COURSE STRUCTURE (R20)

I - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE01	Professional Communication-I	2	0	0	2	30	70	100
2	20FE03	Differential Equations	2	1	0	3	30	70	100
3	20FE05	Applied Chemistry	3	0	0	3	30	70	100
4	20ME01	Engineering Graphics	2	0	4	4	30	70	100
5	20ME02	Engineering Mechanics	2	1	0	3	30	70	100
Laboratory Courses									
6	20FE52	Applied Chemistry Lab	0	0	3	1.5	15	35	50
7	20ME52	Engineering Mechanics and Fuel Testing Lab	0	0	3	1.5	15	35	50
8	20ME51	Engineering Workshop	0	0	3	1.5	15	35	50
Total			**11**	**2**	**13**	**19.5**	**195**	**455**	**650**

II - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE02	Professional Communication-II	2	0	0	2	30	70	100
2	20FE04	Linear Algebra and Transformation Techniques	2	1	0	3	30	70	100
3	20FE08	Engineering Physics	2	1	0	3	30	70	100
4	20CS01	Programming for Problem Solving using C	3	0	0	3	30	70	100
5	20AE01	Elements of Aerospace Engineering	3	0	0	3	30	70	100
6	20MC01	Constitution of India	2	0	0	0	30	70	100
Laboratory Courses									
7	20FE51	Professional Communication Skills Lab	0	0	2	1	15	35	50
8	20FE55	Engineering Physics Lab	0	0	3	1.5	15	35	50
9	20CS51	Programming for Problem Solving using C Lab	0	0	3	1.5	15	35	50
10	20ME54	Computer Aided Engineering Graphics	0	0	3	1.5	15	35	50
Total			**14**	**2**	**11**	**19.5**	**240**	**560**	**800**

III SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE10	Numerical Methods and Integral Calculus	2	1	0	3	30	70	100
2	20EE02	Basic Electrical and Electronics Engineering	3	0	0	3	30	70	100
3	20AE02	Engineering Fluid Mechanics	2	1	0	3	30	70	100
4	20AE03	Engineering Thermodynamics	2	1	0	3	30	70	100
5	20AE04	Strength of Materials	2	1	0	3	30	70	100
6	20MC02	Environmental Science	2	0	0	0	30	70	100
Laboratory Courses									
7	20EE52	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5	15	35	50
8	20AE51	Engineering Fluid Mechanics Lab	0	0	3	1.5	15	35	50
9	20AE52	Strength of Materials Lab	0	0	3	1.5	15	35	50
10	20AES1	Advanced AutoCAD	1	0	2	2	--	50	50
Total			**14**	**4**	**11**	**21.5**	**225**	**575**	**800**

IV SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE09	Probability and Statistics	3	0	0	3	30	70	100
2	20AE05	Aerospace Materials and Manufacturing	3	0	0	3	30	70	100
3	20AE06	Aerodynamics	3	0	0	3	30	70	100
4	20AE07	Aircraft Structures-I	2	1	0	3	30	70	100
5	20HS01	Universal Human values 2: Understanding Harmony	3	0	0	3	30	70	100
Laboratory Courses									
6	20AE53	Manufacturing Technology Lab	0	0	3	1.5	15	35	50
7	20AE54	Thermal Engineering Lab	0	0	3	1.5	15	35	50
8	20AE55	MATLAB applications in Engineering Lab	0	0	3	1.5	15	35	50
9	20ITS1	Problem Solving Using Python	1	0	2	2	--	50	50
Total			**15**	**1**	**11**	**21.5**	**195**	**505**	**700**
Honors/Minor Courses						4			

V - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20AE08	Aircraft Systems and Instruments	3	0	0	3	30	70	100
2	20AE09	Gas Dynamics	2	1	0	3	30	70	100
3	20AE10	Aircraft Structures-II	2	1	0	3	30	70	100
4		**PROGRAM ELECTIVE – I**	3	0	0	3	30	70	100
	20AE11	Industrial Aerodynamics							
	20AE12	Finite Element Methods in Engineering							
	20AE13	UAV Systems Design							
5		**OPEN ELECTIVE – I**	3	0	0	3	30	70	100
Laboratory Courses									
6	20AE56	Aerodynamics Lab	0	0	3	1.5	15	35	50
7	20AE57	Aircraft Structures Lab	0	0	3	1.5	15	35	50
8	20AES2	Component Modelling using CATIA	1	0	2	2	-	50	50
9	20PI01	Summer Internship	-	-	-	1.5	-	50	50
		TOTAL	**14**	**02**	**08**	**21.5**	**180**	**520**	**700**

VI - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20AE14	Elements of Heat Transfer	3	0	0	3	30	70	100
2	20AE15	Flight Dynamics	3	0	0	3	30	70	100
3	20AE16	Air Breathing Propulsion	3	0	0	3	30	70	100
4	**PROGRAM ELECTIVE – II**		3	0	0	3	30	70	100
	20AE17	Introduction to Computational Fluid Dynamics							
	20AE18	Viscous Flows							
	20AE19	Airport Design							
5		**OPEN ELECTIVE-II**	3	0	0	3	30	70	100
Laboratory Courses									
6	20AE58	Aircraft Design Lab	0	0	3	1.5	15	35	50
7	20AE59	Propulsion Lab	0	0	3	1.5	15	35	50
8	20AE60	Aircraft Component Modelling and Analysis Lab	0	0	3	1.5	15	35	50
9	20HSS1	Soft Skills Course	1	0	2	2	-	50	50
		TOTAL	**16**	**0**	**11**	**21.5**	**195**	**505**	**700**

VII - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		**PROGRAM ELECTIVE - III**	3	0	0	3	30	70	100
	20AE20	Helicopter Aerodynamics							
	20AE21	Combustion in Aerospace Vehicles							
	20AE22	Mechanics of Composites							
2		**PROGRAM ELECTIVE - IV**	3	0	0	3	30	70	100
	20AE23	Introduction to Space Technology							
	20AE24	Space Vehicle Propulsion							
	20AE25	Aeroelasticity							
3		**PROGRAM ELECTIVE - V**	3	0	0	3	30	70	100
	20AE26	Instrumentation Measurements and Experiments in Fluids							
	20AE27	Propellant Technology							
	20AE28	Space Mechanics							
		OPEN ELECTIVE - III	3	0	0	3	30	70	100
5		**OPEN ELECTIVE - IV**	3	0	0	3	30	70	100
6	20HS02	Management Science for Engineers	3	0	0	3	30	70	100
Laboratory Courses									
7	20AES3	Fluid Flow Analysis using Ansys Fluent	1	0	2	2	-	50	50
8	20PI02	Industrial/Research Internship	-	-	-	3	-	50	50
		TOTAL	**19**	**0**	**02**	**23**	**180**	**520**	**700**

VIII - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Laboratory Courses									
1	20PI03	Project Work	0	0	24	12	60	140	200

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
20AD81	Introduction to Artificial Intelligence	ASE, CE, ECE, EEE, & ME
20AD82	Introduction to Data Science	ASE, CE, ECE, EEE, & ME
20AD83	Introduction to Machine Learning	ASE, CE, ECE, EEE, & ME
20AD84	Fundamentals of Deep Learning	ASE, CE, ECE, EEE, & ME
20AE81	Principles of Flight	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE82	Space Science	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE83	Aircraft Systems	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE84	Air Transportation Systems	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE81	Basics of Civil Engineering	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE82	Disaster Management	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE83	Fundamentals of Geospatial Technologies	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE84	Environmental Sanitation	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CS81	Unix and Shell Programming	ASE, CE, ECE, EEE, & ME
20CS82	Introduction to Algorithm Techniques	ASE, CE, ECE, EEE, & ME
20CS83	Principles of Computer Architecture	ASE, CE, ECE, EEE, & ME
20CS84	PHP Programming	ASE, CE, ECE, EEE, & ME
20CS85	Object Oriented Software Engineering	ASE, CE, ECE, EEE, & ME
20EC81	Satellite Technology	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC82	Elements of Communication Systems	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC83	Microprocessors and Interfacing	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC84	Analog and Digital Communications	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC85	Systems and Signal Processing	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC86	Cellular Technology	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
20EE81	Linear Control Systems	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE82	Basics of Electrical Measurements	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE83	Utilization of Electrical Energy	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE84	Electric Vehicles	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20IT81	OOP through JAVA	ASE, CE, ECE, EEE, & ME
20IT82	Web Technologies using PHP	ASE, CE, ECE, EEE, & ME
20IT83	Mobile Application Development	ASE, CE, ECE, EEE, & ME
20IT84	Cyber Security & Digital Forensics	ASE, CE, ECE, EEE, & ME
20ME81	Renewable Energy Sources	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME82	Robotics in Automation	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME83	Operations Research Techniques	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME84	Elements of Automobile Engineering	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT

B.Tech. (ISem.)	20FE01 - PROFESSIONAL COMMUNICATION - I	L	T	P	Cr.
		2	0	0	2

Pre-requisites: Nil

Course Educational Objectives: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

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

- **CO1** : Write sentences and paragraphs using proper grammatical structures and word forms (**Remember – L1**)
- **CO2** : Comprehend the given text by employing suitable strategies for skimming and scanning and draw inferences (**Understand – L2**)
- **CO3** : Write summaries of reading texts using correct tense forms & appropriate structures (**Remember – L1**)
- **CO4** : Write Formal Letters, Memos & E-Mails (**Apply – L3**)
- **CO5** : Edit the sentences/short texts by identifying basic errors of grammar/vocabulary/syntax (**Understand – L2**)

Unit - I

Exploration - 'A Proposal to Girdle the Earth – Nellie Bly'; Reading: Skimming for main idea; Scanning for specific information; Grammar & Vocabulary: Content Words; Function Words; Word Forms: verbs, nouns, adjectives and adverbs; Nouns: Countable and Uncountable, Singular and Plural forms; Wh - Questions; Word Order in Sentences; Writing: Paragraph Analysis; Paragraph Writing; Punctuation and Capital Letters

Unit – II

On Campus- 'The District School as it Was by One Who Went to it – Warren Burton'; Reading: Identifying Sequence of Ideas; Grammar & Vocabulary: Cohesive Devices: Linkers/Signposts/Transition signals, Synonyms, Meanings of Words/Phrases in the context; Writing: Memo Drafting.

Unit – III

Working Together-'The Future of Work'

Reading: Making basic inferences; Strategies to use text clues for comprehension; Summarizing; Grammar & Vocabulary: Verbs: Tenses; Reporting Verbs for Academic Purpose; Writing**:** Rephrasing what is read; Avoiding redundancies and repetitions; Abstract Writing/ Summarizing.

Unit – IV

'A.P.J.Abdul Kalam'; Grammar & Vocabulary: Direct & Indirect Speech; Articles and their Omission; Writing: E-Mail Drafting.

Unit – V

'C.V.Raman'; Grammar & Vocabulary: Subject-Verb Agreement; Prepositions; Writing: Formal Letter Writing.

Text Books:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient BlackSwan, Hyderabad, 2019.
2. "Panorama – A Course on Reading", A collection of prose selections, Oxford University Press, New Delhi, 2016.

Reference Books:

1. Swan, M., "Practical English Usage", Oxford University Press, 2016.
2. Kumar,S and Latha, P, "Communication Skills", Oxford University Press, 2018.
3. Rizvi Ashraf M., "Effective Technical Communication", Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, "Professional Communication", I.K. International Publishing House Pvt. Ltd., New Delhi, 2008.
5. Wood, F.T., "Remedial English Grammar", Macmillan, 2007.

B.Tech. (I Sem.)	20FE03 - DIFFERENTIAL EQUATIONS	L	T	P	Cr.
		2	1	0	3

Pre-requisites :Nil

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 also learn solving of first order partial differential equations.

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 (**Apply – L3**)

CO2: Distinguish between the structure and methodology of solving higher order differential equations with constant coefficients (**Understand – L2**)

CO3: Apply various Numerical methods to solve initial value problem (**Apply – L3**)

CO4: Generate the infinite series for continuous functions and investigate the functional Dependence (**Understand – L2**)

CO5: Solve partial differential equations using Lagrange's method (**Apply – L3**)

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 of differential equations – Orthogonal Trajectories.

UNIT –II

Linear Differential Equations of Higher Order

Homogeneous and Non Homogeneous Linear differential equations of second and higher order with constant coefficients with R.H.S. functions e^{ax}, sin $(ax+b)$, cos $(ax+b)$, x^m, $e^{ax}V(x)$, $xV(x)$, Method of variation of parameters.

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

Functions of several variables

Generalized Mean Value Theorem (without proof), Maclaurin's series, Functions of several variables, Jacobians (Cartesian and polar coordinates), Functional dependence. Maxima and Minima of function with two variables.

UNIT – V

Partial Differential Equations

Formation ofPartial Differential Equations by elimination of arbitrary constants and arbitrary functions.Solution of first order and first degree linear partial differential equation – Lagrange's method.

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 Books:

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi,2011.
2. Erwin Kreyszig, *"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 & sons, New Delhi,2011.
4. S. S. Sastry, *"Introductory Methods of Numerical Analysis"* 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

B.Tech. (I Sem) **20FE05 - APPLIED CHEMISTRY**

L	T	P	Cr.
3	0	0	3

Pre-requisites:Nil

Course Educational Objectives: It enables the students to understand the fundamental concepts of chemistry and to provide them with the knowledge of industrial problems and finding the solutions. It helps to strengthen the basic concepts of water, fuel technologies**,** electrochemistry, corrosion and advanced materials used in technologies.

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

CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications.(**Understand - L2**)

CO2: Understand the issues related to conventional fuels, biofuels and photo-voltaic cells in energy production.(**Understand - L2**)

CO3: Apply Nernst Equation for calculating electrode cell potentials and compare batteries for different applications.(**Apply - L3**)

CO4: Apply principles of corrosion for design and effective maintenance of various equipment.(**Apply - L3**)

CO5: Analyse the suitability of engineering materials like polymers, lubricants, nano materials and composites in technological applications.(**Understand – L2**)

UNIT – I

Water Technology

Sources of water and quality;Hardness of Water - Temporary and permanent hardness, units and their inter relation, problems on hardness and disadvantages of hard water in industries. Boiler troubles - Reasons, disadvantages and methods of prevention for Scale and sludge formation, caustic embrittlement, boiler corrosion and carry over (priming and foaming), W.H.O standards of potable water; Water softening: Ion- Exchange Process, merits and demerits; Desalination of brackish water - Electro dialysis and reverse osmosis; Treatment of industrial waste water.

UNIT – II

Fuel Technology

Classification of fuels (solid, liquid and gaseous 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. Bio fuels - Characteristics of bio fuels, sources of bio mass and advantages -Production of biodiesel from rape seed oil; Photo-voltaic Cell - Design, working, schematic diagram, advantages and disadvantages.

UNIT – III

Electro Chemistry & Batteries

Types of Electrodes -Calomel Electrode, Glass Electrode**,** Calculation of EMF of Cell**,** Applications of Nernst Equation**,** Applications of Electro chemical Series

Batteries -Lead-acid Battery, Lithium ion Battery, H_2– O_2 Fuel Cell, Mg-Cu reserve battery.

UNIT – IV

Science of Corrosion

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 and Galvanic series; Factors Influencing Corrosion -Nature of metal (purity, position in galvanic series, relative area of cathode & 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 - Differences between thermoplasts and thermosets, Types of polymerization with examples, Preparation properties and engineering applications of PVC, Teflon, BUNA-S and Polyurethane; Lubricants -Characteristics of a good lubricant and properties of lubricants (viscosity, flash and fire points, cloud and pour points, aniline point) and applications; Nano Materials -Introduction, definition, extraordinary changes observed at nano size of materials and reasons, types of nano-materials, Gas-Phase Synthesis of nanomaterials, Applications; Composites -Advantageous characteristics of Composites, Constituents, Fibre reinforced composites (GFRP, CFRP), Reasons for failure of composites.

TEXT BOOKS

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

REFERENCE BOOKS

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, Jyotsna Cherukuri, "A Text book of Engineering Chemistry", VGS Publications, Vijayawada, 1st Edition, 2009.

B.Tech. (I Sem.) **20ME01 - ENGINEERING GRAPHICS**

L	T	P	Cr.
2	0	4	4

Pre-requisites : Mathematics

Course Educational Objective:

To recognize the Bureau of Indian Standards of Engineering Drawing and develop an ability to get familiarized with orthographic projections and isometric views of solid objects.

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

CO1:Identify the geometrical objects considering BIS standards. (**Remember-L1**)
CO2:Comprehend the basics of orthographic projections and deduce orthographic projectionsofa point and a line at different orientations. (**Understand-L2**)
CO3:Represent graphically the geometrical planes at different positions and orientations. (**Understand-L2**)
CO4: Analyze and draw solid objects at different positions and orientations. (**Apply- L3**)
CO5: Visualize isometric and orthographic views of geometrical objects and convert one form to another. (**Understand-L2**)

UNIT – I
INTRODUCTION TO ENGINEERING DRAWING:
Introduction: Introduction**,** Principles of Engineering Drawing 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:
Introduction, 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: Introduction,Planes parallel to one of the reference planes-Inclined to one reference plane and perpendicular to other-Oblique planes.

UNIT – IV
PROJECTIONS OF SOLIDS: Introduction,RegularPolyhedral, Solids of Revolution**,** Projection of solids in simple position - Axis inclined to one of the reference planes and parallel to the other-Axis inclined to both Principle Planes.

UNIT – V
ISOMETRIC VIEWS: Introduction-theory of isometric projection, isometric views, isometric axes, scale, lines and planes-Isometric view of prism, pyramid, cylinder and 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 BOOKS:

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

BOS APPROVED REFERENCE BOOKS:

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.) **20ME02 - ENGINEERING MECHANICS**

L	T	P	Cr.
2	1	0	3

PRE-REQUISITES : Physics, Mathematics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to develop the ability to predict the behavior of rigid solid 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: Apply free body diagram concepts to analyze rigid bodies in static conditions. (Apply-L3)

CO2: Apply the equilibrium Equations of rigid bodies associated with frictional forces. (Apply-L3)

CO3: Identify the location of centroid / centre of gravity and evaluate the moment of inertia of plane sections/solids. (Apply-L3)

CO4: Understand the behavior of moving bodies in rectilinear motion using kinematic equations or motion curves. (Understand-L2)

CO5: Examine the behavior of moving bodies using dynamic equilibrium conditions. (Apply-L3)

UNIT-I

SYSTEM OF FORCES: Introduction, Basic terminology in Mechanics, laws of Mechanics, characteristics of force, system of forces-types, Resolution and Composition of forces, Resultant of coplanar concurrent force system, Resultant of coplanar non-concurrent force system-moment of a force and couple.

EQUILIBRIUM OF SYSTEM OF FORCES: Free Body Diagram, Lami's theorem, Equilibrium of a rigid body subjected to coplanar concurrent forces and non-concurrent forces, Equilibrium of connected bodies.

UNIT-II

FRICTION: Introduction, Frictional force, laws of Coulomb friction, angle of friction, limiting friction and angle of repose, problems on blocks resting on horizontal and inclined planes.

UNIT - III

CENTROID AND AREA MOMENT OF INERTIA: Introduction, centroid, axis of symmetry, centroid of simple figures from first principles, centroid of simple composite sections, area moment of inertia, polar moment of inertia, theorems of moment of inertia, moment of inertia of rectangle, circle, semi circle, I and T cross sections.

CENTRE OF GRAVITY AND MASS MOMENT OF INERTIA: Centre of gravity, centre of gravity of solid cylinder, right circular cone, hemi sphere, mass moment of inertia, radius of gyration, mass moment of inertia of uniform rod, rectangular plate, circular plate and solid cylinder only.

UNIT –IV

KINEMATICS: Introduction, general principles in dynamics, types of motion, rectilinear motion, motion curves, motion with uniform velocity, motion with uniform acceleration, motion with varying acceleration, angular motion, relationship between linear and angular motions.

UNIT – V

KINETICS: Introduction, Newton's second law of motion-inertia force, D-Alembert's principle, bodies in rectilinear translation, fixed axis rotation of rigid bodies.

TEXT BOOKS

1. S.S. Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age, 2012.
2. N.H. Dubey, Engineering Mechanics, Mc Graw Hill, 2013.

REFERENCES

1 F. L. Singer, Engineering Mechanics, Harper – Collins, 1994
2. B. Bhattacharya, Engineering Mechanics, Oxford University Press, 2008
3. A.K.Tayal, Engineering Mechanics, Umesh Publications, 2012.
4. R.K.Bansal, Engineering Mechanics, Laxmi Publications, 1996.
5. R.K.Rajput, A Text book of Applied Mechanics, Laxmi Publications, 2011.

L	T	P	Cr.
0	0	3	1.5

B.Tech. (I Sem) **20FE52 - APPLIED CHEMISTRY LAB**

Pre-requisites:Nil

Course Educational Objectives: This course enables the students to analyze water samples and perform different types of volumetric titrations. It provides them with an overview of preparation of polymers and properties of fuels.

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

CO1: Assess quality of water based on the procedures given. (Understand - **L2**)

CO2: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus. (Understand - **L2**)

CO3: Acquire practical knowledge related to preparation of polymers. (Understand - **L2**)

CO4: Exhibit skills in performing experiments based on theoretical fundamentals. (**Understand - L2**)

List of Experiments

(Any of the 10 experiments are required to be conducted)

Model Experiment

1) Determination of amount of Na_2CO_3 using standard HCl solution.

Water Analysis

2) Determination of alkalinity of water sample**.**
3) Determination of total Hardness of water by EDTA method.
4) Determination of permanent hardness of water by EDTA method.

Preparation of Polymers

5) Nylon Fibers
6) Bakelite

Redox Titrations

7) Estimation of Mohr's salt by using potassium permanganate.
8) Estimation of Mohr's salt by using potassium dichromate.
9) Determination of Copper(II) using standard hypo solution.

Demonstration Experiments

10) Determination of pH of the given sample solution/ soil using pH meter.
11) Determination of Turbidity of the given sample water.

Estimations

12) Determination of ferrous content in the given sample of iron ore against potassium dichromate using potassium ferricyanide as external indicator.
13) Determination of Iron(III) by colorimetric method.

Fuels

14) Determination of flash and fire points of a given fuel/lubricant.

REFERENCES

Lab manual

B.Tech. (I Sem.)	20ME52 - ENGINEERING MECHANICS AND FUEL TESTING LAB	L	T	P	Cr.
		0	0	3	1.5

PRE-REQUISITES: Engineering Mechanics, Applied Chemistry

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to demonstrate the concepts of engineering mechanics and fuels through experiments.

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

CO1: Verify the basic laws of Mechanics in static environment. (Apply-L3)

CO2: Evaluate the forces in the mechanical systems. (Apply-L3)

CO3: Estimate various properties of fuel like Viscosity Flash and Fire point. (Apply-L3)

CO4: Determine calorific-value of fuels. (Apply-L3)

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 Determination of coefficient of friction between the two materials using Tilting-plane method.
5 Estimate Time period of oscillations of a simple and compound pendulum.
6 Verification of Newton 's second law.
7 Determination of viscosity of given oil using Saybolt Viscometer.
8 Determination of Calorific value of given fuel using Junkers Gas Calorimeter.
9 Determination of viscosity of given oil using Red-wood-II Viscometer.
10 Determination of viscosity of given oil using Englers Viscometer.
11 Determination of Flash and Fire point of given oil using ABELS Apparatus.
12 Determination of Calorific value of given fuel using BOMB Calorimeter.

REFERENCES:

Lab-Manual

L	T	P	Cr.
0	0	3	1.5

B.Tech. (I Sem.) **20ME51 - ENGINEERING WORKSHOP**

PRE-REQUISITES: Physics and Mathematics

COURSE EDUCATIONAL OBJECTIVE:

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

COURSE OUTCOMES: After completion of the course students will be able to:

CO1: Develop different prototypes in the carpentry section. (Understand-L2)
CO2: Fabricate various basic prototypes in fitting trade. (Understand-L2)
CO3: Demonstrate various operations related to plumbing, tin smithy and black smithy. (Understand-L2)
CO4: Perform various basic house wiring techniques. (Apply-L3)

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

Trade –1: CARPENTRY SHOP

Introduction to various types of wood such as Teak, Sal, Oak, Beach, Neam, Wallnut Mango, Shisham, Deodar, Babul.Demonstration, function and use of carpentry hand-tools and their safety precautions. Introduction to various types of wooden joints, their relative advantages anduses.

Job I - Marking, sawing, plaining and chiselling operations.
Job II - Preparation of half lap-joint
Job III – Preparation of Mortise and Tenon Joint

Trade –2: FITTING SHOP

Introduction to fitting shop tools, common materials used in fittingshop, description, demonstration,care, use of tools and safety precautions.

Job I-Making a L-Fit from a rectangular piece ofMildSteel
(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

Introduction to tin-smithy, specification and use of hand tools, accessories and the safety precautions.

Job I - Preparation of a rectangulartray.
Job II- Preparation of an 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

Introduction –demonstration, use of hand tools, accessories and safety precautions.

Job I – preparation of pipelayout.

Job II – Pipe threading.

Trade -5: BLACK SMITHY

Introduction–demonstration of tools, equipment and safety precautions.

Job I – Preparation of S–Hook.

Job II – Preparation of Chisel

Trade -6: HOUSE WIRING

Demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVCConduits.Study of electrical safety measures and demonstration about use of protective devices suchas fuses, and relays includingearthling.

Job I – One lamp controlled by one one-way switch.

Job II – Two lamps in series and parallel connection with one-way switch.

Job III- Florescent lamp and calling bell circuit.

Job IV - One lamp connection with two 2- way switches (stair case connection).

Job V -- House wiring circuit.

REFERENCES

1. LBRCE Workshop LabManual.
2. S.K.HajraChoudary and A.K.Choudary, –Workshop Technology-I‖, MediaPromotersand 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‖,ScitechPublicationsIndiaPvt.Ltd, 2015.

II SEM

B.Tech.(II Sem.) **20FE02 - PROFESSIONAL COMMUNICATION - II**

L	T	P	Cr.
2	0	0	2

Pre-requisites: Nil

Course Educational Objective: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

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

- **CO1:** Produce a coherent paragraph interpreting a figure/graph/chart/table (**Understand – L2**)
- **CO2:** Comprehend the given texts thoroughly by guessing the meanings of the words contextually (**Understand – L2**)
- **CO3:** Use language appropriately fordescribing /comparing/contrasting/givingdirections & suggestions (**Remember – L1**)
- **CO4:** Write formal/informal dialogues with an understanding of verbal/non-verbal features of communication. (**Understand – L2**)
- **CO5:** Write well structured essays; Reports &Résumé (**Apply – L3**)

UNIT - I

Fabric of Change- 'H.G. Wells and the Uncertainties of Progress – Peter J. Bowler'; Reading: Studying the use of Graphic elements in texts; Grammar & Vocabulary**:** Quantifying Expressions; Adjectives and adverbs; Comparing and Contrasting; Degrees of Comparison; Writing: Information Transfer

UNIT - II

Tools for Life - 'Leaves from the Mental Portfolio of a Eurasian – Sui Sin Far'; Reading: Global Comprehension; Detailed Comprehension; Grammar & Vocabulary**:** Active & Passive Voice; Idioms & Phrases; Writing: Structured Essays using suitable claims and evidences

UNIT - III

'Homi Jahangir Bhabha';

Grammar & Vocabulary: Words often confused; Common Errors; Writing**:** Incident & Investigation Reports

UNIT - IV

'Jagadish Chandra Bose'; Grammar & Vocabulary: Use of Antonyms; Correction of Sentences; Writing**:** Dialogue Writing

UNIT - V

'**Prafulla Chandra Ray'**; Grammar & Vocabulary: Analogy; Sentence Completion; Writing**:** Writing a Résumé

TEXT BOOKS:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient Black Swan, Hyderabad, 2019.
2 "The Great Indian Scientists" published by Cengage Learning India Pvt. Ltd., Delhi, 2017

REFERENCE BOOKS:

1. Swan, M., "Practical English Usage", Oxford University Press, 2016.
2. Kumar,S and Latha, P, "Communication Skills", Oxford University Press, 2018.
3. Rizvi Ashraf M., "Effective Technical Communication", Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, "Professional Communication", I.K.International Publishing House Pvt.Ltd., New Delhi, 2008.
5. Wood,F.T., "Remedial English Grammar", Macmillan, 2007.

B.Tech.(IISem.)	20FE04 - LINEAR ALGEBRA AND TRANSFORMATION TECHNIQUES	L	T	P	Cr.
		2	1	0	3

Pre-requisites: Nil

Course Educational Objective: In this course, students learn Matrix Algebra and introduced with transformation techniques such as Laplace Transforms and Z – Transforms.

Course Outcomes: At the end of the course, the student will be able to
CO1: Investigate the consistency of the system of equations and solve them (**Apply – L3**)
CO2: Determine the eigen vectors and inverse, powers of a matrix using Cayley – Hamilton Theorem (**Apply - L3**)
CO3: Use the concepts of Laplace Transforms to various forms of functions (**Understand – L2**)
CO4: Solve ordinary differential equations by using Laplace Transforms (**Apply – L3**)
CO5: Apply Z - Transforms to solve difference equations (**Apply – L3**)

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

UNIT – III
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.

UNIT – IV
Inverse Laplace Transforms
Inverse Laplace transforms– Linear Property - Shifting Properties - Convolution theorem, Applications of Laplace transforms to ordinary differential equations.

UNIT – V
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.

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 BOOKS:

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi,2011.
2. Erwin Kreyszig, *"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 & sons, New Delhi,2011.

B.Tech.(IISem.)	20FE08 - ENGINEERING PHYSICS	L	T	P	Cr.
		2	1	0	3

Pre-requisites: Nil

Course Educational Objectives : It enables the students to understand the fundamental concepts of elastic behaviour of materials, lasers, optical fibers, acoustics, ultrasonics, magnetic, dielectric, superconducting and nano materials.

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

CO1: Analyse the different mechanical properties of materials(**Understand – L2**).
CO2: Apply the lasers and optical fibres in different fields(**Apply - L3**).
CO3: Summarize the properties of sound waves(**Understand – L2**).
CO4: Classify the different types of magnetic and dielectric materials(**Understand - L2**).
CO5: Identify the properties of superconducting and nano materials(**Understand – L2**).

UNIT – I

Elasticity

Stress, Strain, Hooke's Law, Elastic behavior of a material, Factors affecting elasticity, Classification of elastic modulus, relation between Young's, bulk and rigidity modulus, bending of beam – bending moment of a beam and Cantilever (qualitative treatment).

UNIT – II

Lasers and Optical fibers

Lasers**:** Introduction- Principle of laser (absorption, spontaneous and stimulated emission of radiation), Einstein Coefficients,Nd-YAG laser, Helium Neon laser- applications.
Optical Fibers: Optical Fiber principle, Structure of optical fiber, numerical aperture and acceptance angle, types of optical fibers - applications.

UNIT – III

Acoustics &Ultrasonics

Acoustics: Introduction **–** Reverberation - Reverberation time - Sabine's formula (Derivation using growth and decay method)–absorption coefficient and its determination.
Ultrasonics: Production of ultrasonics by Magnetostriction - Detection of ultrasonics - acoustic grating – Non-Destructive Testing- Through transmission method and pulse echo method - Applications.

UNIT – IV

Magnetic & Dielectric materials

Magnetic parameters, Classification of magnetic materials-Diamagnetic, paramagnetic and ferromagnetic materials, Hysteresis loop, soft and hard magnetic materials, Applications of Ferro magnetic materials.
Dielectric polarization - Electronic and ionic polarization, orientation polarization (Qualitative), Local field, ClaussiusMosotti equation, Applications of dielectric materials.

UNIT – V

Superconducting and nanomaterials

Introduction- Meissner effect, Type I and Type II super conductors, Josephson Effect, Applications of super conductors.
Nanomaterials**:** Introduction, classification, properties, different methods of preparation and applications.

TEXT BOOKS

1. V. Rajendran, "*Engineering Physics*", TMH, New Delhi, 6th Edition, 2011.
2. M.N. Avadhanulu, P.G. Kshirsagar, "Engineering *Physics*", S. Chand & Co., 2ndEdition, 2014.

REFERENCE BOOKS

1. M.N. Avadhanulu, TVS Arun Murthy, "Applied *Physics*", S. Chand & Co., 2ndEdition, 2007.
2. P.K. PalaniSamy, "*Applied Physics*", Sci. Publ. Chennai, 4th Edition, 2016.
3. P. Sreenivasa Rao, K Muralidhar, "*Applied Physics*", Him. Publi. Mumbai, 1st Edition, 2016.
4. Hitendra K. Mallik , AK Singh " *Engineering Physics*", TMH, New Delhi, 1st Edition, 2009.

B.Tech.(IISem.)	20CS01 - PROGRAMMING FOR PROBLEM SOLVING USING C	L	T	P	Cr.
		3	0	0	3

Pre-requisite: NIL

COURSE EDUCATIONAL OBJECTIVE: The Objective of the course is to make learn the basic elements of C programming, control structures, derived data data types, Modular programming, user defined structures, basics of files and its I/O operations.

COURSE OUTCOMES (COs): At the end of this course, the student will be able to

CO1: Familiar with syntax and semantics of the basic programming language constructs. (**Understand - L2**)

CO2: Construct derived data types like arrays in solving problem.(**Apply - L3**)

CO3: Decompose a problem into modules and reconstruct it using various ways of user-defined functions. (**Apply - L3**)

CO4: Use user-defined data types like structures and unions and its applications to solve problems.(**Apply- L3**)

CO5: Discuss various file I/O operations and its application.(**Understand - L2**)

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, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.

Control statements: if, if else, else if ladder and switch statements, while, do-while and for statements, break, continue, goto and labels.

UNIT – II

Arrays- concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.

Character Arrays: declaration, initialization, reading, writing strings, string handling functions, Pre-processor Directives and macros.

Applications of Arrays: Linear search, Binary search, Bubble Sort.

UNIT – III

Pointers- concepts, declaring & initialization of pointer variables, pointer expressions, pointer arithmetic, pointers and arrays, pointers and character arrays, pointers to pointers.

Functions: basics, category of functions, parameter passing techniques, recursive functions-comparison with Iteration, Functions with arrays, Standard library functions, dynamic memory management functions, command line arguments.

Storage classes - auto, register, static and extern,

UNIT – IV

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef .

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.

TEXT BOOKS:

1 ReemaThareja, Programming in C, Oxford University Press, 2nd Edition, 2015

REFERENCE BOOKS:

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

2 E Balagurusamy, Computer Programming, McGraw Hill Education, 8th Edition.

3 C: The Complete Reference, McGraw Hall Education, 4th Edition.

4 PradeepDey, Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition, 2011

5 Stephen G.Kochan, Programming in C, Pearson Education, 3rd Edition, 200

B.Tech. (II Sem.)

20AE01 - ELEMENTS OF AEROSPACE ENGINEERING

L	T	P	Cr.
3	0	0	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(**Remember - L1**]

CO2: Classify the various forces and moments acting on an airfoil(**Understand - L2)**

CO3: Differentiatethe working principles of various aircraft engines systems(**Understand - L2)**

CO4: Formulate the basic aspects of space flight(**Apply - L3)**

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. (II Sem.)	20MC01 - CONSTITUTION OF INDIA	L	T	P	Cr.
		2	0	0	0

Pre-requisites: Nil

Course Educational Objectives

• To enable the student to understand the importance of constitution.

• To understand the structure of Executive, Legislature and Judiciary.

• To understand Philosophy of fundamental rights and duties.

• To understand the autonomous nature of constitution bodies like SupremeCourt and High Court Controller and Auditor General of India and ElectionCommission of India.

• To understand the Central and State relation, financial and administrative.

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

CO1: Understand history and philosophy of constitution with reference to Preamble,Fundamental Rights and Duties(**Understand – L2**).

CO2: Understand the concept of Unitary and Federal Government along with therole of President, Prime Minister and Judicial System(**Understand – L2**).

CO3: Understand the structure of the state government, Secretariat, Governor and Chief Ministerand their functions(**Understand – L2**).

CO4: learn local administration viz. Panchayat, Block, Municipality and Corporation(**Understand – L2**).

CO5: learn about Election Commission and the process and about SC, ST, OBCand women(**Understand – L2**).

UNIT – I:

Introduction to Indian Constitution: 'Constitution' meaning of the term, IndianConstitution – Sources and Constitutional History, Features – Citizenship,Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT – II:

Union Government and its Administration Structure of the Indian Union: FederalismCentre – State relationship, President: Role, Power and Position. Prime Minister(PM) and Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, RajyaSabha. The Supreme Court and High Court: Powers and Functions.

UNIT – III:

State Government and its Administration Governor – Role and Position – ChiefMinister (CM) and Council of Ministers. State Secretariat: Organization, Structureand Functions.

UNIT – IV:

A Local Administration -- Role and Importance,Municipalities – Mayor and Role of Elected Representative,Panchayati Raj: Functions of PanchayatiRaj Institution, Zilla Panchayat, Elected Officials and their roles, Villagelevel – Role of Elected and Appointed officials.

UNIT – V:

Election Commission: Election Commission – Role of Chief Election Commissionerand Election Commissionerate State Election Commission: Functions andCommissions for the welfare of SC/ST/OBC and Women.

Reference Books

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall ofIndia Pvt.Ltd., New Delhi.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J.A. Siwach, Dynamics of Indian Government and Politics.
4. D.C. Gupta, Indian Government and Politics.
5. H.M.Sreevai. Constitutional Law of India, 4th edition in 3 volumes (UniversalLaw Publication).
6. J.C. Johari, Indian Government and Politics Hans.
7. J.Raj, Indian Government and Politics.
8. M.V. Pylee, Indian Constitution, Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd., New Delhi.
9. Noorani, A.G. (South Asia Human Rights Documentation Centre), Challengesto Civil Right). Challenges to Civil Rights Guarantees in India, OxfordUniversity Press 2012.

E-Resources:

1. nptel.ac.in/courses/109104074/8.
2. nptel.ac.in/courses/109104045.
3. nptel.ac.in/courses/101104065.
4. www.hss.iitb.ac.in/en/lecture-details.
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indianconstitution.

* * *

B.Tech. (II Sem.)	20FE51 - PROFESSIONAL COMMUNICATION SKILLS LAB	L	T	P	Cr.
		0	0	2	1

Pre-requisites : Nil

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 this course, the student will be able to

CO1: Introduce oneself and others using appropriate language and details (**Understand – L2**)

CO2: Comprehend short talks and speak clearly on a specific topic using error free English(**Understand – L2**)

CO3: Report effectively after participating in informal discussions ethically (**Remember –L1**)

CO4: Interpret data aptly, ethically & make oral presentations (**Apply – L3**)

Syllabus: Professional Communication Skills Lab (PCS) 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

ICS Lab: Practice - Listening: Identifying the topic, the context and specific information
Speaking: Introducing oneself and others

Exercise – II

CALL Lab: Understand - Framing questions

ICS Lab: Practice - Listening: Answering a series of questions about main idea and supporting ideas after listening to audio text
Speaking: Discussing in pairs/small groups on specific topics; Delivering short structured talks using suitable cohesive devices (JAM)

Exercise – III

CALL Lab: Understand - Comprehension practice – Strategies for Effective Communication

ICS Lab: Practice - Listening: Listening for global comprehension and summarizing
Speaking: Discussing specific topics in pairs/small groups, reporting what is discussed

Exercise – IV

CALL Lab: Understand- Features of Good Conversation – Strategies for Effective Communication.

ICS Lab: Practice -Listening: Making predictions while listening to conversations/transactional dialogues with/without video
Speaking: Role – plays – formal & informal – asking for and giving information / directions / instructions / suggestions

Exercise – V

CALL Lab: Understand - Features of Good Presentation, Methodology of Group Discussion
ICS Lab: Practice - Introduction to Group Discussions
Listening: Answering questions, identifying key terms and understanding concepts
Speaking: Formal Oral & Poster presentations on topics from academic contexts without the use of PPT

Lab Manual:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient BlackSwan, Hyderabad, 2019.

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.

B.Tech. (II Sem.)	20FE55 - ENGINEERING PHYSICS LAB	L	T	P	Cr.
		0	0	3	1.5

Pre - requisites: Nil

Course Educational Objectives: This course enables the students to acquire theoretical ideas, analytical techniques, and graphical analysis, by completing a host of experiments with the procedures and observational skills for appropriate use of 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(**Understand – L2**).
CO2: Determine the wavelength of laser source and width of slit(**Apply - L3**).
CO3: Estimate the magnetic field using Stewart's and Gee's apparatus and the rigidity modulus of material using Torsional Pendulum(**Understand - L2**).
CO4: Identify the phenomena of resonance in strings(**Understand – L2**).
CO5: Improve report writing skills and individual team work with ethical values(**Understand – L2**)

List of Experiments

(Any of the 10 experiments are required to be conducted)

General experiments:

1. Determine the frequency of AC supply by using Sonometer.
2. Verification of Laws of vibrations in stretched strings -Sonometer.
3. Determine the frequency of a tuning fork by using Melde' s arrangement.
4. Study the magnetic field along the axis of a current carrying circular coil using Stewart's& Gee's apparatusand to verify Biot - Savart's law.
5. Determine the rigidity modulus of a given material using Torsional pendulum.
6. Determination of Young's modulus by the method of single Cantilever oscillations.
7. Measurement of magnetic susceptibility by Gouy's method.
8. Determination of ultrasonic velocity in Liquid.
9. Determination of dielectric constant by charging and discharging method.
10. Determination of velocity of sound by Volume resonator method.

Optics lab experiments:

11. Determine the wavelength of a laser radiation.
12. Determine the width of a single slit by forming diffraction pattern.
13. Determine the acceptance angle and numerical aperture of a fiber.
14. Measure the bending losses in the optical fiber cable at different wavelengths.

B.Tech. (II Sem.)	20CS51 - PROGRAMMING FOR PROBLEM SOLVING USING C LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisite : NIL

Course Educational Objective: The objective of the course is to learn the basic elements of C Programming Structures like Data Types, Expressions, Control Statements, and Various I/O Functions and to solve simple mathematical problems using control structures. Design and implementation of various software components, which solve real world problems.

Course Outcomes (CO): *At the end of this course, the student will be able to:*

CO1: Apply control structures of C in solving computational problems.(**Apply - L3**)

CO2: Implement derived data types & use modular programming in problem solving(**Apply- L3**)

CO3: Implement user defined data types and perform file operations.(**Apply- L3**)

CO 4: Improve individual / teamwork skills, communication & report writing skills with ethical values.

# of modules at most 10can be taught and all the modules should be in line with theory.

Module 1: Introduction to Raptor Tool.

Module 2: Problem solving using Raptor Tool

Module 3: Exercise Programs on Basics of C-Program.

Module 4: Exercise Programs on Control Structures.

Module 5: Exercise Programs on Loops & nesting of Loops.

Module 6: Exercise Programs on Arrays & Strings.

Module 7: Exercise Programs on Pointers.

Module 8: Exercise Programs on Functions.

Module 9: Exercise Programs on user defined data types.

Module 10: Exercise Programs on Files.

B.Tech. (II Sem.)	20ME54 - COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	Cr.
		0	0	3	1.5

PRE-REQUISITES: Engineering Graphics, Mathematics

Course Educational Objective: The course aims to teach developing and drawing of engineering objects using AutoCAD. The student will be taught the fundamentals of AutoCAD and then asked to develop the projections of objects related to straight lines, planes, solids, orthographic and isometric views, development of surfaces using principles of engineering drawing.

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

CO1: Draw simple objects using functional tools in AutoCAD. (**Understand-L2**)

CO2: Develop and draw the positions and views of points, lines, planes and solids using AutoCAD. (**Understand-L2**)

CO3: Develop and draw the orthographic and isometric projections of simple objects using Auto-CAD. (**Understand-L2**)

CO4: Develop and draw the projections of the solids by developing the surfaces using AutoCAD. (**Understand-L2**)

BASIC AUTOCAD 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, pline, 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, LINES AND PLANES

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.

4. Projection of planes: Single stage projections.

PROJECTION OF SOLIDS

1. Projection of solids in simple position and transfer of points.

2. Projection of solids with axes inclined to one reference plane & parallel to other.

3. Sections of solids: Simple sections

ORTHOGRAPHIC PROJECTIONS

1. Conversion of plane figures to orthographic views.

2. Conversion of circular figures to orthographic views.

3. Conversion of combination of plane figures and circular figures to orthographic views.

ISOMETRIC PROJECTIONS

1. Conversion of plane figures to isometric views.
2. Conversion of circular figures to isometric views.
3. Conversion of combination of plane figures and circular figures to isometric views.

DEVELOPMENT OF SURFACES

1. Parallel-line development (prism, cylinder) for objects in simple position**.**
2. Radial-line development (cone, pyramid) for objects in simple position.

TEXTBOOK

1. D.M. Kulkarni, A.P Rastogi, and A.K. Sarkar, "Engineering Graphics with AutoCAD", PHI Learning Private Limited, New Delhi, 2009.

REFERENCE

1. N. D. Bhatt, "Engineering Drawing", 51st Revised and Enlarged Edition, Charotar Publishers, 2012.

III SEM

B.Tech. (III Sem.)	20FE10 - NUMERICAL METHODS AND INTEGRAL CALCULUS	L	T	P	Cr.
		2	1	0	3

Pre-requisites : None

Course Educational Objective: The main objective of this course is to enable the students learn Numerical Techniques for solving the equations and apply interpolation techniques. They will also learn about the Fourier analysis of single valued functions, Multiple Integrals in different coordinate systems and Vector differentiation.

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

CO1: Estimate the best fit polynomial for the given tabulated data using Interpolation.(Understand – L2)
CO2: Apply numerical techniques in solving of equations and evaluation of integrals. (Apply – L3)
CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes. (Apply – L3)
CO4: Generate the single valued functions in the form of Fourier series and obtain Fourier series representation of periodic function. (Apply – L3)
CO5: Evaluate the directional derivative, divergence and angular velocity of a vector function. (Apply – L3)

UNIT – I
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 – II
Numerical Solution of Equations and Numerical Integration
Solutions of Algebraic and Transcendental Equations – Regula Falsi method and Newton Raphson Method in one variable.
Numerical Integration
Trapezoidal rule – Simpson's 1/3 Rule –Simpson's 3/8 Rule.

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

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

UNIT – V
Vector Differentiation
Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl – Irrotational fields-potential surfaces - Laplacian and second order operators

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.
3. S. S. Sastry, *"Introductory Methods of Numerical Analysis"* 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

REFERENCES

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 & sons, New Delhi,2011.

B.Tech. (III Sem.)	20EE02 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	Cr.
		3	0	0	3

Prerequisite: Physics

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: Apply network reduction techniques to simplify electrical circuits. **(Apply-L3)**
CO2: Illustrate the working principle of DC machines and transformers. **(Understand-L2)**
CO3: Understand V-I characteristics of semiconductor devices. **(Understand-L2)**
CO4: Illustrate the configuration of Transistors and their applications. **(Understand-L2)**

UNIT – I: Electrical Circuit Fundamentals

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 (Basic problems).

UNIT – II: DC Network Theorems and AC Fundamentals

Theorems-Superposition, Thevenin's, Norton's and Maximum Power Transfer (Basic problems in DC excitation only)

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-bandwidth-quality factor.

UNIT – III: DC Machine Fundamentals and Single-Phase Transformers

DC generator principle, constructional details, emf equation, types of generators (Theory only).
DC motor principle, Back emf, types of motor (Theory only).
Construction and Principle of operation of single-phase transformers-Emf equation

UNIT–IV: P-N Junction Diode and Zener Diode

P-N Junction Diode: Operation and V-I characteristics of PN junction diode, Rectifiers-Half Wave Rectifier, Full Wave Rectifier-Bridge type, Zener Diode-Voltage Regulator.

UNIT – V: Transistors

Construction, Principle of Operation, Symbol, CB, CE configurations, JFET, MOSFET and application of transistor as an amplifier (Theory only).

TEXT BOOKS:

1. A.Sudhakar and Shyammohan S Palli, "Electrical Circuits" Tata McGraw-Hill, 3rd Edition.2017
2. M.S.Sukhija, T.K.Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford University Press, 2016 Edition.

REFERENCE:

1. Kothari and Nagarath, "Basic Electrical Engineering", TMH Publications, 3rd Edition.2013
2. G.S.N.Raju, "Electronic Devices and Circuits", I.K.International.2006

B.Tech. (III Sem.) **20AE02 - ENGINEERING FLUID MECHANICS**

L	T	P	Cr.
2	1	0	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 (Analyze-L4)
CO2: Apply differential relations to characterize the behavior of fluid flow (Apply-L3)
CO3: Apply the conservation laws to solve elementary fluid flow problems (Apply-L3)
CO4: Analyze the simple pipe network for fluid transportation (Apply-L3)
CO5: Analyze the performance of various hydraulic turbines and pumps (Analyze-L4)

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. Rathakrishnan. E, Fluid Mechanics an Introduction, Fourth Edition, Prentice Hall of India, 2021.

REFERENCES

1. Balachandran P, Engineering Fluid Mechanics, 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.) **20AE03 - ENGINEERING THERMODYNAMICS**

L	T	P	Cr.
2	1	0	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 (Understand-L2)
CO2: Apply the laws of thermodynamics to analyze various thermal systems.(Apply-L3)
CO3: Analyze the entropy change of various processes.(Apply-L3)
CO4: Analyze the properties of different gas mixtures and pure substances. (Analyze-L4)
CO5: Analyze ideal gas power cycles and refrigeration cycle to estimate various performance parameters (Analyze-L4)

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, Simple Vapour 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, Van Wylen. G. J, Fundamentals of Thermodynamics, Fifth Edition John Wiley & sons, publications Inc, 1998.

B.Tech. (III Sem.)	20AE04 - STRENGTH OF MATERIALS	L	T	P	Cr.
		2	1	0	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 behaviour in different types of members under various load conditions (Analyse-L4)

CO2: Evaluate stress, shear force, bending moment, deflection for beams and torsion for circular shafts under different loading conditions (Apply-L3)

CO3: Evaluate shear stress distributions over different cross sections (Apply-L3)

CO4: Apply the failure theories on structural members (Apply-L3)

CO5: Analyze internal stresses due to internal pressures in thin and thick cylindrical shells. (Apply-L3)

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.) **20MC02 - ENVIRONMENTAL SCIENCE**

L	T	P	Cr.
2	0	0	0

Pre-requisites: Nil

Course Objectives:
In this course the student will learn about

- Environmental issues like over population, human health etc related to local, regional and global levels.
- The necessity of resources, their exploitation and sustainable management.
- The interactions of human and ecosystems and their role in the food web in the natural world.
- The global biodiversity, threats to biodiversity and its conservation.
- Environmental problems like pollution, disasters and possible solutions.
- The importance of environmental decision making in organizations through audits.

Course Outcomes:

After the completion of this course, the students will able to

CO1: Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions. (Remember - L1)

CO2: Evaluate local, regional and global environmental issues related to resources and their sustainable management. (Understand – L2)

CO3: Realize the importance of ecosystem and biodiversity for maintaining ecological balance. (Understand – L2)

CO4: Acknowledge and prevent the problems related to pollution of air, water and soil. (Apply – L3)

CO5: Identify the significance of implementing environmental laws and abatement devices for environmental management. (Understand – L2)

Unit I
Nature and scope of Environmental Problems

- Introduction to Environmental Science
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards.
- 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, conflicts over water, interlinking of rivers, dams-benefits and problems, Rain water harvesting
- 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

- Structure and functions of an Ecosystem, Food chains and Food webs, Ecological succession, Ecological pyramids, Biogeochemical cycles
- Biodiversity, Values of biodiversity, Bio geographical classification of India. Endangered and endemic species of India, Threats to biodiversity; Man and wild life conflicts, 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, Noise pollution, Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste, Disaster Management.

Unit V
Environmental Management

- Sustainable development and unsustainability
- Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Stockholm Conference
- Environmental Impact Assessment (EIA)
- Green building
- Environmental Law- Air, Water, Wild life, Forest, and Environmental protection act

Text Books:

1. Anubha Kaushik, C.P.Kaushik, "Perspectives in Environmental Studies", 5nd edition, New age international publishers, Delhi, 2016.
2. G. Tyler Miller, Scott Spoolman, "Introduction to Environmental Studies", 13th Edition, Cengage Learning, New Delhi, 2009.

Reference Books:

1. M. Anji Reddy, "Textbook of Environmental Sciences and Technology", 2nd Edition, BS Publications, Delhi 2011.
2. Deeshita Dave, P. Udaya Bhaskar, "Environmental Studies", 2nd Edition, Cengage Learning, New Delhi, 2012.
3. S.Deswal, A. Deswal, "A Basic course in Environmental Studies", 2nd Edition, Educational & Technical Publishers, Delhi, 2014.
4. R. Rajagopalan, "Environmental Studies (From Crisis to Cure)", 3rd Edition, Oxford University Press, New Delhi, 2012.
5. De, A.K, "Environmental Chemistry", 5th Edition, New Age International (P) Limited, New Delhi, 2003.
6. Dr.K.V.S.G. Murali Krishna, "Environmental Studies", 1st Edition, VGS Techno Series, Vijayawada, 2010.
7. Mahua Basu, S.Xavier, "Fundamentals of Environmental Studies", 1st edition, Cambridge University Press, Delhi, 2016.

B.Tech. (III Sem.)	20EE52 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisites : Nil

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.

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

CO1: Examine electrical circuits using network theorems. **(Apply-L3)**
CO2: Analyze VI characteristics of semiconductor devices. **(Understand-L2)**
CO3: Analyze electrical circuits.**(Understand-L2)**
CO4: Design Resonance circuits. **(Apply-L3)**

List of Experiments

(Any of the 10 experiments are required to be conducted)

1. V-I relations of passive elements (R, L, C).
2. Verification of Kirchhoff's Laws (KCL and KVL.).
3 Measurement of active power, reactive power and power factor of ACcircuits.
4. Calculation of Resonant frequency, Bandwidth and Quality factor of resonant circuits.
5. Verification of Superposition theorem.
6. Verification of Thevenin's and Norton's theorems.
7. Verification of Maximum power transfer theorem.
8. Plot the V-I characteristics of a p-n junction diode.
9. Plot the V-I characteristics of Zener diode.
10. Plot the V-I characteristics of BJT.
11. Calculation of ripple factor and regulation of Full Wave Rectifier with and without filters .
12. Plot the V-I characteristics of MOSFET.

B.Tech. (III Sem.) 20AE51 - ENGINEERING FLUID MECHANICS LAB

L	T	P	Cr.
0	0	3	1.5

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: Apply the principles Fluid mechanics in discharge measuring devices used in pipes channels and tanks (Apply-L3)
CO2: Analyze the performance of various hydraulic machines (Analyze-L4)

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

B.Tech. (III Sem.)	20AE52 - STRENGTH OF MATERIALS LAB	L	T	P	Cr.
		0	0	3	1.5

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. (Analyze-L4)
CO2: Perform tests and analyze materials subjected to tension, torsion, bending, and bucking (Apply-L3)

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.)	20AES1-ADVANCED AUTOCAD	L	T	P	Cr.
		1	-	2	2

PRE-REQUISITES: Engineering Graphics, Working knowledge of Microsoft Windows, Basic knowledge AutoCAD & CAD drawing

Course Educational Objective: The course aims to teach developing and drawing of engineering objects using AutoCAD. The student will be taught the advanced features of AutoCAD related to Manipulating Objects and Data, Blocks and Attributes, Layer Management, Layouts, Plotting, Template Drawing Creation.

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

CO1: Draw objects using functional tools in AutoCAD. (**Understand-L2**)
CO2: Create blocks and attributes using AutoCAD. (**Apply-L3**)
CO3: Develop Layout Viewports and Dimensioning in Layouts using Auto-CAD. (**Apply-L3**)
CO4: Draw **Template Drawing** Using Drawing Templatesusing AutoCAD. (**Understand-L2**)

Drawing Objects Multilines, Donuts, Construction Geometry, Point Objects, Revision Clouds, Wipeouts, Boundaries, Regions
Manipulating Objects and Data Using Quick Select, Purging Objects, Exploding Objects, Dividing and Measuring Objects, Geometry Calculator

Dimensioning-Center Marks, Ordinate Dimensions, Geometric Dimensioning and Tolerances, Dimension Styles and Overrides **Reusable Content** Using Design Center, Creating Custom Tool Palettes, Managing and Sharing Tool Palettes, Using External References

Blocks and Attributes Blocks, Attributes, Edit and Extract Attributes, **Dynamic Blocks**, working with Dynamic Blocks, Creating Dynamic Block Definitions, Dynamic Block Authoring Tools, Additional Visibility Options

Layer Management and Best Practices Layer Properties Manager, Layer Filters, Layer States Manager, Layer Standards **Layouts and Views** Creating Layouts, Modifying Layouts and Using, Page Setups, Creating Layout Viewports, working with Layout, Viewports, Controlling Object Visibility in, Layout Viewports, Dimensioning in Layouts

Plotting Plotter Configuration Files, Plot Style Tables, Publishing Drawings, **Introduction to Sheet Sets** Creating Sheet Sets, working with Sheet Sets, Setting Sheet Set Properties, Using Fields in Sheet Sets, Using Attributes in Sheet Sets, Publishing, Transmitting, and Archiving, Sheet Sets. **Template Drawing Creation** Using Drawing Templates

TEXTBOOK

1. D.M. Kulkarni, A.P Rastogi, and A.K. Sarkar, "Engineering Graphics with AutoCAD", PHI Learning Private Limited, New Delhi, 2009.

REFERENCE

1. N. D. Bhatt, "Engineering Drawing", 51st Revised and Enlarged Edition, Charotar Publishers, 2012.

IV SEM

L	T	P	Cr.
3	0	0	3

B.Tech. (IV Sem.) **20FE09 - PROBABILITY AND STATISTICS**

Pre-requisite(s) **: None**

Course Educational Objective: The objective of this course is to provide students with the foundations and applications of probabilistic and statistical methods mainly used in varied applications in engineering and science.

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

- **CO1:** Understand various probabilistic situations using the various laws of probability and random variables **(Understand - L2)**
- **CO2:** Apply probability distributions like Binomial, Poisson, Normal and Exponential distributions in solving engineering problems (**Apply - L3**)
- **CO3:** Calculate the standard error of sampling distribution and confidence intervals for parameters like mean and proportion based on the sample data. **(Apply - L3)**
- **CO4:** Analyze the data scientifically with the appropriate statistical methodologies to apply the suitable test of hypothesis **(Analyze - L4)**
- **CO5:** Construct the regression lines to predict the dependent variables and calculate the Correlation Coefficient for a bivariate statistical data.**(Apply – L3)**

Unit-1:

Probability and Random variables

Probability, Sample space and events, Additive Rule, Conditional probability, Multiplicative rule, Baye's theorem.

Random variables – Discrete and continuous Random Variables, distribution function. Mathematical Expectation of one-dimensional Random Variable.

Unit-2:

Probability Distributions

Binomial distribution , Poisson distribution , Poisson approximation to Binomial distribution, Exponential distribution, Normal distribution , Normal approximation to Binomial distribution.

Unit-3:

Sampling distribution & Estimation

Population, sample, parameter, statistic, sampling distribution, Standard error, Types of sampling, Sampling distribution of means and sampling distribution of variance,

Parameter estimations –point estimation and interval estimation for mean and proportions.

Unit-4:

Tests of Hypothesis

Hypothesis, Null and Alternate Hypothesis, , Type I and Type II errors, level of significance.

Z-test for means and proportions, t-test for single mean, difference of means, paired t-test, F-test for equality of population variances, χ^2 - test for goodness of fit and independence of attributes.

Unit-5:

Correlation & Regression

Karl Pearson's coefficient of correlation, linear Regression, Regression lines, Regression coefficients, Spearman's Rank correlation coefficient, Spearman's Rank correlation for repeated ranks.

TEXT BOOKS

1. Jay L.Devore "Probability and Statistics for engineering and the sciences." , 8th edition, Cengage Learning india, 2012.

2. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", 11thEdition, Sultan Chand and sons, New Delhi,2014.

REFERENCES

1. Miller & Freund's "Probability and Statistics for Engineers",8th edition. PHI, New Delhi,2011.

2. B.V. Ramana, "Higher Engineering Mathematics", 1st Edition, TMH, New Delhi, 2010

B.Tech. (IV Sem.)	20AE05 - AEROSPACE MATERIALS AND MANUFACTURING	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Nil

Course Educational Objectives: The objectives of this course are to acquire knowledge on structure of metals and alloys, understand the concept of alloys and equilibrium diagrams and to learn primary manufacturing processes, working of basic machines and various operations to be performed and also about conventional and unconventional machining processes

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

CO1: Estimate the properties of the metals and alloys based on structures. (Understand-L2)
CO2: Classify, construct and analyze equilibrium diagrams, various ferrous, non-ferrous metals and alloys.(Understand-L2)
CO3: Acquire knowledge of the basic aspects of casting process.(Understand-L2)
CO4: Know the various basic concepts of welding process, metal forming process and sheet metal operations in the manufacturing of products.(Understand-L2)
CO5: Know different conventional and unconventional machining processes while manufacturing a product. (Understand-L2)

UNIT – I

STRUCTURE OF METALS: Crystal Structures-Body centered cubic, Face cantered cubic, closed packed hexagonal, Mechanism of grain and grain boundaries, Effect of grain boundaries on the properties of metal / alloys, Determination of grain size. Solid solutions-Interstitial Solid Solution and Substitution Solid Solution, Hume Rothery rules.

UNIT – II

EQUILIBRIUM DIAGRAMS AND TRANSFORMATIONS: Classification of equilibrium diagrams- isomorphous, eutectic, partial eutectic equilibrium diagrams. Lever rule, Study of Cu-Ni and Iron-Iron carbide equilibrium diagram.
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 – III

INTRODUCTION TO MANUFACTURING AND CASTING: Classification of Manufacturing Processes; Engineering Materials.Steps Involved in Making a Casting-Advantages and Its Applications, Types of Patterns- Pattern Allowances, Principles of Gating, Gating Ratio, Types of Raisers, Special Casting Processes – Centrifugal – Die - Investment – Continuous.

UNIT - IV

WELDING: Classification of Welding Process- Types of Weld- Welded Joints, Principle and Applications- Gas Welding- Arc Welding- Friction Welding, Soldering and Brazing.
METAL FORMING PROCESSES: Types of Rolling Mills and Products; Principles of Forging - Types of Forging-Smith Forging, Drop Forging

EXTRUSION OF METALS: Hot Extrusion and Cold Extrusion –Forward Extrusion and Backward Extrusion, Impact Extrusion, Hydrostatic Extrusion.

UNIT - V

MACHINING PROCESSES: Tool Geometry; Cutting Tool & Tool Wear- Cutting Materials; Cutting Fluids; Introduction and Working Principle of Lathe and Operations

SHAPING, PLANNING, MILLING AND DRILLING MACHINES: Principles of Working, Principle Parts, Specifications, Classification, Comparison and Operations Performed.

INTRODUCTION TO UNCONVENTIONAL MACHINING PROCESSES: Classification of Unconventional Machining Processes. Abrasive Jet Machining, Ultrasonic Machining, Laser Beam Machining

TEXT BOOK

1. V.D.Kotgire, S.V.Kotgire, Material Science and Metallurgy, Everest Publishing House, 24th Edition, 2008.
2. Rao. P. N, Manufacturing Technology, Volume 1 and 2 Tata McGraw-Hill, 2013.

REFERENCES

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
3. Richard A.Flinn, Paul K.Trojan, Engineering Materials and Their Applications, Jaico Publishing House, 4thEdition, 1999.
4. William and callister, Materials Science and engineering, Wiley India private Ltd., 2011.

B.Tech. (IV Sem.) **20AE06 - AERODYNAMICS**

L	T	P	Cr.
3	0	0	3

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. (Apply-L3)
CO2: Apply conformal transformation to from aerodynamic shapes. (Apply-L3)
CO3: Apply potential flow theory to solve for airfoil characteristics. (Apply-L3)
CO4: Apply the Prandtl's lifting line theory to predict finite wing properties. (Apply-L3)
CO5: Analyze the effect of boundary layer on flow over objects. (Analyze-L4)

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", Sixth Edition, McGraw-Hill Book Co., New York, 2017.
2. Rathakrishnan. E, Theoretical Aerodynamics, Wiley, 2013.

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

B.Tech. (IV Sem.) **20AE07 - AIRCRAFT STRUCTURES - I**

L	T	P	Cr.
2	1	0	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 (Apply-L3)
CO2: Analyze the behavior of beams, frames and trusses under various loading conditions (Analyze-L4)
CO3: Analyze the statically indeterminate structures under various loading conditions (Analyze-L4)
CO4: Evaluate the strain energy stored in the structural members (Apply-L3)
CO5: Analyze the buckling of columns and compressive member under various loading conditions (Analyze-L4)

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.

B.Tech. (IV Sem.)	20HS01 – UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Nil

Course Educational Objective: To become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

COURSE OUTCOMES: At the end of the course, the student will be able to-
CO1: Apply the value inputs in life and profession **(Apply – L3)**
CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the self, and the Body **(Understand – L2)**
CO3: Understand the role of a human being in ensuring harmony in society **(Understand – L2)**
CO4: Understand the role of a human being in ensuring harmony in the nature and existence. **(Understand – L2)**
CO3: Distinguish between ethical and unethical practices (**Apply – L3**)

UNIT-I: Need, Basic Guidelines, Content and Process for Value Education

'Natural Acceptance' and Experiential Validation- as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic Human Aspirations; Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity

UNIT-II: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer);

Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

UNIT-III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship;

Understanding the harmony in the society: Resolution, Prosperity, fearlessness

and co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family, Gratitude as a universal value in relationships.

UNIT-IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence.

UNIT-V: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics, Strategy for transition from the present state to Universal Human Order

TEXT BOOKS

Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCES

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

B.Tech. (IV Sem.) **20AE53 - MANUFACTURING TECHNOLOGY LAB**

L	T	P	Cr.
0	0	3	1.5

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 (Apply-L3)
CO2: Fabricate machine components with suitable welding, lathe and other machining operations (Understand-L2)
CO3: Manufacture plastic components using various plastic processing techniques (Understand-L2)

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.)	20AE54 - THERMAL ENGINEERING LAB	L	T	P	Cr.
		0	0	3	1.5

Prerequisite: 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 (Apply-L3)

CO2: Analyze the performance characteristics of Internal Combustion Engines (Analyze-L4)

CO3: Evaluate the performance parameters of refrigeration and air conditioning systems (Apply-L3)

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.)	20AE55 - MATLAB APPLICATIONS IN ENGINEERING LAB	L	T	P	Cr.
		0	0	3	1.5

Pre-requisites: Engineering Mechanics and Numerical Methods

Course Educational Objectives: This course is designed to use the basic in-built commands and to write the MATLAB code to solve ordinary differential equation, integration and make the user-friendly environment using graphical user interface.

Course Outcomes: At the end of the course, the student will be able to
CO1: Apply the basic MATLAB operations in basic engineering problems (Apply-L3)
CO2: Solve the system of linear algebraic equation using matrix operation (Apply-L3)
CO3: Apply the graphical user interface to write the code as more user friendly (Apply-L3)

LIST OF EXPERIMENTS

Part – I: Introduction to MATLAB

1. Basic matrix operations
2. Solving ordinary differential equations
3. Solving double integration problems
4. Plotting of simple 2D and 3D graphs
5. Introduction to graphical user interface – addition and subtraction

Part – II: Application of MATLAB

6. Solving of system of linear algebraic equation using matrix
7. Solving of ordinary differential equation using Runge-Kutta method a numerical approach
8. Solving of integration using Simpson's 1/3 rule a numerical approach
9. Graphics – kinematics of particle – position, velocity and acceleration
10. Develop the graphical user interface to identify the area moment of inertia of simple section – trapezoidal and triangle
11. Identification of shear force and bending moment diagram of cantilever beam with point load
12. Identification of pathline traced by a particle in fluid domain.

B.Tech. (IV Sem.) 20ITS1-PROBLEM SOLVING USING PYTHON	L	T	P	Cr.
	1	-	2	2

Pre-requisite : Programming languages like C Language.

Course Educational Objective:

The Objective of Python course is to lead the students from the basics of writing and running Python scripts in problem solving and also to design and implement the modules and understands the working of classes and objects in python.

Course Outcomes (COs):*At the end of the course, the student shall be able to*

- **CO 1:** Identify various programming constructs available in Python and apply them in solving computational problems. (**Apply - L3)**
- **CO 2:** Demonstrate data structures available in Python and apply them in solving computational problems. (**Apply - L3**)
- **CO 3:** Implement modular programming, string manipulations and Python Libraries (**Apply - L3**)
- **CO 4:** Improve individual / teamwork skills, communication & report writing skills with ethical values.

Introduction: Language basics and example problems

Implement Python Script for checking the given year is leap year or not.

Implement Python Script for finding biggest number among 3 numbers.

Implement Python Script for displaying reversal of a number.

Implement Python Script to check given number is Armstrong or not.

Implement Python Script to print sum of N natural numbers.

Implement Python Script to check given number is palindrome or not.

Implement Python script to print factorial of a number.

Implement Python Script to print all prime numbers within the given range.

Modue 1: Exercise Programs on Lists.

Write a Python script to display elements of list in reverse order.

Write a Python script to find the minimum and maximum elements without using built-in operations in the lists.

Write a Python script to remove duplicates from a list.

Write a Python script to append a list to the second list.

Write a Python script to count the number of strings in a list where the string length is 2 or more.

Module 2: Exercise Programs on Tuples.

Write a Python script to create a tuple with different data types.

Write a Python script to find the repeated items of a tuple.

Write a Python script to replace last value of tuples in a list.

Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]

Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]

Write a Python script to sort a tuple by its float element.

Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')]

Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]

Module 3: Exercise Programs on Sets.

Write a Python script to add member(s) in a set.

Write a Python script to perform Union, Intersection, difference and symmetric difference of given two sets.

Write a Python script to test whether every element in S is in T and every element in T is in S.

Module 4: Exercise Programs on Dictionaries

Write a Python script to sort (ascending and descending) a dictionary by value.

Write a Python script to check whether a given key already exists or not in a dictionary.

Write a Python script to concatenate following dictionaries to create a new one.

Sample Dictionary : dic1={1:10, 2:20} dic2={3:30, 4:40} dic3={5:50,6:60}

Expected Result : {1: 10, 2: 20, 3: 30, 4: 40, 5: 50, 6: 60}

Write a Python script to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys.

Write a Python program to map two lists into a dictionary.

Module 5: Exercise Programs on functions and recursion.

a) Define a function max_of_three() that takes three numbers as arguments and returns the largest of them.

b) Write a program which makes use of function to display all such numbers which are divisible by 7 but are not a multiple of 5, between given range X and Y.

c) Define functions to find mean, median, mode for the given numbers in a list.

d) Define a function which generates Fibonacci series up to n numbers.

e) Implement a python script for factorial of number by using recursion.

f) Implement a python script to find GCD of given two numbers using recursion.

Module 6: Exercise programs on Strings

a) Implement Python Script to perform various operations on string using string libraries.

b) Implement Python Script to check given string is palindrome or not.

c) Implement python script to accept line of text and find the number of characters, number of vowels and number of blank spaces in it.

d)Implement python script that takes a list of words and returns the length of the longest one.

Module 7: Exercise programs on Regular Expressions

a) Write a Python script to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).

b) Write a Python script to check whether password is valid or not.

Conditions for a valid password are:

Should have at least one number.

Should have at least one uppercase and one lowercase character.

Should have at least one special symbol.

Should be between 6 to 20 characters long.

Module 8 : Exercise programs on Matplotlib Library

a) Write a Python program to draw a line with suitable label in the x axis, y axis and a title.

b) Write a Python program to plot two or more lines with legends, different widths and colors.

c) Write a Python program to create multiple plots.

d) Write a Python programming to display a bar chart using different color for each bar.

e) Write a Python programming to create a pie chart with a title.

f)Write a Python program to draw a scatter plot with empty circles taking a random distribution in X and Y and plotted against each other.

V SEM

B.Tech. (V Sem.) 20AE08- AIRCRAFT SYSTEMS AND INSTRUMENTS

L	T	P	Cr.
3	0	0	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 (Understand-L2)
CO2: To understand the performance of hydraulic and pneumatic systems in the aircraft operation (Understand-L2)
CO3: To analyze the performance of various engine systems of an aircraft (Analyze-L4)
CO4: To employ necessary auxiliary systems in the operation of an aircraft (Apply-L3)
CO5: To employ various instruments necessary of the aircraft operation (Apply-L3)

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.) **20AE09- GAS DYNAMICS**

L	T	P	Cr.
2	1	0	3

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

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: To apply the of compressible fluid flow equations to solve flow problems (Apply-L3)

CO2: To apply the steady one-dimensional flow principles in designing the nozzles and diffusers (Apply-L3)

CO3: To analyze the supersonic flow behaviour over objects (Analyze-L4)

CO4: To analyze fluid flow through ducts by considering friction and heat transfer affects (Analyze-L4)

CO5: To apply compressible flow theory to analyze flow over wings (Apply-L3)

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, 7th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2021

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.) **20AE10- AIRCRAFT STRUCTURES – II**

L	T	P	Cr.
2	1	0	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 (Analyze-L4)

CO2: To determine location of shear centre for open and closed sections (Apply-L3)

CO3: To analyze the shear flow distribution for open and closed sections (Analyze-L4)

CO4: To analyze the behavior of thin plates subjected to bending and buckling loads (Analyze-L4)

CO5: To apply the principles of bending and shear flow over aircraft components (Apply-L3)

UNIT - I

BENDING STRESS: 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–Batho Theory, 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, Second Edition, 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. (V Sem.)

20AE11- INDUSTRIAL AERODYNAMICS

L	T	P	Cr.
3	0	0	3

Pre-requisites: Aerodynamics

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

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

CO1: To analyze the aerodynamics effects on wind turbines, buildings and its ventilation (Analyze-L4)

CO2: To analyze the effects of aerodynamics in automobiles (Analyze-L4)

CO3: To analyze the effects of wind and flow induced vibrations over objects (Analyze-L4)

CO4: To apply the effects of aerodynamics in flapping wing vehicles (Analyze-L4)

UNIT I

WIND ENERGY AND WIND TURBINES: 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. (V Sem.)	20AE12- FINITE ELEMENT METHODS IN ENGINEERING	L	T	P	Cr.
		3	0	0	3

Pre-requisites: Numerical Methods, Strength of Materials

Course Educational Objectives: To understand the concepts such as discretization, natural co-ordinates, stiffness matrix etc, the analysis of trusses and beams, the concepts of axisymmetric solids subjected to axisymmetric loading and the importance of isoparametric elements, the Eigen value and Eigen vectors for dynamic problems.

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

CO1: To identify mathematical model for solution of common engineering problems (Understand-L2)

CO2: To analyze structural behavior of Plane Truss Elements (Analyze-L3)

CO3: To determine the design quantities (deformation, strain, stress) for engineering structures under different loading conditions (Apply-L3)

CO4: To formulate new solutions for the existing problems using FEM approaches (Apply-L3)

CO5: To estimate natural frequencies of bar and beam structures (Apply-L3)

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 TRUSSES: Introduction- Plane Trusses- Local and Global Coordinate Systems-Transformation Matrix- Element Stiffness Matrix-Stress Calculations.

UNIT - III

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 - IV

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

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.

REFERENCES

1. Chandraputla, Ashok, Belegundu., Introduction to Finite Elements in Engineering, 4th edition, Pearson Education India, 2015
2. Rao.S.S, The Finite Element Methods in Engineering, 4th edition, 6th reprint, B.H. Pergamon, 2010.
3. Reddy.J.N, An introduction to Finite Element Method, 3rd edition, 13th reprint, McGraw Hill, 2011.
4. 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.
5. David Hutton., Fundamentals of Finite Element Analysis, Tata McGraw Hill, 2005
6. George R Buchanan, R.Rudra Moorthy., Finite Element Analysis, Tata McGraw Hill, 2006

L	T	P	Cr.
3	0	0	3

B.Tech. (V Sem.) **20AE13- UAV SYSTEMS DESIGN**

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 (Understand-L2)

CO2: To acquire the knowledge and importance of payload integration with UAV airframe (Understand-L2)

CO3: To understand the advanced concepts of UAV and MAV system design to the engineers (Understand-L2)

CO4: To analyze the Performance of UAVs and MAVs subsystems for stable fly (Analyis-L4)

UNIT I

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

UNIT II

AIRFRAME DESIGN: Fixed Wing -Rotor -VTOL-STOL- Blimp 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

PAYLOADS AND COMMUNICATIONS: Non-dispensable Payloads, Dispensable Payloads, Communication Media Radio Communication, Mid-air Collision (MAC) Avoidance, Communications Data Rate, Bandwidth Usage Antenna Types

UNIT V

ASSEMBLY: Introduction, Assembling the UAV Empennage, Wiring and Servo Motors - Problems in Wiring Installation, Wings, RC- Control Techniques

References

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

B.Tech. (V Sem.)	20AE56- AERODYNAMICS LAB	L	T	P	Cr.
		0	0	3	1.5

Course Educational Objectives: To learn the basic experiments in wind tunnel, open jet facility and 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 (Analyze-L4)
CO2: To analyze nozzle flow characteristics (Analyze-L4)

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. Determination of center of pressure and aerodynamics center for symmetrical and cambered airfoil
4. Generation of potential flow pattern over objects using Hele-Shaw Apparatus.
5. Visualization of flow field around a flat plate using open channel.
6. Pressure Distribution over a smooth circular cylinder.
7. Pressure Distribution over a symmetrical aerofoil.
8. Pressure Distribution over a cambered aerofoil.
9. Flow visualization over objects using smoke tunnel.
10. Yaw effect on Pitot probe and Pitot-Static probe in incompressible and compressible flows
11. Flow thorough Convergent Nozzle
12. Flow through Convergent- Divergent Nozzle
13. Supersonic Flow Visualization using Shadowgraph Technique.
14. Flow visualization of submerged water jet

B.Tech. (V Sem.) **20AE57- AIRCRAFT STRUCTURES LAB**

L	T	P	Cr.
0	0	3	1.5

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

Course Outcomes: At the end of the semester, the student will be able to
CO1: To analyze the behavior of beam subjected to different loading conditions (Analyze-L4)
CO2: To analyze deflection of various structural members based on different theories (Analyze-L4)
CO3: To analyze the performance of governors and gyroscope (Analyze-L4)

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. (V Sem.) 20AES2- COMPONENT MODELLING USING CATIA	L	T	P	Cr.
	1	0	2	2

Pre-requisites: Engineering Graphics, Working knowledge of Microsoft Windows, Basic knowledge CAD drawing

Course Educational Objective: The course Describes the functional capabilities and general usage of: Part Design, Generative Shape Design, Assembly Design. The student will be taught the advanced features like patterns, threading, Advanced Surfacing and Assembly Drafting of CATIA

Course Outcomes: At the end of the course, the student will be able
CO1: To draw, modify and constrain sketches (Apply-L3)
CO2: To model and assemble various components (Apply-L3)

Module-I
CATIA as a CAD software: - Concept of Parametric Modeling, Feature Based Modeling, User Interface, Mouse operations, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools, Constrain tool bar, Transformation Tool bar, User Selection Filter, Standards, Visualizations. File types and Management, drawing profiles

Module-II
Sketcher: Profile toolbar, operation (corner, chamfer, relimitations, transformations, project 3D element), constriants, types of constraints, workbench. sketch tools, Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations.

Module-III
Part Modelling: Modeling of Machined component, Material Addition and Removal (Pad, Pocket, Shaft, Groove), Sketch and Positioned Sketch, Types of Fillets, Types of Chamfer, Types of Hole. Pattern (Rectangular, Circular, User), Thread/Tap, Datum Features (Plane, Axes, Points), Simple Draft Advance Design features: - Axis System, Types of draft, Shell, Stiffener, rib slot, Multisection solid,

Module-IV
Drafting: Introduction to Drafting & Detailing Theory- (types Generative – Interactive), Initial Drafting setting, Sheet Background, Views (ortho, ISO), Dimensions (Types- Generate Dimension & Create Dimension). Annotations: - GD & T, Symbols, Note, Leaders, Table, Symbols (Machining, Roughness, Welding, Custom), Dress-up Toolbar.

Module-V
Surfacing Modeling based Plastic Component: - Environment, Tool bars, Surface Creation (Extrude, Revolve, Sphere, Cylinder), Surface Modification, Surface Editing (Trim, Split, Shape Fillet, Close Surface, Thickness). Offset (All 3 types), Fill, Blend, Join, healing, Project-Combine Advanced Surfacing: - Adaptive Sweep, Sweep (ALL), Multisection Surface.

Module-VI
Assembly & Mechanism: Introduction to Assembly: - Types of assembly approach, Types of Constrains and DOF, placement of components in the Assembly, Manipulating Components, BOTTOM UP Approach- TOP DOWN Approach: - Part, Product, Component, Space Analysis, Reuse Pattern, Save management. Assembly Drafting: - Scene (Exploded View), Bill of material, Ballon creation, Graph Tree Reordering.

VI SEM

B.Tech. (VI Sem.)	20AE14- ELEMENTS OF HEAT TRANSFER	L	T	P	Cr.
		3	0	0	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 concepts used in heat exchangers.

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

CO1: To formulate heat conduction phenomenon through plane, cylindrical surfaces (Apply-L3)

CO2: To analyze steady state heat conduction in planes walls and cylindrical shells (Analyze-L4)

CO3: To analyse the convective heat transfer phenomenon in both external and internal flows (Analyze-L4)

CO4: To understand the thermal radiation concepts (Understand-L2)

CO5: To apply the heat transfer principles on the working of heat exchangers and electronic equipment (Apply-L3)

UNIT - I

CONDUCTIVE HEAT TRANSFER: Introduction, Heat Conduction-Fourier Law of Heat Conductive-Thermal Conductivity-General Heat Conduction Equation in Cartesian, Cylindrical Co-ordinates

UNIT – II

ONE- DIMENSIONAL STEADY STATE CONDUCTION: Heat Conduction in Plane Wall and Cylindrical shell with Constant Thermal Conductivity- Electrical Analogy-Thermal Resistance-Heat Flow Through Composite Wall and Cylinder - Critical thickness of Insulation, Uniform Internal Heat Generation in Slab, Extended Surfaces

UNIT - III

CONVECTIVE HEAT TRANSFER: Introduction-Types of Convection- Convective Heat Transfer Coefficient- Significance of Non-Dimensional Numbers, Convective Boundary Layers, The Convection Heat Transfer Equations-Velocity Boundary Layer, Thermal Boundary Layer, Thermal Boundary Layer for Flow Past Heated Plate, Free Convection

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

APPLICATIONS:

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.

COOLING OF ELECTRONIC EQUIPMENT: Manufacturing of Electronic Equipment, Cooling Load of Electronic Equipment, Thermal Environment, Electronics Cooling in Different Applications, Conduction Cooling, Air Cooling: Forced Convection, Fan Selection, Cooling Personal Computers, Liquid Cooling, Immersion Cooling

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

TEXT BOOK

1. Sachdeva. R.C, Fundamentals of Engineering Heat and Mass Transfer, Fifth Edition, New Age Intl. Publishers, 2015.

REFERENCES

1. Rathakrishnan. E, Elements of Heat transfer CRC press, New York, 2012.
2. Yunus A. Cengel, Afshin J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications McGraw-Hill, 2020.
3. Holman. J.P, Heat transfer, McGraw-Hill Higher Education, 2010.
4. Ghoshdastidar. P.S, Heat Transfer, Oxford University Press, 2012.

B.Tech. (VI Sem.) **20AE15- FLIGHT DYNAMICS**

L	T	P	Cr.
3	0	0	3

Pre-requisites: Engineering Mechanics, 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 determine thrust and power requirement conditions for steady level flight (Apply-L3)
CO2: To estimate performance parameters of flight during manoeuvring (Apply-L3)
CO3. To apply the conditions of static stability and control in the aircraft design (Apply-L3)
CO4: To understand various concepts and conditions of dynamic stability and control (Understand-L2)

UNIT - I
STEADY FLIGHT PERFORMANCE: Earth's Atmosphere, Concept of Drag, Equations of Motion in Steady Flight, Performance Design Parameters, Thrust Required and 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, 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, McGrawhill Education, 2017
2. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2017.

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.) **20AE16- AIR BREATHING PROPULSION**

L	T	P	Cr.
3	0	0	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 determine the performance parameters of various jet engines (Apply-L3)
CO2: To analyze flow thorough subsonic and supersonic inlets (Analyze-L4)
CO3: To estimate the performance parameters of aircraft compressor (Apply-L3)
CO4: To identify the parameters governing the working of combustion chambers (Understand-L2)
CO5: To determine the performance parameters of turbines of jet engines (Apply-L3)

UNIT - I
FUNDAMENTALS OF AIRBREATHING PROPULSION: Working of Gas Turbine Engine, Characteristics of Turboprop, Turbofan, And Turbojet Cycle Analysis, Performance Characteristics, Thrust Equation - Factors Affecting Thrust — Methods of Thrust Augmentation. Ramjet and Scramjet

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, 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

TEXT BOOK
1. Ganesan. V, Gas Turbines, Third Edition, Tata McGraw-Hill, New Delhi, 2017
2. Saravanamuttoo. H.I.H, Rogers. G. F. C, Cohen. H, Straznicky. P. V, Nix. A. C, Gas Turbine Theory, Seventh Edition, Pearson Education, 2019.

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. (VI Sem.)	20AE17 – INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS	L	T	P	Cr.
		3	0	0	3

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 and compressible flow problems

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

CO1: To formulate the governing equations of fluid dynamics (Apply-L3)

CO2: To apply the discretization techniques to governing equations of fluid dynamics (Apply-L3)

CO3: To understand various CFD techniques (Understand-L2)

CO4: To apply various CFD techniques to solve fluid dynamic problems (Apply-L3)

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.

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

UNIT – II

Basics Aspects of Discretization

Introduction, Introduction of Finite Differences, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, Grid Generation

UNIT – III

Simple CFD Techniques: Introduction, Lax-Wendroff Technique, Maccormack's Techniques, Space Marching, Relaxation Technique and its use with low-speed inviscid Flow, Artificial Viscosity.

UNIT – IV

Numerical Solutions of Quasi 1-D Nozzle Flows: Introduction, Supersonic Isentropic Nozzle Flow- Maccormack's Techniques, Governing Equations, Finite difference Equations, CFD Solution of Purely Subsonic Isentropic Nozzle Flow, Shock Capturing

UNIT – V

Incompressible Couette Flow: Introduction, The Physical Problem and its exact Analytical Solution, Implicit Crank-Nicholson Technique, Pressure Correction Method

REFERENCES

1. Anderson.J.D, Computational Fluid Dynamics-Basics with Applications, Mc Graw Hill, 2017.
2. Anderson, D. A, Tannehill. J. C, Pletcher. R. H, Computational Fluid Mechanics and Heat Transfer, CRC Press, 2012.
3. Patankar. S. V, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.
4. Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

B.Tech. (VI Sem.) **20AE18- VISCOUS FLOWS**

L	T	P	Cr.
3	0	0	3

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 [Apply-L3]
CO2: To apply the viscous flow equations to solve fluid flow problems [Apply-L3]
CO3: To analyze laminar and turbulent boundary layer flow fields of objects [Analyze-L4]
CO4: To describe the properties of compressible boundary layer flow [Understand-L2]

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, 3rd Editon,2017.
2. Schlichting, H, Boundary Layer Theory, McGraw Hill New York, 7th Edition, 2014.
3. Reynolds, A.J, Turbulent Flows in Engineering, John Wiley & Sons, 1980.
4. Panton, R.L, Incompressible Flow, John Wiley and Sons, 1984.

B.Tech. (VI Sem.) **20AE19- AIRPORT DESIGN**

L	T	P	Cr.
3	0	0	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
CO1: To Acquire the concept of air traffic rules and clearance procedures for airline operation [Understand-L2]
CO2: To Analyze the various air traffic data for air traffic services [Analyze-L4]
CO3: To Analyze the influence of aerodrome design factors for service establishments [Analyze-L4]

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. Virendra kumar 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. (VI Sem.) **20AE58- AIRCRAFT DESIGN LAB**

L	T	P	Cr.
0	0	3	1.5

Course Educational Objectives: To learn the aircraft design methodologies.

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

CO1: To estimate design parameters of an aircraft system, component, or process as per the requirement [Apply- L3]

CO2: To calculate design parameters of an aircraft as per the assigned specifications [Apply-L3]

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. (VI Sem.)	20AE59- PROPULSION LAB	L	T	P	Cr.
		0	0	3	1.5

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

CO1: To estimate the performance parameters of various jet engine components [Apply-L3]
CO2: To characterize the wall and free jet [Apply-L3]
CO3: To prepare various solid propellent grains [Apply-L3]

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. Preparation of solid propellant grains
12. Study of Properties of aviation fuel
    Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)

B.Tech. (VI Sem.)	20AE60- AIRCRAFT COMPONENT MODELLING AND ANALYSIS LAB	L	T	P	Cr.
		0	0	3	1.5

Course Educational Objectives: To learn modeling package (CATIA) to draw 3D parts and Assembly of various aircraft components, 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 3D geometric modeling [Apply-L3]

CO2: To solve and analyze the structural components of aircraft for deformations and stresses using a numerical tool [Analyze-L4]

Any ten experiments are to be performed:

1. Design and drafting 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 conventional aircraft parts
5. Assembly of conventional 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
15. Eigenvalue buckling analysis of oleo strut

L	T	P	Cr.
1	-	2	2

B.Tech. (VI Sem.) **20HSS1- SOFT SKILLS (SOC)**

Course Educational Objectives:
The Soft Skills Laboratory course equips students with required behavioral, interpersonal & Intrapersonal skills, communication skills, leadership skills etc. It aims at training undergraduate students on soft skills leading to enhanced self-confidence, esteem, and acceptability in professional circles.
Course Outcomes (COs): At the end of the course, student will be able

CO1: To Develop self-awareness and personality traits for professional growth
(Understand – L2)
CO2: Work effectively in multi-disciplinary and heterogeneous teams through knowledge of teamwork, Inter-personal relationships, conflict management and leadership quality.
(Apply – L3)
CO3: Communicate through verbal/oral communication with good listening skills and empathy (Apply – L3)
CO4: Apply skills required to qualify in recruitment tests, Interviews & other professional assignments (Apply – L3)

Personality Development Skills
Role of language in Personality – How language reflects, impacts Personality – Using gender-neutral language in MNCs – being culturally-sensitive-Personality Traits - Grooming & Dress code
Activities: Group Discussion/Role play/Presentations (authentic materials: News papers, pamphlets and news clippings)

Impactful Communication
Activities : Extempore / Story Telling/ Group Discussion (Case studies/Current affairs etc.)/ Elocution on Interpretation of given quotes/ Critical Appreciation and Textual Analysis/ Writing reviews on short story/videos/book/Social Media profiling/ Pronunciation Practice

Professional Skills:
Career Planning- job vs. career- goal setting- SWOT analysis-Time management – self-management – stress-management.
Activities: SWOT analysis of the self/Goal setting-Presentation/Writing Report/Listening exercises/Effective Resume-Writing and presentation/ Interview Skills: Mock interviews/Video samples.

REFERENCES :

1. Edward Holffman, "Ace the Corporate Personality", McGraw Hill,2001
2. Adrian Furnham, Personality and Intelligence at Work, Psyc 2. hology Press, 2008.
3. M.Ashraf Rizvi, "Effective Technical Communication", 1 st edition, Tata McGraw Hill, 2005
4. Ace of Soft skills Gopalaswamy Ramesh, Pearson Education India, 2018
5. Soft Skills for the Workplace, Goodheart-Willcox Publisher · 2020.
6. How to Win Friends and Influence People, Dale Carnegie · 2020

VII SEM

B.Tech. (VII Sem.) **20AE20– HELICOPTER AERODYNAMICS**

L	T	P	Cr.
3	0	0	3

Pre-Requisites: Aerodynamics and Flight Dynamics

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 understand the functions of various components of helicopter [Understand-L2]

CO2: To apply momentum theory in the design of propeller [Apply-L3]

CO3: To analyze the performance of helicopter in various operating conditions [Analyze-L4]

CO4: To analyze the stability modes of helicopter [Analyze-L4]

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, Prentice Hall of India Pvt. Ltd, New Delhi, 2018.
2. Gessow, A., Myers, Aerodynamics of Helicopter, Continuum International Publishing Group Ltd. 1997
3. B. W. McCormick, Aerodynamics of V/STOL Flight, Dover Publications, 1999.
4. W. Johnson, Helicopter Theory, Dover Publications Inc.; Revised edition 2003
5. B. W. McCormick, Aerodynamics, Aeronautics & Flight Mechanics, John Wiley, 1995.

B.Tech. (VII Sem.) 20AE21-COMBUSTION IN AEROSPACE VEHICLES

L	T	P	Cr.
3	0	0	3

Pre-Requisites: Thermodynamics and Elements of Heat Transfer

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

CO1: To understand the basic concepts of propulsion unit [Understand-L2]

CO2: To understand the various factors effecting the combustion process in aircraft engines-piston and jet engines [Understand-L2]

CO3: To understand the various combustion models of rocket engines [Understand-L2]

CO4: To understand the reaction and mixing process in supersonic combustion [Understand-L2]

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 – ramjet, scramjet - 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. Kuo K.K. “Principles of Combustion” John Wiley and Sons, 2005.
2. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, Second edition 2014.
3. Mishra D. P., “Fundamentals of Combustion”, Prentice Hall of India, New Delhi, 2008.
4. Mukunda H. S., “Understanding Combustion”, Second edition, Orient Blackswan, 2009.
5. Warren C. Strahle, “An Introduction to Combustion”, Taylor and Francis, 1993.
6. Beer, J.M., and Chegar, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.

B.Tech. (VII Sem.) **20AE22 - MECHANICS OF COMPOSITES**

L	T	P	Cr.
3	0	0	3

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 stress-strain relations of orthotropic materials [Understand L2]
CO2: To analyze properties of composite lamina at micro level and macro level [Analyze-L4]
CO3: To analyze characteristics of layered composites [Analyze-L4]
CO4: To understand the nomenclature of sandwich structures [Understand-L2]
CO5: To apply techniques of fabrication processes to manufacture composites [Apply-L3]

UNIT - I
STRESS STRAIN RELATION: Introduction- Definition -classification of composites- 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: Macro Mechanics – Stress-strain relations of orthotropic lamina with respect to on axis, off axis - Micro mechanics – Mechanics of materials approach to stiffness- determine material properties -elasticity approach to stiffness-bounding Techniques

UNIT- III
MULTI DIRCTIONAL COMPOSITES: Macro mechanical behavior of laminate, Classical Lamination Theory-stress strain variation in a laminate- 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, Pressure Bagging- Pultrusion, Resin Transfer Molding - Auto Clave-Filament Winding, Introduction to functionally graded materials

REFERENCES

1. Jones, R.M., "Mechanics of Composite Materials", 2nd Edition, Taylor and Francis, 2015.
2. Valery V. Vasiliev and Evgeny V. Morozov "Mechanics and Analysis of Composite Materials" Elsevier Science Ltd.
3. Krishan K. Chawla "Composite Materials Science and Engineering" 2nd Edition, Springer,2012
4. Carlsson, L.A., Kardomateas, G.A., "Structural and Failure Mechanics of Sandwich", Solid Mechanics and its Applications, Vol 121, Springer Heidlberg, New York, 2011.
5. Agarwal, B.D., Broutman, L.J., K. Chandrashekhara "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, Fourth Edition, 2017.

B.Tech. (VII Sem.) 20AE23- INTRODUCTION TO SPACE TECHNOLOGY

L	T	P	Cr.
3	0	0	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 [Understand-L2]
CO2: To understand the orbital mechanics and it's maneuvering [Understand-L4]
CO3: To understand the basic aspects of trajectories of rockets and missiles [Understand-L4]
CO4: To analyze the dynamics of spacecraft attitude [Analyze-L4]

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. Wiesel. W. E, Spaceflight Dynamics, McGraw-Hill, 2nd Edition, 2013
3. Hale. F. J, Introduction to Space Flight, Prentice-Hall, 1994.
4. Brown. C. D, Spacecraft Mission Design, AIAA Education Series, 1998.

B.Tech. (VII Sem.) **20AE24-SPACE VEHICLE PROPULSION**

L	T	P	Cr.
3	0	0	3

Pre-requisite: Airbreathing Propulsion

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 understand the working of ramjet and scram jet engines [Understand-L2]

CO2: To evaluate the preliminary parameters of rocket propulsion. [Apply-L3]

CO3: To understand the working of liquid and solid propellant rocket systems [Understand-L2]

CO4: To apply the advanced rocket propulsion techniques for a mission [Apply-L3]

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.

REFERENCES

1. Sutton. G.P and Oscar Biblarz "Rocket Propulsion Elements", Wiley-Interscience, 7th Edition., 2000.
2. Mattingly. J. D, Elements of Propulsion: Gas Turbines and Rockets, AIAA Educational Series, 2017
3. Gorden, C.O, Aero Thermodynamics of Gas Turbine and Rocket Propulsion, AIAA Education Series, New York, 1997.

B.Tech. (VII Sem.)	20AE25 - AEROELASTICITY	L	T	P	Cr.
		3	0	0	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 aircraft wing [Analyze-L4]
CO2: To design the aircraft wing by considering effects of flow induced vibration [Apply-L3]
CO3: To analyze aeroelastic phenomena in aircraft wing [Analyze-L4]
CO4: To analyze aeroelastic phenomenon in various applications [Analyze-L4]

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, Dover Publications Inc.; Illustrated edition, 2008
2. Bisplinghoff Raymond and Holt Ashley., Principles of Aeroelasticity, Dover Books on Engineering 2nd Edition, 2013
3. Earl H. Dowell., A Modern Course in Aeroelasticity, Springer. 5th Edition, 2014

B.Tech. (VII Sem.)	20AE26-INSTRUMENTATION, MEASUREMENTS AND EXPERIMENTS IN FLUIDS	L	T	P	Cr.
		3	0	0	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
CO1: To employ the wind tunnels for aerodynamic testing of bodies [Apply-L3]
CO2: To adopt and use a visualization technique to understand the flow field [Apply-L3]
CO3: To employ the suitable instrument to measure the velocity, temperature and pressure of fluid flow [Apply-L3]
CO4: To acquire experimental data and to estimate the uncertainty in measured values during experimentation [Apply-L3]

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. PIV, 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.

REFERENCES

1. E. Rathakrishnan, Instrumentation, Measurements and Experiments in Fluids, CRC press, CRC Press; 2nd edition, 2020
2. Jack Philip Holman, Experimental methods for Engineers, McGraw Hill Education; 7th edition, 2017.
3. Jewel B. Barlow, William H. Rae, Alan Pope., Low Speed Wind Tunnel Testing, Wiley India Pvt Ltd; Third edition, 2010.
4. Pope, A., Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
5. Ernest Doebelin, Measurement Systems, McGraw Hill Education; 6th edition, 2017
6. John H. Lienhard V Thomas G. Beckwith, Roy D. Marangoni, Mechanical Measurements, Pearson Education; Revised 6e edition, 2020

B.Tech. (VII Sem.) **20AE27 - PROPELLANT TECHNOLOGY**

L	T	P	Cr.
3	0	0	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 able
CO1: To understand the characteristics of aircraft fuels [Understand-L2]
CO2: To understand the characteristics of solid propellants used in rockets [Understand-L2]
CO3: To understand the characteristics of liquid propellants used in rockets [Understand-L2]
CO4: To understand the properties of cryogenic propellants [Understand-L2]
CO5: To test the propellants to estimates their characteristics [Apply-L3]

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, Hydrogen Fuel

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, Liquid and Cryogenic propellant testing

REFERENCES
1. Sutton. G.P and Oscar Biblarz "Rocket Propulsion Elements", Wiley-Interscience,7th Edition., 2000.
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.

B.Tech. (VII Sem.) **20AE28-SPACE MECHANICS**

L	T	P	Cr.
3	0	0	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 [Understand-L2]
CO2: To evaluate trajectory details of ballistic missiles [Analyze-L4]
CO3: To apply N-body aspects in space exploration issues [Apply-L3]
CO4: To know the general aspects of satellite injection and orbit perturbations [Understand-L2]
CO5: To evaluate interplanetary trajectories of spacecraft [Analyze-L4]

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.

REFERENCES
1. W.E. Wiesel, "Spaceflight Dynamics", McGraw-Hill, 1997
2. Cornelisse, Schoyer HFR, Wakker KF, "Rocket Propulsion and Space Flight Dynamics", Pitman publications, 1984
3. Van de Kamp, P., "Elements of Astro-mechanics", Pitman, 1979.
4. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc.,1982.
5. Vladimir A. Chobotov, "Orbital Mechanics", AIAA Education Series, AIAA Education Series, Published by AIAA, 2002

B.Tech. (VII Sem.) 20HS02-MANAGEMENT SCIENCE FOR ENGINEERS

L	T	P	Cr.
3	0	0	3

Course Description:

In this course, students will learn fundamental concepts and contributions of management. This course also teaches human resources practices which play a vital role in the organisation it gives knowledge about use of improve quality of work and project management.

Course Objectives:

1. To make students understand management, its principles, contribution to management, organization, and its basic issues and types
2. To make students understand the concept of plant location and its factors and plant layout and types, method of production and work study importance
3. To understand the purpose and function of statistical quality control.And understand the material management techniques
4. To make students understand the concept of HRM and its functions
5. To make students understand PERT & CPM methods in effective project management and need of project crashing and its consequence on cost of project

Course Outcomes:

CO1: Understand management principles to practical situations based on the organization structures**. (L2)**

CO2: Design Effective plant Layouts by using work study methods. **(L2)**

CO3: Apply quality control techniques for improvement of quality and materials management. **(L3)**

CO4: Develop best practices of HRM in corporate Business to raise employee productivity. **(L2)**

CO5: Identify critical path and project completion time by using CPM and PERT techniques. **(L3)**

UNIT I

Introduction: Management - Definition, Nature, Importance of management Functions of Management - Taylor's scientific management theory, Fayal's principles of management, Contribution of Elton mayo,Maslow, Herzberg, Douglas MC Gregor, Basic Concepts Of Organisation- Authority, Responsibility Delegation of Authority, Span of control, Departmentation and Decentralization - Organisation structures(Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization)

UNIT II

Operations Management: Plant location, Factors influencing location,Principles and types of plant layouts - Methods of production (job, batch and mass production), Work study - Basic procedure involved in method study and Work measurement

UNIT III

Statistical quality control –Concept of Quality & Quality Control-functions ,Meaningof SQC - Variables and attributes - X chart, R Chart, C Chart, P Chart,(simple Problems) Acceptance sampling, Sampling plans, Deming's contribution to quality.

Materials management –Meaning and objectives,inventory control-Need for inventory control, Purchase procedure, Store records, EOQ, ABC analysis, Stock levels

UNIT IV

Human Resource management (HRM): Concepts of HRM, Basic functions of HR manager:Man power planning, Recruitment, Selection, Training and development, Placement, Wage and salary administration, Promotion, Transfers Separation, performance appraisal, Job evaluation and merit rating.

UNIT V

Project management: Early techniques in project management - Network analysis: Programme evaluation and review technique (PERT), Critical path method (CPM), Identifying critical path, Probability of completing project within given time, Project cost analysis, project crashing (simple problems)

Text Books:

Dr. A.R.Aryasri, Management Science, TMH, 10th edition, 2012

References:

1. Koontz & weihrich – Essentials of management, TMH, 10th edition, 2015
2. Stoner, Freeman, Gilbert, Management, 6th edition Pearson education, New Delhi, 2004
3. O.P. Khana, Industrial engineering and Management L.S.Srinath, PERT & CPM

B.Tech. (VII Sem.)	20AES3-FLUID FLOW ANLYSIS USING ANSYS FLUENT	L	T	P	Cr.
		1	0	2	2

Course Educational Objective: To learn the finite element package ANSYS Fluent to analyze the incompressible and compressible flow field characteristics

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

CO1: To demonstrate the various modules of Ansys Fluent [Apply-L3]

CO2: To solve and analyze the characteristics of flow over aerodynamic objects and flow through ducts [Analyze-L4]

Module – I

Introduction

Introduction to ANSYS Fluent, Basic Steps for CFD Analysis using ANSYS Fluent, Guide to a Successful Simulation Using ANSYS Fluent, Starting and Executing ANSYS Fluent

Design Modeler

Introduction, Viewing, 2D Sketching, Selection, Planes and Sketches, Geometry Representations, 3D Modeling

Module – II (Meshing)

Introduction to Meshing Mode in Fluent, Starting Fluent in Meshing Mode, Graphical User Interface, Size Functions and Scoped Sizing, Object Based Meshing - Surface, Volume, Creating Mesh, Determining Mesh Statistics and Quality

Module – III (Solver Settings and Solution)

Introduction, Solution Procedure Overview, Available Solvers, Choosing a Solver, Discretisation, Initialization, Case Check, Convergence, Solution Accuracy, Grid-Independent Solutions, Mesh Adaption,

Module – IV (Post-Processing)

Post Processing- Overview, GUI Layout, Case Comparison, Creating Locations-types, Color, Render and View, Other Graphics Objects, Generating Tables, Charts and Reports, Animation, Files

Module – V (Tutorials)

Fluid Flow and Heat Transfer in a Mixing Elbow, Flow over Cylinder, Compressible Flow over Airfoil, Flow through convergent nozzle, Flow through convergent-divergent Nozzle,