Kaneko, Flow-Induced Vibrations: Classifications and Lessons from Practical Experiences, Second Edition, Academic Press, 2013.

B.Tech. (VI Sem.)	17AE64 - PROPULSION LAB	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the various basic experiments related to components of jet engines and piston engines.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To analyze the performance of various jet engines components
CO2: To analyze the performance of piston engine components

Any of the 10 Experiments are required to be conducted

1. Free jet characteristics
2. Wall jet characteristics
3. Free convective heat transfer rate over an airfoil
4. Forced convective heat transfer rate over an airfoil
5. Cascade testing of compressor blade row
6. Cascade testing of turbine blade row
7. Performance characteristics of three stage axial flow compressor
8. Measurement of burning velocity of pre-mixed flame
9. Performance evaluation of thrust produced by propeller (constant pitch and variable pitch) at various speeds
10. Flow through subsonic inlet
11. Burn rate measurements of solid propellant
12. Study of Properties of aviation fuel
13. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)

B.Tech. (VI Sem.)	17AE65 - AIRCRAFT STRUCTURES LAB	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To understand various principles and theorems involved in the theory of aircraft structures, vibrations and experimental analysis by doing simple and advanced experiments and analyzing the results.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To analyze beam structures subjected to different loading conditions
CO2: To analyze deflection based on different theories
CO3: To analyze the performance of cams, governors and gyroscope

Any of the 10 Experiments are required to be conducted

1. Verification of Maxwell's Reciprocal Theorem.
2. Verification of Castigliano's Theorem.
3. Verification of Superposition Theorem.
4. Non Destructive Test- Dye Penetration Test and Magnetic Particle Detection.
5. Determination of Beam Deflection (C, Z, L and T- Sections).
6. Compression Test of Columns.
7. Wagner Beam-Tension Field Beam.
8. Determination of Shear Center of Open Section (C, Z and T-Sections).
9. Forced Vibration of Beams.
10. Bending Modulus of a Sandwich Beam.
11. Unsymmetrical Bending of a Cantilever Beam (C, Z, L and T-Sections)
12. Composite Laminate preparation and testing.
13. Shear Failure of Bolted and Riveted Joints.
14. Determine gyroscopic couple using Gyroscope

B.Tech. (VI Sem.)	17PD08 - EMPLOYABILITY ENHANCEMENT SKILLS-II	L	T	P	Cr.
		1	-	-	0

Prerequisite: NIL

Course Educational Objective (CEO): This course will make students proficient in Quantitative techniques, language & communication skills to qualify in placement tests, demonstrate industry-readiness skills by applying concepts and tools that will serve as building blocks for analytical thinking and professional development.

Course Outcomes (COs): After the completion of this course, student will be able to:
CO1: To identify, analyze and apply quantitative techniques related to qualify in Placement tests.
CO2: To effectively utilize verbal ability & communication skills to qualify in Placement tests.
CO3: To effectively communicate in professional as well as social contexts.
CO4: To apply key soft skills effectively in Job Interviews as well in other professional contexts
CO5: Inculcate lifelong learning through personal effectiveness as well as leadership.

UNIT – I:
Verbal Ability: Tenses& Conditional Clauses
Quantitative Aptitude: Alligation or Mixture**,** Simple Interest and Compound Interest

UNIT – II:
Verbal Ability: Sentence Completions
Quantitative Aptitude: Time and work, Pipes and Cistern, Permutations and Combinations, Probability

UNIT – III:
Verbal Ability: Spot the Errors
Quantitative Aptitude: Time and Distance, Problems on trains,Boats and Streams, Races and Games of Skill

UNIT – IV:
Verbal Ability: Jumbled Sentences, Cloze Tests
Quantitative Aptitude: Area, Volume and Surface Areas, Progressions

UNIT – V:
Verbal Ability: Advanced Reading Comprehension
Quantitative Aptitude: Clocks and Calendars, Cubes and Dice

TEXT BOOKS

1. Objective Arithmetic, S. CHAND Publishers.
2. R.S.AGGARWAL, *Verbal & Non-Verbal Reasoning*, S. CHAND Publishers.
3. Objective English. Edgar Thorpe, Pearson Education, New Delhi.2009.
4. Sanjay Kumar, PushpaLata: Communication skills. Oxford, Delhi, 2012.
5. Vocabulary Builder for Students of Engineering and Technology (A self – study manual for vocabulary Enhancement) Y.Saloman Raju, Maruthi Publishers

REFERENCES

1. Meenakshi Raman, Sangeetha: Technical Communication, Oxford University Press, 2008
2. Baron's Guide on GRE
3. Dinesh Khattar, *The Pearson Guide to Quantitative Aptitude*, Pearson Education
4. M. Tyra, *Magical Book on Quicker Maths*, BSC Publishers
5. Quantitative Aptitude by Arun Sharma
6. Vocabulary Builder for Students of Engineering and Technology (A self – study manual for vocabulary Enhancement) Y.Saloman Raju, Maruthi Publishers

L	T	P	Cr.
2	2	-	3

B.Tech. (VII Sem.) **17AE24 - MECHANICS OF COMPOSITES**

Course Educational Objectives: To Learn the basic knowledge about composite materials at micro and macro level, lamina and laminates, basic design concepts of sandwich panels, functionally graded materials and the manufacturing process of composite materials.

Course Outcomes: At the end of the semester, the student will be able
CO1: To understand the stress-strain relations applicable for composite materials
CO2: To analyze behaviour of composite materials at micro level and macro level
CO3: To design the multi directional composites
CO4: To design different types of sandwich panels used in aerospace industries
CO5: Toapply techniques of fabrication processes to manufacture composites

UNIT - I
STRESS STRAIN RELATION: Introduction- Definition of composites-classification Advantages and application and limitations of composite materials, reinforcements and matrices, Generalized Hooke's Law – Compliance and reduced stiffness matrix- stress-strain relation of orthotropic lamina.

UNIT- II
METHODS OF ANALYSIS: Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to on axis, off axis

UNIT- III
MULTI DIRCTIONAL COMPOSITES: Governing differential equation for a general laminate, Classical Lamination Theory- Symmetric, Antisymmetric laminates, angle ply and cross ply laminates. Failure criteria for composites.

UNIT- IV
SANDWICH CONSTRUCTIONS: Basic design concepts of sandwich construction -Materials used for sandwich construction – Flexural rigidity- deflection of sandwich beams – Applications of Sandwich Structures - Failure modes of sandwich panels.

UNIT- V
FABRICATION PROCESSES: Fibres-Glass, Carbon and Boron, Laminate Composite-Open and closed mould processes, lay-up, Vacuum bagging, Pultrusion, ResinTransfer Molding - Auto Clave-Filament Winding.
FUNCTIONALLY GRADED MATERIALS: Introduction to functionally graded materials – lengthwise and thickness-wise - power law.

TEXT BOOKS
1. Calcote, LR., "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
2. Jones, R.M., "Mechanics of Composite Materials", 2nd Edition McGraw-Hill, KogakushaLtd.,Tokyo, 1998.
3. Carlsson, L.A., Kardomateas, G.A., "Structural and Failure Mechanics of Sandwich", Solid Mechanics and its Applications, Vol 121, Springer Heidlberg, New York, 2011.

REFERENCES

1. Agarwal, B.D., Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.) 17AE25 - COMPUTATIONAL FLUID DYNAMICS

Course Educational Objectives: To learn the basic governing equations of fluid dynamics,mathematical behaviour of partial differential equations, phenomena of various discretization techniques, techniques to solve the simple incompressible flow problems, and basic techniques to solve simple heat transfer problems .

Course Outcomes: At the end of the semester, the student will be able to
CO1: Formulate the basic fluid dynamics problem mathematically
CO2: Analyze the mathematical behaviour of partial differential equations
CO3: Apply the grid generation principles for different problems.
CO4: Solve elementary incompressible fluid problems using the CFD techniques
CO5: Solve the elementary heat transfer problems using the CFD techniques

UNIT - I
Introduction
Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics.
Governing Equations of Fluid Dynamics: Introduction, Control Volume, Substantial Derivative, Divergence of Velocity, Continuity Equation, Momentum Equation and Energy Equation, Conservation and Non-conservation forms of governing flow equations.

UNIT - II
Mathematical Behavior of Partial Differential Equations
Introduction, Classification of Quasi-Linear Partial Differential Equations, Eigen Value Method, Hyperbolic Equations, Parabolic Equations, Elliptic Equations.

UNIT - III
Basics Aspects of Discretization
Introduction, Introduction of Finite Differences, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, Grid Generation.

UNIT - IV
Incompressible Fluid Flow: Introduction, Implicit Crank-Nicholson Technique, Pressure Correction Method, Computation of Boundary Layer Flows

UNIT - V
Heat Transfer
Finite Difference Applications in Heat conduction and Convention, Heat conduction - steady heat conduction in a rectangular geometry, transient heat conduction in a plane wall, Two-Dimensional transient heat conduction, Finite difference application in convective heat transfer.

TEXT BOOK
1. Anderson.J.D, Computational Fluid Dynamics-Basics with Applications, Mc Graw Hill, 1995.
2. Thanigaiarasu. S, Computational Fluid Dynamics and Heat Transfer.

REFERENCES
1. Anderson, D. A, Tannehill. J. C, Pletcher. R. H, Computational Fluid Mechanics and Heat Transfer, CRC Press, 2012.
2. Patankar. S. V, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.
3. Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

B.Tech. (VII Sem.)	17AE26 - INSTRUMENTATION, MEASUREMENTS AND EXPERIMENTS IN FLUIDS	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the need of experimentation and wind tunnel techniques, theory of flow visualization techniques and analogue methods, working principle of various velocity measurement instruments, working of various pressure and temperature measurement instruments, and principle data acquisition and uncertainty estimation of measured data.

Course Outcomes: At the end of the semester, the student will be able to
CO1: Employ the wind tunnels for aerodynamic testing of bodies.
CO2: Adopt and use a visualization technique to understand the flow field.
CO3: Employ the suitable instrument to measure the velocity, temperature and pressure of fluid flow.
CO4: Acquire experimental data and to estimate the uncertainty in measured values during experimentation**.**

UNIT - I
NEED AND OBJECTIVE OF EXPERIMENTAL STUDY: Introduction, Measurement Systems, Performance Terms.
WIND TUNNELS: Introduction, Classification, Low-speed Wind Tunnels, Power Losses in Wind Tunnel, Energy Ratio, High-speed Wind Tunnels, Instrumentation and Calibration of Wind Tunnels, Wind Tunnel Balance-Wire Balance, Strut-Type, Platform Type, Yoke Type, Strain-Gauge Balance, Balance Calibration.

UNIT - II
FLOW VISUALIZATION AND ANALOG METHODS: Introduction, Classification of Visualization Techniques, Smoke Tunnel, Interferometer, Schlieren and Shadowgraph, Hele-Shaw Apparatus, Electrolytic Tank, Hydraulic Analogy, Hydraulic Jumps.

UNIT - III
VELOCITY MEASUREMENT: Introduction, Velocity & Mach number from pressure measurements, Laser droplet anemometer- LDA Principle, Doppler shift equation, Reference beam system, Fringe system. Measurement of velocity by Hot-Wire Anemometer- Constant Current Hot-Wire Anemometer (CCA), Constant Temperature Hot-Wire Anemometer, Hot-Wire Probes, Limitations of Hot-Wire Anemometer, Measurement of velocity using vortex shedding Technique, Fluid Jet Anemometer

UNIT - IV
PRESSURE MEASUREMENT TECHNIQUES: Introduction, Barometers, Manometers, Dial type pressure gauge, Pressure Transducers, Pitot, Static, and Pitot-Static Tube and Its characteristics, Flow direction measurement probes and Low Pressure Measurement Gauges.
TEMPERATURE MEASUREMENT: Introduction, Types of thermometers, Thermocouples, RTD, Thermistors, Pyrometers, Temperature measurement in fluid flows.

UNIT - V
DATA ACQUISITION: Introduction, Data Acquisition Principle, Generation of Signal, Signal Conditioning, Multiplexing, Data Conversion, Data Storage and Display, Data Processing, Digital Interfacing, Data Acquisition using Personal Computers.

UNCERTAINTY ANALYSIS: Introduction, Estimation of measurement errors, External estimation of errors, Internal estimate of the error, Uncertainty Analysis- Uses of uncertainty analysis, Uncertainty estimation, General procedure- Uncertainty in flow Mach number, Uncertainty calculation.

TEXT BOOK

1. E. Rathakrishnan, Instrumentation, Measurements and Experiments in Fluids, CRC press, 2007.

REFERENCES

1. Jack Philip Holman, Walter J. Gajda, Experimental methods for Engineers, Edition: 4, McGraw-Hill, 1984.
2. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication,1984.
3. Pope, A., Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
4. Ernest Doebelin, Measurement Systems, McGraw Hill Professional, 2003.
5. Thomas G. Beckwith, Mechanical Measurements, Nelson Lewis Buck, Edition: 5, Addison-Wesley Pub. Co., 1961.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.) **17AE27 - APPLIED GAS DYNAMICS**

Course Educational Objectives: To understand the behaviour of airflow both internal and external in compressible flow regime, emphasis on supersonic flows, basic details of flow with friction, flow with heat transfer and supersonic wind tunnels.

Course Outcomes (COs)

CO1: To understand the concept of continuum, compressibility, gas flow thermodynamics andmechanics.
CO2: To evaluate the flow properties variation across a shock wave and expansion fan.
CO3: To design and analyze the CD nozzle, supersonic inlet, supersonic wind tunnel and etc.
CO4: To solve numerical problems related to the flow with friction, and flow with heat transfer.
CO5: To increase the performance of an aircraft during transonic and supersonic speeds.

UNIT - I

TWO-DIMENSIONAL COMPRESSIBLE FLOWS: Introduction, General Linear Solution for Supersonic Flow-Existence of Characteristics in a Physical Problem, Equation for the streamlines from Kinematic Flow Condition, Flow over Wave shaped Wall

UNIT - II

METHOD OF CHARACTERISTICS: Introduction, Concept of Characteristics, Compatibility Relation, Numerical Computational Method, Theorems for Two Dimensional Flow, Numerical Computation with Weak Finite Waves, Design of Supersonic Nozzle-Contour Design Details

UNIT - III

HYPERSONIC TUNNEL: Hypersonic Tunnel Circuit, Hypersonic Nozzle, Calibration of Hypersonic Tunnels, Determination of Mach Number, Flow Angularity, Turbulence Level, Reynolds number Effects, Force Measurement

UNIT - IV

RAREFIED GAS DYNAMICS: Introduction, Molecular Model of Gases, Mean Free path of Molecules, Knudsen Number, Flow Regimes, Boltzmann's Relation, Basic Concepts of Kinetic Theory, Slip Flow, Transition and Free Molecular Flow

UNIT - V

JETS: Introduction, Classification of Jets, Different Zones of Subsonic Jet, Mathematical Treatment of jet Profile, Turbulence Characteristics of Free Jets, Supersonic Jet-Correction Expansion, Over Expansion, Underexpansion, Experimental Methods for Studying Jets-JetTest Facility, Mixing Mechanism, Jet Control Techniques, Jet Noise

REFERENCES

1. Rathakrishnan. E, Applied Gas Dynamics, John Wiley and Sons Pvt. Ltd, 2010
2. Rathakrishnan. E, Gas Dynamics, Third Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2010.
3. Ascher H. Shapiro, The dynamics and thermodynamics of compressible fluid flow Vol I, The Ronald press Co. New York, 1953.
4. Liepmann. H. W,Roshko. A, Elements of Gas Dynamics, Dover Publications, 2001.
5. Thomson P.A, Compressible Fluid Dynamics, McGraw-Hill, New York, 1972
6. Shen. C, Rarefied Gas Dynamics: Fundamentals, Simulation and Micro Flows, Springer, 2005.

B.Tech. (VII Sem.) 17AE28 - INTRODUCTION TO SPACE TECHNOLOGY

L	T	P	Cr.
3	-	-	3

Course Educational Objectives: To learn the space mission strategies and fundamental orbital mechanics, flight trajectories of rockets and missiles, and fundamentals of atmospheric re-entry issues and satellite attitude

Course Outcomes: At the end of the semester, the student will be able
CO1: To understand the basics of launching satellites in space
CO2: To analyze the orbital elements and it's maneuvering
CO3: To analyze the trajectories of rockets and missiles
CO4: To analyze the dynamics of spacecraft attitude

UNIT - I
INTRODUCTION: Space Mission-Types-Space Environment-Launch Vehicle Selection, Introduction to Rocket Propulsion-Fundamentals of Solid Propellant Rockets- Fundamentals of Liquid Propellant Rockets-Rocket Equation

UNIT - II
FUNDAMENTALS OF ORBITAL MECHANICS & ORBITAL MANEUVERS:
ORBITAL MECHANICS: Two-Body Motion-Circular, Elliptic, Hyperbolic, And Parabolic Orbits-Basic Orbital Elements-Ground Trace
ORBITAL MANEUVERS: In-Plane Orbit Changes-Hohmann Transfer-Bi-Elliptical Transfer-Plane Changes- Combined Maneuvers-Propulsion for Maneuvers

UNIT - III
ASCENT FLIGHT MECHANICS OF ROCKETS AND MISSILES: Two-Dimensional Trajectories of Rockets and Missiles-Multi-Stage Rockets-Vehicle Sizing-Two Stage Multi-Stage Rockets Trade-Off Ratios-Single Stage to Orbit- Sounding Rocket-Aerospace Plane-Gravity Turn Trajectories

UNIT - IV
ATMOSPHERIC REENTRY: Introduction-Steep Ballistic Reentry-Ballistic Orbital Reentry-Skip Re-Entry- "Doubledip" Re-Entry - Aero-Braking - Lifting Body Re-Entry

UNIT - V
SATELLITE ATTITUDE DYNAMICS: Torque Free Axi-Symmetric Rigid Body-Attitude Control for Spinning Spacecraft - Attitude Control for Non-Spinning, Spacecraft - The Yo-Yo Mechanism – Gravity – Gradient Satellite-Dual Spin Spacecraft-Attitude Determination

REFERENCES
1. Sellers. J, Understanding Space: An Introduction to Astronautics, McGraw- Hill, 2000.
2. Hale. F. J, Introduction to Space Flight, Prentice-Hall, 1994.
3. Brown. C. D, Spacecraft Mission Design, AIAA Education Series, 1998.
4. Wiesel. W. E, Spaceflight Dynamics, McGraw-Hill, 1997

B.Tech. (VII Sem.)	17AE29 - THEORY OF ELASTICITY	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To understand the principles of elasticity theory, displacement of simple beams, linear elastic solids under mechanical loads.

Course Outcomes: At the end of the semester, the student will be able to

CO1: To analyze the equations of compatibility by using plane stress and plane strain conditions.
CO2: To apply Saint Venant's principles to determine the displacements of simple beams.
CO3: To analyze the stresses and strains in 3-Dimensional problems.
CO4: To solve the linear elasticity problems using various analytical techniques.
CO5: To analyze the vectors and tensors to enhance the theory of elasticity where ever necessary

UNIT - I

ELASTICITY: Two dimensional stress analysis - Plane stress - Plane strain - Equations of Compatibility - Stress function - Boundary conditions.

PROBLEM IN RECTANGULAR COORDINATES - Solution by polynomials - Saint Venant's principles -Determination of displacement - Simple beam problems.

UNIT - II

PROBLEMS IN POLAR COORDINATES - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT - III

ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS - Principle stresses – Homogeneous deformations – Strain at a point – Principal axes of strain - Rotation.

UNIT - IV

GENERAL THEOREMS: Differential equations of equilibrium and conditions of compatibility – Determination of displacement - Uniqueness of solution - Reciprocal theorem.

UNIT - V

BENDING OF PRISMATIC BARS - Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

REFERENCES

1. Timoshenko. S. P, Goodier. J. N, Theory of Elasticity, Third Edition, Tata McGraw Hill, 2010.
2. Lurie. A. I, Theory of Elasticity, Fourth Edition, Springer , 2005.
3. Sadhu Singh., Applied stress analysis, Khanna Publishers, 2000
4. Dally. J. W, and Riley.W. F, Experimental stress analysis, Mc Graw-Hill, 1991.
5. Love .A. E. H., A treatise on Mathematical theory of Elasticity, Dover publications Inc, 2011.

B.Tech. (VII Sem.) 17AE30 - INTRODUCTION TO SMART STRUCTURES	L	T	P	Cr.
	3	-	-	3

Pre requisition: Materials and Metallurgical science, Composite Structures

Course Educational Objective: The objective of this course is to provide the basic knowledge on different types and structure of smart alloys as well as the techniques used to functionalize common materials.

COURSE OUTCOMES: By the end of the course students will be able to:

CO1: Analyse the behavior of smart materials such as piezoelectric ceramics, shape memory alloys and electroactive polymers
CO2: Apply smart materials in Aerospace vehicles
CO3: Analyse properties of shape memory alloy smart materials

UNIT I

INTRODUCTION AND HISTORICAL PERSPECTIVE: Overview of Intelligent /Smart materials – Functional materials – Polyfunctional materials - Generation of smart materials, Diverse areas of intelligent materials – Primitive functions of intelligent materials - Intelligent inherent in materials – Examples of intelligent materials, structural materials - Technological applications of Intelligent materials in aerospace.

UNIT II

SMART MATERIALS AND PROPERTIES: The principal ingredients of smart materials – Sensing technologies – Micro sensors – Hybrid smart materials – Optical properties (optical bandgap engineering, nonlinear optical effects) - Electrical properties (piezoelectric effect). Thermo-mechanical properties (shape memory and phase change alloys) - Magnetic properties (magnetoresistance and magnetostrictive effect).

UNIT III

SMART ACTUATORS & COMPOSITE MATERIALS: Piezoelectric materials – Properties of commercial piezoelectric materials –Piezoelectric sensors and actuators – Smart materials featuring piezoelectric elements – Review of Composite Materials, Micro and Macro-mechanics, Integration of Smart Sensors and Actuators to Smart Structures – Active Fibre Composites (AFC)- failure criteria for composites; aircraft applications and related design issues

UNIT IV

SHAPE – MEMORY (ALLOYS) SMART MATERIALS: Background on shape memory alloys (SMA) - Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – phase transformations – Cu based SMA, chiral materials – Applications of SMA – SMA fibers – reaction vessels, nuclear reactors, chemical plants, etc. – Micro robot actuated by SMA – SMA memorisation process (Satellite antenna applications).

UNIT V

ADVANCES IN SMART STRUCTURES & MATERIALS: Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self- Healing Polymers, Intelligent System Design, Emergent System Design, Selected applications of smart structures in aircraft design.

REFERENCES:

1. M.V.Gandhi and B.S. Thompson, Smart Materials and Structures Chapman and Hall, London, First Edition, 1992
2. T.W. Deurig, K.N.Melton, D.Stockel and C.M.Wayman, Engineering aspects of Shape Memory alloys, Butterworth –Heinemann, 1990
3. C.A.Rogers, Smart Materials, Structures and Mathematical issues, TechnomicPublising Co., USA, 1989.

B.Tech. (VII Sem.)	17AE31 - HYPERSONIC AERODYNAMICS	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the basic properties of Hypersonic flows, inviscid hypersonic flow theories, the mathematical formulations for viscous hypersonic flows, and the high temperature effects in high-speed flows.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To apply the hypersonic flow theories to analyze flow over bodies
CO2: To analyze the inviscid and viscous effect of hypersonic flow.
CO3: To analyse the viscous interactions in hypersonic flow.
CO4: To analyse the effect of high temperature on gas dynamics.

UNIT - I
FUNDAMENTALS OF HYPERSONIC AERODYNAMICS:
Introduction to Hypersonic Aerodynamics-Differences Between Hypersonic Aerodynamics and Supersonic Aerodynamics-Concept of Thin Shock Layers-Hypersonic Flight Paths-Hypersonic Similarity Parameters-Shock Wave and Expansion Wave Relations of in Viscid Hypersonic Flows

UNIT - II
INVISCID HYPERSONIC FLOWS: Local Surface Inclination Methods-Newtonian Theory-Modified Newtonian Law-Tangent Wedge and Tangent Cone and Shock Expansion Methods-Approximate Theory-Thin Shock Layer Theory.

UNIT - III
VISCOUS HYPERSONIC FLOW: Boundary Layer Equation for Hypersonic Flow-Hypersonic Boundary Layers-Self Similar and Non-Self-Similar Boundary Layers-Solution Methods for Non Self Similar Boundary Layers, Aerodynamic Heating

UNIT - IV
VISCOUS INTERACTIONS IN HYPERSONIC FLOWS: Introduction - Concept of Viscous Interaction in Hypersonic Flows-Strong and Weak Viscous Interactions-Hypersonic Viscous Interaction Similarity Parameter-Introduction to Shock Wave Boundary Layer Interactions

UNIT - V
HIGH TEMPERATURE GAS DYNAMICS: Nature of High Temperature Flows-Chemical Effects in Air-Real and Perfect Gases-Gibb's Free Energy and Entropy-Chemically Reacting Mixtures-Recombination and Dissociation.

REFERENCES
1. John. T Bertin, Hypersonic Aerothermodynamics, published by AIAA Inc., Washington. D.C., 1994.
2. John. D. Anderson. Jr., Hypersonic and High Temperature Gas Dyanmics, Mc. Graw hill Series, New York, 1996.
3. John. D. Anderson. Jr., Modern compressible flow with historical perspective, Mc. Graw Hill Publishing Company, New York, 1996

B.Tech. (VII Sem.)	17AE32 - PROPELLANT TECHNOLOGY	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To know the properties of liquid fuels, various solid, liquid, and cryogenic propellants, and the testing procedures and facilities of propellants.

Course Outcomes: At the end of the semester, the student will be capable
CO1: To analyze the characteristics of aircraft fuels.
CO2: To analyze the characteristics of solid propellants used in rockets.
CO3: To analyze the characteristics of liquid propellants used in rockets.
CO4: To analyze the properties of cryogenic propellants.
CO5: To test the propellants to estimates their characteristics.

UNIT - I
LIQUID FUELS: Properties and Tests for Petroleum Products, Motor Gasoline, Aviation Gasoline, Aviation Turbine Fuels, Requirements of Aviation Fuels - Kerosene Type - High Flash Point Type, Requirements for Fuel Oils.

UNIT - II
SOLID PROPELLANTS: Double Base Propellants, Composite Propellants, Metallized Composite Propellants, Introduction to Different Fuels and Oxidizers of Composite Propellants, Combustion Instabilities and Their Classification, Classification of Solid Propellant Grains Shapes.

UNIT - III
LIQUID PROPELLANTS: Classification- Mono Propellants, Bi-Propellants, Non Hypergolic and Hypergolic Systems, Gel Propellants Systems, Various Tank Configurations, Tank Ullage, Propellant Slosh, Ignition Delay, Performance of Selected Bipropellant Systems.

UNIT –IV
CRYOGENIC PROPELLANTS: Introduction to Cryogenic Propellants, Storage and Handling, Geysering Phenomenon, Elimination of Geysering Effect in Missiles

UNIT - V
PROPELLANT TESTING: Laboratory Testing - Arc Image Furnace, Ignitability Studies - Differential Thermal Analysis - Thermo-Gravimetric Analysis, Particle Size Measurement - Micro-Merograph, Strand Burner Tests, Performance Characteristics Estimation.

REFERENCES
1. Sutton, G.P., Rocket Propulsion Elements, John Wiley, 1993.
2. Sharma, S.P., Mohan .C., Fuels And Combustion, Tata Mcgraw Hill Publishing Co, Ltd., 1984
3. Cornelissse, J.W., Rocket Propulsion and Space Dynamics, J.W. Freeman & Co., Ltd., London, 1980.
4. Panrner, S.F. Propellant Chemistry, Reinhold Publishing Corp., N.Y 1985.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.) **17AE33 - THEORY OF VIBRATIONS**

Course Educational Objectives: To learn about vibratory system and its natural frequency, effects of damping and forced vibrations on a system, the two degree of freedom systems and multi-degree of freedom systems.

Course Outcomes: At the end of the semester, the student will be able to

CO1: Toformulatemathematical models for mechanical systems using mass, spring and dampers

CO2: To analyze the systems with damped free vibrations single degree of freedom

CO3: To develop a single degree of freedom forced vibrating mechanical system under various types of excitation conditions

CO4: To analyze and modify two degree of freedom mechanical systems

CO5: To analyze and design mechanical systems of multi degrees of freedom

UNIT - I

UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, Differential Equation – Solution of Differential Equation, Torsional Vibrations, Equivalent Stiffness of Spring Combinations - Series – Parallel, Natural Frequency of a System by Energy Method.

UNIT - II

DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, Different Types of Damping - Viscous – Coulomb – Structural, Under Damped, Over Damped, Critically Damped, Logarithmic Decrement.

UNIT - III

FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, Forced Vibrations - Constant Harmonic Excitation – Steady State – Forced Vibration with Rotating and Reciprocating Unbalance Mass - Excitation of The Support, Vibration Isolation and Transmissibility - Typical Isolators and Mount Types, Vibration Measuring Instruments – Vibrometer – Accelerometer.

UNIT - IV

TWO DEGREES OF FREEDOM SYSTEMS: Introduction, Principal Modes of Vibrations, Free Vibration - Two Masses Fixed On a Tightly Stretched String - Double Pendulum – Torsional System, Forced Vibration - Undamped with Harmonic Excitation - Undamped Dynamic Vibration Absorber.

UNIT - V

MULTI DEGREE OF FREEDOM SYSTEMS: Undamped Free Vibrations of a Multi Degree of Freedom System - Influence Coefficients - Flexibility Coefficients, Maxwell Reciprocal Theorem, Torsional Vibrations of Multi Rotor Systems, Numerical Method – Determination of Natural Frequency of Vibration– Matrix Method- Rayleigh's Method.

REFERENCES

1. Thomson. W. T, Theory of vibrations with Applications, CBS Publishers & distributors, 2002.
2. Grover. G. K, Mechanical vibrations: M.K.S. Systems, Nemchand& Bros, 1972
3. Singh. V. P, Mechanical vibrations, Dhanpat Rai & Sons, 2016.
4. Rao. V. D, Srinivas. J, Textbook of Mechanical Vibrations, PHI Learning Pvt, Ltd, 2004.
5. Rao. S. S, Mechanical Vibrations, Prentice Hall, 2011.

B.Tech. (VII Sem.) 17AE34 - FATIGUE AND FRACTURE MECHANICS

L	T	P	Cr.
3	-	-	3

Course Educational Objectives: To learn about large variety of fracture mechanisms and fracture modes associated with failure, and various regimes of fatigue crack growth and life estimation.

Course Outcomes (COs): At the end of the semester, the student will be able
CO1: To predict material failure for any combination of applied stresses.
CO2: To estimate failure conditions of a structure
CO3: To determine the stress intensity factor for simple components of simple geometry
CO4: To understand the failure of materials due to high temperatures.

UNIT - I
PHYSICAL ASPECTS OF FATIGUE: Phase in Fatigue Life - Crack Initiation - Crack Growth - Final Fracture, Dislocations -Fatigue Fracture Surfaces, Design Philosophy – Total Life Approach, Damage Tolerance Approach.

UNIT - II
FATIGUE OF STRUCTURES: S-N Curves - Endurance Limit - Effect of Mean Stress and, Variable Stress, Gerber, Goodman and Soderberg Relations and Diagrams -Design of Components Subjected to Axial, Bending, Torsion Loads and Combination of them. Notches and Stress Concentrations - Neuber's Stress Concentration Factors - Plastic Stress Concentration Factors - Notched S-N Curves.

UNIT - III
STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR: Low Cycle Fatigue 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 - IV
FRACTURE MECHNAICS: Strength and Stress Analysis of Cracked Bodies – Potential Energy and Surface Energy - Griffith's Theory - Effect of Thickness On Fracture Toughness - Stress Intensity Factors for Typical Geometries.

UNIT - V
FAILURES OF STRUCTURES: High Temperature Failures – Creep Curve, Stress-Rupture Testing, Creep Deformation Mechanisms, Elevated-Temperature Fracture, Wear Failures – Abrasive Wear, Erosive Wear, Erosive-Corrosion Wear, Grinding Wear, Adhesive Wear, Environment Assisted Failures – Stress Corrosion Cracking, Corrosion Fatigue, Hydrogen Damage, Liquid Metal Embrittlement.

REFERENCES

1. Prasanth Kumar, Elements of fracture mechanics, Wheeter publication, 1999.
2. Barrois W, Ripely, E.L, Fatigue of aircraft structure, Pegamon press. Oxford, 1983.
3. Knott. J.F., Fundamentals of Fracture Mechanics, Buterworth& Co., Ltd., London,1983.
4. Sin, C.G., Mechanics of fracture Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
5. Subra Suresh, Fatigue of materials, Cambridge University Press, Second edition, 1998.
6. Anderson. T. L, Fracture mechanics: Fundamentals and applications, CRC, ThirdEdition, 2005.

B.Tech. (VII Sem.)	17AE92 - AIRPORT DESIGN (Add on course – III)	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: □ To study the procedure of the formation of aerodrome and its design, various maintenance activities for airport maintenance, air traffic control, procedure and air traffic service.

Course Outcomes : At the end of the semester, the student will be able to
CO1: Acquire the concept of air traffic rules and clearance procedures for airline operation.
CO1: Analyze the various air traffic data for air traffic services.
CO3: Analyze the influence of aerodrome design factors for service establishments.

UNIT I
BASIC CONCEPTS: 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: 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. Comparison of various ATC services.

UNIT III
FLIGHT INFORMATION: Flight Information, Alerting Services, Coordination, Emergency Procedures and Rules of the Air Radar service, basic radar terminology - identification procedures using primary / secondary radar - performance checks - use of radar in area and approach control services - assurance control and coordination between radar / non radar control

UNIT IV
AERODROME DATA: Aerodrome data - basic terminology - aerodrome reference code - aerodrome reference point - aerodrome elevation - aerodrome reference temperature - instrument runway, physical characteristics; length of primary / secondary runway - width of runways - minimum distance between parallel runways etc - obstacles restriction. Comparison between domestic and international airports.

UNIT V
VISUAL AIDS FOR NAVIGATION: Visual aids for navigation, wind direction indicator, landing direction indicator, location and characteristics of signal area, markings, lights, 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.

REFERENCE
1. Virendrakumar and Sathish Chandra, Airport Planning and Design, Galgotia publications Pvt Ltd, New Delhi, 2012.
2. Aeronautical Information Publication (India) Vol. I & II, the English book store, 17-1, Connaught Circus, New Delhi, 2006.
3. M.S Nolan, "Fundamentals Air Traffic Control", Latest Edition, YESDEE Publishers, 2010.
4. Seth B. Young, Alexander T. Wells, "Airport Planning and Management" McGraw-Hill Education, New Delhi, 2011.

B.Tech. (VII Sem.)	17AE66 - AIRCRAFT COMPONENT MODELING AND ANALYSIS LAB	L	T	P	Cr.
		-	-	2	1

Course Educational Objectives: To learn surface modeling package (CATIA) to draw 2D sketches, 3D parts, various aircraft components and assembly drawing, and finite element package (ANSYS) to analyze the behavior of simple structural elements under static loading system.

Course Outcomes: At the end of the semester, the student will be able to

CO1: To draw aircraft components in 2D and 3D geometric modeling

CO2: To solve and analyze the structural components of aircraft for deformations and stresses using a numerical tool.

Any ten experiments are to be performed:

1. Design anddrafting of aircraft wing structural elements
2. Design and drafting of aircraft fuselage structural elements
3. Design and drafting of landing gear
4. Design and drafting of rotary engine
5. Design and draftingconventional aircraft
6. Assembly of landing gear
7. Modal analysis of beam with different end conditions
8. Modal analysis of nose cone
9. Modal analysis of wing
10. Modal analysis of fuselage-Monocoque
11. Static analysis of cantilever beam.
12. Static analysis of composite laminate
13. Static analysis of bending of curved beam
14. Analysis of thermal stresses in bar

L	T	P	Cr.
-	-	2	1

B.Tech. (VII Sem.) **17AE67 - AIRCRAFT DESIGN LAB**

Course Educational Objectives: To learn the aircraft design methodologies.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To design an aircraft system, component, or process as per the requirement
CO2: To design an aircraft as per the assigned specifications

Experiments are to be performed:
1. Aircraft conceptual sketch and its gross weight estimation algorithm
2. Preliminary weight estimation
3. Trade off study on range
4. Trade off study on payload
5. Fixed sizing
6. Load or Induced Drag Estimation
7. Preliminary design of an aircraft fuselage
8. Preliminary design of load distribution on a fuselage
9. Estimate the Critical Mach number for an Airfoil
10. Static Performance: Thrust required curve
11. Static Performance: Power required curve
12. Drawing all the 3 views of a new Aircraft

B.Tech. (VIII Sem.)	17AE35 - HELICOPTER ENGINEERING	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the function of various parts of helicopter, rotor theories and power requirements of helicopter motion, performance of helicopter in hovering and climbing, performance of horizontal and forward flight and control.

Course Outcomes: At the end of the course, student will be able
CO1: To analyze the performance various components of helicopter.
CO2: To apply momentum theory in the design of propeller
CO3: To analyze the performance of helicopter in various operating conditions
CO4: To analyze the stability modes of helicopter

UNIT – I
BASICS OF HELICOPTER CONFIGURATION: Introduction, Configurations of Helicopter, Specifics of Helicopters, Articulated Rotor Systems, Effect of Cyclic Pitch Change, Swash Plate, Rotor Systems - Fully Articulated Rotor - Semi-Rigid rotor - Rigid Rotor - Coriolis effect, Methods of control.

UNIT – II
MOMENTUM THEORY: Introduction, Thrust Generation - Hovering - Figure of Merit, Blade Element Theory, General Expression for V_i - Local Solidity, Top Loss, Performance of ideally Twisted Constant Chord Blade, Rapid performance in Hover - Equivalent Chord.

UNIT – III
PERFORMANCE IN HOVERING AND CLIMBING: Introduction, Optimum Hovering Rotor, Induced Torque, Profile Drag Torque, Performance Equation - Optimum Rotor Design, Ground effect.

UNIT – IV
PERFORMANCE IN HORIZONTAL FLIGHT: Introduction, Flapping and lag Hinge, Steady Hover, Equilibrium in Horizontal Blade - Blade Hinge Motion, Blade Element Angle of Attack - Flapping Coefficient,
FORWARD FLIGHT: Introduction to Forward Flight, Performance equation, Drag-Lift Ratio, Profile Drag-Lift Ratio Charts, Profile Power, Parasite Power, Blade Stall - Introduction.

UNIT – V
STABILITY AND CONTROL: Introduction, Stability Terms - Trim - Static Stability - Dynamic Stability, Rotor Static Stability, Stability in Hover, Dynamic Stability, Dynamic Stability Reduction, Stability in Forward Flight,

REFERENCES

1. E. Rathakrishnan., Helicopter Aerodynamics, PHI, 2018.
2. Gessow, A., Myers, Aerodynamics of Helicopter, G.C MacMillan & Co., N.Y. 1987.
3. B. W. McCormick, Aerodynamics of V/STOL Flight, Academic Press, 1987.
4. W. Johnson, Helicopter Theory, Princeton university Press, 1980.
5. B. W. McCormick, Aerodynamics, Aeronautics & Flight Mechanics, John Wiley, 1995.

B.Tech. (VIII Sem.)	17AE36 - WIND ENGINEERING	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: The objectives of this course are to provide students with a basic knowledge of the formation, history, probability of occurrence and geographic distribution of extreme wind events, with special focus on tropical cyclones, design wind loads for low-rise structures and their bases, analyze the structural response to wind loading and evaluate the methods specific to wind engineering practice, including wind tunnel modelling and destructive testing.

Course Outcomes: At the end of the course, student will be able

CO1: To describe about the properties of Atmosphere, atmospheric motions, local winds and different types of Terrains.

CO2: To interpret the Atmospheric Boundary Layer Equations including turbulence profiles, Power spectral Densities, length scales and roughness parameters.

CO3: To apply atmospheric boundary layer equations on bluff bodies to study time varying forces, wake regions, flow separations and reattachment regions.

CO4: To analyze wind loading characteristics using various assessment methods like Quasi-Steady method, Peak factor method and Extreme value method.

CO5: To predict the Aeroelastic phenomena of various bluff bodies like circular cables, tall structures and Launch vehicles.

UNIT - I

THE ATMOSPHERE: Atmospheric Circulation, Stability of atmospheres – definitions & implications, Effects of friction, Atmospheric motion – Local winds, Building codes, Terrains-different types

UNIT - II

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

UNIT - III

BLUFF BODY AERODYNAMICS: Governing Equations, Boundary layers and separations – Wake and Vortex formation two dimensional, Strouhal Numbers, Reynolds numbers, Separation and Reattachments, Oscillatory Flow patterns, Vortex shedding flow switching– Time varying forces to wind velocity in turbulent flow, Structures in three dimensional

UNIT - IV

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

UNIT - V

AEROELASTIC PHENOMENA: Vortex shedding and lock in phenomena in turbulent flows, across wind galloping, wake galloping - Torsional divergence, along wind galloping of circular cables, cross wind galloping of circular cables, Wind loads & their effects on tall structures, Launch vehicles

TEXT BOOKS

1. Emil Simiu& Robert H Scanlan, Wind effects on structures - fundamentals and applications to design, John Wiley & Sons Inc New York, 1996.

REFERENCES

1. Y. Tamura, A. Kareem, Advance Structural Wind Engineering, Springer Science & Business Media, 19-Jul-2013 - Science
2. Tom Lawson Building Aerodynamics Imperial College Press London, 2001
3. N J Cook, Design Guides to wind loading of buildings structures Part I & II, Butterworths, London, 1985 IS: 875 (1987) Part III Wind loads, Indian Standards for Building codes.

B.Tech. (VIII Sem.)	17AE37 - CRYOGENICS	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the properties of cryogenics fluid, the liquefaction process, working principle of liquefaction, the storage systems and applications.

Course Outcomes:
CO1: To describe the properties of cryogenic fuels
CO2: To analyse the various liquefaction systems
CO3: To describe the purification and cryogenic storage process.

UNIT - I
INTRODUCTION TO CRYOGENIC SYSTEM: Introduction- Historical Development- Mechanical Properties –Thermal Properties-Electric and Magnetic properties – Properties of cryogenic fluids.

UNIT - II
GAS LIQUEFACTION: Minimum work for liquefaction – Methods to produce low temperature – Liquefaction systems for gases other than Neon, Hydrogen and Helium. Liquefaction systems for Neon, Hydrogen and Helium.

UNIT - III
COMPONENTS OF LIQUEFACTION SYSTEMS: Heat Exchangers – Compressors and Expanders – Expansion valve – Losses for real machines.

UNIT - IV
GAS SEPARATION AND PURIFICATION SYSTEM: Properties of mixtures – Principles of mixtures – Principles of gas separation – Air separation systems. Cryogenic Refrigeration system – Working media – Solids, Liquids and gases.

UNIT - V
CRYOGENIC FLUID STORAGE & TRANSFER – Cryogenic storage systems – Insulation Fluid transfer mechanics – Cryostat – Cryo Coolers.
Applications: Space technology – in- flight air separation and collection of LOX – Gas Industry – Biology - Medicine - Electronics.

REFERENCES
1. Barron. R. F, Cryogenic Systems,Oxford University Press, Second Edition, 1985.
2. Sittig. M, Cryogenic Research and Applications, Van Nostrand Reinhold Inc.,U.S,First Edition, 1963.
3. Scott. R. B, Cryogenics Engineering, Von NostrandInc, New Jersey, 1960.
4. Weisend. J. G, Hand book of cryogenic engineering- -II, Taylor and Francis,1998.

B.Tech. (VIII Sem.)	17AE38 - AEROELASTICITY	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Theory of Vibrations, Aerodynamics, Theory of Elasticity

Course Educational Objectives: To learn the phenomenon of aeroelasticity in aircraft, theories and solutions to understand the aeroelastic problems.

Course Outcomes: At the end of the semester, the student will be able
CO1: To analyze the effects of vortex induced vibration on components of an aircraft
CO2: To design the aircraft components by considering effects of flow induced vibration
CO3: To analyseaeroelastic phenomena in aerospace vehicles
CO4: To estimate the flutter velocity using various methods

UNIT - I
AEROELASTICITY PHENOMENA: Vibration of Beams due to Coupled Torsion-Flexure, The Aero-elastic Triangle of Forces, Stability versus Response Problems, Aeroelasticity in Aircraft Design, Vortex Induced Vibration.

UNIT - II
DIVERGENCE OF A LIFTING SURFACE: Simple Two Dimensional Idealizations, Strip Theory, Fredholm Integral Equation of the Second Kind, Exact solutions for simple rectangular wings, Semirigid assumption and approximate solutions, Generalized coordinates, Successive approximations, Numerical approximations using matrix equations.

UNIT - III
STEADY STATE AEROELASTIC PROBLEMS: Loss and reversal of aileron control, Critical aileron reversal speed, Aileron efficiency, Semirigid theory and successive approximations, Lift distributions, Rigid and elastic wing.

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

UNIT - V
AEROELASTIC PROBLEMS IN CIVIL AND MECHANICAL ENGINEERING: Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges.

REFERENCES
1. Fung, Y.C., An Introduction to the Theory of Aeroelasticity, John Wiley & Sons Inc., New york 1985.
2. Broadbent, E.G., Elementary Theory of Aeroelasticity, BunHill Publications Ltd., 1986.
3. Bisplinghoff., R.L., Ashley, H., Halfmann, R.L., Aeroelasticity, Addison Wesley Publishing Co., Inc., Second Edition, 1987.
4. Scanlan, R.H.,Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, MacMillan Co., N.Y., 1991.

L	T	P	Cr.
3	-	-	3

B.Tech. (VIII Sem.) **17AE39 - BOUNDARY LAYER THEORY**

Course Educational Objectives: To learn the fundamental equations governing the viscous fluid flow phenomenon, solutions of various viscous flow problems, basic formulations of laminar boundary layer, basic aspects of turbulent boundary layer over objects, and elementary aspects of compressible boundary layer.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To formulate fundamental equations of viscous flow
CO2: To apply the viscous flow equations to solve fluid flow problems
CO3: To analyze laminar and turbulent boundary layer flow fields of objects
CO4: To describe the properties of compressible boundary layer flow

UNIT - I
FUNDAMENTAL EQUATIONS OF VISCOUS FLOW: Fundamental Equations of Viscous Flow, Conservation of Mass, Conservation of Momentum-Navier-Stokes Equations, Energy equation, Dimensional Parameters in Viscous Flow, Non-dimensional form of the Basic Equations and Boundary conditions

UNIT - II
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 - Estimation of boundary layer thickness-Displacement thickness, momentum and energy thickness for two-dimensional flows

UNIT - III
LAMINAR BOUNDARY LAYER: Laminar boundary layer equations, Flat Plate Integral analysis of Energy equation, flow separation - Blasius solution for flat-plate flow –Falkner-Skan Wedge flows - Boundary layer temperature profiles for constant plate temperature – Integral equation of Boundary layer - Pohlhausen method - Thermal boundary layer calculations

UNIT - IV
TURBULENT BOUNDARY LAYER: 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 LAYER: Compressible boundary layer equation, Recovery factor, similarity solutions, laminar supersonic cone rule, shock-boundary layer interaction.

REFERENCES
1. White, F.M, Viscous Fluid Flow, McGraw Hill Book Co., Inc., New York, 1985.
2. Reynolds, A.J, Turbulent Flows in Engineering, John Wiley & Sons, 1980.
3. Panton, R.L, Incompressible Flow, John Wiley and Sons, 1984.
4. Anderson, J.D, Fundmentals of Aerodynamics, McGraw Hill Book Co., Inc., New York, 1985.
5. Schlichting, H, Boundary Layer Theory, McGraw Hill New York, 1979.

B.Tech. (VIII Sem.) **17AE40 - ADVANCED PROPULSION SYSTEMS**

L	T	P	Cr.
3	-	-	3

Pre-requisites: Propulsion-I, Propulsion-II

Course Educational Objectives: To learn the fundamentals scramjet propulsion systems, functions of nuclear propulsion systems, basics of electrical propulsion systems, the micro propulsion**,** propellant-less and advanced propulsion systems.

Course Outcomes: At the end of the semester, the student will be capable
CO1: To analyze the scram jet engine performance.
CO2: To analyze the performance nuclear prolusion systems.
CO3: To apply the electric propulsion for space applications.
CO4: To understand the various micro propulsion systems.
CO5: To understand the various advanced chemical propulsion systems.

UNIT- I
SCRAMJET PROPULSION: Fundamental Considerations of Hypersonic Air Breathing Vehicles, Scramjet Inlets, Supersonic Flow Combustors, Scramjet Performance, Scramjet and Ram Rocket Propulsion System, Dual Mode Combustion System

UNIT - II
NUCLEAR PROPULSION SYSTEM: Types of Nuclear Propulsion Systems, Fission Nuclear Rockets - Gaseous Core Nuclear Rockets, Fusion Nuclear Propulsion Systems, Performance and Application Areas, Nuclear Hazards.

UNIT -III
ELECTRIC PROPULSION SYSTEM: Overview of Application Areas, Ideal Flight Performance, Electro Thermal Thrusters- Resistojets and Arcjets, Electric Thrusters- Electrostatic, Electromagnetic, Electric Power Generation in Space.

UNIT - IV
MICRO PROPULSION: Introduction to Micro Propulsion, Micro Mono Propellant Thrusters, Micro Bi-Propellant Thruster, Micro Cold Gas Thrusters, Micro Ion Thruster, Micro Ppt Thruster, Microchip Laser Thruster.

UNIT –V
PROPELLANT-LESS AND ADVANCED CHEMICAL PROPULSION SYSTEM: High Performance Chemical Propulsion Systems - Tripropellant Systems - High Energy Density Propulsion Systems - Metalized Propellant Systems, Solar Sail, Magnetic Sail, Tether Propulsion, Photon Rockets

REFERENCES
1. Tajmar. M, Advanced Space Propulsion Systems, Springer, First Edition, 2002.
2. Martin J.L. Turner, Rocket and Space Propulsion: Principles, Practice and New Developments, Springer, Third Edition, 2009.
3. Sutton, G.P., Rocket Propulsion Elements, John Wiley, 1993.
4. Bruno. C, Accettura. A. G, Advanced Propulsion Systems And Technologies, Today To 2020, AIAA, 2008.

B.Tech. (VIII Sem.) **17AE41 - THEORY OF PLATES AND SHELLS**

L	T	P	Cr.
3	-	-	3

Course Educational Objectives: To learn the methods to solve the plates with various shapes, and types of shell structures in aerospace vehicles.

Course Outcomes: At the end of the semester, the student will be able to

CO1: To apply the classical lamination plate theory in engineering structures
CO2: To analyze the stability of rectangular plates under various loading conditions
CO3: To apply the various approximation techniques to evaluate the problems.
CO4: To analyze the circular cylindrical shells under various loading conditions

UNIT - I

CLASSICAL PLATE THEORY: Plate Structures in Aerospace Vehicles-Classical Plate Theory– Assumptions – Differential Equation – Boundary Conditions, Different Loads

UNIT - II

PLATES OF VARIOUS SHAPES: Navier's Solution and Energy Method- Rectangular and Circular Plates with Various End Conditions – Levy's Method of Solution for Rectangular Plates Under Different Boundary Conditions.

UNIT - III

EIGEN VALUE ANALYSIS: Stability and Free Vibration Analysis of Rectangular Plates.

UNIT - IV

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

UNIT - V

SHELLS: Shell Structures in Aerospace Vehicles- Basic Concepts of Shell Type of Structures – Membrane Analysis and Bending Theories Forcircular Cylindrical Shells.

REFERENCES

1. Varadan. T. K, Bhaskar. K, Theory of Plates and Shells,Narosa Publishers, 1999.
2. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
3. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, McGraw-Hill Book Co. 1986
4. Timoshenko, S.P. Winowsky. S., Kreger, Theory of Plates and Shells, McGraw-Hill Book Co. 1990.
5. Chandrashekhara. K, Theory of Plates, University of Press,2001.

B.Tech. (VIII Sem.)	17AE42 - AERO ENGINE REPAIR AND MAINTENANCE	L	T	P	Cr.
		3	-	-	3

Course Educational Objectives: To learn the function of various components of piston engine and inspection, maintenance, troubleshooting of piston engine and overhauling procedures of piston engines, the function of jet engine components and overhauling procedures of Gas turbine components.

Course Outcomes: At the end of the semester, the student will be able
CO1: To analyze the performance of piston engine components
CO2: To inspect and troubleshoot the piston engines components
CO3: To prepare the piston engine testing procedures
CO4: To analyze the performance of jet engine components
CO5: To prepare overhaul procedures for jet engine components

UNIT - I
CLASSIFICATION OF PISTON ENGINE COMPONENTS: Types of Piston Engines – Principles of Operation – Function of Components – Materials Used – Details of Starting the Engines – Details of Carburetion and Injection Systems for Small and Large Engines – Ignition System Components – Spark Plug Details – Engine Operating Conditions at Various Altitudes – Maintenance and Inspection Check to be Carried Out.

UNIT - II
INSPECTIONS OF PISTON ENGINES: Inspection and Maintenance and Trouble Shooting – Inspection of All Engine Components – Daily and Routine Checks – Overhaul Procedures – Compression Testing of Cylinders – Special Inspection Schedules – Engine Fuel, Control and Exhaust Systems – Engine Mount and Super Charger – Checks and Inspection Procedures.

UNIT - III
OVERHAULING OF PISTON ENGINES: Symptoms of Failure – Fault Diagnostics – Case Studies of Different Engine Systems –Tools and Equipment Requirements for Various Checks and Alignment During Overhauling – Tools for Inspection – Tools for Safety and for Visual Inspection – Methods and Instruments for Non-Destructive Testing Techniques – Equipment for Replacement of Part and Their Repair. Engine Testing: Engine Testing Procedures and Schedule Preparation – Online Maintenance

UNIT - IV
CLASSIFICATION OF JET ENGINE COMPONENTS: Types of Jet Engines – Principles of Operation – Functions of Components – Materials Used – Details of Starting and Operating Procedures – Gas Turbine Engine Inspection & Checks – Use of Instruments for Online Maintenance – Special Inspection Procedures: Foreign Object Damage – Blade Damage – Etc. Maintenance Procedures of Gas Turbine Engines – Trouble Shooting and Rectification Procedures – Component Maintenance Procedures – Systems Maintenance Procedures. Gas Turbine Testing Procedures – Test Schedule Preparation – Storage of Engines –Preservation and De-Preservation Procedures

UNIT - V
OVERHAUL PROCEDURES: Engine Overhaul Procedures – Inspections and Cleaning of Components – Repairs Schedules for Overhaul – Balancing of Gas Turbine Components. Trouble Shooting - Procedures for Rectification – Condition Monitoring of the Engine On Ground and at Altitude – Engine Health Monitoring and Corrective Methods.

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1. Kroes& Wild, Aircraft Power plants, 7th Edition – McGraw Hill, New York, 1994.
2. Gas Turbine Engines, TURBOMECA, The English Book Store, New Delhi, 1993.
3. Pratt & Whitney, The Aircraft Gas Turbine Engine and its Operation, (latest edition), The English Book Store, New Delhi, 1974.