JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in AERONAUTICAL ENGINEERING
COURSE STRUCTURE & SYLLABUS (R18)

Applicable From 2018-19 Admitted Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics - I	3	1	0	4
2	PH102BS	Engineering Physics	3	1	0	4
3	CS103ES	Programming for Problem Solving	3	1	0	4
4	ME104ES	Engineering Graphics	1	0	4	3
5	PH105BS	Engineering Physics Lab	0	0	3	1.5
6	CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC109ES	Environmental Science	3	0	0	0
		Induction Programme				
		Total Credits	**13**	**3**	**10**	**18**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Mathematics - II	3	1	0	4
2	CH202BS	Chemistry	3	1	0	4
3	ME203ES	Engineering Mechanics	3	1	0	4
4	ME205ES	Engineering Workshop	1	0	3	2.5
5	EN205HS	English	2	0	0	2
6	CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	EN207HS	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	**12**	**3**	**8**	**19.0**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	EE300ES	Basic Electrical and Electronics Engineering	3	0	0	3
3	AE303PC	Theory of Structures	3	0	0	3
4	AE304PC	Fluid Mechanics and Hydraulics	3	0	0	3
5	AE305PC	Aerodynamics - I	3	1	0	4
6	AE306PC	Mechanics of Solids Lab	0	0	2	1
7	AE307PC	Fluid Mechanics and Hydraulics Lab	0	0	4	2
8	EE309PC	Basic Electrical and Electronics Engineering Lab	0	0	2	1
9	*MC309	Constitution of India	3	0	0	0
		Total Credits	**18**	**2**	**8**	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE401ES	Probability Distributions and Numerical Methods	3	1	0	4
2	AE402PC	Low Speed Aerodynamics	3	0	0	3
3	AE403PC	Aircraft Materials and Production	3	1	0	4
4	AE404PC	Analysis of Aircraft Structures	3	1	0	4
5	AE405PC	Aero-Thermodynamics	3	0	0	3

6	AE406ES	Aerodynamics Lab	0	0	2	1
7	AE407PC	Aerospace Structures Lab	0	0	2	1
8	AE408PC	Aircraft Materials and Production Lab	0	0	2	1
10	*MC409	Gender Sensitization Lab	0	0	2	0
		Total Credits	**15**	**3**	**8**	**21**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE501PC	Aircraft Propulsion	3	1	0	4
2	AE502PC	High Speed Aerodynamics	3	0	0	3
3	AE503PC	Finite Element Methods	3	0	0	3
4	SM504MS	Business Economics and Financial Analysis	3	0	0	3
5	AE505PC	Aircraft Systems and Controls	3	0	0	3
6	AE506PC	Aircraft Performance and Stability	3	0	0	3
7	AE507PC	Computer Aided Aircraft Engineering Drawing	0	0	2	1
8	AE508PC	Flight Control Lab	0	0	2	1
9	AE509PC	Aircraft Propulsion Lab	0	0	2	1
10	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	**21**	**1**	**6**	**22**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	AE601PC	Space Propulsion	3	0	0	3
2	AE602PC	Computational Aerodynamics	3	1	0	4
3	AE603PC	Helicopter Aerodynamics	3	0	0	3
4		Professional Elective - I	3	0	0	3
5		Open Elective - I	3	0	0	3
6	AE604PC	Aircraft Design	3	0	0	3
7	AE605PC	Aerospace Propulsion Lab	0	0	2	1
8	AE606PC	CFD Lab	0	0	2	1
9	EN608HS	Advanced Communication Skills Lab	0	0	2	1
10	*MC609	Environmental Science	3	0	0	0
		Total Credits	**21**	**1**	**6**	**22**

***MC609 - Environmental Science – Should be Registered by Lateral Entry Students Only.**

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE701PC	Vibration and Aero-elasticity	3	0	0	3
2		Professional Elective – II	3	0	0	3
3		Professional Elective – III	3	0	0	3
4		Professional Elective - IV	3	0	0	3
5		Open Elective - II	3	0	0	3
6	AE702PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	AE703PC	Seminar	0	0	2	1
8	AE704PC	Project Stage - I	0	0	6	3
		Total Credits	**15**	**0**	**8**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Professional Elective – V	3	0	0	3
2		Professional Elective - VI	3	0	0	3
3		Open Elective - III	3	0	0	3
4	AE801PC	Project Stage - II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

Professional Elective – I

AE611PE	Advanced Solid Mechanics
AE612PE	Design and Analysis of Composite Structures
AE613PE	Unmanned Air Vehicles

Professional Elective – II

AE711PE	Space Mechanics
AE712PE	Rockets and Missiles
AE713PE	Wind Tunnel Technique

Professional Elective – III

AE721PE	Experimental Aerodynamics
AE722PE	Hypersonic Aerodynamics
AE723PE	Advanced Computational Aerodynamics

Professional Elective – IV

AE731PE	Industrial Aerodynamics
ME732PE	Turbo Machinery
AE733PE	Theory of Combustion

Professional Elective – V

AE811PE	Heat Transfer
AE812PE	Cryogenics
AE813PE	Aero Engine Design

Professional Elective – VI

AE821PE	Precision Engineering
AE822PE	Practical Non-Destructive Testing
AE823PE	CAD/CIM

***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

MA101BS: MATHEMATICS - I

B.Tech. I Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives: To learn

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form
- Concept of Sequence.
- Concept of nature of the series.
- Geometrical approach to the mean value theorems and their application to the mathematical problems
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative
- Finding maxima and minima of function of two and three variables.

Course Outcomes: After learning the contents of this paper the student must be able to

- Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations
- Find the Eigen values and Eigen vectors
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Analyse the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions
- Find the extreme values of functions of two variables with/ without constraints.

UNIT-I: Matrices

Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non-Homogeneous equations. Gauss elimination method; Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors

Linear Transformation and Orthogonal Transformation: Eigen values and Eigenvectors and their properties: Diagonalization of a matrix; Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by Orthogonal Transformation

UNIT-III: Sequences & Series

Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences.
Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence.

UNIT-IV: Calculus

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT-V: Multivariable calculus (Partial Differentiation and applications)

Definitions of Limit and continuity.

Partial Differentiation; Euler's Theorem; Total derivative; Jacobian; Functional dependence & independence, Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCE BOOKS:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

PH102BS: ENGINEERING PHYSICS

B.Tech. I Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives:

- The course aims at making students to understand the basic concepts of Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
- Students will be able to demonstrate competency and understanding of the concepts found in Mechanics, Harmonic Oscillations, Waves in one dimension, wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.
- The main purpose of this course is to equip engineering undergraduates with an understanding of the scientific method, so that they may use the training beneficially in their higher pursuits.
- Today the need is to stress principles rather than specific procedures, to select areas of contemporary interest rather than of past interest, and to condition the student to the atmosphere of change he will encounter during his carrier.

Course outcomes: Upon graduation, the graduates will have:

- The knowledge of Physics relevant to engineering is critical for converting ideas into technology.
- An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements.
- In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fibre Optics.
- Various chapters establish a strong foundation on the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.

UNIT-I: Introduction to Mechanics

Transformation of scalars and vectors under Rotation transformation, Forces in Nature, Newton's laws and its completeness in describing particle motion, Form invariance of Newton's second law, Solving Newton's equations of motion in polar coordinates, Problems including constraints and friction, Extension to cylindrical and spherical coordinates.

UNIT-II: Harmonic Oscillations

Mechanical and electrical simple harmonic oscillators, Complex number notation and phasor representation of simple harmonic motion, Damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator, Quality factor, Mechanical and electrical oscillators, Mechanical and electrical impedance, Steady state motion of forced damped harmonic oscillator, Power observed by oscillator.

UNIT-III: Waves in one dimension

Transverse wave on a string, The wave equation on a string, Harmonic waves, Reflection and transmission of waves at a boundary, Impedance matching, Standing waves and their Eigen frequencies, Longitudinal waves and the wave equations for them, Acoustic waves and speed of sound, Standing sound waves.

UNIT-IV: Wave Optics

Huygen's principle, Superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's rings, Michelson's interferometer, Mach-Zehnder interferometer, Fraunhofer diffraction from a single slit and circular aperture, Diffraction grating- resolving power.

UNIT-V: Lasers and Fibre Optics

Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser. Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

TEXT BOOKS:

1. Engineering Mechanics, 2nd ed.- MK Harbola, Cengage Learning
2. I. G. Main, "Vibrations and waves in physics', 3rd Edn, Cambridge University Press, 2018.
3. Ajoy Ghatak, "Optics", McGraw Hill Education, 2012

REFERENCE BOOKS:

1. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006
2. O. Svelto, "Principles of Lasers"
3. "Introduction to Mechanics", M.K.Verma, Universities Press

CS103ES/CS203ES: PROGRAMMING FOR PROBLEM SOLVING

B.Tech. I Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives:

- To learn the fundamentals of computers.
- To understand the various steps in program development.
- To learn the syntax and semantics of C programming language.
- To learn the usage of structured programming approach in solving problems.

Course Outcomes: The student will learn

- To write algorithms and to draw flowcharts for solving problems.
- To convert the algorithms/flowcharts to C programs.
- To code and test a given logic in C programming language.
- To decompose a problem into functions and to develop modular reusable code.
- To use arrays, pointers, strings and structures to write C programs.
- Searching and sorting problems.

UNIT - I: Introduction to Programming

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems
Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming
Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments
Bitwise operations: Bitwise AND, OR, XOR and NOT operators
Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do-while loops
I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr. Command line arguments

UNIT - II: Arrays, Strings, Structures and Pointers:

Arrays: one- and two-dimensional arrays, creating, accessing and manipulating elements of arrays
Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings
Structures: Defining structures, initializing structures, unions, Array of structures
Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation)
Enumeration data type

UNIT - III: Preprocessor and File handling in C:

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef
Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

UNIT - IV: Function and Dynamic Memory Allocation:

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries

Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions
Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT - V: Introduction to Algorithms:
Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc.
Basic searching in an array of elements (linear and binary search techniques),
Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms),
Basic concept of order of complexity through the example programs

TEXT BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
2. Hall of India
3. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
4. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
5. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

ME104ES/ME204ES: ENGINEERING GRAPHICS

B.Tech. I Year I Sem.	L	T/P/D	C
	1	0/0/4	3

Pre-requisites: Nil

Course objectives:

- To provide basic concepts in engineering drawing.
- To impart knowledge about standard principles of orthographic projection of objects.
- To draw sectional views and pictorial views of solids.

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

- Preparing working drawings to communicate the ideas and information.
- Read, understand and interpret engineering drawings.

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain & Diagonal.

UNIT- II

Orthographic Projections: Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures. Auxiliary Planes.

UNIT – III

Projections of Regular Solids – Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere

UNIT – IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone,
Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

UNIT – V

Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa –Conventions

Introduction to CAD: (For Internal Evaluation Weightage only):

Introduction to CAD Software Package Commands. - Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package

TEXT BOOKS:

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

REFERENCE BOOKS:

1. Engineering Drawing / Basant Agrawal and McAgrawal/ McGraw Hill
2. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers

PH105BS: ENGINEERING PHYSICS LAB

B.Tech. I Year I Sem.	L	T/P/D	C
	0	0/3/0	1.5

List of Experiments:

1. Melde's experiment:
   To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

2. Torsional pendulum:
   To determine the rigidity modulus of the material of the given wire using torsional pendulum.

3. Newton's rings:
   To determine the radius of curvature of the lens by forming Newton's rings.

4. Diffraction grating:
   To determine the number of lines per inch of the grating.

5. Dispersive power:
   To determine the dispersive power of prism by using spectrometer.

6. Coupled Oscillator:
   To determine the spring constant by single coupled oscillator.

7. LCR Circuit:
   To determine quality factor and resonant frequency of LCR circuit.

8. LASER:
   To study the characteristics of LASER sources.

9. Optical fibre:
   To determine the bending losses of Optical fibres.

10. Optical fibre:
    To determine the Numerical aperture of a given fibre.

Note: Any 8 experiments are to be performed

CS106ES/CS206ES: PROGRAMMING FOR PROBLEM SOLVING LAB

B.Tech. I Year I Sem.	**L**	**T/P/D**	**C**
	0	**0/3/0**	**1.5**

[Note:The programs may be executed using any available Open Source/ Freely available IDE
Some of the Tools available are:
CodeLite: https://codelite.org/
Code::Blocks: http://www.codeblocks.org/
DevCpp : http://www.bloodshed.net/devcpp.html
Eclipse: http://www.eclipse.org
This list is not exhaustive and is NOT in any order of preference]

Course Objectives: The students will learn the following:

- To work with an IDE to create, edit, compile, run and debug programs
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- To Write programs using the Dynamic Memory Allocation concept.
- To create, read from and write to text and binary files

Course Outcomes: The candidate is expected to be able to:

- formulate the algorithms for simple problems
- translate given algorithms to a working and correct program
- correct syntax errors as reported by the compilers
- identify and correct logical errors encountered during execution
- represent and manipulate data with arrays, strings and structures
- use pointers of different types
- create, read and write to and from simple text and binary files
- modularize the code with functions so that they can be reused

Practice sessions:

a. Write a simple program that prints the results of all the operators available in C (including pre/ post increment , bitwise and/or/not , etc.). Read required operand values from standard input.
b. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values form standard input.

Simple numeric problems:

a. Write a program for fiend the max and min from the three numbers.
b. Write the program for the simple, compound interest.
c. Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standard input.
d. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:
e. 5 x 1 = 5
f. 5 x 2 = 10
g. 5 x 3 = 15
h. Write a program that shows the binary equivalent of a given positive number between 0 to 255.

Expression Evaluation:

a. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
b. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
c. Write a program that finds if a given number is a prime number
d. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
e. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
f. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
g. Write a C program to find the roots of a Quadratic equation.
h. Write a C program to calculate the following, where x is a fractional value.
i. 1-x/2 +x^2/4-x^3/6
j. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+…….+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Arrays and Pointers and Functions:

a. Write a C program to find the minimum, maximum and average in an array of integers.
b. Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimension array.
c. Write a C program that uses functions to perform the following:
d. Addition of Two Matrices
e. ii. Multiplication of Two Matrices
f. iii. Transpose of a matrix with memory dynamically allocated for the new matrix as row and column counts may not be same.
g. Write C programs that use both recursive and non-recursive functions
h. To find the factorial of a given integer.
i. ii. To find the GCD (greatest common divisor) of two given integers.
j. iii. To find x^n
k. Write a program for reading elements using pointer into array and display the values using array.
l. Write a program for display values reverse order from array using pointer.
m. Write a program through pointer variable to sum of n elements from array.

Files:

a. Write a C program to display the contents of a file to standard output device.
b. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
c. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.
d. Write a C program that does the following:
   It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function)
   Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function)
   The program should then read all 10 values and print them back.

e. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).

Strings:

a. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
b. Write a C program that converts a number ranging from 1 to 50 to Roman equivalent
c. Write a C program that uses functions to perform the following operations:
d. To insert a sub-string in to a given main string from a given position.
e. ii. To delete n Characters from a given position in a given string.
f. Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
g. Write a C program that displays the position of a character ch in the string S or – 1 if S doesn't contain ch.
h. Write a C program to count the lines, words and characters in a given text.

Miscellaneous:

a. Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
b. Write a C program to construct a pyramid of numbers as follows:

```
1          *          1          1          *
1 2        * *        2 3        2 2        * *
1 2 3      * * *      4 5 6      3 3 3      * * *
                                 4 4 4 4    * *
                                            *
```

Sorting and Searching:

a. Write a C program that uses non recursive function to search for a Key value in a given
b. list of integers using linear search method.
c. Write a C program that uses non recursive function to search for a Key value in a given
d. sorted list of integers using binary search method.
e. Write a C program that implements the Bubble sort method to sort a given list of
f. integers in ascending order.
g. Write a C program that sorts the given array of integers using selection sort in descending order
h. Write a C program that sorts the given array of integers using insertion sort in ascending order
i. Write a C program that sorts a given array of names

Suggested Reference Books for solving the problems:

i. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
ii. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
iii. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
iv. Hall of India
v. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
vi. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
vii. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

*MC109ES: ENVIRONMENTAL SCIENCE

B.Tech. I Year I Sem.	L	T/P/D	C
	3	0/0/0	0

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations

Course Outcomes:

- Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT-I

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT-II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT-III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT-IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Issues and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-

economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHI Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

MA201BS: MATHEMATICS - II

B.Tech. I Year II Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives: To learn

- Methods of solving the differential equations of first and higher order.
- Evaluation of multiple integrals and their applications
- The physical quantities involved in engineering field related to vector valued functions
- The basic properties of vector valued functions and their applications to line, surface and volume integrals

Course Outcomes: After learning the contents of this paper the student must be able to

- Identify whether the given differential equation of first order is exact or not
- Solve higher differential equation and apply the concept of differential equation to real world problems
- Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelopiped
- Evaluate the line, surface and volume integrals and converting them from one to another

UNIT-I: First Order ODE

Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of natural growth and decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II: Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, \sin ax, \cos ax,$ polynomials in x, $e^{ax}V(x)$ and $x\,V(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallelopiped).

UNIT-IV: Vector Differentiation

Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCE BOOKS:

1. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

CH102BS/CH202BS: CHEMISTRY

B.Tech. I Year II Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives:

- To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
- To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
- To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.
- To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways

Course Outcomes: The basic concepts included in this course will help the student to gain:

- The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
- The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
- The required skills to get clear concepts on basic spectroscopy and application to medical and other fields.
- The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.

UNIT - I:

Molecular structure and Theories of Bonding: Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules. π molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d-orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT - II:

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems.

UNIT - III:

Electrochemistry and corrosion: Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – methods of application. Electroless plating of Nickel.

UNIT - IV:

Stereochemistry, Reaction Mechanism and synthesis of drug molecules: Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation alanalysis of n- butane.

Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1, S_N2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid.

Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

UNIT - V:

Spectroscopic techniques and applications: Principles of spectroscopy, selection rules and applications of electronic spectroscopy. vibrational and rotational spectroscopy. Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.

TEXT BOOKS:

1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry by P.C.Jain & M.Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
3. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
4. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.
5. University Chemistry, by B.M. Mahan, Pearson IV Edition.
6. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan

ME203ES: ENGINEERING MECHANICS

B.Tech. I Year II Sem.	L	T/P/D	C
	3	1/0/0	4

Course Objectives: The objectives of this course are to

- Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
- Perform analysis of bodies lying on rough surfaces.
- Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
- Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
- Explain the concepts of work-energy method and its applications to translation, rotation and plane motion and the concept of vibrations

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

- Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces.
- Solve problem of bodies subjected to friction.
- Find the location of centroid and calculate moment of inertia of a given section.
- Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
- Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.

UNIT-I:

Introduction to Engineering Mechanics - Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

UNIT-II:

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. – Theorem of Pappus

UNIT-III:

Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem

Mass Moment of Inertia: Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT-IV:

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT-V:

Kinetics of Rigid Bodies -Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

TEXT BOOKS:

1. Shames and Rao (2006), Engineering Mechanics, Pearson Education
2. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics & Dynamics

REFERENCE BOOKS:

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition, 1983.
2. Andrew Pytel, Jaan Kiusalaas, "Engineering Mechanics", Cengage Learning, 2014.
3. Beer F.P & Johnston E.R Jr. Vector, "Mechanics for Engineers", TMH, 2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
7. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

ME105ES/ME205ES: ENGINEERING WORKSHOP

B.Tech. I Year II Sem.	L	T/P/D	C
	1	0/3/0	2.5

Pre-requisites: Practical skill

Course Objectives:

- To Study of different hand operated power tools, uses and their demonstration.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
- To develop a right attitude, team working, precision and safety at work place.
- It explains the construction, function, use and application of different working tools, equipment and machines.
- To study commonly used carpentry joints.
- To have practical exposure to various welding and joining processes.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

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

- Study and practice on machine tools and their operations
- Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
- Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
- Apply basic electrical engineering knowledge for house wiring practice.

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

I. Carpentry – (T-Lap Joint, Dovetail Joint, Mortise & Tenon Joint)
II. Fitting – (V-Fit, Dovetail Fit & Semi-circular fit)
III. Tin-Smithy – (Square Tin, Rectangular Tray & Conical Funnel)
IV. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern)
V. Welding Practice – (Arc Welding & Gas Welding)
VI. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)
VII. Black Smithy – (Round to Square, Fan Hook and S-Hook)

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

TEXT BOOKS:

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal / Anuradha.

REFERENCE BOOKS:

1. Work shop Manual - P. Kannaiah/ K. L. Narayana/ SciTech
2. Workshop Manual / Venkat Reddy/ BSP

EN105HS/EN205HS: ENGLISH

B.Tech. I Year II Sem.	**L**	**T/P/D**	**C**
	2	**0/0/0**	**2**

INTRODUCTION

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.*

Learning Objectives: The course will help to

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.

Course Outcomes: Students should be able to

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNIT –I

'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.

Basic Writing Skills: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT –II

'Ancient Architecture in India' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Synonyms and Antonyms.

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

Writing: Format of a Formal Letter-**Writing Formal Letters** E.g.., Letter of Complaint, Letter of Requisition, Job Application with Resume.

UNIT –III

'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places and Events – **Classifying**- Providing Examples or Evidence

UNIT –IV

'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension**-** Intensive Reading and Extensive Reading

Writing: Writing Practices--Writing Introduction and Conclusion - Essay Writing-Précis Writing.

UNIT –V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: **Technical Reports**- Introduction – Characteristics of a Report – Categories of Reports

Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

TEXT BOOK:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

REFERENCE BOOKS:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006). Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

CH106BS/CH206BS: ENGINEERING CHEMISTRY LAB

B.Tech. I Year II Sem.	L	T/P/D	C
	0	0/3/0	1.5

Course Objectives: The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:

- Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
- To determine the rate constant of reactions from concentrations as an function of time.
- The measurement of physical properties like adsorption and viscosity.
- To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.

Course Outcomes: The experiments will make the student gain skills on:

- Determination of parameters like hardness and chloride content in water.
- Estimation of rate constant of a reaction from concentration – time relationships.
- Determination of physical properties like adsorption and viscosity.
- Calculation of R_f values of some organic molecules by TLC technique.

List of Experiments:

1. Determination of total hardness of water by complexometric method using EDTA
2. Determination of chloride content of water by Argentometry
3. Estimation of an HCl by Conductometric titrations
4. Estimation of Acetic acid by Conductometric titrations
5. Estimation of HCl by Potentiometric titrations
6. Estimation of Fe^{2+} by Potentiometry using $KMnO_4$
7. Determination of rate constant of acid catalysed hydrolysis of methyl acetate
8. Synthesis of Aspirin and Paracetamol
9. Thin layer chromatography calculation of R_f values. eg ortho and para nitro phenols
10. Determination of acid value of coconut oil
11. Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal
12. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
13. Determination of partition coefficient of acetic acid between n-butanol and water.
14. Determination of surface tension of a give liquid using stalagmometer.

REFERENCE BOOKS:

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi)
3. Vogel's text book of practical organic chemistry 5^{th} edition
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara

EN107HS/EN207HS: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B.Tech. I Year II Sem.	L	T/P/D	C
	0	0/2/0	1

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

Learning Outcomes: Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Syllabus

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

a. **Computer Assisted Language Learning (CALL) Lab**
b. **Interactive Communication Skills (ICS) Lab**

Listening Skills

Objectives

1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions

- Describing objects/situations/people
- Role play – Individual/Group activities

- **The following course content is prescribed for the English Language and Communication Skills Lab based on Unit-6 of AICTE Model Curriculum 2018 for B.Tech First English. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the Lab)**

Exercise – I
CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III
CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations.

Exercise – IV
CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: Making a Short Speech – Extempore.

Exercise – V
CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Interview Skills.
Practice: Mock Interviews.

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Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:**

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. **Interactive Communication Skills (ICS) Lab:**

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

B.Tech. II Year I Sem.	L	T/P/D	C
	3	1/0/0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Course Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper the student must be able to

- Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
- Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
- Taylor's and Laurent's series expansions of complex function.

UNIT - I: Basic Probability **8 L**

Probability spaces, conditional probability, independent events, and Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT - II: Probability distributions **10 L**

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution
Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

UNIT - III: Testing of Hypothesis **10 L**

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region.
Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

UNIT - IV: Complex Variables (Differentiation) **10 L**

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT - V: Complex Variables (Integration) **10 L**

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

REFERENCE BOOKS:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

EE300ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. II Year I Sem.

L	T/P/D	C
3	0/0/0	3

Course Objectives:

- To introduce the concepts of electrical circuits and its components.
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To import the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations
- To identify and characterize diodes and various types of transistors.

UNIT - I:

D.C. CIRCUITS

Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation.

A.C. CIRCUITS

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits , Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - II:

ELECTRICAL INSTALLATIONS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT - III:

ELECTRICAL MACHINES

Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

UNIT - IV:

P-N JUNCTION AND ZENER DIODE: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

RECTIFIERS AND FILTERS: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - V:

BIPOLAR JUNCTION TRANSISTOR (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

FIELD EFFECT TRANSISTOR (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCE BOOKS:

1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
9. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

AE303PC: THEORY OF STRUCTURES

B.Tech. II Year I Sem.

L	T/P/D	C
3	0/0/0	3

Course Objectives:

- Understand various aspects of mechanics of materials as applied to engineering problems in a systematic manner stressing the fundamentals.
- Analyze problems on thermal stresses, shear force, bending moment and deflection of beams
- Discuss the equilibrium and compatibility conditions for two-dimensional and three-dimensional elastic bodies.

Course Outcomes:

- Describe the types of loads , materials and properties of aircraft structures
- Calculate the response of statically determinate and indeterminate structures under various loading conditions
- Apply the theories of elasticity to predict failure of aircraft structures.

UNIT - I

Introduction: Mechanical properties of materials; Stresses and strains; Hooke‘s law, elastic constant, relation between modulii, working stress, factor of safety, poisons ratio ; bars of varying cross section; Thermal stresses. Torsion of solid and hollow circular shafts and shear stress variations; Power transmission in shafts; Shear force and bending moment diagrams for different types of beams with various loads.

UNIT - II

Stresses in Beams: Bending stresses and Shear stress variation in beams of symmetric and un-symmetric sections; Beams of uniform strength; Flexural stresses: Bending equations, calculation of bending stresses for different sections of beams like I, L, T, C, angle section.

UNIT - III

Beams and Columns: Deflection of beams by Double integration method, Macaulay‘s method, moment area method, conjugate beam method; Principle of superposition. Columns, types of columns, Euler‘s formula instability of columns, Rakine‘s and Jonson‘s formula, Eigen values and Eigen modes, concept of beam-column.

UNIT - IV

Redundant Structures: Trusses, perfect frames, analysis of trusses; Determinate and indeterminate structures, order of redundancy; Redundant analysis, analysis of determinate structures, area movement method, Clayperons method, slope deflection method, moment distribution method.

UNIT - V

Theory of Elastisity: Equilibrium and compatibility conditions and constitute relations for elastic solid and plane: generalized plane strain cases Airy‘s stress function Stress on inclined planes, stress transformations determination of principal stresses and strains by analytical method and graphical method - Mohr‘s circles and its constructions.

TEXT BOOKS:

1. R. K Bansal, —Strength of Materials‖, Laxmi publications, 5th Edition, 2012.
2. T. H. G. Megson, —Aircraft Structures for Engineering Students‖, Butterworth-Heinemann Ltd, 5th Edition, 2012.
3. Gere, Timoshenko, —Mechanics of Materials‖, McGraw Hill, 3rd Edition, 1993.

REFERENCE BOOKS:

1. Dym, C. L, Shames, I. H, —Solid Mechanics‖, McGraw Hill, Kogakusha, Tokyo, 7th Edition, 2007.
2. Stephen Timoshenko, —Strength of Materials‖, Vol I & II, CBS Publishers and Distributors, 3rd Edition, 2004.
3. R. K. Rajput, —Strength of Materials‖, S. Chand and Co., 1st Edition, 1999.
4. Timoshenko, S, Young, D. H. —Elements of Strength of Materials‖, T. Van Nostrand Co. Inc., Princeton N.J, 4th Edition, 1977.

AE304PC: FLUID MECHANICS AND HYDRAULICS

B.Tech. II Year I Sem.

L	T/P/D	C
3	0/0/0	3

Course Objectives:

- Illustrate about the basic properties of a fluid, hydrostatic forces on submerged bodies and different manometers.
- Derive the basic principles of a fluid-continuity, momentum, Euler and Bernoulli‘s equations.
- Explain the concept of boundary layer theory and importance of Prandtl‘s boundary layer theory.
- Understand the flow through pipes and their losses for different geometries.

Course Outcomes:

- Basic fluid mechanics and description of fluid motion
- Various equations to solve fluid dynamics problems
- Concept of boundary layer

UNIT - I

Fluid Properties and Fluid Statics: Density, specific weight, specific gravity, surface tension and capillarity, Newton‘s law of viscosity, incompressible and compressible fluid, numerical problems; Hydrostatic forces on submerged bodies - Pressure at a point, Pascal's law, pressure variation with temperature and height, center of pressure plane, vertical and inclined surfaces; Manometers - simple and differential Manometers, inverted manometers, micro manometers, pressure gauges and numerical problems. Buoyancy - Archimedes principle, metacenter, Meta centric height calculations; Stability

UNIT - II

Fluid Kinematics and Basic Equations of Fluid Flow Analysis: Stream line, path line, streak line, stream surface, stream tube, classification of flows, steady, unsteady, uniform, non-uniform, laminar, turbulent flows, one dimensional approximation, examples of real 1-D flows, two dimensional approximation, 2-D flow in wind tunnel; Continuity equations for 1-D and 2-D flows both compressible and incompressible, stream function for two dimensional incompressible flows; Vortices, irrotational flow, velocity potential function

UNIT – III:

Fluid Dynamics: Basic laws for a system in integral form: Reynolds transport theorem, Conservation of mass, Newton‘s 2nd law; Application of the basic laws for a control volume; Kinematics; Motion of a fluid particle; Fluid deformation; Differential analysis of fluid motion: Continuity equation, Differential momentum equation, Surface and body forces, substantive derivative, local derivative and convective derivative, momentum equation, Euler's and Bernoulli's equation, phenomenological basis of Naviers-stokes equation, introduction to vortex flows, flow measurements : pressure, velocity and mass flow rate, viscosity, pivot-static tube, venture meter and orifice meter, viscometers. Statement of Buckingham‘s π- theorem, similarity parameters - Reynolds number, Froude number, concepts of geometric, kinematic and dynamic similarity, Reynolds number as a very approximate measure of ratio of inertia force and viscous force.

UNIT - IV

Boundary Layer Theory and Pipe Flow: Boundary layer - introductory concepts of boundary layer, large Reynolds number flows and Prandtl‘s boundary layer hypothesis Pressure drag and skin friction drag; Pipe flow - Reynolds experiment, Darcy‘s equation, major and minor losses in pipes and numerical problems. Flow between parallel plates, flow through long tubes –fully developed flow, Turbulent flow, variation of friction factor with Reynolds‘s Number, Moody's chart.

UNIT - V

TURBO MACHINERY: Introduction and classification of fluid machines: Turbo machinery analysis; The angular momentum principle; Euler turbo machine equation; Velocity triangles; Application to fluid systems - Working principle overview of turbines, fans, pumps and compressors.

TEXT BOOKS:

1. Shames I H, —Mechanics of Fluids‖, Kogakusha, Tokyo, 7th Edition, 2007.
2. R. K Bansal, —Fluid mechanics and hydraulic machines‖, Laxmi publications ltd, 9th Edition, 2011.
3. Robert W Fox, Alan T McDonald, —Introduction to fluid Mechanics‖, John Wiley and Sons, 6th Edition, 1995.
4. Streeter V. L, Wylie, E.B., —Fluid Mechanics‖, McGraw-Hill, 9th Edition, 1983.

REFERENCE BOOKS:

1. Yuan S W, —Foundations of fluid Mechanics‖, Prentice-Hall, 2nd Edition, 1987.
2. Milne Thompson L M, —Theoretical Hydrodynamics‖, MacMillan, 5th Edition, 1968.
3. Ratha krishnan. E, —Fundamentals of Fluid Mechanics‖, Prentice-Hall, 5th Edition, 2007.
4. Som S. K, Biswas. G —Introduction to fluid mechanics and fluid machines‖, Tata McGraw-Hill, 2nd Edition, 2004

AE305PC: AERODYNAMICS – I

B.Tech. II Year I Sem. **L T/P/D C**
Course Code: **3 1/0/0 4**

Course Objectives:

- Understand the basics of aerodynamics, aerofoil and wing characteristics
- Calculate forces and moments acting on aero foils and wings under ideal flow conditions.
- Design a propeller and determine aerodynamic interaction effects between different components of aircraft.

Course Outcomes:

- Theoretical Aerodynamics
- Conformal Transformation

UNIT - I

Introductory Topics for Aerodynamics: Properties of fluid, units, dimensions, form of matter, pressure, temperature, density, viscosity, specific heats and relations, enthalpy, entropy, atmosphere-ISA, types of flow, 1-D flow equations, conservation of mass, momentum, energy, equation of state, pressure coefficient.

UNIT - II

Potential Flow: Potential flow, velocity potential, stream function, Laplace equation, flow singularities-Uniform flow. source, sink, doublet, Vortex, Non lifting and lifting flow over a cylinder Kutta-Joukowski theorem. Magnus effect, circulation,

UNIT - III

Finite Wing Theory: Vortex motions, vortex line, vortex tube, vortex sheet; Circulation; Kelvin and Helmhotz theorem; Biot-Savart‘s law, applications, Rankine‘s vortex; Flow past finite wings, vortex model of the wing and bound vortices; Induced drag; Prandtl‘s lifting line theory; Elliptic wing. Influence of taper and twist applied to wings, effect of sweep back wings; Delta wings, primary and secondary vortex; Elements of lifting surface theory. Source Panel Vortex panel and Vortex lattice methods.

UNIT – IV

Flow Past Non-Lifting Bodies and Interference Effects: Flow past non-lifting bodies, method of singularities; Wing-body interference; Effect of propeller on wings and bodies and tail unit; Flow over airplane as a whole.

UNIT - V

Conformal Transformation: Conformal transformation, Kutta-Zhukovasky transformation- circle to straight line, circle to ellipse, circle to symmetric aerofoil, circle to chambered aerofoil, circle to circular arc.

TEXT BOOKS:

1. E. L. Houghton and P. W. Carpenter, —Aerodynamics for Engineering Students‖, Edward Arnold Publishers Ltd., London, 5th Edition, 1982,
2. J. D. Anderson, —Fundamentals of Aerodynamics‖, Mc Graw Hill Book Co., New York, 5th Edition, 1985.
3. John J. Bertin and Russell M. Cummings, —Aerodynamics for Engineering Students‖, Pearson, 5th Edition, 2009.

REFERENCE BOOKS:

1. L. J. Clancy, —Aerodynamics‖, Pitman, 1st Edition, 1986.
2. L. H. Milne, S. Thomson, —Theoretical Aerodynamics‖, Dover, 2nd Edition, 1985.
3. K. Karamcheti, — Principles of Ideal-Fluid Aerodynamics‖, Krieger Pub Co; 2nd edition, 1980.

AE306PC: MECHANICS OF SOLIDS LAB

B.Tech. II Year I Sem.	**L**	**T/P/D**	**C**
Course Code:	**0**	**0/2/0**	**1**

Course Objectives:

- Understand basic knowledge on the mechanical behavior of materials like aluminum, mild steel, and cast iron.
- Adopt with the experimental methods to determine the mechanical properties of materials.

Course Outcomes:

- Identify microstructures and wear properties of engineering materials.
- Examine the defects in the materials by non-destructive testing
- Test the important mechanical properties of ferrous and non-ferrous materials.

List of Experiments:

1. **Brinell Hardness Test:** Determination of Brinell number of a given test specimen.
2. **Rockwell Hardness Test:** Determination of hardness number of different specimens such as steel, brass, copper and aluminum.
3. **Tension Test:** Study the behavior of mild steel and various materials under different loads. To determine
    a) Tensile
    b) Yield strength
    c) Elongation
    d) Young ‘s modulus
4. **Torsion Test:** Determine of Modulus of rigidity of various specimens.
5. **Izod Impact Test:** Determination the toughness of the materials like steel, copper, brass and other alloys using Izod test
6. **Charpy Impact Test:** Determine the toughness of the materials like steel, copper, brass and other alloys using Charpy test.
7. **Compression Test on Short Column:** Determine the compressive stress on material.
8. **Compression Test on Long Column:** Determine Young ‘s modulus of the given long column.
9. **Testing of Springs: Determine** the stiffness of the spring and the Modulus of rigidity of wire material.
10. **Deflection Test For SSB And Cantilever Beam: Determine** the Young‘s modulus of the given material with the help of deflection of SSB and cantilever beam

REFERENCE BOOKS:

1. Gere, Timoshenko, —Mechanics of Materialsǁ, McGraw Hill, 3rd Edition, 1993.
2. R. S Kurmi, Gupta, —Strength of Materialsǁ, S. Chand, 24th Edition, 2005.
3. William Nash, —Strength of Materialsǁ, Tata McGraw Hill, 4th Edition, 2004.

AE307PC: FLUID MECHANICS AND HYDRAULICS LABORATORY

	L	T/P/D	C
B.Tech. II Year I Sem.			
Course Code:	**0**	**0/4/0**	**2**

Course Objectives:

- Gain knowledge on working of centrifugal pumps, positive displacement pumps, hydraulic turbines centrifugal blowers and steam turbines.
- Compare performance of various machines at different operating points.
- Knowledge of various flow meters and the concept of fluid mechanics.

Course Outcomes:

- Obtain the necessary practical skills & real time knowledge
- Apply scientific method for analysing the qualitatively & quantitatively to solve the problems.
- Flow behaviour in various geometry of cross sectional

List of Experiments:

1. **Calibration:** Calibration of Venturi meter and orifice meter.
2. **Pipe Flow Losses:** Determination of pipe flow losses in rectangular and circular pipes
3. **Bernoulli's Theorem:** Verification of Bernoulli's theorem.
4. **Reynolds Experiment:** Determination of Reynolds Number of fluid flow
5. **Impact of Jet on Vanes:** Study Impact of jet on Vanes.
6. **Centrifugal Pumps:** Performance test on centrifugal pumps.
7. **Reciprocating Pumps:** Performance test on reciprocating pumps.
8. **Pelton Wheel Turbine:** Performance test on piston wheel turbine.
9. **Francis Turbine:** Performance test on Francis turbine.
10. **Flow Through Weirs:** Rate of discharge Flow through Weirs
11. **Flow Through Notch:** Flow through rectangular and V-Notch
12. **Flow Though Orifice Mouth Piece:** Flow analysis of different shapes of mouth pieces

REFERENCE BOOKS:

1. Yuan S W, —Foundations of fluid Mechanics‖, Prentice-Hall, 2nd Edition, 1987.
2. Milne Thompson L M, —Theoretical Hydrodynamics‖, MacMillan, 5th Edition, 1968.
3. Rathakrishnan. E, —Fundamentals of Fluid Mechanics‖, Prentice-Hall, 5th Edition, 2007.
4. Som S. K., Biswas. G, —Introduction to fluid mechanics and fluid machines‖, Tata McGraw-Hill, 2nd Edition, 2004.

EE309PC: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

B.Tech. II Year I Sem. **L T/P/D C**
0 0/2/0 1

Pre-requisites: Basic Electrical and Electronics Engineering

Course Objectives:

- To introduce the concepts of electrical circuits and its components
- To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- To study and understand the different types of DC/AC machines and Transformers.
- To import the knowledge of various electrical installations.
- To introduce the concept of power, power factor and its improvement.
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

- To analyze and solve electrical circuits using network laws and theorems.
- To understand and analyze basic Electric and Magnetic circuits
- To study the working principles of Electrical Machines
- To introduce components of Low Voltage Electrical Installations
- To identify and characterize diodes and various types of transistors.

List of experiments/demonstrations:

PART A: ELECTRICAL

1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
   (ii) Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star) in a Three Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Three-phase Induction Motor
6. No-Load Characteristics of a Three-phase Alternator

PART B: ELECTRONICS

1. Study and operation of
   (i) Multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. PN Junction diode characteristics
3. Zener diode characteristics and Zener as voltage Regulator
4. Input & Output characteristics of Transistor in CB / CE configuration
5. Full Wave Rectifier with & without filters
6. Input and Output characteristics of FET in CS configuration

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCE BOOKS:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.

3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
8. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
9. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

***MC309/*MC409: CONSTITUTION OF INDIA**

B.Tech. II Year I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**0**

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

AE401ES: PROBABILITY DISTRIBUTIONS AND NUMERICAL METHODS

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	3	**1/0/0**	**4**

Pre-requisites: Mathematics courses in first two years of study

Objectives: To learn

- Most of the random situations are described as functions of many single random variables. In this unit, the objective is to learn functions of many random variables through joint distributions and ANOVA
- The random processes, The classification of random processes, Markov chain, Classification of states
- Stochastic matrix (transition probability matrix) Limiting probabilities, Applications of Markov chains
- Various methods to find the roots of an equation
- Fitting linear, non- linear and exponential curves for the given data.
- The concept of interpolation and fitting a interpolating polynomial.
- Concept of finite differences and to estimate the value for the given data using interpolation.
- Finding the derivatives and proper integrals of given functions using finite differences.
- Solving ordinary differential equations using numerical techniques.

Course outcomes: After learning the contents of this paper the student must be able to

- Formulate and solve problems involving the multiple random variables and the ANOVA for analysing the experimental data.
- The student would able to understand about the random process, Markov process and Markov chains which are essentially models of many time dependent processes such as signals in communications, time series analysis, queuing systems. The student would be able to find the limiting probabilities and the probabilities in n^{th} state.
- Find a better approximate root of a given equation.
- Fit a linear, non-linear and exponential curve for the given data.
- Find the finite difference operators in a given data or value of the dependent variable for a given independent variable
- Evaluate the derivative at a given value and integral of a function.
- Solve the initial value problems.

UNIT - I: Multiple Random variables, Correlation & Regression

Joint probability distributions- Joint probability mass / density function, Marginal probability mass / density functions, Covariance of two random variables- ANOVA for one-way classified data.

UNIT - II: Stochastic processes

Introduction to Stochastic Processes –Classification of Random processes, Methods of description of random processes-Stationary and non-stationary random process-Average values of single random process and two or more random processes. Markov process, Markov chain, classification of states – Examples of Markov Chains, Stochastic Matrix.

UNIT - III: Solution of Algebraic, Transcendental Equations and Curve fitting

Bisection method, Regula-Falsi method, Iteration method, Newton-Raphson method.

Curve Fitting: Method of least squares**,** Fitting a straight line, Second degree parabola and Non-linear curves of the form $y = ae^{bx}$, $y = ab^{x}$, $y = ax^{b}$ by the method of least squares.

UNIT - IV: Interpolation and Numerical Differentiation

Finite differences: Forward, Backward and Central differences, - Newton's interpolation formulae, Central difference interpolation formulae: Gauss's forward and backward interpolation formulae, Interpolation with unequal intervals: Lagrange's interpolation formula.

Numerical differentiation: Derivatives using Newton's interpolation formulae.

UNIT - V: Integration and Solution of Ordinary Differential Equations of First Order

Trapezoidal rule Simpson's 1/3rd and 3/8th rule- Solution of ordinary differential equations by Taylor's series, Picard's method of successive approximations, Euler's method, Runge-Kutta method (second and fourth order)

TEXT BOOKS:

1. Probability and Statistics for Engineers and Scientists by Sheldon M Ross, Academic Press
2. S S Sastry, Introductory Methods of Numerical Analysis, Fifth Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

REFERENCE BOOKS:

1. T. T. Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons, Ltd, 2004.
2. B V Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Private Limited, New Delhi, 29th Reprint, 2017

AE402PC: LOW SPEED AERODYNAMICS

B.Tech. II Year II Sem. **L T/P/D C**
3 0/0/0 3

Course Objectives:

- Understand the basics of aerodynamics, aerofoil and wing characteristics
- Calculate forces and moments acting on aero foils and wings under ideal flow conditions.
- Design a propeller and determine aerodynamic interaction effects between different components of aircraft.

Course Outcomes:

- Introduction to Low speed aerodynamics
- Aerofoil and wing Theory
- Concept of boundary layers

UNIT - I

Aerofoil and Wing: Forces and moments on aircraft, wing platform geometry, Aerofoil nomenclature, aerodynamic characteristics, centre of pressure and aerodynamic centre; Wing of infinite aspect ratio, generation of lift, starting Vortex, Kutta's trailing edge condition, pressure distribution on aerofoil,

UNIT - II

Forces and Moments on Aircraft: Types of drag, wake, Estimation of lift, drag and pitching moment coefficient from pressure distribution, Aerofoil characteristics, C_l vs Angle of attack. Aspect ratio effect on C_l curve, C_l vs C_d, pitching moment coefficient, Steady level flight, wing loading, drag polar.

.

UNIT – III:

Propellers and Propulsion: Froudes momentum theory of propulsion, Airscrew, airscrew pitch, geometric Pitch, mean pitch, vortex system of an airscrew, performance of blade, actuator disc in hovering flight.

UNIT - IV

Introduction to Steady Flight Performance: Types of drag, minimum drag condition in level flight, power, conditions of minimum power requirements, - gliding flight, rate of sink, range, - Climbing flight, condition for maximum rate of climb, rate of turning.

UNIT - V

Boundary Layer Theory: Introduction to boundary layer, laminar and turbulent boundary layer, transition, boundary layer on flat plate, displacement thickness, momentum thickness, energy thickness, effect of curvature, temperature boundary layer.

TEXT BOOKS:

1. E. L. Houghton and P. W. Carpenter, —Aerodynamics for Engineering Students‖, Edward Arnold Publishers Ltd., London, 5th Edition, 1982,
2. J. D. Anderson, —Fundamentals of Aerodynamics‖, Mc Graw Hill Book Co., New York, 5th Edition, 1985.
3. John J. Bertin and Russell M. Cummings, —Aerodynamics for Engineering Students‖, Pearson, 5th Edition, 2009.

Reference Books:

1. L. J. Clancy, —Aerodynamics‖, Pitman, 1st Edition, 1986.
2. L. H. Milne, S. Thomson, —Theoretical Aerodynamics‖, Dover, 2nd Edition, 1985.
3. K. Karamcheti, — Principles of Ideal-Fluid Aerodynamics‖, Krieger Pub Co; 2nd edition, 1980.

AE403PC: AIRCRAFT MATERIALS AND PRODUCTION

B.Tech. II Year II Sem. **L T/P/D C**
3 1/0/0 4

course objectives:

- Study the composition of microstructures of metals and alloys with their applications in aerospace industry.
- Discuss the various manufacturing processes and selection of process for suitable applications.
- Understand the working principles and applications of conventional and unconventional machining along with their advantages and disadvantages.
- Demonstrate the importance of composites with their applications in different areas of aerospace industry.

Course Outcomes:

- Describe the basics of manufacturing processes, techniques, and quality process.
- Composite material, properties and characteristics.

UNIT - I

Aircraft Engineering Materials: Engineering materials Steels, study of iron, iron carbon phase diagram, heat treatment-annealing, normalizing, hardening and tempering of Aluminum and steel, Non-Ferrous metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Corrosion - Types of Corrosions - Prevention – Protective Treatments.

UNIT - II

Casting, Welding and Inspection Techniques: General principles of various casting processes Sand casting, die-casting, centrifugal casting, investment casting, Shell molding types; Principles and equipment used in arc welding, gas welding, resistance welding, solid, laser welding, and electron beam welding, soldering and brazing techniques. Need for NDT, ultrasonic testing, Radiographic testing, Flight testing.

UNIT - III

Sheet Metal Processes in Aircraft Industry: Sheet metal operations: shearing, punching, super plastic forming; operations in bending like stretch forming spinning drawing. Riveting, types and techniques, equipment, fasteners, integral tanks, final assembly of aircraft, Jigs and Fixtures, stages of assembly, aircraft tooling concepts.

UNIT - IV

Conventional and Unconventional Machining Processes: General working principles, applications and operations of lathe, shaper, milling machines, grinding, drilling machine, computer numeric control machining. Working principles and applications of abrasive jet machining, ultrasonic machining, Electric discharge machining and electro chemical machining, laser beam, electron beam, plasma arc machining.

UNIT - V

Aircraft Composites: Introduction, Physical metallurgy, Wrought aluminum alloys, Cast aluminum alloys, Production of semi-fabricated forms, Aerospace applications, Plastics and rubber, Introduction to fiber reinforced plastics, glass and carbon composites; Fibers and resins; Characteristics and applications, Classification of aircraft materials; Materials used for aircraft components, Application of composite materials, Super alloys, indigenized alloys, emerging trends in aerospace materials

TEXT BOOKS:

1. S. Kalpakjian, Steven R. Schmid, —Manufacturing Engineering and Technology‖, Addison Wesley 5th Edition, 1991.
2. S. C. Keshu, K. K Ganapathy, —Aircraft production technology and management‖, Interline Publishing House, Bangalore, 3rd Edition, 1993.
3. Douglas F. Horne, —Aircraft production technology‖, Cambridge University Press, 1st Edition, 1986.

REFERENCE BOOKS:

1. S. C. Keshu, K. K Ganapathy, —Air craft production techniques‖, Interline Publishing House, Bangalore, 3rd Edition, 1993.
2. R. K. Jain, —Production technology‖, Mc Graw Hill, 1st Edition, 2002.
3. O. P. Khanna, M. Lal, —Production technology‖, Dhanpat Rai Publications, 5th Edition, 1997.

AE404PC: ANALYSIS OF AIRCRAFT STRUCTURES

B.Tech. II Year II Sem. **L T/P/D C**
3 1/0/0 4

Pre-Requisites: Theory of Structures

Course Objectives:

- Understand the aircraft structural components and its behavior under different loading conditions.
- Obtain knowledge in plate buckling and structural instability of stiffened panels for airframe structural analysis.
- Explain the thin walled section and structural idealization of panels and differentiate from the type of loads carried.
- Solve for stresses and deflection in aircraft structures like fuselage, wing and landing gear.

Course Outcomes:

- Types of structure used in aircraft and various loads experienced by components

UNIT - I

Introduction to Aircraft Structural Components and Energy Methods: Aircraft Structural components and loads, functions of structural components, airframe loads; Types of structural joints, type of loads on structural joints; Aircraft inertia loads; Symmetric manoeuvre loads, gust loads. Monocoque and semi monocoque structures, stress in thin and thick shells; Introductions to energy principles, Castilians theorems, Maxiwells reciprocal theorem, unit load method, Rayleigh Ritz method, total potential energy method, flexibility method.

UNIT - II

Thin Plate Theory, Structural Instability: Analysis of thin rectangular plates subject to bending, twisting, distributed transverse load, combined bending and in-plane loading: Thin plates having small initial curvature, energy methods of analysis. Buckling of thin plates: Elastic, inelastic, experimental determination of critical load for a flat plate, local instability, instability of stiffened panels, failure stresses in plates and stiffened panels. Tension field beams- complete diagonal tension, incomplete diagonal tension, post buckling behaviour.

UNIT - III

Bending, Shear and Torsion of Thin Walled Beams: Unsymmetrical bending: Resolution of bending moments, direct stress distribution, position of neutral axis; Deflections due to bending: Approximations for thin walled sections, temperature effects; Shear loaded thin walled beams: General stress, strain and displacement relationships, direct stress and shear flow system, shear centre, twist and warping. Torsion of beams of closed section: Displacements associated with Bredt-Batho shear flow; Torsion of open section beams; Warping of cross section, conditions for zero warping; Bending, shear, torsion of combined open and closed section beams.

UNIT - IV

Structural Idealization: Structural idealization: Principal assumptions, idealization of panel, effect on the analysis of thin walled beams under bending, shear, torsion loading- application to determining deflection of open and closed section beams. Fuselage frames - bending, shear and torsion.

UNIT – V

Analysis of Fuselage, Wing and Landing Gear: Wing spar and box beams, tapered wing spar, open and closed sections beams, beams having variable stringer areas; wings – three boom shell in bending,

torsion and shear, tapered wings, deflections, cutouts in wings; Cutouts in fuselages; Fuselage frame and wing rib; principle of stiffener, web constructions. Landing gear and types; Analysis of landing gear.

TEXT BOOKS:

1. T. H. G. Megson, ―Aircraft Structures for Engineering Students‖, Butterworth-Heinemann Ltd, 5th Edition, 2012.
2. E. H. Bruhn, ―Analysis and Design of Flight vehicles Structures‖, Tri-state off set company, USA, 4th Edition, 1965.

REFERENCE BOOKS:

1. B. K. Donaldson, ―Analysis of Aircraft Structures - An Introduction‖, Mc Graw Hill, 3rd Edition, 1993.
2. S. Timoshenko, ―Strength of Materials, Vols I and II‖, Princeton D. Von Nostrand Co., Reprint, 1977.

AE405PC: **AERO - THERMODYNAMICS**

B.Tech. II Year II Sem.

L	T/P/D	C
3	0/0/0	3

Course Objectives:

- To introduce fundamental concepts in thermodynamics, heat transfer, and refrigeration and air conditioning. apply mathematical foundations, principles in solving thermodynamics problems.

Course Outcomes:

- This course provides the basic knowledge about thermodynamic laws and relations, and their application to various processes**.**

UNIT - I

First Law of Thermodynamics: Concept of continuum-Macroscopic approach-thermodynamic systems-properties-state, path and process, quasi-static process- work and heat-zeroth law and first law of thermodynamics-internal energy-enthalpy- applications of first law of thermodynamics to closed and open system.

UNIT - II

Second Law of Thermodynamics: Second law of thermodynamics-Kelvin's and Clausius statements of second law-reversibility and irreversibility-carnot theorem-carnot cycle- reversed Carnot cycle-clausius inequality-concept of entropy-principle of energy-availability and unavailability-Exergy for closed and an open system.

UNIT - III

Properties of Pure Substances and Power Cycle: Properties of pure substances-Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, H-S diagrams, PVT surfaces thermodynamics properties of steam, calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and Regeneration cycle.

UNIT - IV

Air Standard Cylces and IC Engines

Cycle-air standard efficiency-Otto cycle-diesel cycle- dual cycle- Brayton cycle-components of IC engines-Two stroke and four stroke cycle engine-performance of IC engine-supercharging.

UNIT - V

Refrigeration, Air Conditioning and Psychrometry: Concepts of psychrometry, Psychrometric relation and charts-processes-Refrigeration Systems-Air-conditioning systems and its types- simple vapour compression system-vapour absorption system-Refrigerants.

TEXT BOOKS:

1. Nag. P.K., "Engineering Thermodynamics", McGraw Hill Education (India) Private Limited; Fifth edition, April 2013.
2. Rathakrishnan E, "Fundamentals of Engineering Thermodynamics", Prentice Hall India, 2 revised edition 2005.
3. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach" McGraw-Hill Science/Engineering/Math; 7th edition 2010.

REFERENCE BOOKS:

1. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987

4. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
5. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004

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AE406ES: AERODYNAMICS LAB

B.Tech. II Year II Sem.

L	T/P/D	C
0	0/2/0	1

Pre-Requisites: Aerodynamics-1 and Low Speed Aerodynamics

Course Objectives:

- Understand the behavior of flow properties over different models using subsonic wind tunnel.
- Demonstrate experimentally the pressure distribution over circular, symmetric and cambered airfoils and evaluate lift and drag.
- Illustrate flow visualization studies at low speeds over different aerodynamic bodies.

Course Outcomes:

- Point out the pressure distribution of symmetrical and unsymmetrical airfoil and 2D cylinder.
- Examine flow visualization of airfoil and bluff bodies

List of Experiments

1. Calibration of subsonic wind tunnel.
2. Pressure Distribution-Cylinder
3. Pressure Distribution-Symmetric Airfoil
4. Pressure Distribution-Cambered Airfoil
5. Force measurement using wind tunnel balance.
6. Flow over a Flat Plate
7. Flow visualization studies in low speed over cylinder
8. Flow Visualization Studies - Airfoil Flow visualization studies in low speed over airfoil at different angles of incidence.
9. Wake analysis over a cylinder and airfoils
10. Blower Test Rig; Efficiency of blower test rig for 3 different vane settings.
11. Axial Flow Compressor; Efficiency of axial flow compressor
12. Centrifugal Flow Compressor

REFERENCE BOOKS:

1. L. J. Clancy, —Aerodynamics", Pitman, 1st Edition, 1986.
2. Alan pope, — Low Speed Wind Tunnel Testing‖, John Wiley, 2nd Edition, 1999.
3. N. M. Komerath, —Low Speed Aerodynamics‖, Extrovert, 1st Edition, 2012.

AE407PC: AEROSPACE STRUCTURES LAB

B.Tech. II Year II Sem.

L	T/P/D	C
0	0/2/0	1

Pre-Requisites: Theory of Structure

Course Objectives:

- Provide basic knowledge on the mechanical behavior of materials like aluminum, mild steel, and cast iron.
- Visualize the crack detection using various NDT methods and also discuss the changing strength due to these defects.
- Understand the concept of locating the shear centre for open and closed section of beams.
- Obtain buckling strength of both long and short columns using different elastic supports.

Course Outcomes:

- Various load testing methodology and selecting the suitable structure for different components

LIST OF EXPERIMENTS

1. Direct Tension Test; Tensile testing using UTM, mechanical and optical extensometers, stress strain curves and strength test or various engineering materials.
2. Deflection Test ; Stress and deflections of beams for various end conditions, verification of Maxwell's theorem
3. Buckling Test; Compression tests on long columns, Critical buckling loads.
4. Buckling Test; Compression tests on short columns, Critical buckling loads, south well plot.
5. Bending Test; Unsymmetrical Bending of a Beam.
6. Shear Centre for Open Section; Shear Centre of an open Section beam.
7. Shear Centre for Closed Section; Shear Centre of a closed Section beam.
8. Wagner's Theorem; Wagner beam – Tension field beam.
9. Sandwich Panel Tension Test; Fabrication and determine the young's modulus of a sandwich structures.
10. Non-Destructive Testing; Study of non-destructive testing procedures using dye penetration,
11. Non-Destructive Testing; Magnetic particle inspection and ultrasonic techniques.
12. Vibration Test; Determination of natural frequency of beams under free and forced vibration using.

REFERENCE BOOKS:

1. Megson, T.H.G., Aircraft Structures for Engineering Students, 4th edn., Elsevier, 2007, ISBN 0-750-667397.
2. Peery, D.J. and Azar, J.J, Aircraft Structures, 2nd ed, McGraw-Hill, 1982, ISBN 0-07-049196-8.
3. Bruhn. E.H, Analysis and Design of Flight Vehicles Structures, Tri-state Off-set Company, USA, 1965.
4. Lakshmi Narasaiah, G., Aircraft Structures, BS Publications, 2010.

AE408PC: AIRCRAFT MATERIALS AND PRODUCTION LAB

B.Tech. II Year II Sem.

L	T/P/D	C
0	0/2/0	1

Course Objectives:

- Understand the basic conventional machining operation using for aircraft structural members production.
- Illustrate other unconventional machining techniques required for aircraft production.
- Perform the basic computer numerical control machining operation required for aircraft production technology.

Course Outcomes:

- Operate the various machines used in production, different welding techniques

List of Experiments

1. **Basic Metallurgy - I:** Preparation and study of microstructure of pure materials like Cu and Al. Hardenability of steels by Jominy End Quench test
2. **Basic Metallurgy - II:** Study of microstructures of non-ferrous alloys. Study of microstructure of heat-treated steel.
3. **Lathe Operations:** Introduction- lathe machine, plain turning, Step turning & grooving, Taper turning-compound rest/offset method & Drilling using lathe, External threading-Single start
4. **Shaping & Slotting;** Shaping-V-Block & Slotting-Keyways.
5. **Grinding & Milling:** Grinding-Cylindrical /Surface/Tool & cutter. Milling-Polygon /Spur gear.
6. **Drilling;** Drilling, reaming, counter boring, Counter sinking Taping.
7. **Cnc Machining;** Basic operations, Introduction to CNC programming.
8. **Welding Processes I;** Gas Welding, Brazing, Electric and Black smithy, Soldering.
9. **Welding Process II;** Arc welding. Spot welding, Seam welding, TIG welding and MIG Welding.
10. **Basic Casting;** Sand Casting using different patterns (any two).
11. **Riveting Aluminium Sheets;** Spot and Blind Rivets on aluminium sheets

REFERENCE BOOKS:

1. Keshu S. C, Ganapathy K. K, —Air craft production techniques‖, Interline Publishing House, Bangalore, 3rd Edition, 1993.
2. R. K Jain-Khanna, —Production technology‖, Mc Graw Hill, 1st Edition, 2002.
3. O. P Khanna, Lal. M. Dhanpat Rai, —Production technology, 5th Edition, 1997.

***MC409/*MC309: GENDER SENSITIZATION LAB**

(An Activity-based Course)

B.Tech. II Year II Sem.	**L**	**T/P/D**	**C**
	0	**0/2/0**	**0**

COURSE DESCRIPTION

This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality.

This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

Objectives of the Course:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Learning Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT - I: UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men
- Preparing for Womanhood. Growing up Male. First lessons in Caste.

UNIT – II: GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT – III: GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

UNIT – IV: GENDER - BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu".*

Domestic Violence: Speaking OutIs Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

UNIT – V: GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks-The Brave Heart.

Note: **Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.**

- ***Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on "Gender".***

☞ **ESSENTIAL READING**: The Textbook, "*Towards a World of Equals: A Bilingual Textbook on Gender" written* by A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu **published by Telugu Akademi, Telangana Government in 2015.**

ASSESSMENT AND GRADING:

- Discussion & Classroom Participation: 20%
- Project/Assignment: 30%
- End Term Exam: 50%

AE501PC: AIRCRAFT PROPULSION

B.Tech. III Year AE I Sem.	L	T/P/D	C
	3	1/0/0	4

Pre-Requisites: Nil

Course Objectives:

- Analyse parametric cyclic analysis, performance parameters, efficiency, specific impulse of all air breathing engines.
- Know the design and performance of subsonic and supersonic inlets, types of combustion chambers and factors affecting the combustors.
- Discuss the types of nozzles, flow conditions in nozzles, interaction of nozzle flow with adjacent surfaces and thrust reversal
- Explain different types of compressors and turbines, work done, velocity diagrams and stage efficiency calculations.

Course Outcomes:

- Review the basic thermodynamic principles and fundamentals of gas turbine engines
- Outline the concepts of subsonic and supersonic inlets for jet engines
- Evaluate the operating characteristics of compressors and turbines in terms of blade shapes, angles, and direction of rotation
- Describe the fundamentals of combustion chamber, nozzle, ramjet and rocket propulsion

UNIT - I

Air-Breathing Engines Classes: Classification, operational envelopes; Description and function of gas generator, turbojet, turbofan, turboprop, turbo shaft, ramjet, scramjet, turbojet/ramjet combined cycle engine; Engine thrust, takeoff thrust, installed thrust, thrust equation; Engine performance parameters, specific thrust, specific fuel consumption and specific impulse, thermal efficiency, propulsive efficiency, engine overall efficiency and its impact on aircraft range and endurance; Engine cycle analysis and performance analysis for turbojet, turbojet with afterburner, turbofan engine, turboprop engine.

UNIT - II

Inlets And Combustion Chambers: Internal flow and stall in subsonic inlets, relation between minimum area ratio and eternal deceleration ratio, diffuser performance, supersonic inlets, starting problem on supersonic inlets, shock swallowing by area variation; Classification of combustion chambers, combustion chamber performance, effect of operating variables on performance, flame stabilization.

UNIT - III

Nozzles: Theory of flow in isentropic nozzles, nozzles and choking, nozzle throat conditions, nozzle efficiency, losses in nozzles. Over expanded and under expanded nozzles, ejector and variable area nozzles, interaction of nozzle flow with adjacent surfaces, thrust reversal.

UNIT - IV

Compressors: Principle of operation of centrifugal compressor and axial flow compressor, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant reaction designs of axial flow compressor, performance characteristics of centrifugal and axial flow compressors, stage efficiency calculations, cascade testing.

UNIT - V

Turbines: Principle of operation of axial flow turbines, limitations of radial flow turbines, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant angle designs, performance characteristics, sample ramjet design calculations, flame stability problems in ramjet combustors, integral ram rockets.

TEXT BOOKS:

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 Rocket‖, AIAA, 1991.

REFERENCE BOOKS:

1. Cohen, H. Rogers, G. F.C. and Saravanamuttoo, H.I.H. —Gas Turbine Theory‖, Longman, 1989.
2. Oates, G.C. - Aero thermodynamics of Aircraft Engine Components‖, AIAA Education Series, New York, 1985.

AE502PC: HIGH SPEED AERODYNAMICS

B.Tech. III Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Low speed aerodynamics

Course Objectives:

- Understand the effect of compressibility at high-speeds and the ability to make intelligent design decisions.
- Explain the dynamics in subsonic, transonic and supersonic flow regimes in both internal and external geometries.
- Analyze the airfoils at subsonic, transonic and supersonic flight conditions using the perturbed flow theory assumption.
- Formulate appropriate aerodynamic models to predict the forces and performance of realistic three-dimensional configurations.

Course Outcomes:

- Air compressibility and isentropic relations inform of speed
- Shock and expansion waves,
- Supersonic wind tunnel, nozzle design, flow visualisation technique

UNIT-I

INTRODUCTION TO COMPRESSIBLE FLOWS: Basic concepts: Introduction to compressible flow, brief review of thermodynamics and fluid mechanics, integral forms of conservation equations, differential conservation equations, continuum postulates, acoustic speed and mach number, governing equations for compressible flows.

UNIT-II

SHOCK AND EXPANSION WAVES: Shocks and expansion waves: Development of governing equations for normal shock, stationery and moving normal shock waves, applications to aircrafts, supersonic wind tunnel, shock tubes, shock polars, supersonic pitot probes; oblique shocks, governing equations, reflection of shock, Prandtl-Meyer expansion flow, shock expansion method for flow over airfoil, introduction to shock wave boundary layer interaction.

UNIT-III

ONE DIMENSIONAL AND QUASI ONE-DIMENSIONAL FLOW: Quasi one-dimensional flow: Isentropic flow in nozzles, area Mach relations, choked flow, under and over expanded nozzles, slip stream line. One dimensional flow: Flow in constant area duct with friction and heat transfer, Fanno flow and Rayleigh flow, flow tables and charts for Fanno flow and Rayleigh flow.

UNIT-IV

APPLICATIONS OF COMPRESSIBLE FLOWS AND NUMERICAL TECHNIQUES: Small perturbation equations for subsonic, transonic, supersonic and hypersonic flow; Experimental characteristics of airfoils in compressible flow, supercritical airfoils, area rule; Theory of characteristics, determination of the characteristic lines and compatibility equations, supersonic nozzle design using method of characteristics.

UNIT-V

EXPERIMENTAL METHODS IN COMPRESSIBLE FLOWS: Experimental methods: Subsonic wind tunnels, supersonic wind tunnels, shock tunnels, free-piston shock tunnel, detonation-driven shock tunnels, and expansion tubes and characteristic features, their operation and performance, flow visualization techniques for compressible flows.

TEXT BOOKS:

1. John D. Anderson, —Modern Compressible flow with historical perspective‖, McGraw-Hill Education, 3rd Edition, 2002.
2. John D. Anderson, —Fundamentals of Aerodynamics‖, McGraw-Hill Education, 6th Edition, 2016.

REFERENCE BOOKS:

1. Ascher H. Shapiro, —The Dynamics and Thermodynamics of Compressible Fluid Flow‖ John Wiley & Sons; Volume 1 ed. Edition, 1977.
2. Radhakrishnan Ethirajan, —Gas Dynamics‖, John Wiley & Sons, 2nd edition 2010.
3. H W Liepmann and A Roshko, —Elements of Gas Dynamics‖, John Wiley & Sons, 4th edition, 2003.

AE503PC: FINITE ELEMENT METHODS

B.Tech. III Year AE I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-requisites: Mechanics of Solids

Course Objective: The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in Civil Engineering. At the end of the course, the participants are expected to have fair understanding of:

- Basics of Finite Element Analysis.
- Available material models for structural materials, soils and interfaces/joints.
- Modeling of engineering systems and Soil–Structure Interaction (SSI).
- Importance of interfaces and joints on the behavior of engineering systems.
- Implementation of material model in finite element method and applications

Course Outcomes: At the end of the course, the student will be able to, Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate and solve problems in one dimensional structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems. ANSYS, ABAQUS, NASTRAN, etc.

UNIT – I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations: Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional & Interpolation Elements

One Dimensional Problems: 1-D Linear and 1-D Quadratic Elements - Finite element modeling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT – II

Analysis of Trusses: Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection.

UNIT – III

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Estimation of Load Vector, Stresses

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded Isoparametric elements and numerical integration.

UNIT – IV

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two-dimensional analysis of thin plate.

UNIT – V

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss and beam.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of softwares such as ANSYS, ABAQUS, NASTRAN using Hexahedral and Tetrahedral Elements.

TEXT BOOKS:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu /Pearson

REFERENCE BOOKS:

1. An Introduction to the Finite Element Method / J. N. Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

SM504MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B.Tech. III Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Course Objective: To learn the basic business types, impact of the economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

Course Outcome: The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

UNIT – I: Introduction to Business and Economics

Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.

Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT - II: Demand and Supply Analysis

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.

Supply Analysis: Determinants of Supply, Supply Function and Law of Supply.

UNIT- III: Production, Cost, Market Structures & Pricing

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

Cost analysis: Types of Costs, Short run and Long run Cost Functions.

Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.

Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

UNIT - IV: Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

UNIT - V: Financial Analysis through Ratios: Concept of Ratio Analysis, Importance, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata Mc –Graw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata Mc Graw Hill Education Pvt. Ltd. 2012.

REFERENCE BOOKS:

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

AE505PC: AIRCRAFT SYSTEMS AND CONTROLS

B.Tech. III Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Nil

Course Objectives:

- Explain the concept and meaning of system and classify the various systems required for aircraft and their contribution in order to fulfil the aircraft tasks.
- Describe the various types of Electrical power generations and distribution in aircraft.
- Impart the knowledge of pneumatic, hydraulic and environmental control system.
- Demonstrate different actuators, flight control system and advanced flight actuation system.

Course Outcomes:

- The principles of flight control
- The principle and working of electronic and mechanical control systems
- Various types of aircraft instruments
- Static & dynamic characteristics of instruments

UNIT- I

Introduction To Aircraft Systems: System concepts, everyday examples of systems, sub-systems; Generic system definition, inputs, outputs, feedback, external influence. Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems; Specification of requirements, mission requirements, performance requirements; Operating environment conditions.

UNIT- II

Electrical Systems and Air Conditioning, Pressurizing Systems: Electrical loads in aircraft. Electrical power generation and control- DC, AC- types. Power distribution- primary, secondary. Power conversion and energy storage; Load protection; Electrical load management systems, variable speed constant frequency (VSCS) cycloconverter, 270 V DC systems; Basic air cycle systems; Vapour cycle systems, boost-strap air cycle system; Evaporative vapour cycle systems; Evaporative air cycle systems; Oxygen systems; Fire protection systems, de-icing and anti icing systems.

UNIT- III

Hydraulic Systems and Pneumatic Systems: Hydraulic systems: Study of typical workable system, function, merits, application, system loads, design requirements; Principal components; Hydraulic fluid: required properties, operating fluid pressures, temperatures, and flow rates; Hydraulic piping, pumps, reservoir, accumulator; Landing gear and brake management systems. Pneumatic systems; Advantages; - Working principles; Typical air pressure system; Brake system; Typical pneumatic power system; Components, landing gear systems; Classification.

UNIT- IV

Engine Control and Fuel Systems: Principle of operation of aircraft gas turbine engines; Engine - airframe interfaces; Control of fuel flow, air flow, exhaust gas flow- need, means, system parameters, basic inputs and outputs; Limited authority control systems, full authority control systems- examples; Engine monitoring- sensors, indicators; Power off takes- need, types, effect on engine performance; Fuel systems- characteristics, components, operating modes; Fuel tank safety- fuel inserting system.

UNIT- V

Airplane Control Systems: Flight control systems- primary and secondary flight control conventional systems; Power assisted and fully powered flight controls ; Power actuated systems; Engine control systems; Push pull rod system, flexible push full rod system; Components; Modern control systems; Digital fly by wire systems , control laws, implementation; Auto pilot system active control technology,

communication and navigation systems instrument landing systems; Control linkages, actuation- types, description and redundancy.

TEXT BOOKS:

1. Moir, I. and Sea bridge, A, —Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration‖, John Wiley, 3rd Edition 2008.
2. Moir, I. and Sea bridge, A, —Design and Development of Aircraft Systems- An Introduction‖, AIAA Education Series‖, AIAA, 2004.

REFERENCE BOOKS:

1. Pallett, E.H.J., —Aircraft Instruments and Integrated Systems‖, Longman Scientific &Technical 10th edition, 1992.
2. Harris, D, —Flight Instruments and Automatic Flight Control Systems‖, 6th edition, 2004.
3. Bolton, W., —Pneumatic and Hydraulic Systems‖, Butterworth-Heinemann.

AE506PC: AIRCRAFT PERFORMANCE AND STABILITY

B.Tech. III Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisite: Low speed aerodynamics

Course Objectives:

- Learn the different Regimes of aircraft and performance requirements at different atmospheric conditions.
- Understand the different type of velocities and gives differences between stall velocity and maximum and minimum velocities.
- Estimate the time to climb and descent and gives the relation between rate of climb and descent and time to climb and descent at different altitudes.
- Illustrate the velocity and radius required for different type of maneuvers like pull-up, pull down and steady turn.

Course Outcomes:

- Aerodynamic characteristics, engine performance, and effects of flight altitude on aircraft performance
- Predict and analyse the performance of an airplane for accelerating and Non-accelerating cases
- Calculate the range and endurance of propeller and jet driven airplane
- Describe the different aircraft maneuvers

UNIT-I

Introduction to Aircraft Performance: The role and design mission of an aircraft; Performance requirements and mission profile; Aircraft design performance, the standard atmosphere; Off-standard and design atmosphere; Measurement of air data; Air data computers; Equations of motion for performance - the aircraft force system; Total airplane drag- estimation, drag reduction methods; The propulsive forces, the thrust production engines, power producing engines, variation of thrust, propulsive power and specific fuel consumption with altitude and flight speed; The minimum drag speed, minimum power speed; Aerodynamic relationships for a parabolic drag polar.

UNIT- II

Cruise Performance: Maximum and minimum speeds in level flight; Range and endurance with thrust production, and power producing engines; Cruise techniques: constant angle of attack, constant mach number; constant altitude, methods- comparison of performance. The effect of weight, altitude and temperature on cruise performance; Cruise performance with mixed power-Plants.

UNIT- III

Climb and Decent Performance: Importance of Climb and descent performance, Climb and descent technique generalized performance analysis for thrust producing, power producing and mixed power plants, maximum climb gradient, and climb rate. Energy height and specific excess power, energy methods for optimal climbs - minimum time, minimum fuel climbs. Measurement of best climb performance. Descent performance in Aircraft operations. Effect of wind on climb and decent performance.

UNIT- IV

Aircraft Manoeuvre Performance: Lateral maneuvers- turn performance- turn rates, turn radius-limiting factors for turning performance. Instantaneous turn and sustained turns, specific excess power, energy turns. Longitudinal aircraft maneuvers, the pull-up, maneuvers. The maneuver envelope, Significance. Maneuver boundaries, Maneuver performance of military Aircraft, transport Aircraft.

UNIT- V

Safety Requirements -Take-off And Landing Performance and Flight Planning: Estimation of takeoff distances. The effect on the takeoff distance of weight wind, runway conditions, ground effect. Takeoff performance safety factors. Estimation of landing distances. The discontinued landing, Baulk landing, air safety procedures and requirements on performance. Fuel planning fuel requirement, trip fuel, Environment effects, reserve, and tankering**.**

TEXT BOOKS:

1. Anderson, J.D. Jr., —Aircraft Performance and Design‖, International edition McGraw Hill, 1st Edition, 1999, ISBN: 0-07-001971-1.
2. Eshelby, M.E., —Aircraft Performance theory and Practice‖, AIAA Education Series, AIAA, 2nd Edition, 2000, ISBN: 1-56347-398-4.

REFERENCE BOOKS:

1. McCormick, B.W, —Aerodynamics, Aeronautics and Flight Mechanics‖, John Wiley, 2nd Edition, 1995, ISBN: 0-471-57506-2.
2. Yechout, T.R. et al., —Introduction to Aircraft Flight Mechanics‖, AIAA Education Series, AIAA, 1st Edition, 2003, ISBN: 1-56347-577-4.
3. Shevel, R.S., —Fundamentals of Flight‖, Pearson Education, 2nd Edition, 1989, ISBN: 81-297-0514-1.

AE507PC: COMPUTER AIDED AIRCRAFT ENGINEERING DRAWING

B.Tech. III Year AE I Sem.	L	T/P/D	C
	0	0/2/0	1

Pre-Requisites: Engineering Graphics

Course Objectives:

- Understand the concepts and various tools used in design module
- Understand the design of typical structural components.
- Understand the design of typical aircraft components.
- Understand the design of three view diagram of a typical aircraft.

Course Outcomes:

- Exposure to computer aided design and drafting software
- Learn part design and assembly by design tool

LIST OF EXPERIMENTS

Week-I: SKETCHER; Interface, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools, Constrain tool bar, Transformation Tool bar, User Selection Filter, Standards, Visualizations.
Week-2: PART DESIGN; Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations.
Week-3: SHEET METAL DESIGN; Walls, Cutting and Stamping, Bending, Rolled Walls,
Week-4: SURFACE DESIGN; Surfacer, Operations, Wireframe, Replication.
Week-5: ASSEMBLY; Product Structure Tools, Constrains.
Week-6: GD&T ; Introduction to Geometric Dimensioning and Tolerance, Weld Symbols, GD&T Symbols, Types of Tolerances, Types of views, Roughness Symbols.
Week-7: DRAFTING; Views, Annotations, Sheet Background.
Week-8: DESIGN OF AIRCRAFT WING; Design of any two types of Aircraft structures
Week-9: DESIGN OF FUSELAGE; Design of fuselage with internal components
Week-10: DESIGN OF NOSE CONE; Design of Nose cone structures
Week-11: DESIGN OF LANDING GEAR; Design of Main landing gear and nose landing gear

REFERENCE BOOKS:

1. http://www.ehu.eus/asignaturasKO/DibujoInd/Manuales/R12_manual_catia_v5.pdf
2. http://www.engr.psu.edu/xinli/edsgn497k/TeaPotAssignment.pdf
3. http://file1.engineering.com/pdf/PartDesign.pdf

AE508PC: FLIGHT CONTROL LAB

B.Tech. III Year AE I Sem.	L	T/P/D	C
	0	0/2/0	1

Pre-Requisites: Aircraft Performance & Stability

Course Objectives:

- Understand the basics simulation of unaccelerated and accelerated level flight for climb and descend
- Analyse the take-off and landing performance and ground roll for different modes of aircraft.
- Identify the basic controls and manoeuvre of in complex flight Path

Course Outcomes:

- Exposure to flight simulation
- Exposure to MATLAB

LIST OF EXPERIMENTS

Week-1: SIMULATION OF UNACCELERATED AND ACCELERATED LEVEL FLIGHT

1. Simulation of steady flight

Week-2: SIMULATION OF UNACCELERATED AND ACCELERATED CLIMB

1. Simulation of steady climb

Week-3: SIMULATION OF UNACCELERATED AND ACCELERATED DESCENT

1. Simulation of steady descent

Week-4: SIMULATION OF TAKE-OFF PERFORMANCE

1 Estimation of takeoff velocity

Week-5: SIMULATION OF LANDING PERFORMANCE

1. Estimation of ground roll distance
2. Estimation of total landing distance

Week-6: SIMULATION OF CONVENTIONAL FLIGHT PATH

1. Perform the given mission profiles

Week-7: STABILIZATION OF LONGITUDINAL PERTURBED AIRCRAFT

1. Perform the operation from disturbed flight to trim flight

Week-8: STABILIZATION OF LATERAL PERTURBED AIRCRAFT

1. Simulate lateral directional modes.

Week-9: SIMULATION OF SPIN RECOVERY

1. Perform the operation of spin recovery

Week-10: SIMULATION OF COORDINATED LEVEL TURN

1. Perform the level turn at given turn rate.
2. Perform the level turn at given turn radius.

Week-11: SIMULATION OF BARREL ROLL MANOEUVRE

1. Perform the barrel roll manoeuvre

REFERENCE BOOKS:

1. Peter John Davison. "A summary of studies conducted on the effect of motion in flight simulator pilot training".

2. Beard, Steven; et al. "Space Shuttle Landing and Rollout Training at the Vertical Motion Simulator" (PDF). AIAA. Retrieved 5 February 2014.

WEB REFERENCE:

1. https://ch.mathworks.com/help/aeroblks/flight-simulator-interfaces.html

AE509PC: AIRCRAFT PROPULSION LAB

B.Tech. III Year AE I Sem.	L	T/P/D	C
	0	0/2/0	1

Pre-Requisites: Aircraft Propulsion, Thermodynamics

Course Objectives:

- To familiarise the students to the working of jet engines and its different working conditions

Course Outcomes

- To understand how to do the heat transfer analysis over the surface of the aircraft structure, the working of different jet engines

List of Experiments

Week-1: Study of jet engines parts
Week-2: Study of free convective heat transfer over a flat plate
Week-3: Study of forced convective heat transfer over a flat plate
Week-4: Ignition studies of solid and liquid propellants
Week-5: Operation of a ramjet engine
Week-6: Velocity Profile Study of Free Jet
Week-7: Velocity Profile Study of Wall Jet
Week-8: Study of Thrust of hybrid propulsion system with oxidiser-fuel mixing ratio
Week-9: Preparation of fuel grain for hybrid rocket
Week-10: Burning rate measurement of solid propellants in a strand burner

*MC510: INTELLECTUAL PROPERTY RIGHTS

B.Tech. III Year AE I Sem.	L	T/P/D	C
	3	0/0/0	0

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT & REFERENCE BOOKS:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

AE601PC: SPACE PROPULSION

B.Tech. III Year AE II Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Nil

Course Objectives:

- Evaluate various space missions, parameters to be considered for designing trajectories and rocket mission profiles
- Understand the fundamentals of chemical rocket propulsion, types of igniters and performance considerations of rockets.
- Discuss the working principle of solid and liquid propellant rockets and gain basic knowledge of hybrid rocket propulsion.
- Illustrate electric propulsion techniques, ion and nuclear rocket and the performances of different advanced propulsion systems.

Course Outcomes:

- Propulsion system in rockets and missiles
- Type of trajectory and orbits

UNIT - I

Principles of Rocket Propulsion: History of rockets, Newtons third law, orbits and space flight, types of orbits, basic orbital equations, elliptical transfer orbits, launch trajectories, the velocity increment needed for launch, the thermal rocket engine, concepts of vertical takeoff and landing, SSTO and TSTO, launch assists.

UNIT - II

Fundamentals of Rocket Propulsion: Operating principle, Rocket equation, Specific impulse of a rocket, internal ballistics, Rocket nozzle classification, Rocket performance considerations of rockets, types of igniters, preliminary concepts in nozzle less propulsion, air augmented rockets, pulse rocket motors, static testing of rockets and instrumentation, safety considerations.

UNIT - III

Solid Rocket Propulsion: Salient features of solid propellant rockets, selection criteria of solid propellants, estimation of solid propellant adiabatic flame temperature, propellant grain design considerations. Erosive burning in solid propellant rockets, combustion instability, strand burner and T-burner, applications and advantages of solid propellant rockets.

UNIT - IV

Liquid and Hybrid Rocket Propulsion: Salient features of liquid propellant rockets, selection of liquid propellants, various feed systems and injectors for liquid propellant rockets, thrust control cooling in liquid propellant rockets and the associated heat transfer problems, combustion instability in liquid propellant rockets, peculiar problems associated with operation of cryogenic engines, introduction to hybrid rocket propulsion, standard and reverse hybrid systems, combustion mechanism in hybrid propellant rockets, applications and limitations.

UNIT-V

Advanced Propulsion Techniques: Electric rocket propulsion, types of electric propulsion techniques, Ion propulsion, Nuclear rocket, comparison of performance of these propulsion systems with chemical rocket propulsion systems, future applications of electric propulsion systems, Solar sail.

TEXT BOOKS:

1. Hill, P.G. and Peterson, C.R., —Mechanics and Thermodynamics of Propulsion‖, 2nd Edition, Addison Wesley, 1992.
2. Turner, M. J. L., —Rocket and Spacecraft Propulsion‖, 2nd Edition, MIT Press, 1922.

3. Hieter and Pratt, —Hypersonic Air breathing propulsion‖ 5th Edition, 1993.

REFERENCE BOOKS:

1. Sutton, G.P., —Rocket Propulsion Elements‖ John Wiley & Sons Inc., New York, 5th Edition, 1993.
2. Mathur, M. L., and Sharma, R.P., —Gas Turbine, Jet and Rocket Propulsion‖, Standard Publishers and Distributors, Delhi, 1988.
3. Tajmar, M., Advanced Space Propulsion Systems, Springer 2003

AE602PC: COMPUTATIONAL AERODYNAMICS

B.Tech. III Year AE II Sem.	L	T/P/D	C
	3	1/0/0	4

Pre-Requisites: Nil

Course Objectives:

- Discuss the fundamental aspects of numerical discretization and the major theories, approaches and methodologies used in computational aerodynamics.
- Analyze to build up the skills in the actual implementation of computational aerodynamics methods boundary conditions, turbulence modelling etc by using commercial CFD codes.
- Demonstrate the applications of CFD for classic fluid dynamics problems and basic thoughts and philosophy associated with CFD.
- Understand the various grids used in practice, including some recommendations related to grid quality and choose appropriate data structure to solve problems in real world.

Course Outcomes:

- Mesh creation technique
- Solving PDF by using numerical technique

UNIT- I

Introduction to Computational Aerodynamics: Need of computational fluid dynamics, philosophy of CFD, CFD as a research tool as a design tool, applications in various branches of engineering, models of fluid flow finite control volume, infinitesimal fluid element, substantial derivative physical meaning of divergence of velocity, derivation of continuity, momentum and energy equations, physical boundary conditions significance of conservation and non-conservation forms and their implication on CFD applications strong and weak conservation forms shock capturing and shock fitting approaches.

UNIT - II

Mathematical Behavior of Partial Differential Equations and Their Impact On Computational Aerodynamics: Classification of quasi-linear partial differential equations by Cramer‘s rule and Eigen value method, general behavior of different classes of partial differential equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations: domain of dependence and range of influence for hyperbolic equations, well-posed problems.

UNIT - III

Basic Aspects of Discretization: Introduction to finite difference: finite difference approximation for first order, second order and mixed derivatives, explicit and implicit approaches, truncation and round-off errors, consistency, stability, accuracy, convergence, efficiency of numerical solutions. Von Neumann stability analysis, physical significance of CFL stability condition. Need for grid generation, structured grids artesian grids, stretched (compressed) grids, body fitted structured grids, H-mesh, C-mesh, O-mesh, I-mesh, multi-block grids, C-H mesh, H-O-H mesh, overset grids, adaptive grids, unstructured grids: triangular, tetrahedral cells, hybrid grids, quadrilateral, hexahedral cells.

UNIT - IV

CFD Techniques: Lax-Wendroff technique, MacCormack‘s technique, Crank Nicholson technique, Relaxation technique, aspects of numerical dissipation and dispersion. Alternating-Direction-Implicit (ADI) Technique, pressure correction technique: application to incompressible viscous flow, need for staggered grid. Philosophy of pressure correction method, pressure correction formula. Numerical procedures: SIMPLE, SIMPLER, SIMPLEC and PISO algorithms, boundary conditions for the pressure correction method.

UNIT-V

Finite Volume Methods: Basis of finite volume method, conditions on the finite volume selections, cell-centered and cell vertex approaches. Definition of finite volume discretization, general formulation of a numerical scheme, two-dimensional finite volume method with example.

TEXT BOOKS:

1. J. D. Anderson, Jr., ―Computational Fluid Dynamics- The Basics with Applications‖, McGraw-Hill Inc, 2012.
2. D. A. Anderson, J. C. Tannehill, R. H. Pletcher, ―Computational Fluid Mechanics and Heat Transfer‖, 1st edition, 1997.

REFERENCE BOOKS:

1. Hirsch, C., ―Numerical Computation of Internal and External Flows: The Fundamentals of Computational Fluid Dynamics‖, Vol. I, Butter worth-Heinemann, 2nd edition, 2007.
2. Hoffmann, K. A. and Chiang, S. T., ―Computational Fluid Dynamics for Engineers‖, Engineering Education Systems, 4th edition, 2000.
3. Patankar, S.V., ―Numerical Heat Transfer and Fluid Flow‖, Hemisphere Pub. Corporation, 1st edition, 1980.

AE603PC: HELICOPTER AERODYNAMICS

B.Tech. III Year AE II Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Low speed aerodynamics

Course Objectives:

- Understand the elements of helicopter aerodynamics and ground effect machines, their components and methods of control.
- Formulate the mathematical model using simple blade element theory, analyze its figure of merit and evaluate power estimations.
- Evaluate performance and its effect on altitude and understand the preliminary stability aspects of helicopters.
- Apply the aerodynamics, propulsion and control concepts for various VTOL and STOL aircraft and ground effect machines.

Course Outcomes:

- Working principle of helicopter
- Types of helicopter

UNIT-I

Elements of Helicopter Aerodynamics: Configurations based on torque reaction, jet rotors and compound helicopters, methods of control, collective and cyclic pitch changes, lead and lag, flapping hinges.

UNIT-II

Ideal Rotor Theory: Hovering performance, momentum and simple blade element theories, figure of merit, profile and induced power estimation, constant chord and ideal twist rotors.

UNIT-III

Power Estimates: Induced, profile and parasite power requirements in forward flight. Performance curves with effects of altitude, preliminary ideas on helicopter stability.

UNIT-IV

Lift, Propulsion and Control of VSTOL Aircraft: Various configurations: propeller, rotor, ducted fan and jet lift, tilt wing and vectored thrust, performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT-V

Ground Effect Machines: Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine, drag of hovercraft on land and water, applications of hovercraft.

TEXT BOOKS:

1. Gessow A, and Myers G C, —Aerodynamics of Helicopter‖, Macmillan &Co., 1st Edition 1987.
2. McCormick B W, —Aerodynamics of V/STOL Flight‖, Academic Press, 1st Edition, 1987.

REFERENCE BOOKS:

1. Johnson W, —Helicopter Theory‖, Princeton University Press, 1st Edition, 1980.
2. McCormick BW, —Aerodynamics, Aeronautics and Flight Mechanics‖ John Wiley, 1st Edition, 1995.
3. Gupta L, —Helicopter Engineering‖, Himalayan Books, 1st Edition, 1996.

AE611PE: ADVANCED SOLID MECHANICS (PE – I)

B.Tech. III Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Theory of Structures

Course Objectives:

- Understand the theory of elasticity including stress strain/displacement and Hooke‘s law relationships.
- Analyze solid mechanics problems using classical methods and energy methods.
- Solve for stresses and deflections of beams under unsymmetrical loading and axisymmetric loading.
- Locate the shear center of thin wall beams and obtain stresses and deflections of beams on elastic foundations.

Course Outcomes: To Learn Fracture mechanism and Technique to solve complex structure.

UNIT - I

Traction and Stresses: Concept of traction, Cauchy‘s stress theorem, postulate of Cauchy stress tensor, traction on arbitrary planes, extreme normal and shear traction, octahedral shear stress, and other stress measure – engineering stress.

UNIT - II

Axisymmetric Analysis: Introduction, thick walled cylinder subjected to internal and external pressures – lame‘s problem. Stress in composite tubes- shrink fits, sphere with purely radial displacements, stresses due to gravitation, rotating disks of uniform thickness, disks of variable thickness, rotating shafts and cylinders.

UNIT - III

Bending of Curved Beams: Winkler- Bach formula, elasticity solution for: pure bending of curved beams, curved cantilever under end loading. Beams on elastic foundation, Derivation of the basic governing equation, solution to beam on an elastic foundation subjected to a point load at the center moment at the center, Udl over some length asymmetrically about the center

UNIT - IV

Fracture Mechanics Classes: Brittle fracture, stress intensity factor, fracture toughness, fracture conditions, fracture modes, plane stress and plane strain, plastic collapse at a notch, experimental determination of KIC, strain-energy release rate, elasto-plastic fracture mechanics, Green‘s theorem.

UNIT - V

Theories of Failure: Introduction, theories of failure, significance of the theories of failure, use of factor of safety in design, a note on the use of factor of safety, Mohr‘s theory of failure.

TEXT BOOKS:

1. L. S. Srinath, —Advanced Mechanics of Solids‖, Tata McGraw-Hill, New Delhi, 2009.
2. P. Raymond, —Solid Mechanics in Engineering‖, Willey, 2001.

REFERENCE BOOKS:

1. M.H. Sadd, —Elasticity: Theory, Applications, and Numerics ‖, Academic Press, 2nd Edition, 2009.
2. R.G. Budynas, —Advanced Strength and Applied Stress Analysis‖, McGraw Hill, 3rd Edition, 1999.
3. A.P. Boresi, R.J. Schmidt, —Advanced Mechanics of Materials‖, John Willey & Sons, 6th Edition, 2003.

AE612PE: DESIGN AND ANALYSIS OF COMPOSITE STRUCTURES (PE – I)

B.Tech. III Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Theory of Structures

Course Objectives:

- Understand the fabrication, analysis and design of composite materials & structures.
- Explain basic composites technology, including materials and processes, manufacturing, structural design, maintenance, proof of structures and other considerations.
- Identify the static testing procedure and repairing methodology of composite structural members and joints.
- Enrich to develop structural designs using composite materials.

Course Outcomes:

- Design of composite material
- Technique to solve and repair composite structure

UNIT - I

Stress Strain Relation: Introduction- Advantages and application of composite materials, reinforcements and matrices; Generalized Hooke‘s Law; Elastic constants for anisotropic, orthotropic and isotropic materials.

UNIT - II

Methods of Analysis: Micro mechanics: Mechanics of materials approach, elasticity approach to determine material properties; Macro Mechanics; Stress-strain relations with respect to natural axis, arbitrary axis; Determination of material properties; Experimental characterization of lamina.

UNIT - III

Laminated Plates, Sandwich Constructions and Fabrication Process: Governing differential equation for a general laminate, angle ply and cross ply laminates; Failure criteria for composites. Basic design concepts of sandwich construction; Materials used for sandwich construction; Failure modes of sandwich panels; Various open and closed mould processes; Manufacture of fibers; Types of resins and properties and applications; Netting analysis.

UNIT - IV

Damage Tolerance In Composites: Introduction, sources of damage, types of damage, FAR requirements and advisory circulars, building block approach; Impact damages: Damage growth under fatigue loads; residual strength: Tests and analytical methods; Detailed design: Basics of projections, drawing standards and conventions, introduction to CADD, design of composite parts and assembly design; Optimization: Fundamentals of optimization, mathematical concepts in optimization, Optimization of composite plates.

UNIT - V

TESTING OF COMPOSITE STRUCTURES: Factors influencing testing, test environment, test methods and standards, introduction to static testing of composite structures and examples; Repair of composite aircraft structures: Introduction to repair, repair philosophy, repair sequence, repair criteria, damage assessment, classification of repair, selection of repair joints, repair procedures, certification of repair.

TEXT BOOKS:

1. Gibson, R. F, —Principles of Composite Material Mechanics‖, CRC Press, 2nd Edition, 2007.
2. Jones, R.M, Taylor & Francis, —Mechanics of Composite Materials‖, 2nd Edition, 2010 (Indian Print).

3. Reddy, J.N., —Mechanics of Laminated Composite Plates and Shells – Theory and Analysis‖, CRC Press, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Agarwal, B.D., and Broutman, L.J., —Analysis and Performance of Fibre Composites‖, John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., —Handbook on Advanced Plastics and Fibre Glass‖, Von Nostrand Reinhold Co., New York, 1989.
3. Autar K. Kaw —Mechanics of Composite Materials‖, 2nd Edition, CRC Press, 2005.

AE613PE: UNMANNED AIR VEHICLES (PE – I)

B.Tech. III Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Low speed aerodynamics, helicopter aerodynamics

Course Objectives:

- Introduce to the student about the basic ideas of Unmanned Air Vehicles.
- Familiarize the students about the aerodynamics and airframe configurations.
- Accustom the student to the wide variety of unmanned air vehicles.
- Acquaint the student about the various communication and navigation systems of unmanned air vehicles.

Course Outcomes:

- Types of UAV configuration
- Working principles of UAV, Stability and control and avionics system of UAV

UNIT - I

Introduction to Unmanned Aircraft Systems: The systemic basis of UAS-system composition; Conceptual phase; Preliminary design; Selection of the system; Some applications of UAS.

UNIT - II

Aerodynamics and Airframe Configurations: Lift-induced Drag; Parasitic Drag; Rotary-wing aerodynamics; Response to air turbulence; Airframe configurations scale effects; Packaging density; Aerodynamics; Structures and mechanisms; Selection of power-plants; Modular construction; Ancillary equipment.

UNIT - III

Characteristics of Aircraft Types: Long-endurance, long-range role aircraft; Medium-range, tactical aircraft; Close-range / battlefield aircraft; MUAV types; MAV and NAV types; UCAV; Novel hybrid aircraft configurations; Research UAV.

UNIT - IV

Communications Navigation: Communication media; Radio communication; Mid-air collision (MAC) avoidance; communications data rate and bandwidth usage; Antenna Types NAVSTAR Global Positioning System (GPS) - TACAN - LORAN C - Inertial Navigation - Radio Tracking - Way-point Navigation.

UNIT - V

Control and Stability: HTOL Aircraft - Helicopters - OTE/OTE/SPH - Convertible Rotor Aircraft - Payload Control -Sensors –culmon filter- Autonomy.

TEXT BOOK:

1. Reg Austin., Unmanned Aircraft Systems, John Wiley and Sons., 2010.

REFERENCE BOOKS:

1. Milman & Halkias, —Integrated Electronics‖, McGraw Hill, 1999.
2. Malvino & Leach, —Digital Principles & Applications‖, McGraw Hill, 1986.
3. Collinson R.P.G, —Introduction to Avionics‖, Chapman and Hall, India, 1996.
4. Bernad Etikin, "Dynamic of flight stability and control‖, John Wiley, 1972.

AE604PC: AIRCRAFT DESIGN

B.Tech. III Year AE II Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites:

- Low Speed Aerodynamics & High-speed Aerodynamics

Course Objectives:

- Understand the basic skills involved in weight estimation for aircraft conceptual design process.
- Illustrate relevant theoretical knowledge, applicable for initial sizing and configuration layout of aircraft.
- Evaluate basic techniques in literature retrieval and query, also creative and have systematic scientific research methods and working abilities

Course Outcomes:

- Design of aircraft for various application, Effort estimation, Development life cycle

UNIT - I

Overview of The Design Process: Phases of aircraft design, aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, integrated product development and aircraft design. initial conceptual sketches, takeoff gross weight estimation, airfoil selection, airfoil design, airfoil design considerations, wing geometry and wing vertical location, wing tip shapes, tail geometry and arrangements, thrust to weight ratio, thrust matching, wing loading performance, constraint analysis.

UNIT - II

Initial Sizing and Configuration Layout: Sizing with fixed engine and with rubber engine. geometry sizing of fuselage, wing, tail, control surfaces, development of configuration lay out from conceptual sketch. the inboard profile drawing, lofting- definition, significance and methods, flat wrap lofting, special consideration in configuration lay out, Isobar tailoring, Sears-Haack volume distribution, structural load paths, radar, IR, visual detectability, aural signature, considerations of vulnerability, crashworthiness, producibility, maintainability, fuselage design, crew station, passengers and payload

UNIT - III

Propulsion, Fuel System Integration, Landing Gear and Baseline Design Analysis – I: Propulsion selection, jet engine integration, propeller engine integration, engine design considerations, engine size estimation, fuel system design and integration, landing gear and sub systems arrangements, guidelines and significance of design layout, report of initial specifications. Estimation of lift curve slope, maximum lift coefficient, complete drag build up, installed performance of an engine, installed thrust methodology, net propulsive force, part power operation, aircraft structures and loads categories, air load distribution on lifting surfaces, review of methods of structural analysis, material selection, weights and moments statistical group estimation method, centre of gravity excursion control.

UNIT - IV

Baseline Design Analysis – II: Estimation of static pitch stability, velocity stability and trim, estimation of stability and control derivatives, static lateral, directional stability and trim. estimation of aircraft dynamical characteristics, handling qualities, Cooper – Harper scale, relation to aircraft dynamic characteristics, performance analysis and constraint analysis– steady level flight, minimum thrust required for level flight, range and loiter endurance, steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb, level turning flight, gliding flight, energy maneuverability methods of optimal climb trajectories and turns, the aircraft operating envelope, take off analysis, balanced field length, landing analysis, fighter performance measures of merit, effects of wind on aircraft

performance, initial technical report of baseline design analysis and evaluation, refined baseline design and report of specifications.

UNIT - V

Cost Estimation, Parametric Analysis, Optimisation, Refined Sizing and Trade Studies: Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, cost measures of merit, aircraft and airline economics, DOC and IOC, airline revenue, breakeven analysis, investment cost analysis, parametric analysis and optimization, improved conceptual sizing methods, sizing matrix plot and carpet plot, trade studies, design trades, requirement trades, growth sensitivities, multivariable design optimization methods, measures of merit, determination of final baseline design configuration, preparation of type specification report. case studies on design of DC-3 and Boeing B-707&747; General dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber

TEXT BOOKS:

1. Daniel P. Raymer, ―Aircraft Design: A Conceptual Approach‖, AIAA Educational Series, USA, 4th edition, 2006.
2. J. F. Marchman, L. R. Jenkinson, ―Aircraft Design Projects for Engineering students‖, AIAA Publishers, USA, 2003.
3. Ajoy Kumar Kunda, ―Aircraft Design‖, Cambridge University Press, UK, 2010.

REFERENCE BOOKS:

1. E. Torenbeek, ―Synthesis of Subsonic Airplane Design‖, Delft University Press, New York, 1986.
2. E. H Bruhn, ―Analysis and Design of Flight Vehicles Structures‖, Jacobs Publishing House, USA, New Edition, 1973.
3. E. E Scheler, L.G Dunn, ―Airplane Structural Analysis and Design‖, John Wiley & Sons, USA, 1963.
4. D. Howe, ―Aircraft conceptual Design Synthesis‖, John Wiley and Sons Publishers, USA, 2005.

AE605PC: AEROSPACE PROPULSION LAB

B.Tech. III Year AE II Sem.	L	T/P/D	C
	0	0/2/0	1

Pre-Requisites:

- Thermodynamics
- Aircraft propulsion

Course Objectives:

- Understand the basics of propulsion, working principles of reciprocating engines, performance estimation based on rotation angles, and components of engine and their functions
- Knowledge about the operation of valves, ports and their functioning in four stroke and two stroke engines.
- Calculation of percentage of carbon residue and flash and fire point temperatures of a Lubricating Oil.
- Understand the basic characteristics and range of performance of axial flow gas turbine. Perform parametric jet engine performance analysis and turbo machinery and basic combustion calculations.

Course Outcomes:

- Working principle of IC engine, compressor
- Turbine efficiency

LIST OF EXPERIMENTS

Week-1 ENGINE DISASSEMBLY AND ASSEMBLY

1. To understand the working mechanism and identifying various components to build an IC engine.
2. Brief description about Components of engine and their functions.

Week-2 FLASH POINT AND FIRE POINT TEST

1. Determination of flash point and fire point for a sample using pen sky martin‘s test.

Week-3 DETERMINATION OF DYNAMIC VISCOSITY OF A GIVEN SAMPLE USING REDWOOD VISCOMETER

1. Determine kinematic viscosity and dynamic viscosity of given sample using a viscometer.
2. Order fluctuating temperature is measured in terms of viscosity

Week-4 MECHANICAL EFFICIENCY OF AXIAL COMPRESSOR

1. Calculation of the Mechanical efficiency of axial compressor- power required, power Available, Compression Ratio.

Week-5 GAS TURBINE PARAMETERS CALCULATION

1. Calculation of work, power and Thrust requirement in gas turbine- combustion power input, work heat relationship.

Week-6 GAS TURBINE EFFICIENCY AND PERFORMANCE DIAGRAMS

1. Elucidate T-S, H-S diagrams for the gas turbine and compare efficiencies of non-ideal engine components.

Week-7 GAS TURBINE EFFICIENCY CALCULATIONS

1. Calculation of thermal, propulsive and overall efficiency of turbo jet cycle.

Week-8 WORK OUTPUT OF AXIAL TURBINE

1. Calculation of total work output of axial turbine- out put work necessary, Available output.

Week-9 NOZZLE PERFORMANCE

1. Calculation of various nozzle performance with airflow

Week-10 CALORIFIC VALUE OF DIFFERENT FUELS

1. Calculation of calorific value of different fuels and materials using digital bomb calorimeter and optimizing astute fuels

Week-11 FREE AND FORCED CONVECTION

1. Estimation of convection coefficient of air using forced jet or free convection apparatus

Week-12 PROPELLER TEST RIG

1. Calculation of propeller efficiency and thrust availability using propeller test rig at various blade pitch angles.

REFERENCE BOOKS:

1. https://www.cast-safety.org/pdf/3_engine_fundamentals.pdf
2. https://en.wikipedia.org/wiki/Reciprocating_engine

AE606PC: CFD LAB

B.Tech. III Year AE II Sem.	L	T/P/D	C
	0	0/2/0	1

Pre-Requisites:
- Computer Aided Aircraft Engineering Drawing
- Computational Aerodynamics

Course Objectives:
- Experience in computing aerodynamic problems and understanding flow physics over the objects.
- Knowledge in estimating flow analysis for different mach numbers.
- Determining the aerodynamic forces like mainly lift and drag.
- Analyze the errors and cause of errors in computational analysis.

Course Outcomes:
- Numerical Simulation of Aerodynamic problem
- Hands on experience on various solving technique with boundary conditions

LIST OF EXPERIMENTS

Week-1: INTRODUCTION
Introduction to computational aerodynamics, the major theories, approaches and methodologies used in computational aerodynamics. Applications of computational aerodynamics for classical aerodynamic‘s problems.

Week-2: INTRODUCTION TO GAMBIT
Introduction to gambit, geometry creation, suitable meshing types and boundary conditions.

Week-3: INTRODUCTION TO FLUENT
Introduction to fluent, boundary conditions, solver conditions and post processing results.

Week-4: FLOW OVER A FLAT PLATE
Flow over a flat plate at low Reynolds numbers, observe the boundary layer phenomena, no slip condition and velocity profile inside the boundary layer.

Week-5: FLOW THROUGH PIPE
Flow through pipe at different Reynolds numbers; observe the velocity changes for laminar and turbulent flows.

Week-6: FLOW OVER A CIRCULAR CYLINDER
Flow over a circular cylinder at different Reynolds numbers, observe the properties at separation region and wake region.

Week-7: FLOW OVER A CAMBERED AEROFOIL
Flow over a cambered aerofoil at different velocities, observe flow properties and compare the computation results with experimental results (consider the model from aerodynamics laboratory).

Week-8: FLOW OVER A SYMMETRIC AEROFOIL
Flow over a symmetric aerofoil at different velocities, observe flow properties and compare the computation results with experimental results (consider the model from aerodynamics laboratory).

Week-9: FLOW OVER WEDGE
Flow over wedge body at supersonic mach number; observe the shock wave phenomena and change of properties across the shock wave.

Week-10: FLOW OVER A CONE
Flow over a cone at supersonic mach number; observe the shock waves and 3D relieving effect.

Week-11: CODE DEVELOPMENT
Solution for the following equations using finite difference method
I. One dimensional wave equation using explicit method of lax.
II. One dimensional heat conduction equation using explicit method.

Week-12: CODE DEVELOPMENT
Generation of the following grids
I. Algebraic grids.
II. Elliptic grids.

REFERENCE BOOKS:

1. Anderson, J.D., Jr., Computational Fluid Dynamics The Basics with Applications, McGraw-Hill Inc, 1st Edition 1998.
2. Hoffmann, K. A. and Chiang, S. T., —Computational Fluid Dynamics for Engineers‖, 4th Edition, Engineering Education Systems (2000).
3. Hirsch, C., —Numerical Computation of Internal and External Flows: The Fundamentals of Computational Fluid Dynamics‖, Vol. I, 2nd Edition., Butterworth-Heinemann (2007).
4. JAF. Thompson, Bharat K. Soni, Nigel P. Weatherill —Grid generation‖, 1st Edition 2000.

EN608HS: ADVANCED COMMUNICATION SKILLS LAB

B.Tech. III Year AE II Sem.	**L**	**T/P/D**	**C**
	0	**0/2/0**	**1**

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organize ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

4. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

5. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

REFERENCE BOOKS:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hill 2009.

***MC609: ENVIRONMENTAL SCIENCE**

B.Tech. III Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**0**

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

Course Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT - I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health,

Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

AE701PC: VIBRATION AND AERO-ELASTICITY

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Course Objectives: Nil

- Know the concepts of vibration and single degree of freedom systems.
- Analyze the two Degree and Multi degree of Freedom Systems.
- Understand the interaction among the aerodynamic, elastic and inertia forces.

Course Outcomes:

- To study the dynamic behavior of different aircraft components and the interaction among the aerodynamic, elastic and inertia forces.

UNIT I

Basic Motions: Simple harmonic motion – Terminologies – Newton's Law – D' Alembert's principle – Energy Methods

UNIT II

Single Degree of Freedom Systems: Free vibrations – Damped vibrations – Forced Vibrations, with and without damping –support excitation – Vibration measuring instruments.

UNIT III

Multi Degree of Freedom Systems: Two degrees of freedom systems – Static and Dynamic couplings vibration absorber-Principal co- ordinates, Principal modes and orthogonal condition – Eigen value problems. Hamilton's principle-Lagrangean equation and application – Vibration of elastic bodies-Vibration of strings- Longitudinal, Lateral and Torsional vibrations.

UNIT IV

Approximate Methods: Rayleigh's and Holzer Methods to find natural frequencies.

UNIT V

Elements of Aeroelasticity: Aeroelastic problems-collar's triangle of forces-wing divergence-aileron control reversal-flutter.

TEXT BOOKS

1. Timoshenko S., "Vibration Problems in Engineering"– John Wiley and Sons,New York, 1993.
2. Fung Y.C., "An Introduction to the Theory of Aero elasticity" – John Wiley & Sons, New York, 1995.

REFERENCE BOOKS

1. Bisplinghoff R.L., Ashley H and Hoffman R.L., "Aero elasticity" – Addision Wesley Publication, New York, 1983.
2. Tse. F.S., Morse, I.F., Hinkle, R.T., "Mechanical Vibrations", – Prentice Hall, New York, 1984.
3. Scanlan R.H. & Rosenbaum R., "Introduction to the study of Aircraft Vibration & Flutter", John Wiley and Sons. New York, 1982.
4. Tongue. B. H., "Principles of Vibration", Oxford University Press, 2000.

AE711PE: SPACE MECHANICS (PE – II)

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Course Objectives:

- Impart the knowledge in two-body, restricted three-body and n-body problem, Hamiltonian dynamics, canonical transformations, Poincare surface sections.
- Analyze the basic Newtonian dynamics and spacecraft altitude dynamics.
- Provide necessary knowledge to study the satellite and interplanetary trajectories and Formal approaches for handling coordinate transformations.
- Solve the orbital problems related to Earth satellite orbits using Hamilton‘s and generate interplanetary orbits in the frame work of restricted three-body problem.

Course Outcomes:

- Solar Systems and various coordinate systems
- Effect of perturbation on satellite
- Satellite orbits
- Missile trajectory

UNIT-I

Introduction to Space Mechanics: Basic concepts: The solar system, Reference frames and coordinate systems, The celestial sphere, The ecliptic, Motion of vernal equinox, Sidereal time, Solar Time, Standard Time, The earth‘s atmosphere. The many body problem, Lagrange-Jacobi identity. The circular restricted three body problem, Libration points, Relative Motion in the N-body problem.

UNIT-II

The Two Body Problem: Equations of motion-General characteristics of motion for different orbits-Relations between position and time for different orbits, Expansions in elliptic motion, Orbital Elements. Relation between orbital elements and position and velocity: Launch vehicle ascent trajectories, General aspects of satellite injection. Dependence of orbital parameters on in-plane injection parameters, Launch vehicle performances, Orbit deviations due to injection errors.

UNIT-III

Perturbed Satellite Orbit: Special and general perturbations- Cowell‘s Method, Encke‘s method. Method of variations of orbital elements, General perturbations approach. Two-dimensional interplanetary trajectories, Fast interplanetary trajectories, Three dimensional interplanetary trajectories. Launch of interplanetary spacecraft. Trajectory about the target planet.

UNIT-IV

Ballistic Missile Trajectories: The boost phase, the ballistic phase, Trajectory geometry, optimal flights. Time of flight, Re-entry phase. The position of the impact point, Influence coefficients.

UNIT-V

Low-Thrust Trajectories: Equations of Motion. Constant radial thrust acceleration, Constant tangential thrust (Characteristics of the motion), Linearization of the equations of motion, Performance analysis.

TEXT BOOKS:

1. J. W. Cornelisse, —Rocket Propulsion and Spaceflight Dynamics‖, Pitman Publishing, London, 1979.
2. William E. Wiesel, —Spaceflight Dynamics‖, McGraw-Hill, 3rd Edition, New Delhi, 2010.

REFERENCE BOOKS:

1. Vladimir A. Chobotov, —Orbital Mechanics‖, AIAA Education Series, USA, 3rd Edition, 2002.
2. Kaplan, Marshall H., —Modern Spacecraft Dynamics and Control‖, John Wiley & Sons, New York, 1976.
3. Wiesel, William E., —Spaceflight Dynamics‖, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition 2007.
4. David A. Vellado, —Fundamentals of Astrodynamics and Applications‖, Springer, Germany, 3rd Edition, 2007.

AE712PE: ROCKETS AND MISSILES (PE – II)

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Course Objectives

- To compute and analyze the various forces and moments acting on a rocket
- To formulate the equations of motions for flight and separation phases
- To understand the combustion and propulsion systems in rocket
- To select suitable materials for the rockets and missiles
- To understand the design, performance and testing aspects

Course Outcomes:

- To provide the design basics of rockets and missiles, their construction and functions
- To focus on design principles, performance, materials selection and testing of rockets and missiles
- To understand aerodynamics, flight dynamics, optimization of performance of multi-stage rockets and separation dynamics of rockets and missiles

UNIT I

Rocket Dynamics: Classification of launch vehicles and missiles – Rocket systems - Airframe components - Forces and moments acting on a rocket – Propulsion, aerodynamics, gravity – inertial and non-inertial frames - coordinate transformation – Equations of motion for three-dimensional motion through atmosphere and vacuum, earth's atmosphere, numerical problems

UNIT II

Solid Propulsion and Pyrotechnics: Solid propellant rockets - classification, components and their design considerations, propellant grain design - grain mechanical properties, ballistics and burn rate design issues - igniter design - types of nozzles and thrust vector control, pyrotechnic devices and systems-classification, mechanisms and application of pyrotechnic devices in rockets and missiles. Design problems in rocket systems.

UNIT III

Liquid Propulsion and Control Systems: Liquid propellant rockets – classification and components - thrust chamber, feed systems, propellant tanks, turbo-pumps, types of valves and applications- their design considerations. Different bipropellant systems like cryogenics and their characteristics, pogo and slooh engine gimbal systems and thrusters for control. Spacecraft propulsion and control systems-Design problems.

UNIT IV

Multi-Staging of Rocket and Separation Dynamics: Navigation and guidance systems in rockets and missiles - aerodynamic control systems of missiles- multi-staging of rockets - vehicle optimization techniques -stage separation system – dynamics, separation techniques - rocket flight dispersion, numerical problems.

UNIT V

Design, Materials and Testing of Rockets: Design requirements and selection, performance evaluation and assessment, space environment on the selection of materials for rockets and spacecraft, material selection for specific requirements, advance materials-super alloys and composite materials. Qualification of rocket and missile systems, types of testing and evaluation of design and function.

TEXT BOOKS:

1. Ramamurthi.K.: Rocket Propulsion. Macmillan Publishers India first edition. 2010.

2. Sutton.G.P. and Biblarz.O: Rocket Propulsion Elements. 7th edition. Wiley India Pvt Ltd. 2010.
3. Cornelisse, J.W, Schoyer H F R, and Wakker K F, "Rocket Propulsion and Space Dynamic", Pitman Publishing Co., 1979.

REFERENCE BOOKS:

1. Ronald Humble, Henry and Larson.Space Propulsion Analysis and Design. Mc Graw-Hill. 1995
2. George M. Siouris, Missile Guidance and Control Systems, Springer-Verlag New York, 2000.

AE713PE: WIND TUNNEL TECHNIQUE (PE – II)

B.Tech. IV Year AE I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Aerodynamics

Course Objectives:

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

Course Outcomes:

- Ability to use various techniques of Aerodynamic data generation

UNIT I

Principles of Model Testing: Buckingham Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities.

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Special Wind Tunnel Techniques: Intake tests – store carriage and separation tests - Unsteady force and pressure measurements –wind tunnel model design

TEXT BOOKS:

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

REFERENCE BOOKS:

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

AE721PE: EXPERIMENTAL AERODYNAMICS (PE – III)

B.Tech. IV Year AE I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Aerodynamics

Course Objectives:

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

Course Outcomes:

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

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

AE722PE: HYPERSONIC AERODYNAMICS (PE – III)

B.Tech. IV Year AE I Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: High Speed Aerodynamics

Course Objectives:

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

Course Outcomes:

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

UNIT I

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

UNIT II

Simple Solution Methods For Hypersonic Inviscid Flows: Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.

UNIT III

Viscous Hypersonic Flow Theory: Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self-similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT IV

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

UNIT V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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AE723PE: ADVANCED COMPUTATIONAL AERODYNAMICS (PE – III)

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: CFD

Course Objectives:

- Explain the concept of panel methods, analyze various boundary conditions applied and demonstrate several searching and sorting algorithms.
- Describe the initial methods applied in the process of CFD tools development their advantages and disadvantages over modern developed methods.
- Demonstrate different methods evolved in analyzing numerical stability of solutions and evaluate the parameters over which the stability depends and their range of values.
- Understand advanced techniques and methods in time marching steps and identify different boundary conditions for different cases in CFD techniques.

Course Outcomes:

- Different techniques to solve the complex fluid dynamics problem numerically

UNIT - I

Numerical Solutions: Euler equations: Flux approach, Lax-Wendroff method, basic principles of upwind schemes, flux vector splitting, Steger Warming flux vector splitting, Van Leer flux vector splitting, Upwind reconstruction, evolution, Godunov‘s first order upwind method, Roe‘s first order upwind method.

UNIT- II

Time Dependent Methods: Stability of solution, explicit methods, FTFS, FTCS, FTBS, Leapfrog method, Lax method. Implicit methods: Euler‘s FTCS, Crank Nicolson method, description of Lax-Wendroff scheme, McCormack two step predictor-corrector method, description of time split methods, approximate factorization schemes.

UNIT- III

Boundary Conditions: Boundary Layer Equations: Setting up the boundary layer equations, flat plate boundary layer solution, boundary layer transformations, explicit and implicit discretization, solution of the implicit difference equations, integration of the continuity equation, boundary layer edge and wall shear stress, Keller-box scheme. Concept of dummy cells, solid wall inviscid flow, viscous flow, farfield concept of characteristic variables, modifications for lifting bodies inlet outlet boundary, injection boundary, symmetry plane, coordinate cut, periodic boundaries, interface between grid blocks, flow gradients at boundaries of unstructured grids.

UNIT- IV

Method of Characteristics: Philosophy of method of characteristics, determination of characteristic lines, two dimensional irrotational flow, determination of compatibility equations, unit processes, supersonic nozzle design by the method of characteristics, supersonic wind tunnel nozzle, minimum length nozzles, domain of dependence and range of influence.

UNIT- V

Panel Methods: Basic formulation, boundary conditions, physical considerations, reduction of a problem to a set of linear algebraic equations, aerodynamic loads, preliminary considerations prior to establishing numerical solution, steps toward constructing a numerical solution, solution of thin airfoil with lumped vortex filament, accounting for effects of compressibility and viscosity.

TEXT BOOKS:

1. Tannehill John C, Anderson Dale A, Pletcher Richard H, ―Computational Fluid Mechanics and Heat Transfer‖, Taylor & Francis, 2nd Edition, 1997.
2. Chung T G, ―Computational Fluid Dynamics‖, Cambridge University Press, 2nd Edition, 2010.
3. Katz Joseph and Plotkin Allen, ―Low-Speed Aerodynamics‖, Cambridge University Press, 2nd Edition, 2006.

REFERENCE BOOKS:

1. Anderson J D, ―Modern Compressible Fluid Flow‖, 2nd Edition, McGraw Hill, 1990.
2. Anderson J D, ―Fundamentals of Aerodynamics‖, Tata McGraw Hill, 5th Edition, 2010.
3. Anderson J D, ―Computational Fluid Dynamics‖, McGraw Hill, 1995.

AE731PE: INDUSTRIAL AERODYNAMICS (PE – IV)

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Low speed Aerodynamics

Course Objectives:

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

Course Outcomes:

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

UNIT I

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

UNIT II

Wind Energy Collectors: Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III

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

UNIT IV

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 V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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ME732PE: TURBO MACHINERY (PE – IV)

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-requisites: Thermal Engineering, Heat Transfer

Course Objectives:

- Provide students with opportunities to apply basic flow equations
- Train the students to acquire the knowledge and skill of analyzing different turbo machines.
- How to compare and chose machines for various operations

Course Outcomes:

- Ability to design and calculate different parameters for turbo machines
- Prerequisite to CFD and Industrial fluid power courses
- Ability to formulate design criteria
- Ability to understand thermodynamics and kinematics behind turbo machines

UNIT - I

Introduction to Turbomachinery: Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler‘s, Bernoulli‘s, equation and its applications, expansion and compression process, reheat factor, preheat factor

UNIT - II

Fundamental Concepts of Axial and Radial Machines: Euler‘s equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje‘s slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT - III

Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.

Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance

UNIT - IV

Axial Flow Compressors: Flow Analysis, Work, and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT - V

Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

TEXT BOOKS:

1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill

REFERENCE BOOKS:

1. A Treatise on Turbo machines / G. Gopal Krishnan *and* D. Prithviraj/ SciTech
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

AE733PE: THEORY OF COMBUSTION (PE – IV)

B.Tech. IV Year AE I Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Nil

Course Objectives:

- Understand the concepts in combustion theory and illustrate students involved in combustion research with the required fundamental knowledge in combustion stoichiometry.
- Familiarize in the area of combustion in various engines, generalise stability limits and flame stabilization in diffusion flame.
- Calculate the combustion efficiency. Discuss fundamental combustion problems arising from gas turbine combustion or more generally from combustion in steady flowing premixed systems.
- Determine the supersonic combustion. Combustion in rocket engines and emission. Different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, afterburners.

Course Outcomes:

- To familiarize the students in the area of combustion in various engines.

UNIT-I

Basics Of Combustion Theory: Combustion stoichiometry and thermo chemical calculation, chemical kinetics and equilibrium, transport phenomena, theory of viscosity, conductivity and diffusivity.

UNIT-II

Pre-Mixed Flames: Description of premixed flames, burning velocity and parametric dependences, experimental methods of measuring burning velocity, simple one-dimensional thermal theory of flame, concepts of minimum ignition energy, quenching distance, stability limits and flame stabilization.

UNIT-III

Diffusion Flame: Jet flame physical description, theoretical analysis-Burke-Schumann‘s analysis, mechanism of soot formation, Defining of premixed, diffusion flames, liquid fuel combustion flames. Liquid fuel combustion, difference between premixed and diffusion flames, liquid fuel combustion-conservation equations, calculation of mass burning rate, droplet burning.

UNIT-IV

Combustion In Reciprocating And Gas- Turbine Engines: Description of the combustion process in piston engines, Combustion efficiency and factors affecting it, Rankine - Hugoniot curves, deflagration and detonation in reciprocating engines and preventive methods; Description of different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, afterburners.

UNIT-V

Combustion In Rocket Engines And Emission: Types of rockets based on combustion, solid fuel combustion, combustion of carbon particle, simplified analysis, boundary layer combustion, combustion of carbon sphere with co burning gas phase; Chemical emission from combustion and its effects, exhaust gas analysis, emission control.

TEXT BOOKS:

1. Stephen R Turns, ―An Introduction to combustion Concepts and Application‖, TMH Publication, 3rd Edition, 2011.
2. Fawzy El-Mahallawy, Saad El-Din Habik, Elsevier ―Fundamentals and Technology of combustion‖, 1st Edition, 2002.

REFERENCE BOOKS:

1. Charles E. Baukal, —Heat Transfer in Industrial Combustion‖, CRC Press, 1st Edition, 2000.
2. G. Singer, —Combustion, Fossil Power Systems‖ Ed Publications, 4th Edition, 1966.
3. S. P. Sharma, Chandra Mohan —Fuels and Combustion‖, Tata McGraw Hill Publishing Co., 1st Edition, 1987.

AE811PE: HEAT TRANSFER (PE – V)

B.Tech. IV Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Note: Heat Transfer Data Book is permitted.

Pre-requisite: Thermodynamics

Course Objectives: To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

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

- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Understand one dimensional transient conduction heat transfer
- Understand concepts of continuity, momentum and energy equations
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation and radiation heat transfer
- Design of heat exchangers using LMTD and NTU methods

UNIT – I

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

UNIT – III

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Π Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

UNIT – IV

Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.
Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT - V
Heat Transfer with Phase Change:
Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling.
Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.
Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

TEXT BOOKS:
1. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

REFERENCE BOOKS:
1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastidar / Oxford

AE812PE: CRYOGENICS (PE – V)

B.Tech. IV Year AE II Sem.	L	T/P/D	C
	3	0/0/0	3

Pre-Requisites: Nil

Course Objectives:

- Understand the behavior of fluids at cryogenic temperatures and utilize the feature for cryogenic application in aerospace propulsion.
- Analyze the behavior of solids at cryogenic temperatures and develop systems used in hybrid rocket propulsion systems.
- Estimate thermodynamically gas liquefaction systems and elucidate the application of liquefied gas in aerospace propulsion.
- Create thermodynamically gas separation systems and experiment in a sustained environment for possible synthesis of rarefied gases for testing.

Course Outcomes:

- Cryogenic propulsion system

UNIT- I

Introduction to Cryogenics: Thermo physical and fluid dynamic properties of liquid and gas hydrogen, Thermo physical and fluid dynamic properties of liquid and gas helium, Liquefaction systems of hydrogen and helium gases, Liquefaction systems of hydrogen and helium gases, Refrigeration and liquefaction principals; Joule Thomson effect and inversion curve; Adiabatic and isenthalpic expansion with their comparison.

UNIT- II

Properties of Cryogenic Substance: Cryogenic fluids, Solids at cryogenic temperatures; Superconductivity, Recuperative – Linde – Hampson, Claude, Cascade, Heylandt, Kapitza, Collins, Simon; Regenerative – Stirling cycle and refrigerator, Slovay refrigerator, Gifford-McMahon refrigerator, Vuilleumier refrigerator, Pulse Tube refrigerator; Liquefaction of natural gas.

UNIT- III

Cryogenic Insulations: Vacuum insulation, Evacuated porous insulation, Gas filled Powders and fibrous materials. Solid foams, Multilayer insulation, Liquid and vapour Shields, Composite insulations.

UNIT- IV

Storage and Instrumentation of Cryogenic Liquids: Design considerations of storage vessel; Dewar vessels; Industrial storage vessels; Storage of cryogenic fluids in space; Transfer systems and Lines for cryogenic liquids; Cryogenic valves in transfer lines; Two phase flow in Transfer system; Cool-down of storage and transfer systems, Measurement of strain, pressure, flow, liquid level and Temperature in cryogenic environment; Cryostats.

UNIT - V

Cryogenic Equipments: Cryogenic heat exchangers – recuperative and regenerative; Variables affecting heat exchanger and system performance; Cryogenic compressors, Pumps, expanders; Turbo alternators; Effect of component inefficiencies; System Optimization, Magneto-caloric refrigerator; 3He-4He Dilution refrigerator; Cryopumping; Cryogenic Engineering applications in energy, aeronautics, space, industry, biology, preservation Application of Cryogenic Engineering in Transport.

TEXT BOOKS:

1. Flynn, T.M., Dekker, Marcel —Cryogenic Engineeringǁ, Plenum Press, USA, 2009.

2. Timmerhaus, K.D, Flynn, T.M, —Cryogenic Process Engineering‖, Plenum Press, USA, 2009.

REFERENCE BOOKS:

1. Bose A. and Sengupta P.—Cryogenics: Applications and Progress‖, Tata McGraw Hill, 2010.
2. Barron R., —Cryogenic Systems‖, Oxford University Press, 2012.
3. Haselden, G.G., Cryogenic Fundamentals‖, Academic Press, 2012.

AE813PE: AERO ENGINE DESIGN (PE – V)

B.Tech. IV Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Aerodynamics, Aircraft Performance, Aircraft Propulsion

Course Objectives:

- Perform parametric and performance analysis of aircraft engines to achieve engine performance requirements identified in constraint and mission analysis.
- Describe the fundamental thermodynamic and gas dynamic principles used in the parametric analysis and performance analysis of aero engines.
- Explain the fundamental design tools used for analysis and preliminary design of main burner and afterburner, fundamental design tools used for analysis and preliminary design of inlet and nozzle.
- Demonstrate, Analyze and choose appropriate materials used in rockets& missiles, mission and weight requirements.

Course Outcomes:

- Engine design requirements and selection criteria

UNIT- I

Fundamentals Of Engine Design: Engine design roadmap, preliminary propulsion design sequence, basic definitions, unit conversions, standard atmosphere, compressible flow equations, mission profile, performance requirements and constraints, desired capabilities.

UNIT- II

Constraint Analysis And Mission Analysis: Concept, design tools, preliminary estimates for constraint analysis, examples of constraint analysis, selection of preliminary design point, complete constraint boundary conditions, constant speed climb, horizontal acceleration, climb and acceleration, takeoff acceleration, constant altitude and speed cruise, constant altitude and speed turn, best subsonic cruise Mach number and altitude, liter, warm-up, takeoff rotation, constant energy height maneuver, general determination of takeoff weight, example and sample mission analysis

UNIT- III

Engine Selection: Parametric cycle analysis, station numbering, gas model, component efficiencies, engine performance analysis, computational inputs and outputs, finding plausible solutions. Parametric and performance behaviors, examples, integrated results, design choices, performance cycle analysis, component performance analysis, iterative solution scheme, component behavior.

UNIT- IV

Engine Sizing: Subsonic inlets, supersonic inlets, nozzles, drag, sizing, constraints, selecting number of engines, final reprise, engine system design, engine static structure, starting, overall operation.

UNIT- V

Engine Component Operation: Operation lines, fan and compressor aerodynamics, turbine aerodynamics, engine life, high pressure and low-pressure turbine design, combustion system components, combustion process, fuels, and ignition, afterburners, sample inlet and exhaust nozzle design.

TEXT BOOK:

1. Mattingly J.D., Heiser W.H., Pratt D.T., —Aircraft Engine Design‖, AIAA ES, 2nd Edition, 2002.

REFERENCE BOOKS:

1. Mathur, M., and Sharma, R.P., — Gas Turbines and Jet and Rocket Propulsion‖, Standard Publishers, New Delhi 1998
2. Cornelisse, J.W., —Rocket Propulsion and Space Dynamics‖, J.W., Freeman & Co. Ltd., London, 1982
3. Parker, E.R., —Materials for Missiles and Spacecraft‖, McGraw-Hill Book Co. Inc., 1982

AE821PE: PRECISION ENGINEERING (PE – VI)

B.Tech. IV Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Nil

Course Objectives:

- Understand the BIS code fits and tolerances for geometrical dimensioning and tolerance (GD & T).
- Understand the principal application of different measuring instruments.
- Summarize the application of latest manufacturing techniques (nano).

Course Outcomes:

- Tolerance and accuracy
- Nano measurements techniques

UNIT- I

Accuracy and Alignment Tests: Accuracy and alignment tests: General concept of accuracy, spindle rotation accuracy, test methods, displacement accuracy, dimensional wear of cutting tools, accuracy of NC systems, clamping errors, setting errors, location of rectangular prism, cylinder, basic type of tests, measuring instruments used for testing machine tools, alignment tests, straightness, flatness, parallelism, squareness, circularity, cylindricity.

UNIT- II

Influence of Static Stiffness, Thermal Effects: Influence of static stiffness, thermal effects: Static stiffness, nature of deformation in a machine tool, overall stiffness of a lathe, compliance of work piece, errors due to the variation of the cutting force and total compliance, accuracies due to thermal effects, methods of decreasing thermal effects-Influence of vibration on accuracy.

UNIT- III

Precision Machining: Top down and bottom up approach, development of nanotechnology, precision and micromachining, diamond turning of parts to nanometer accuracy. Stereo microlithography, machining of micro-sized components, mirror grinding of ceramics, ultra-precision block gauges.

UNIT- IV

Nano Measuring Systems: In-process measurement of position of processing point, post process and online measurement of dimensional features, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems.

UNIT- V

Lithography: Nano Lithography, photolithography, nano lithography, photolithography, electron beam lithography, ion beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.

TEXT BOOKS:

1. Murthy R. L, ―Precision Engineering in Manufacturing‖, New Age International, New Delhi, 2005.
2. Norio Taniguchi, ―Nanotechnology‖, Oxford university press, Cambridge, 1996.

REFERENCE BOOKS:

1. Lee Tong Hong, ―Precision Motion control, Design and Implementation‖, Springer Verlag, UK, 2001.
2. Liangchi Zhang, ―Precision Machining of Advanced Materials‖, Trans Tech Publications Ltd., Switzerland, 2001.
3. Hiromu Nakazawa, ―Principles of precision engineering‖, Oxford university press, 1994.

AE822PE: PRACTICAL NON-DESTRUCTIVE TESTING (PE – VI)

B.Tech. IV Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Nil

Course Objectives:

- Understanding the basic principles of various non-destructive testing methods, fundamentals, discontinuities in different product forms.
- Differentiate various defect types and select the appropriate non-destructive testing methods for better evaluation of the specimen.
- Implement and document a written procedure paving the way for further training in specific techniques of non-destructive inspection of the experimental subject.
- Recognize the principles and operational techniques of the radiographic testing followed by its interpretation and evaluation.

Course Outcomes:

- Different type of testing
- Principles of electronic measurement devices

UNIT - I

Overview of Non-Destructive Testing: NDT versus mechanical testing, overview of the non-destructive testing methods for the detection of manufacturing defects as well as material characterization; Relative merits and limitations, various physical characteristics of materials and their applications in NDT, visual inspection, v unaided and aided.

UNIT - II

Surface Non-Destructive Examination Methods:

Liquid Penetrant Testing: Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results;

Magnetic particle testing: Theory of magnetism, inspection materials magnetisation methods, interpretation and evaluation of test indications, principles and methods of demagnetization, residual magnetism.

UNIT - III

Thermography and Eddy Current Testing (ET):

Thermography: Principles, contact and non-contact inspection methods, Techniques for applying liquid crystals. Advantages and limitation, infrared radiation and infrared detectors, instrumentations and methods, applications;

Eddy Current Testing: Generation of eddy currents, properties of eddy currents, Eddy current sensing elements, probes, instrumentation, types of arrangement, applications, advantages, limitations, interpretation/evaluation.

UNIT - IV

Ultrasonic Testing (UT) and Acoustic Emission (AE):

Ultrasonic Testing: Principle, transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-scan, B-scan, C-scan; Phased array ultrasound, time of flight diffraction; Acoustic emission technique, V principle, AE parameters, applications.

UNIT - V

Experimental Methods: Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, inverse square, law, characteristics of films, graininess, density, speed, contrast, characteristic curves, pentameters, exposure charts,

radiographic equivalence. Fluoroscopy; Xerox; Radiography, computed radiography, computed tomography.

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu —Practical Non-Destructive Testing, Narosa Publishing House, 2009.
2. Ravi Prakash, —Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.

REFERENCE BOOKS:

1. Paul E Mix, —Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005.
2. Charles, J. Hellier, —Handbook of Non-destructive evaluation‖, McGraw Hill, New York 2001.

AE823PE: CAD/CIM (PE – VI)

B.Tech. IV Year AE II Sem.	**L**	**T/P/D**	**C**
	3	**0/0/0**	**3**

Pre-Requisites: Nil

Course Objectives:

- Understand the basics of computer aided designing, computer aided manufacturing and computer integrated manufacturing.
- To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP).
- Gain knowledge about shop floor control and Flexible manufacturing systems (F.M.S).
- Emphasizes the integration of manufacturing enterprise using computer integrated manufacturing (CIM) technologies.

Course Outcomes:

- Industry need and manufacturing process

UNIT- I

Introduction: Computers in industrial manufacturing, product cycle, CAD/CAM hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, and storage devices, computer graphics, raster scan graphics coordinate system, database structure for graphics modelling, transformation of geometry, three dimensional transformations, mathematics of projections, clipping, hidden surface removal.

UNIT- II

Geometric Modelling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modelling facilities desired, drafting and modelling systems, basic geometric commands, layers, display control commands, editing, dimensioning and solid modelling.

UNIT- III

Group Technology Computer Aided Process Planning: History of group technology, role of G.T in CAD/CAM integration, part families, classification and coding, DCLASS and MCLASS and OPTIZ coding systems, facility design using G.T, benefits of G.T, cellular manufacturing. Process planning, role of process planning in CAD/CAM integration, approaches to computer aided process planning, variant approach and generative approaches, CAPP and CMPP systems.

UNIT- IV

Computer Aided Planning and Control, Shop Floor Control And Introduction To FMS: Production planning and control, cost planning and control, inventory management, material requirements planning (ERP), control, phases, factory data collection system, automatic identification methods, bar code technology, automated data collection system; FMS, components of FMS, types, FMS workstation, material handling and storage system, FMS layout, computer control systems, applications and benefits.

UNIT-V

COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING

Production planning and control, cost planning and control, inventory management, material requirements planning (MRP), shop floor control, lean and agile manufacturing, types of production monitoring systems, structure model of manufacturing, process control and strategies, direct digital control.

TEXT BOOKS:

1. Zimmers, P. Groover, —CAD/ CAM‖, Prentice- Hall India, 2008.
2. Zeid, Ibrahim, —CAD / CAM Theory and Practice‖, Tata McGraw-Hill, 1997.
3. Mikell. P. Groover —Automation, Production Systems and Computer Integrated Manufacturing‖, Pearson Education 2001.
4. Ranky, Paul G., —Computer Integrated Manufacturing‖, Prentice hall of India Pvt. Ltd., 2005
5. Yorem Koren, —Computer Integrated Manufacturing‖, McGraw Hill, 2005.

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1. P. Groover, Automation, —Production Systems & Computer Integrated Manufacturing‖, Pearson Education. 2nd Edition 1989.
2. Lalit Narayan, —Computer Aided Design and Manufacturing‖, Prentice-Hall India. 3rd Edition 2002.
3. Radhakrishnan, Subramanian, —CAD / CAM / CIM‖, New Age.4th Edition 2016.
4. Jami J Shah, Martti Mantyla, —Parametric and Feature-Based CAD/CAM: Concepts, Techniques, and Applications‖, John Wiley & Sons Inc, 1995.
5. Alavala, —CAD/ CAM: Concepts and Applications‖, PHI Publications, 4th Edition, 2016.
6. W. S. Seames, —Computer Numerical Control Concepts and Programming‖, 4th Edition 1999.