Bachelor of Technology - Aerospace Engineering

Syllabus - First Semester

INTRODUCTION TO COMPUTERS AND PROGRAMMING IN C

Course Code: ASE2105 **Credit Units: 03**

Course Objective:
The objective of this course module is to acquaint the students with the basics of computers system, its components, data representation inside computer and to get them familiar with various important features of procedure oriented programming language i.e. C.

Course Contents:

Module I: Introduction
Introduction to computer, history, von-Neumann architecture, memory system (hierarchy, characteristics and types), H/W concepts (I/O Devices), S/W concepts (System S/W & Application S/W, utilities). Data Representation: Number systems, character representation codes, Binary, octal, hexadecimal and their interconversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, Memory storage unit.

Module II: Programming in C
History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.

Module III: Fundamental Features in C
C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break. Storage types (automatic, register etc.), predefined processor, Command Line Argument.

Module IV: Arrays and Functions
One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix computations.
Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.

Module V: Advanced features in C
Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments.
Strings and C string library.
Structure and Union. Defining C structures, Giving values to members, Array of structure, Nested structure, passing strings as arguments.
File Handling.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- "ANSI C" by E Balagurusamy
- Yashwant Kanetkar, "Let us C", BPB Publications, 2nd Edition, 2001.
- Herbert Schildt, "C: The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.
- V. Raja Raman, "Computer Programming in C", Prentice Hall of India, 1995.

References:

- ***Kernighan & Ritchie, "C Programming Language", The (Ansi C Version), PHI, 2nd Edition.***
- ***J. B Dixit, "Fundamentals of Computers and Programming in 'C'.***
- P.K. Sinha and Priti Sinha, "Computer Fundamentals", BPB publication.

PROGRAMMING IN C LAB

Course Code: ASE2110 **Credit Units: 01**

Software Required: Turbo C

Course Contents:

- C program involving problems like finding the nth value of cosine series, Fibonacci series. Etc.
- C programs including user defined function calls
- C programs involving pointers, and solving various problems with the help of those.
- File handling

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Syllabus - Second Semester

OBJECT ORIENTED PROGRAMMING USING C++

Course Code: ASE2203 **Credit Units: 03**

Course Objective:
The objective of this module is to introduce object oriented programming. To explore and implement the various features of OOP such as inheritance, polymorphism, Exceptional handling using programming language C++. After completing this course student can easily identify the basic difference between the programming approaches like procedural and object oriented.

Course Contents:
Module I: Introduction
Review of C, Difference between C and C++, Procedure Oriented and Object Oriented Approach. Basic Concepts: Objects, classes, Principals like Abstraction, Encapsulation, Inheritance and Polymorphism. Dynamic Binding, Message Passing. Characteristics of Object-Oriented Languages. Introduction to Object-Oriented Modeling techniques (Object, Functional and Dynamic Modeling).

Module II: Classes and Objects
Abstract data types, Object & classes, attributes, methods, C++ class declaration, Local Class and Global Class, State identity and behaviour of an object, Local Object and Global Object, Scope resolution operator, Friend Functions, Inline functions, Constructors and destructors, instantiation of objects, Types of Constructors, Static Class Data, Array of Objects, Constant member functions and Objects, Memory management Operators.

Module III: Inheritance
Inheritance, Types of Inheritance, access modes – public, private & protected, Abstract Classes, Ambiguity resolution using scope resolution operator and Virtual base class, Aggregation, composition vs classification hiérarchies, Overriding inheritance methods, Constructors in derived classes, Nesting of Classes.
Module IV: Polymorphism
Polymorphism, Type of Polymorphism – Compile time and runtime, Function Overloading, Operator Overloading (Unary and Binary) Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, pure virtual functions.

Module V: Strings, Files and Exception Handling
Manipulating strings, Streams and files handling, formatted and Unformatted Input output. Exception handling, Generic Programming – function template, class Template Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

Text & References:
Text:
- A.R. Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH, 1997
- R. Lafore, "Object Oriented Programming using C++", BPB Publications, 2004.
- "Object Oriented Programming with C++" By E. Balagurusamy.
- Schildt Herbert, "C++: The Complete Reference", Wiley DreamTech, 2005.

References:
- Parasons, "Object Oriented Programming with C++", BPB Publication, 1999.

- Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication, 2002.
- Yashwant Kanethkar, “Object Oriented Programming using C++”, BPB, 2004

OBJECT ORIENTED PROGRAMMING USING C++ LAB

Course Code: ASE2207 **Credit Units: 01**

Software Required: Turbo C++

Course Contents:

- Creation of objects in programs and solving problems through them.
- Different use of private, public member variables and functions and friend functions.
- Use of constructors and destructors.
- Operator overloading
- Use of inheritance in and accessing objects of different derived classes.
- Polymorphism and virtual functions (using pointers).
- File handling.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab

Syllabus - Third Semester

ELECTRONICS

Course Code: ASE2302 **CreditUnits: 02**

Course Objective:
Basic knowledge of Electronics is very essential for an engineer; it will help in building up the electronics & automation skills in Mechanical Engineers.

Course Contents:
Module I:
Review of conductors, semi-conductors and insulators and their energy band diagrams, PN junction diode, Ideal diode and its characteristics, LED, Zener and Tunnel Diode and their characteristics, Applications of diodes-Rectifiers (Half and full wave, Bridge)

Module II:
BJT-construction and characteristics, Transistor as an amplifier, CE, CB and CC configurations, Transistor biasing, Introduction to FET and MOSFET

Module III:
Cascaded amplifiers, RC coupled Amplifiers, Transformer coupling, Frequency response of RC, TC and their merits and demerits, Introduction to feedback-Positive and negative, Introduction to oscillators, Barkhausen criterion

Module IV:
OPAMP characteristics and specifications, OPAMP as inverting and non-inverting amplifier in open and closed loop mode, Applications of OPAMP

Module V:
Introduction to digital electronics, logic gates, basic laws and theorems of Boolean algebra, single bit latch, flip flops-RS, JK, T, D, Master Slave, Counters, and Registers

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Boylestead&Neshlesky, “Electronics Devices & Circuits”. PHI
- Millman&Halkias, “Integrated Electronics”, TMH.
- Schilling &Belove “Electronics”.

ENGINEERING THERMODYNAMICS

Course Code: ASE2314 **CreditUnits: 02**

Course Objective:
Objective of this course is to achieve an understanding of the scientific principles of thermodynamics, and heat transfer. This course also helps students understand the application of basic fluid mechanics, thermodynamic, and heat transfer principles and techniques, including the use of empirical data, to the analysis of representative fluid and thermal energy components and systems encountered in the practice of electrical, electronic, industrial, and related disciplines of engineering

Course Contents:
Module I: Basic concepts
Thermodynamic system, Intensive and extensive properties, Cyclic process, Zeroth Law of Thermodynamics, Work and heat, Flow work

Module II: First Law of Thermodynamics
Mechanical equivalent of heat, Internal energy, Analysis of non-flow system, Flow process and control volume, Steady flow, Energy equation, Flow processes

Module III: Second Law of Thermodynamics and Entropy
Heat Engine, heat pump, Kelvin Planck and Clausius statement of Second Law of Thermodynamics, Perpetual motion machine, Reversible cycle- Carnot Cycle, Clausius inequality, entropy, entropy change during different processes, Principle of entropy increase, concepts of availability, irreversibility

Module IV: Air-Cycles
Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Sterling cycle, Ericsson cycle, Brayton cycle, Reversed Carnot cycle

Module V: Properties of Steam
Use of steam tables, wet steam, superheat steam, different processes of vapor, Moller Diagram

Module VI: Reciprocating Air compressors
Single stage compressor, Isothermal efficiency, adiabatic efficiency, clearance volume, volumetric efficiency, multi-stage compression with intercooling

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- P.K. Nag, "Engineering Thermodynamics", Tata McGraw Hill
- Sonntag/ Vanhylene, "Fundamentals of Thermodynamics", Wiley
- Rahul Gupta, "Engineering Thermodynamics", Asian Books P. Ltd.
- Gordon Rosers, "Yon Mahew; Engineering Termodynamics", Addison Wesley
- Y.V.C. Rao, "Engineering Thermodynamics", Khanna Publications.
- E. Gutra, "Basic Thermodynamics", Narosa Publications.
- M.L. Mathur, "Mehta F.S. Thermal Engineering", Jain Brothers
- R.K. Rajput, "Thermal Engineering", Laxmi Publications
- Onkar Singh, "Applied Thermodynamics", New Age Publications.
- DhomkundwarKothandaraman, "A Course in Thermal Engineering", DhanpatRai Publications
- S.K. Kulshretha, "Engineering Thermodynamics", Vikas Publications.

STRENGTH OF MATERIALS

Course Code: ASE2315 **CreditUnits: 02**

Course Objective:
The objective of this course is to make the students understand the concept of stress and strain in different types of structure/machine under different loading conditions. The course also covers the simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure and stresses in thin cylinder thick cylinder and spheres due to external and internal pressure.

Course Contents:

Module I: Simple stresses and strains
Concept of stress and strain; St. Vernants principle of stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stress and strains in bars subjected to axial loading. Modulus of elasticity, stress produced in compound bars subject to axial loading. Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls

Module II: Compound stress and strains
The two dimensional system; stress at a point on a plane, principal stresses and principal planes; Mohr's circle of stress, Graphical and Analytical methods for stresses on oblique section of body, Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams.

Module III
Theory of bending stresses in beams due to bending, assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, composite / flitched beams, bending and shear stresses in composite beams.

Module IV: Torsion
Derivation of torsion equation and its assumptions, Applications of the equation of the hollow and solid circular shafts torsional rigidity, combined torsion and bending of circular shafts principal stress and maximum shear stresses under combined loading of bending and torsion, analysis of close-coiled-helical springs.

Module V: Thin cylinders and spheres
Derivation of formulae and calculation of hoop stress, longitudinal stress in a cylinder and sphere subjected to internal pressure.

Module VI: Columns and struts
Columns and failure of columns, Euler's formulas; Rankine-Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications,

Module VII: Slope and deflection
Relationship between moment, slope and deflection, Mohr's theorem; Moment area method; method of integration; Macaulay's method: Use of all these methods to calculate slope and deflection for the following:
a) Cantilevers
b) Simply supported beams with or without overhang
c) Under concentrated loads, uniformly distributed loads or combination of concentrated and uniformly distributed loads

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2000.
- Timoshenko S.P., "Elements of Strength of Materials", East-West affiliated, New Delhi, 2000.
- Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.
- Popov Eger P., "Engineering Mechanics of solids", Prentice Hall, New Delhi, 1998.
- Fenner, Roger. T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi, 1990.
- Sri Nath L.S. et.al., "Strength of Materials", McMillan, New Delhi,2001

FLUID MECHANICS

Course Code: ASE2316 **CreditUnits: 04**

Course Objective:
The objective of this course is that students should understand the, properties of fluids, pressure measurement devices, hydraulic forces on surfaces, buoyancy and flotation in fluids, kinematics and static behavior of fluids, dimension and model analysis, laminar and turbulent flow, flow through pipes and orifices, boundary layer theory.

Course Contents:

Module I: Fluid Properties and Fluid Statics
Newtonian and Non-Newtonian Fluids; Viscosity; Incompressible and compressible fluids, compressibility, Forces on plane surfaces, forces on curved surfaces, buoyant forces, and stability of floating bodies, metacenter and metacenter height.

Module II: Kinematics of Fluid Motion
Steady and unsteady flow; uniform and non-uniform flow; Laminar and turbulent flow; streamline, path line and streak line; continuity equation, irrotational and rotational flow, velocity potential and stream function, vortex flow, free and forced vortex.

Module III: Dynamics of Fluid Flow
Euler's equation of motion and its integration to yield Bernoulli's equation, its practical applications – Pilot tube, Venturimeter; steady flow momentum equation, force exerted on a pipe bend.

Module IV: Dimensional Analysis and Principles of Similarity
Buckingham pi-Theorem and its applications, Geometric, Kinematics and Dynamic similarity; Dimensionless numbers-Reynolds, Froude, Euler, Mach, Weber Number and their significance

Module V: Laminar and Turbulent Flow
Reynold's experiment, critical velocity, steady laminar flow through a circular tube, flow between parallel plates. Transition from laminar to turbulent flow, courses of turbulence, velocity distribution law near a solid boundary, velocity distribution in rough pipes, Hazen – Williams's formula

Module VI: Analysis of Pipe Flow
Energy losses, minor losses in pipe lines, concept of equivalent length, flow between two reservoirs, and multiple pipe systems – in series and parallel, siphon.

Module VII: Flow Measurements
Measurement of flow using Venturimeter, orifice meter, Pitot tube, measurement of flow in open channels – rectangular, triangular, trapezoidal weir, Cipoeletti weir.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- R.K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications (P) Ltd., 2002.
- Gupta, S. C., Fluid Mechanics and Hydraulic Machines, Pearson Education, 2007
- D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria& Sons, 2000.
- F. M. White, Introduction to Fluid Mechanics, McGraw Hill
- I.H. Shames, "Mechanics of Fluids", Tata McGraw Hill
- Douglas, J. F., Gasiorek, J.M. and Swaffield, J., Fluid Mechanics, Pearson Education, 4/e, 2006
- V.L. Streeter and E.B. Wylie, "Fluid Mechanics", Tata McGraw Hill
- Massey B S, Mechanics of Fluids, Van Nostrand Reinhold Co

MECHANICAL ENGINEERING DRAWING LAB

Course Code: ASE2310 **Credit Units: 01**

Course Contents:

Module I: Free-Hand Sketching & Shaft Scale Drawing
Components like cotter joint, knuckle joint; rivets and riveted joints; couplings; flywheels, pulleys, bush bearings, Engine parts, Isometric views from Orthographic Projections of Machine Components

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

- PS Gill, Machine Drawing, S. Chand.
- ND Bhatt, Machine Drawing, Charotar publications
- N Sidheshwar, Machine Drawing, Tata McGraw Hill
- CL Tanta, Mechanical Drawing, "DhanpatRai"

STRENGTH OF MATERIALS LAB

Course Code: ASE2317 **CreditUnits: 01**

List of Experiments

- Universal Testing Machine
- Tensile Test (MS)
- Double Shear Test (MS)
- Compression Test (CI)
- BrinellHardness No.
- Izod Impact
- Testing Machine
- Rockwell Hardness Tester
- Spring Stiffness (Spring Compression Testing machine)
- Torsion testing machine

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

FLUIDS MECHANICS LAB

Course Code: ASE2318 **CreditUnits: 01**

List of Experiments

- Verification of Bernoulli's Theorem
- Experiment using Venturimeter
- Determination of coefficient of Discharge Cd, Cc, C! Using
- Circular/triangular/rectangular orifice
- To find major head losses in a pipe line
- To find minor head losses in a pipe line (sudden expansion/contraction/bend)

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

AIRCRAFT SYSTEMS AND INSTRUMENTATION

Course Code: ASE2319 **CreditUnits: 03**

Course Objective:
The objective of this course is to impart the knowledge about the concepts of various systems in aircraft. This course focuses on analyzing the behavior of various systems and to study the application and real time problems associated with those systems.

Course Contents:
Module I: Flight Control Systems
Primary and secondary flight control, flight control linkage systems, push-pull control rod system, cable and pulley systems, high lift control systems, flight control actuation, linear actuator, mechanical actuator, mechanical screw jack actuator, direct drive actuation, fly-by-wire actuator, electro-hydrostatic actuator, electro-mechanical actuator.

Module II: Engine Control Systems
Engine technology and principle of operation, fuel flow control, air flow control, control systems, control system parameters, input signals, output signals, example systems, engine starting, fuel control, ignition control, engine rotation, throttle levers, starting sequence, engine oil systems.

Module III: Hydraulic and Environment Control Systems
Hydraulic circuit design, hydraulic actuation, hydraulic fluid, fluid pressure and temperature, fluid flow rate, hydraulic piping and pumps, need for controlled environment, heat sources, ram air cooling, fuel cooling, engine bleed, bleed flow and temperature control, air cycle refrigeration, humidity control, hypoxia and tolerance.

Module IV: Pitot Static Instruments & Systems
Pitot static system, air speed indicator, altimeter, Mach meter, Mach/airspeed indicator, vertical speed indicator.

Module V: Gyroscopic Instruments
Gyroscope and its properties, gyro horizon, turn and bank indicator, turn coordinator, direct reading magnetic compass, and directional gyroscope.

Module VI: Navigational Instruments
Very high and ultra-high frequency radio aids, VOR, TACAN, VORTAC, VHF direction finding, instrument landing system, and microwave landing system.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:
- Aircraft systems -Ian Moir and Allan Seabridge
- Aircraft instruments –E H J Pallet

VALUE ENGINEERING

Course Code: ASE2320 **CreditUnits: 03**

Course Objective:
The overall objective of this course is to familiarize the participants with the systematic VE approach to problem solving. Upon completion of the course, each participant should be able to understand the difference between VE and other cost reduction or problem solving techniques. Apply VE techniques individually. Serve on a team conducting a VE study. Make significant contributions to the conduct of an agency's VE or cost management program.

Course Contents:
Module I: Introduction to value and cost elements
Concepts in value and cost elements of product cost and/cost classification.

Module II: Value analysis
Value analysis procedure, parts classification, patents,

Module III: Product life-cycle
Product life-cycle and value oriental efforts, value engineering job plan.

Module IV: Value alternative
Value tests Examination of value alternative, investigations and recommendations, case studies.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Value Engineering: A Blueprint, Brown, J. Industrial Press Inc., New York NY, 1992. Sold through Society for Value Engineers, Northbrook IL.
- Value Engineering, Mudge, A. E. (1971), Mc-Graw Hill Book Company, New York NY. Sold through Society for Value Engineers, Northbrook IL, 1961.
- Value Analysis, Fallon, C. (1980), Miles Value Foundation. Sold through Society for Value Engineers, Northbrook IL.

ELEMENTS OF AEROSPACE ENGINEERING

Course Code: ASE2351 **CreditUnits: 03**

Course Objective:
Being a foundation course for aerospace students, its objective is to provide introductory knowledge about some of the topics of aerospace engineering, such as, flight vehicles, principles of flight mechanics, propulsion systems, aerospace structures, aircraft systems, passenger comfort systems, power-actuated systems, etc.

Course Contents:
Module I: Introduction to Aerospace Systems
Development of Flying Machines, Classification of flight vehicles, Introduction to prominent features of design; Airplanes, helicopter and other flying machines along with examples

Module II: Aircraft Systems
Lifting and non-lifting surfaces, Lift and drag of airfoils, stalling, finite span wing, induced drag. Wing plan-form variations, forward and aft swept wings, high lift devices, use of control surfaces, elementary ideas about stability and control of airplanes.

Module III: Principles of Aerospace Propulsion
Classification of propulsive units and their features; Fixed and variable pitch air screws, piston prop engine, turbo prop engine, turbo jet engines and its variations, ramjet, pulse jet, rockets engines; Solid and liquid propellant engine, the concept of staging of rockets, structural features in each case, Engine starting-systems.

Module IV: Aerospace Vehicle Structure
Importance of strength/weight ratio, introduction to loads on different parts of the vehicle, detailed description of the fuselage, wing and tail surfaces, wing surfaces, wing fuselage jointing methods, different types of under carriages,

Module V: Power Actuated Systems
Hydraulic system: details and various components, selector and sequence, switches, electro-hydro-mechanical system, pneumatic system, fuel systems, etc.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Kermode A.C., “Mechanics of Flight”, Pitman Publication, UK, 1984.
- Kermode A.C., “Aeroplane Structures”, Pitman Publication, UK, 1986.
- Michael J. Kroes and JR Rardon, “Aircraft Basic Science” Tata McGraw-Hill.
- Michael J. Kroes and Thomas W. Wild, “Aircraft Power Plants”.
- John Anderson Jr., “Fundamentals of Aerodynamics”.
- Irewin E. Treager, “Aircraft Gas Turbine Engine Technology”.
- Haughten E.L. and Carpentar P.W., “Aerodynamics for Engineering Students”.

Syllabus - Fourth Semester

AERODYNAMICS-I

Course Code: ASE2401 **CreditUnits: 02**

Course Objective:
In this course, aerospace students are to learn the concepts of flow measurements, fluid motion and the governing equations for incompressible/compressible flows. The students are, thus, in a position to analyze the behavior of various aerodynamic forces that act upon the bodies kept in the flow fields.

Course Contents:
Module I: Introduction
Types of flow, Pitot-static tube: Measurement of air-speed, Pressure coefficient, Aerodynamic force and Moments, Non-dimensional parameters (M, Re, Fr etc.), Flow similarity

Module II: Description of Fluid Motion
Lagrangian and Eulerian methods, Local and material rate of change, Streamline, Pathline and Streakline, Translation, Rotation and rate of deformation of fluid particles, Vorticity and Circulation

Module III: Equation of Fluid Motion
Equation of conservation of mass for control volume, Differential form of conservation equation, Euler's and Navier-Stoke equations, Bernoulli's equation, Momentum equation

Module IV: Incompressible Flow
Potential and Stream function, Basic elementary flows: Uniform flows, source flow, Doublet flow and Vortex flow, Superimposition of elementary flows, Non-lifting and lifting flow over a circular cylinder, Comparison with real flow over circular cylinder, Kutta-Jaukowski theorem, Generation of lift

Module V: Compressible Flow
Compressible flow properties: Total Enthalpy, Total Temperature, Temperature and Pressure ratios as a function of Mach No., Mass Flow Parameter (MFP), Isentropic Area ratio (A/A*), Velocity-Area variations, 2D small amplitude wave propagation, Adiabatic Steady Flow Ellipse, Description of Flow Regimes, Introduction to Normal and Oblique Shock waves

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- John D. Anderson Jr., "Fundamentals of Aerodynamics", 2nd Ed., McGraw Hill.
- Jack D. Mattingly, "Principles of Gas Turbine"' 1st Ed., McGraw Hill, 1996.
- H. Schlichting, "Boundary Layer Theory", 6th Ed., McGraw Hill, 1986.
- Frank M. White, "Fluid Mechanics", 2nd Ed., McGraw Hill, 1986.
- S.W. Yuan, "Foundations of Fluid Mechanics", Prentice Hall.
- E. Rathakrishnan, "Gas Dynamics", Prentice Hall.
- Gupta and Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, 1960.

PROPULSION SYSTEMS-I

Course Code: ASE2402 **CreditUnits: 03**

Course Objective:
This course is aimed at providing the students the basic knowledge and governing laws of various modes of heat transfer, aero- and thermodynamic aspects of propulsive devices, such as, propellers, piston type and turbine type aero engines, their performance parameters and the essential knowledge of fuel combustion, standard ratings of aviation fuels and propellants used in rocket engines.

Course Contents:

Module I: Heat Transfer
Heat transfer process, Heat conduction, thermal conductivity, general equations of heat conduction with source, conduction problems in 1D and 2D with and without source; Convective heat transfer fundamentals, Introduction to radiative heat transfer, Coupled heat transfer problems.

Module II: Propellers
Ideal momentum theory and blade element theory and their relative merits, numerical problems on the performance of propellers using propeller charts, selection of propellers, fixed, variable and constant speed propellers, prop-fan, material for propellers, shrouded propellers helicopter rotor in hovering performance.

Module III: Aircraft Piston Engines
Brief historical sketch of S.I. and C.I. engines, 4-stroke and 2-stroke engines, thermodynamics of engine analysis, combustion process, air standard cycles, various type of arrangements or multi-cylinder aircraft engines, their merits and operational efficiencies, intake and exhaust manifolds, cooling and lubrication systems, valve timing and arrangements, I.H.P., B.H.P and F.H.P, engine performance, effect of altitude, power required and power available, supercharging, preliminary design of aircraft piston engine.

Module IV: Fuel Combustion and Flame Stability
Liquid fuels, hydrocarbons, gasoline, starting mixtures and temperatures, vapor lock, other liquid fuels and blends, combustion knock and knock rating, carburetion and fuel injection, ignition of the charge, ignition system, Gas turbine fuels, solid and liquid propellants.

Module V: Aircraft Gas Turbine Engines
Air-standard Brayton cycle, actual gas turbine engine cycle, compressor and turbine efficiencies, compressor work and turbine work, centrifugal and axial type of compressor, their comparative action, relative merits in operations, combustion chambers: various arrangements, simplex and duplex burners.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Holman J.P., “Heat Transfer”, 2nd Ed., McGraw Hill.
- Gebhart B., “Heat Transfer”, 2nd Ed., McGraw Hill.
- Dommasch, Sherby and Connolly, “Airplane Aerodynamics”, Pitman.
- Litchy L.C., “I C. Engines”, McGraw Hill.
- Mattingly J.D., “Elements of Gas Turbine Propulsion”, McGraw Hill 1st Ed.1997.
- Cohen Rogers and Sarvanmattoo, “Gas Turbine Theory”, John Wiley.
- P. G. Hill and C. R. Peterson, “Mechanics and Thermodynamics of Propulsion”, Addison Wesley, 1970.
- J.L Kereebrock, “Aircraft Propulsion System Technology and Design”, MIT Press, 1991.

AIRCRAFT STRUCTURES-I

Course Code: ASE2411 **CreditUnits: 03**

Course Objective:
In this course, aerospace students will learn the concepts and basic structural analysis of 2-D members in Cartesian and Polar coordinates using various methods. Students will also understand the analysis of torsional loads on bars, shells and walled tubes as well as the analysis of statically indeterminate structures.

Course Contents:
Module I: Analysis of 2D Problems
Analysis of 2-D problems in rectangular and polar co-ordinates employing "Theory of Elasticity: Plane Stress and Plane Strain Condition".

Module II: Structural Analysis Method
Energy Method, strain energy, complimentary energy, The two Castinglino's theorems and application to statically indeterminate system, Unit load method, principle of virtual work and virtual displacement, principle of superposition, reciprocal theorem

Module III: Statically Indeterminate Structures
Truss analysis with single and double redundancy, frames and rings. Torsion and bending of multi-cell box beams.

Module IV: Torsion
Torsion of non-circular solid bars, warping, axially constrained stresses. Torsional deflection of non-circular shell, analysis of thick walled tubes

Module V: Stress Diffusion
The diffusion of stress in stiffened panels, the concept of shear lag

Module VI: Structural Analysis of Wing and Fuselage
Analysis of typical semi-monocoque structures, distribution of concentrated loads in webs, loads on fuselage bulkhead, analysis of wing ribs. Shear flow in tapered webs.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- S. Timoshanko and J.N., "Theory of Elasticity".
- David J. Perry, "Aircraft Structures", McGraw Hill Book Co. 1949.
- T.H.G. Megson, "Aircraft Structures for Engineering Students", Edward Arnold and Co., 2nd Ed, 1990.

NUMERICAL ANALYSIS AND PROGRAMMING

Course Code: ASE2412 **CreditUnits: 02**

Course Objective:
This course deals with the techniques of numerical analysis, which gives the solution to applied problem when ordinary analytical method fails. Emphasis is given on computer programming also so that the given techniques can be used in design of engineering and scientific problems.

Course Contents:
Module I: Solution of Algebraic and Transcendental Equation
Error in a series approximation, Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Solutions of Simultaneous equation: Gauss elimination method, Jacobi iteration method, Gauss Seidal method

Module II: Interpolation
Finite Differences, Difference tables
Polynomial Interpolation**:** Newton's forward and backward formula
Central Difference Formulae: Gauss forward and backward formula.
Interpolation with unequal intervals: Lagrange's Interpolation, Newton Divided difference formula

Module III: Numerical Integration and Differentiation
Introduction, Numerical differentiation Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rules.

Module IV: Solution of differential Equations
Euler's Method, Runga-Kutta Methods.

Module V: Statistical Computation
Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc., Data fitting with Cubic splines
Take-off and landing, Calculations of take-off ground run, Take-off distances, Minimum ground run, assisted take-off, Calculation of landing ground run, Range and endurance and problems connected with them

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
- Gerald &Whealey, "Applied Numerical Analyses", AW
- Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
- Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi
- T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, TMH
- PradipNiyogi, "Numerical Analysis and Algorithms", TMH
- Francis Scheld, " Numerical Analysis", TMH
- Sastry S. S, "Introductory Methods of Numerical Analysis", Pearson Education.
- Gupta C.B., Vijay Gupta, "Introduction to Statistical Methods", Vikas Publishing.
- Goyal, M, "Computer Based Numerical and Statistical Techniques", Firewall Media, New Delhi.

ELEMENTS OF SPACE ENGINEERING

Course Code: ASE2451 **CreditUnits: 03**

Course Objective:
The knowledge of concepts of Space Systems is important for understanding the essentials of Aerospace discipline, particularly subsystems such as Rockets and Missiles; Satellite Launch Vehicles; Satellite Systems; Tracking, Telemetry and Tele-command; Control, Guidance and Navigation; Flight and Orbital Mechanics.

Course Contents:
Module I: Introduction to Space Systems
Evolution of Rocketry, Planet/Solar Systems, Space Exploration, Space Applications, Future Trends

Module II: Elements of Rockets and Satellites
Satellite Launch Vehicles, Missiles, Communication Satellites, Remote Sensing

Module III: Elements of Air-vehicles
Introduction to Flying and Flying Machines

Module IV: Orbital Mechanics and Mission Design
Motion in Gravitational Field, Orbits, Orbital Elements, Hohmann Transfer, Delta-V Requirements, Orbit Perturbations

Module V: Ground Systems
Ground Stations, Link Calculations, Station Keeping, Deep Space Network (DSN), VSATs, GPS, ILS, Auto Pilot and Navigation Systems.

Module VI: Space Craft Systems
Space Craft Types, Attitude Determination and Control, Power Systems, Thermal Control, Space Craft Propulsion, Communication Satellites, Remote Sensing Satellites.

Module VII: Launch Vehicles and Missiles
PSLV, GSLV, Re-useable Vehicles, Propellant & Propulsion Systems, Thermal Protection, Control Systems, SAM, IRBM, ICBM.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Satellite Technology, “Principles and Applications”, Maini, AK
- Guided Weapons Systems Design, Balakrishnan, R
- Space Systems Engineering, Fortesque, PW
- Getting Started With Amateur Satellites, Gould Smith, G
- Wings of Fire, Abdul Kalam, APJ
- Satellite Communication Systems, Evans
- Space Today, Mohan SundaraRajan
- Handbook of Satellite Communications, ITU

AERODYNAMICS LAB-I

Course Code: ASE2405 **CreditUnits: 01**

List of Experiments

Any 8 of the following experiments:

1. Wind tunnel as a tool, their classification, uses and applications.
2. Experiments on Reynold's apparatus.
3. Use of Pitot - static tube and Anemometer for measuring velocity.
4. Measurement of pressure gradient along a wind tunnel.
5. Measurement of velocity profile in favourable and adverse pressure gradient.
6. Smoke visualization over cylinder / airfoils.
7. Pressure distribution over a 2D cylinder.
8. Experiments on potential flow Analogy (Hele-Shaw flow).
9. Setting up of liquid paraffin smoke wire for flow visualization.
10. Measurement of Drag of a 2D cylinder by Jone's Wake Survey method.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	**5**	**35**	**35**

IA: Internal Assessment, EE: External Exam, PR: Performance, LR: Lab Record, V: Viva.

PROPULSION SYSTEMS LAB-I

Course Code: ASE2406 **CreditUnits: 01**

List of Experiments

1. To study the functioning of aircraft piston engines having various arrangements of cylinders.
2. Experiments on the testing of Aircraft Piston Engine.
3. Experiments on Continuous Combustion test rig.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	**5**	**35**	**35**

IA: Internal Assessment, EE: External Exam, PR: Performance, LR: Lab Record, V: Viva.

MACHINE SHOP LAB

Course Code: ASE2407 **CreditUnits: 01**

List of Experiments

1. Operations on the Lathe Machine.
2. Operations on the Shaper Machine.
3. Operations on the Planner Machine.
4. Operations on the Drilling Machine.
5. Operations on the Grinding Machine.
6. Operations on the Milling Machine.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	**5**	**35**	**35**

IA: Internal Assessment, EE: External Exam, PR: Performance, LR: Lab Record, V: Viva.

PROGRAMMING LAB-I (NUMERICAL ANALYSIS)

Course Code: ASE2413 **CreditUnits: 01**

Software Required: Turbo C/C++

Course Contents:
Assignments will be provided for the following:

- Analysis of various numerical and statistical techniques

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	**5**	**35**	**35**

IA: Internal Assessment, EE: External Exam, PR: Performance, LR: Lab Record, V: Viva.

ELECTRICAL MACHINES

Course Code: ASE2403 **CreditUnits: 02**

Course Objective:
Electrical Machines provides the backbone for successful and uninterrupted smooth functioning of any industry. Knowledge of this subject in any engineering branch is vital in process industry. The course covers the machines e.g. Motors & generators characteristics and classifications related to mechanical & automation as well as recent development engineering applications. Successful completion of this course will be very helpful for the students who wish to join challenging industry.

Course Contents:
Module I: DC Generator
Introduction, Generator Principle, Construction, Types of Generators,,Emf equation, Iron loss, Total losses, condition of maximum efficiency
Armature reaction, Demagnetizing and cross magnetizing conductors, AT per pole, Compensating windings, Computation and methods of improving,
Characteristics – Separately excited and self-excited, No Load curve for self-excited generator, critical resistance, OCC at different speeds, critical speed, voltage build up and conditions for voltage of shunt generator, external characteristics, voltage regulation, internal characteristics, external characteristics and no load saturation curve Series generator, Uses of DC generators

Module II: DC Motor
Motor Principle and comparison with generator action, back emf and significance of back emf, voltage equation, condition of maximum power, torque, armature and shaft torque, speed of DC motor, speed regulation, torque and speed of DC motor. Motor characteristics series and shunt motors, comparison, losses and efficiency.
Factors controlling motor speed, speed control of series and shunt motors, Starters, necessity

Module III: Alternators
Basic principle, construction, Equation of induced emf, Alternator on load, Synchronous reactance, voltage regulation, operation and power developed, parallel operation, synchronizing and synchronizing torque, synchronizing current.

Module IV: Induction Motor
Classification, principle, construction, phase wound rotor, production of rotating field, slip, frequency of rotor current, Torque and rotor power factor, starting torque-squirrel cage and slip ring motor, maximum starting torque, effect of change in voltage on starting torque, rotor emf, torque , condition for maximum torque, rotor torque and breakdown torque, starting and maximum torque, power stages, induction motor torque equation, synchronous watt, equivalent circuit of induction motor, and reactance under running conditions,

Module V: Synchronous Motor
Principle of operation, Power flow and power developed, Equivalent Circuit, Excitation, Torques, Condition of Maxima, Power lines and V curve, hunting.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- I J Nagrath& D P Kothari. “Electrical Machines”. TMH
- Irvin Kosow, “Electrical Machines & Transformers”, PHI.
- B L Theraja “Electrical Engineering”.

COMPOSITE MATERIALS

Course Code: ASE2410 **CreditUnits: 02**

Course Objective:
The objective of this course is to provide an understanding of the strength and stress behavior of the composite materials as explained by certain recent theories on the subject. The students are to be equipped with the knowledge of the composite material performance under fatigue, impact and other adverse conditions that an aircraft is subjected to.

Course Contents:
Module I: Introduction
Classification and characteristics of Composite materials, Elementary study of mechanical behavior of composite materials, Advantages of composite materials

Module II: Macro-mechanical Behavior of a Lamina
Analysis of a lamina: Constitutive equations for the lamina of an arbitrary – Orientation, Transformation relations, Strength concepts, Experimental determination of strength and stiffness, Bi-axial strength theories for an orthotropic Lamina: Maximum stress theory, maximum strain theory, Tsai- Hill theory, Tsaiwn tensor theory

Module III: Micro-mechanical Behavior of a Lamina
Determination of elastic constants of an orthotropic Lamina by mechanics of materials approach, Determination of tensile and compressive strength of a lamina in the fiber direction of mechanics of materials approach

Module IV: Analysis of Laminated Components
Classical Lamination Theory: Lamina Stress-Strain behavior, strain and stress behavior in a Laminate, Resultant Laminated forces and moments, Symmetric, Anti-symmetric and non-symmetric Laminate stiffness, Laminate strength: Laminate strength analysis procedure, Laminate strength criteria, thermal and mechanical strength analysis, strength of cross-ply and Angle-ply laminates

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:
- R.M. Jones, “Mechanics of Composite Materials”.
- Sabodh K. Garg and Others, “Analysis of Structural Composite Materials”.
- Robert Nicholle, “Composite Construction Materials Handbook”.
- Bhagwan D. Agarwal and Lawrence, “Analysis and performance of Fibre Composites”, Broutman, John Wiley.
- Ronald and F. Gibson, “Principles of composite Materials Mechanics”, McGraw Hill Int. Ltd.

AEROELASTICITY

Course Code: ASE2414 **CreditUnits: 02**

Course Objective:
This course is prepared with the objective that the students will gain knowledge of aeroelastic nature of the materials used on aircraft, its effect on the aerodynamic forces, stability and performance of the aircraft. Such effects, like in case of flutter, are studied analytically.

Course Contents:
Module I: Introduction
Definition and historical background, Static and dynamic aeroelasticity phenomenon, integration of aerodynamic, elastic and inertia forces, Influence of aeroelasticity phenomenon on aircraft design

Module II: Divergence of Lifting Surface
Phenomenon of divergence, Divergence of 2-D wing section, Divergence of an idealized cantilever wing, Solution to generalized co-ordinates, Method of successive approximation

Module III: Steady State Aeroelasticity Problems in General
Loss and reversal of aileron control: 2D case, Aileron reversal general case, Lift distribution on a rigid and elastic wing, Effect on static longitudinal stability of aircraft

Module IV: Introduction to Flutter and Buffeting
Phenomenon of flutter, Flutter of a cantilever wing, Approximate determination of critical speed by Galerkin's Method, Buffeting and stall flutter

Module V: Non-aeroelastic Problems
Flow around an oscillating circular cylinder, Applications to H-shaped sections, Prevention of aero-elastic instabilities

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Fung Y.C., "An Introduction to Theory of Aeroelasticity", Dover Publications, 1st Ed., 1967.
- R.L Bisplinghoff, Holt Ashley and Halfman R.L. "Aeroelasticity", Addison–Wesley Publishing Co. Reading Mass, 1st Ed, 1965

Syllabus - Fifth Semester

PROPULSION SYSTEMS-II

Course Code: ASE2501 **CreditUnits: 03**

Course Objective:

The objective of this course is to make the students understand the flow dynamics of supersonic and compressible flows through compressor, combustion chamber, nozzles and turbine passages and flows involving heat transfer and frictional effects. The difference in the performance analysis of a turbine engine in ideal and real conditions is discussed so that the students can appreciate the need to study both of these situations.

Course Contents:

Module I: Steady 1-Dimensional Gas Dynamics

Basics, simple flows, nozzle flow, nozzle design, nozzle-operating characteristics for isentropic flow, nozzle flow and shock waves, nozzle characteristics for some operational engines, Rayleigh flow and Fanno flow, effect of frictional duct length in subsonic flow and supersonic flow, numerical problems in 1D flow

Module II: Inlets, Nozzles and Combustion Chambers

Subsonic inlets: pressure recovery, inlet sizing drag flow distortion, Supersonic inlets: Total and sonic state points, A/A* normal shock based internal compression inlets, design sizing and performance, exhaust nozzle, C-D nozzle, engine back pressure control, exit area ratio, and exhaust nozzle system performance in details, Combustion systems, burners, ignition, flame stability, After burners: System design, flame stability, pressure losses

Module III: Parametric Cycle Analysis of Ideal Engines

Steps of engine parametric cycle analysis, basic assumptions, Applications to: Ideal Ramjet, Ideal Turbojet with and without afterburner, Ideal Turbofan engine, optimum BPR and afterburning, Ideal turboprop engine, and Ideal Turboshaft engine

Module IV: Parametric Cycle Analysis of Real Engines

Cycle analysis of turbojet, turbojet with after burner, turbofan and turboprop

Module V: Axial Flow Compressor

Euler's Turbomachinery equations, Axial flow compressor analysis, cascade action, flow field, Euler's equation, velocity diagrams, flow annulus area stage parameters, Degree of reaction, cascade airfoil nomenclature and loss coefficient, diffusion factor, stage loading and flow coefficient, stage pressure ratio, Blade Mach Number, repeating stage, repeating row, mean line design, Flow path dimensions, number of blades per stage, Radial variation, design process, performance

Module VI: Axial Flow Turbine

Introduction to turbine analysis, mean radius stage calculations, stage parameters, stage loading and flow coefficients degree of reaction, stage temperature ratio and pressure ratio, blade spacing, radial variation, velocity ratio, Axial flow turbine, stage flow path, Dimensional stage analysis, Multistage design; steps of design: single stage and two stages, Turbine performance, Blade cooling

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A.: Attendance

Text & References:

- J.D. Mattingly, "Elements of Gas Turbine Propulsion", McGraw Hill 1st Ed. 1997.
- Cohen, Rogers and Sarvanmottoo, "Gas Turbine Theory", John Wiley.
- P.G. Hill and C.R. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison-Wesley, 1970.
- Gorden C. Oates, "Aircraft Propulsion Systems, Technology and Design", AIAA Pub.
- J.L. Kereebrock, "Aircraft Engines and Gas Turbine", MIT Press 1991.

AERODYNAMICS-II

Course Code: ASE2502 **CreditUnits: 03**

Course Objective:
The objective of this course is to make the students understand the transformation of circles into airfoils, Aerodynamic characteristics of thin airfoil in incompressible flow. The study of incompressible flow over finite wings and derivation of linearized velocity potential equation in compressible flow

Course Contents:
Module I: Conformal Transformation
Complex potential function, Blasius theorem, principles of conformal transformation, Kutta - Juokowaski transformation of a circle into flat plate, airfoils and ellipses

Module II: Incompressible Flow over Airfoils
Glauert's thin airfoil theory, symmetrical airfoil, cambered airfoil, flapped airfoil, determination of mean camber line shapes for uniform and linear distribution of circulation, Description of flow about multi-element airfoils

Module III: Incompressible Flow over Finite Wings
Downwash and induced drag, Biot-Savart's law and Helmholtz's theorem, Prandtl's classical lifting line theory, fundamental equations, Elliptic lift distribution, general lift distribution, effect of aspect ratio, Lifting Surface theory, Formation Flying, Ground effect, Flow field of delta wing, Sample calculation of lift and drag on delta plan forms

Module IV: Compressible Subsonic Flows over Airfoils
The derivation of velocity potential equation, Linearized velocity potential equation, Prandtl-Glauert compressibility correction, Critical Mach number, Whitcomb's area rule, Super critical airfoil

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A.: Attendance

Text & References:

- John D. Anderson, Jr., "Fundamentals of Aerodynamics", 2nd Ed. McGraw Hill, 1991.
- Bertin and Smith, "Aerodynamics for Engineers", Prentice Hall, 1989.
- Shevel RS, "Fundamentals of Flight", Prentice Hall,2nded
- Houghton and Brock, "Aerodynamics for Engineering students", 2nd Ed., Edward-Arnold UK.
- Liepmann and Rosheko, "Elements of Gas Dynamics", John Wiley, 1957.

AIRCRAFT STRUCTURES-II

Course Code: ASE2503 **CreditUnits: 03**

Course Objective:
This objective of this course is to make the students understand the analytical study of the buckling behaviour of columns and plates. The students will also study the post buckling behaviour of plates and the behaviour of field beams under tension.

Course Contents:
Module I: Elasticity of Columns
Euler column, higher order differential equations for columns, energy approach, dynamic approach of predicting buckling loads, approximate methods for prediction of buckling loads, Effect of shear on buckling loads, Large deflection of columns, Columns with eccentricity in geometry, Open section columns, Torsional buckling of open section columns, Flexural torsional buckling of open section columns

Module II: Stability of Elastic Plates
Governing differential equation for stability of plates under uniaxial compressive loads, Energy equation for appropriate solution for bucking loads, Rayleigh Ritz technique, Galerkin technique, Buckling loads under axial compressive loads and shear loads, Finite difference equations for estimating buckling loads, Buckling of stiffened plates, Buckling of plates with different boundary conditions

Module III: Post-buckling Behaviour of Plates
Concept of effective width, buckling behaviour of plates

Module IV: Complete Tension and Semi-tension Field Beams
Complete tension field beams, semi-tension field beams

Module V: **Stress and Strain measurements**
Theory of strain measurement, Study of stress fields using methods of photoelasticity

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A.: Attendance

Text & References:

- Iyengar NGR, "Structural stability of Columns and Plates", Affiliated East-West Press (Pvt) Ltd, New Delhi,1st Ed.1986
- Timoshanko S.P. and Goodier J.N., "Theory of Elastic Stability", McGraw Hill Book Co, Reprinted,1989
- Chajis C., "Introduction to Structural Stability", Prentice Hall Inc., Engle Wood Cliff, 1986
- David J. Perry, "Aircraft Structures", McGraw Hill, 1949.
- T.H.G. Megson "Aircraft Structures for Engineering Students", Edward Arnold, UK
- Rivello RM, "Theory and Analysis of Flight Structures", McGraw Hill.
- Experimental Stress Analysis by Dally & Raleigh.

PROGRAMMING LAB-II (MATLAB)

Course Code: ASE2506 **CreditUnits: 01**

Course Objective:
It is matrix based simulation software, which works on algorithms. It carries various toolboxes, which is helpful for day-to-day accessibility to real world. It helps in designing graphic user interface, provides tools for neural network. Hardware that is not economical for general purpose, this software toolbox helps to minimize the cost ability.

Software Requirement: MAT LAB 6.5

S. NO.	NAME OF EXPERIMENTS
1.	To draw the time response for first order transfer function $H(S)=\frac{6}{S+9}$ second order transfer function $H(S)=\frac{45}{S^2+6S+49}$ third order transfer function $H(S)=\frac{8S}{S(S+2)(S+3)}$
2.	To realize the time response in simulink by importing the system parameters from the work window for given transfer function $H(S)=\frac{4S}{S(S+9)(S+5)}$
3.	To draw the bode plot for following function $H(S)=\frac{46S}{(S+2)(S+4)(S^2+2S+4)}$ and draw the bode plot using input arguments that represents the continuous state space system: $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -3 & -4\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u$ $y=\begin{bmatrix}10 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+[0]u$
4.	To draw the Nyquist plot for following function $H(S)=\frac{46S}{(S+2)(S+4)(S^2+2S+4)}$ and draw the Nyquist plot using input arguments that represents the continuous state space system: $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -3 & -4\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u$ $y=\begin{bmatrix}10 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+[0]u$
5.	To draw the root locus plot for following transfer function $H(S)=\frac{45}{S(S+2)(S+4)^2}$

6.	Write a program to determine the values of the DTFT of a real sequence described as a rational function in $e^{-j\omega}$ $X\left(e^{-j\omega}\right)=\frac{0.008-0.033e^{-j\omega}+0.05e^{-j2\omega}-0.033e^{-j3\omega}+0.033e^{-j4\omega}}{1+2.37e^{-j\omega}+2.7e^{-j2\omega}+1.6e^{-j3\omega}+0.41e^{-j4\omega}}$ where K= 256
7.	Write a program to determine the M-point DFT $u[k]$ of the following N-points sequence $u[n]=\begin{cases}1, & 0\le n\le N-1\\ 0, & \text{Otherwise}\end{cases}$ here N=8 and M=16
8.	Express the following Z- transform in factored form, plot its poles and zeros, and then determine its ROCs $G(Z)=\frac{2z^4+16z^3+44z^2+56z+32}{3z^4+3z^3-15z^2+18z-12}$
9.	Write a program to test the stability of the transfer function $H(Z)=\frac{1}{4z^4+3z^3+2z^2+z+1}$
10.	Design a DAS of given four signals with signal conditioning equipments in SIMULINK

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

AIRPLANE STRUCTURES & FEM LAB

Course Code: ASE2508 **CreditUnits: 01**

Course Objective:
This course provides basic knowledge and understanding of various tools available for the modeling and analysis of aircraft structural members. This course provides knowledge to the students about various modeling and analysis tools for the designing of aircraft structures.

List of Experiments:
1. To determination Young's Modulus of steel by Deflection method
2. To verify Maxwell's Reciprocal Theorem
3. To analyze shear center of open (L) section and closed (D) section
4. To analyze shear center of C and I Sections
5. To analyze unsymmetrical bending of beams
6. Introduction to FEM, ANSYS and structural workbench
7. To simulate stress-strain analysis of a rectangular plate
8. To simulate stress analysis of a cylindrical column
9. To simulate static structural analysis of a cantilever beam
10. To simulate structural analysis of a linear column buckling

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

- B.C. Nakra and K.K. Chaudhary, "Instrumentation Measurement and Analysis", Tata McGraw Hill, 2nd Ed, 1993.

SUMMER INTERNSHIP EVALUATION-I

Course Code: ASE2535 **CreditUnits: 03**

Objective:
There are certain phases of every Intern's professional development that cannot be effectively taught in the academic environment. These facets can only be learned through direct, on-the-job experience working with successful professionals and experts in the field. The internship program can best be described as an attempt to institutionalize efforts to bridge the gap between the professional world and the academic institutions. Entire effort in internship is in terms of extending the program of education and evaluation beyond the classroom of a university or institution. The educational process in the internship course seeks out and focuses attention on many latent attributes, which do not surface in the normal classroom situations. These attributes are intellectual ability, professional judgment and decision-making ability, inter-disciplinary approach, skills for data handling, ability in written and oral presentation, sense of responsibility etc.

Guidelines
In order to achieve these objectives:

- **Each student will be allotted a supervisor** for proper guidance.
- **Student will first submit details of company, external guide, project title to coordinator/supervisor as per given schedule.**
- For internal assessment purpose, students will submit an industry feedback and a progress report.
- Student will maintain a file (**Internship File/Project Report**) which he/she will submit after completion of internship. **Further, coordinator will provide NTCC project guidelines and sample to help in preparation of file.** The Internship File aims to encourage students to keep a personal record of their learning and achievement throughout the Programme. It can be used as the basis for lifelong learning and for job applications. Items can be drawn from activities completed in the course modules and from the workplace to demonstrate learning and personal development. The File will assess the student's analytical skills and ability to present supportive evidence, whilst demonstrating understanding of their organization, its needs and their own personal contribution to the organization.

The **layout guidelines** for the Project Report

1. File should be in the following specification

- A4 size paper
- Spiral Binding
- **Font**

For normal text Font Type and Size must be- Times New Roman, 12 pt. The minimum font size of materials within a table or a figure can be 10 point.

- **Margins**

A margin of 3.75 cm (1½ inch) is to be given on the binding edge while on the other sides it is to be 2.5 cm (1 inch). The text of the report, including headings, figures, tables, and notes, but excluding page numbers, must be accommodated within the page area.

- **Line Spacing**

The line spacing in the main text must be between one-and-a-half (1.5). Single line spacing should be given for figure captions, table titles, figure legends, and footnotes. Equations, tables, figures, and quotations should be set off from the main text with adequate space (not less than the normal line spacing adopted for the main text). Two consecutive paragraphs should be separated by a spacing which must be larger than the line spacing adopted for the text.

- **Tables and Figures**

Each sketch, drawing, graph and photograph should have a figure number and title below the figure etc. Numbering should be sequential, chapter wise. For instance, if there are 24 figures chapter 3

spread over all of its sections the figure numbers run from Figure 3.1 through Figure 3.24. In figures experimental data should typically be represented by centered symbols, and theoretical data by continuous curves.
Each table should have a table number and caption above the table. Numbering should be sequential, chapter wise, as in the case of Figure numbers. For instance, if there are 18 tables in chapter 3 the table numbers run from Figure 3.1 through Figure 3.18.

Make sure that figures and tables are complete in other respects such as legends, references (if any) and coordinate labels with units. Each figure and table must be explicitly referred to in the text and located where its first reference occurs, preferably after the reference.

- **Drawings**

All engineering drawings must conform to relevant Standards and should include a title block. If drawings are large they should be included at the back of the report in a separate pocket. In case drawings are made using CAD packages, a CD ROM should be included which contains all the files and details of the packages used.

- **Equations**

The numbering of equations should be sequential, chapter wise. Numbered equations must be explicitly referred to in the text.

2. Report Size: The maximum number of pages of the Report should be preferably between 50-80 pages.

3. Report Layout: The report should contain the following components
Front Page
Declaration
Student Certificate (University)
Certificate (Company)
Acknowledgement
Abstract
Contents
List of Figures
List of Tables
Company Profile (optional)
Chapters
Appendices(optional)
References / Bibliography

The above components are described below:
1. **The Title Page**-- Format will be given by coordinator/supervisor.
2. **Declaration by the Students-**This is page number (i), the beginning of the small case Roman numeral page numbers. The student has to give a declaration to the effect that the data used for the work, the work depicted in the report, and the written material contained in the report are not copied from others and that due permission has been taken from, and due credit has been given to, the sources whenever they are used.
3. Certificate-This is page number (ii). It is given by the Institute. The certificate will be signed by the Faculty Supervisor(s) before the viva-voce after verifying the format and by the Head of the Department after review with the Supervisor(s).
4. Company Certificate: This is a certificate, which the company gives to the students.
5. Contents-This is page number (iii). The table of Contents should be titled just Contents (not Table of Contents). Try to fit it into one or two pages.
6. Acknowledgement-This is page number (iv). Keep this brief and avoid using informal language. This page must be signed by the candidate.
7. Abstract and **Keywords-**This is page number (v). The abstract (preferably one page) should contain the context/relevance of the problem at hand, a description of what was done and a gist of the significant observations/results.
The keywords (maximum 6) are a hint that what is contained in the report.

8. Company Profile: A Company Profile corresponds to a file with company-specific data. Company data can be stored there and included in a booking when needed.

9. **Chapters**—Introduction, Literature Review/Background Study etc. as given by coordinator/supervisor.

10. **References / Bibliography** --This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

ASSESSMENT OF THE INTERNSHIP FILE

Continuous Internal Assessment consists of topic relevance, progress report and industry feedback on company letterhead. Final Assessment includes viva, presentation, execution and report marks.

Examination Scheme:

Components	**IF**	**PR**	**R**	**E**	**V**	**FP**
Weightage (%)	20	20	15	15	15	15

V – Viva, IF – Industry Feedback, FP – Final Presentation, R – Report, PR-Progress Report, E-Execution

PRINCIPLES OF HELICOPTER ENGINEERING

Course Code: ASE2507 **CreditUnits: 03**

Course Objective:
This course is designed to provide knowledge about various terms connected with aerodynamics, flight performance, stability and control of a helicopter with particular emphasis to rotor blades. The students will also understand various parameters of propulsion systems used in helicopters and certain salient aspects of rotor performance and design.

Course Contents:
Module I: Introduction
Helicopter as an aircraft, Basic features, Layout, Generation of lift, Gearbox, tail rotor, power plant, drive to main tail rotor, considerations on blade, feathering and flapping, Rotor controls, various types of rotor, Geometry of the rotor, Blade loading, Effects of solidity, Profile drag, compressibility etc., blade area required, Number of blades, blade form, power losses, rotor efficiency

Module II: Aerodynamics of Rotor Blades
Aerofoil characteristics in forward flight, hovering and state vortex ring, Blade stall, Maximum lift of the helicopter, calculation on induced power high speed limitations, parasite drag, power leading, tip speed ratio on performance, Ground effect

Module III: Power Units and Flight Performance
Piston engines, Gas turbines, Ramjet principle, gross weight of a jet helicopter, Comparative performance, Horsepower required, Range and Endurance, rate of climb, best climbing speed, Ceiling in vertical climb, Autorotation

Module IV: Dynamic Stability and Control
Physical description of effects of disturbances, longitudinal dynamic stability, Stick fixed dynamic stability, longitudinal stability characteristics, lateral dynamic stability, lateral stability characteristics, control response

Module V: Rotor Vibrations
Dynamic model of the rotor, motion of the rigid blades, flapping motion, lagging motion, feathering motion, properties of vibrating systems, phenomenon of vibrations, fuselage response, Vibration absorbers, Measurement of vibration in flight

Module VI: Rotor Blade Design
General considerations, Airfoil selection, blade constructions, materials, factors affecting weight and cost, Design conditions, stress analysis

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:
- Young R.A, "Helicopter Engineering".
- Bramwell, A.R.S, "Helicopter Dynamics".
- Jacob Shapiro, "Principles of Helicopter Engineering".
- John Fay, "The Helicopter and How it Flies".

BOUNDARY LAYER THEORY

Course Code: ASE2509 **CreditUnits: 03**

Course Objective:
This course will provide knowledge of basic concepts of momentum and thermal boundary layers formulation of equations and solutions given by different investigators in case of flat surface and axisymmetric bodies. The study involves the analysis and understanding of empirical results for laminar boundary layer, transition and turbulent boundary layer.

Course Contents:
Module I: Review of Basic Concepts and Formulation of Equation
Boundary layer thickness, Momentum thickness, Energy thickness, Energy thickness, Shape Factor, separation equations of Motion and energy equation for compressible viscous fluid-derivation and discussion, boundary layer equation and their general properties

Module II: Exact Solution and Approximate Methods
Flat plate at zero incidence, Flows with pressure gradient, Von Karman and Polhausen Methods

Module III: Axially Symmetrical Body
Rotation near ground, Circular jet, Boundary layer on a body of revolution, flow in the entrance section of pipe

Module IV: Thermal Boundary Layer
Heat transfer from heated surface, Incompressible and compressible laminar flow over a flat plate, Plate thermometer problem

Module V: Transition
Pipe flow and flow over a flat plate, Critical Reynolds number, turbulent spots, Principles of theory of stability of Laminar flows, Sommerified equation, factors affecting transition, Laminar airfoils

Module VI: Boundary Layer Control
Methods of control, Fundamental equations and exact solution for a flat plate with uniform suction, Compressible Boundary Layers with suction, Approximate solution for a flat plate with uniform suction, Compressible Boundary Layers with suction Approximate solutions, Theoretical and Experimental Results

Module VII: Turbulent Boundary Layer
Fundamentals of Turbulent flow, Mean motion and fluctuations, Reynolds stresses, wind tunnel Turbulence, Prandtl's mixing Length theory, Von Karman's similarity Hypothesis, Velocity distribution laws

Module VIII: Turbulent flow through Pipe
Experimental results through smooth pipes, Relation between laws of friction and velocity distribution, Universal Resistance law for smooth pipe at large Reynolds number, Rough pipe and equivalent roughness

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:
- Schlichting H., "Boundary Layer Theory"
- Houghton and Boswell, "Further Aerodynamics for Engineering Students".

AIRCRAFT SYSTEMS

Course Code: ASE2551 **CreditUnits: 03**

Course Objective:
The objective of this course is to

- Learn the concepts of various systems in aircraft.
- Evaluate the behavior of various systems.
- Study the application and real time problems associated with those systems

Course Contents:

Module I: Flight Control Systems
Primary and secondary flight control, Flight control linkage systems, push-pull control rod system, cable and pulley systems, High lift control surfaces, Flight control actuation, linear actuator, mechanical actuator, mechanical screw jack actuator, Direct drive actuation, fly-by-wire actuator, electro-hydrostatic actuator, electro-mechanical actuator

Module II: Engine Control Systems
Engine starting, engine indications, Engine oil system, fuel flow control, ignition control, Air flow control, engine-off, control system parameters, Input signals, output signals, Reverse Thrust on modern civil aircraft, throttle levers, Starting sequence

Module III: Hydraulic and Pneumatic Systems
Hydraulic circuit design, Hydraulic actuation, Hydraulic Fluid, Fluid pressure, Fluid flow rate, Hydraulic piping, Hydraulic Pumps, Hydraulic reservoir, Emergency power source, Use of bleed air, Engine bleed air control, Bleed air system indications

Module IV: Environment Control Systems
Need for controlled environment, Heat sources, ram air cooling, fuel cooling, Engine bleed, bleed flow and temperature control, Air cycle refrigeration, Humidity control, hypoxia, tolerance

Module V: Gyroscopic Systems
Gyroscope and its properties, Gyro horizon, Turn and bank indicator, turn coordinator, Direct reading magnetic compass,Directional gyroscope.

Module VI: Emergency Systems
Warning systems, Fire detection & suppression, Emergency power source, Emergency landing, Emergency system testing

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:

- Aircraft systems by LanMoir Allan Seabridge.
- Aircraft Systems by David A Lombardo Tata McGraw Hill
- Aircraft Instruments by E H J Pallet.

Syllabus - Sixth Semester

AIRCRAFT MATERIALS & PROCESSES

Course Code: ASE2602 **CreditUnits: 03**

Course Objective:
This course builds up a strong knowledge base of aerospace students in respect of various important materials used in the manufacture of aircraft including certain salient manufacturing processes that are specific to the aircraft manufacturing. The course also covers the design principles of jigs and fixtures that are used for manufacturing various components and assemblies of aircraft to ensure symmetry of the geometric shapes and to increase accuracy/repeatability in dimensions.

Course Contents:

Module I: Introduction
Properties of flight vehicle materials, Importance of strength/weight ratio of materials for Aerospace Vehicles: Structures, Importance of temperature variations, factors affecting choice of material for different parts of airplane

Module II: Light Metal Alloys
Aluminum alloys, Heat treatment, High strength and high corrosion resistant alloys, Magnesium alloys and their properties, Heat treatment, Application to Aerospace Vehicle of these alloys

Module III: Aircraft Steels
Classification of alloy steels, Effect of alloying elements, Carbon steels v/s Alloys steels, corrosion resistant steels, Heat treatment, Corrosion prevention methods, Selection and application of steel alloys to aircraft manufacture

Module IV: High Strength and Heat Resistant Alloys
Classification of heat resistant materials and iron, Nickel and cobalt base alloys, Refractory materials: Ceramics, Titanium and its alloys, properties of Inconel, Monal and K-Monal, Nimonic and super alloys: Application to Aerospace vehicles

Module V: Metal Joining Processes
Weld ability, Standard welding practices e.g. gas welding, resistance welding, Welding of light alloys, Riveting

Module VI: Jigs and Fixtures for Aircraft
General design, Method of location of cylindrical and flat surfaces, Design principles of Wing Jig, Fuselage jig and other components

Module VII: Aircraft Manufacturing Processes
Profiling, Hydro forming, mar forming bending rolls, Spar milling, Spark erosion and Powered metal parts, integral machining, Contour etching, High energy rate forming, Manufacturing of honeycomb structures, General methods of construction of aircraft and aero engine parts

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:

- Chapman WAJ, "Workshop Technology", Vol. I, II, III.
- G.F. Titterton, "Aircraft Materials and Processes", Himalayan Books, New Delhi
- G.B.Ashmead, "Aircraft Production Methods". :
- Lalit Gupta, "Advanced Composite Matertials", Himalayan Books, New Delhi,1998

AIRCRAFT MAINTENANCE & QUALITY ASSURANCE

Course Code: ASE2609 **CreditUnits: 03**

Course Objective:
This course is designed to provide knowledge to the students about all types of preventive maintenance: repairs, overhauls and calibration, rigging and testing of aircraft and its instruments and components/systems etc. This course also provides the knowledge of layout of aircraft structure, corrosion of aircraft components and its prevention and use of FRP components and maintenance requirements associated with it.

Course Contents:

Module I: Introduction
Requirement of maintenance of aircraft, its components, systems, subsystems, Types of maintenance scheduling, Mandatory schedules, Inspection of aircraft and components, Types of Inspections, Repair, Modifications, and Reconditioning, Tools used, Role of airworthiness and flight-testing Issue of C of A

Module II: Testing of Aircraft Materials and Components
Testing techniques for Tension, Hardness, Bending, Impact, Crushing, Torsion, Fatigue, Hydrostatic tests, NDT Techniques: X-ray, Gamma Ray, and Ultrasonic; Magna-flux, Prediction of crack propagation, Preventive design

Module III: Layout of Aircraft Structure
Principle and important sub-groups, Aircraft Station numbering sub-assemblies in airframe, landing gear, Power plant and its attachment, Rotorcraft Structure

Module IV: Corrosion and its Prevention
Corrosion of dissimilar metals, protection, Cleaning, Plating anodic, Oxidation, Paints, Problems of corrosion to aircraft in the vicinity of sea, Protective/Preventive measures

Module V: Fabrication and Repair of FRP Components
Development of metal bonding and composite materials, Bonding Structures, Composites: Characteristics, types, Fabrication and repair

Module VI: Aircraft Assembly and Rigging
Aircraft Assembly, Rigging, Alignment of fixed surfaces and flight controls and systems in details, balancing, Inspection and Maintenance, Flight control system of Helicopter

Module VII:Quality Assurance
Meaning of Quality and quality improvement, need of Quality, Statistical methods for quality control, Process capability, Need of Quality Assurance, Quality Audit, Concept of Zero defect, ISO 9000 quality systems, total quality management

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:

- Kroes et.al, "Aircraft Maintenance and Repair", GLENCOE, 1993.
- G.F. Titterton, "Aircarft Materials and Processes", Himalayan Books, New Delhi-1990.
- Lalit Gupta, "Advanced Composite Materials", Himalayan Books, New Delhi-1998.
- AmitavMitra, "Fundamentals of Quality Control", Pearson Education
- Feigenbaum, "Total Quality Control", McGraw Hill & Co.
- Suresh Dalela, "Quality Systems", Standard Publishers & Distributors

COMPUTATIONAL AERODYNAMICS

Course Code: ASE2611 **CreditUnits: 03**

Course Objective:
This course is to provide an understanding of the concepts of structural analysis; bending, shear, torsion of thin walled tubes and main aircraft components. The course also covers the matrix method and use of Finite Element Method in carrying out the structural analysis.

Course Contents:
Module I: Introduction to Grid Generation
Introduction to grid generation, various grid generation techniques

Module II: Transonic Aerodynamics
Introduction to transonic aerodynamics, Numerical solutions of transonic small perturbation, full potential and Euler equations

Module III: Incompressible Navier-Stokes Equations
Numerical solutions of incompressible Navier-Stokes equations

Module IV: Compressible Navier-Stokes Equations
Numerical solutions of compressible Navier-Stokes equations

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:

- Patrick M Knupp, "Fundamentals of Grid Generation/Book and Disk" ISBN: 0849389879.
- Jack Moran, "An Introduction to Theoretical and Computational Aerodynamics", Dover Publications.
- "Computational Fluid Dynamics Techniques", edited by W.G. Habashi and M.M. Hafez,
- Gordon and Breach Publishers, provided by Taylor & Francis.
- Rudolph X Meyer, "Elements of Space Technology for Aerospace Engineers", Elsevier. ISBN: 0124929400
- Ch. Hirsch, "Numerical Computation of Internal and External Flow's, Volume I, II, John Wiley and Sons, 1989.

AIRCRAFT STABILITY & CONTROL

Course Code: ASE2651 **CreditUnits: 03**

Course Objective:
This objective of this course is to make the students understand various aspects of stability of an aircraft in flight - both stick fixed and stick free, and how geometric features of control surfaces and their proper angular movements achieve it. Students are also given an analytical understanding of longitudinal, lateral and directional stability and measures that can be taken to control the same.

Course Contents:
Module I: Stick Fixed Static Longitudinal Stability
Introduction to stability of airplane, stick fixed longitudinal stability, effect of power, Neutral point, Centre of gravity limits, In flight measurement of stick fixed neutral point

Module II: Control Surfaces and Aerodynamic Balancing
Control surface hinge moments, floating and restoring tendencies, different types of tabs used on airplanes, Frise Aileron, Spoiler Controls

Module III: Stick Free Static Longitudinal Stability
Effect of free elevator on airplane stability, Elevator Control force, stick force gradients, Neutral point, Controls free center of gravity limit, In-flight measurement of stick free neutral point

Module IV: Maneuvering Flight
Effect of acceleration on airplane balancing, Elevator angle per g and stick force per g, Maneuver margins

Module V: Directional Stability and Control
Asymmetric flight, Feather cock stability, contribution of different parts of Airplane, Rudder Fixed and Rudder free static directional stability, rudder lock

Module VI: Lateral Stability and Control
Dihedral Effect, Contribution of different parts of airplane controls in roll, aileron control power, cross coupling of lateral and directional effects

Module VII: Dynamic Stability
(a) Longitudinal Dynamic Stability: Simple analysis of short period and phugoid modes, stick-fixed and stick-free
(b) Lateral and Directional Dynamic Stability: Simple analysis of roll subsidence spiral mode and Dutch roll

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:
- Perkins and Hage, "Airplane Performance Stability and Control".
- Etkin, "Dynamics of flight"
- Dickinson, "Aircraft Stability and control for Pilots and Engineers".
- Babister, "Aircraft Stability and Control".
- DommaschSerby and Connoly, "Airplane Aerodynamics".

PROGRAMMING LAB-III (ADVANCED AUTOCAD)

Course Code: ASE2605 **CreditUnits: 01**

Course Contents:

- Modeling of machine Components such as Connecting Rod, Piston etc.
- 2D modeling for different Geometrics such as Hexagon, Pentagon etc.
- 3D modeling for Nuts and Bolts.
- Modeling of Gear.
- Modeling of Compound Geometrics such as Hollow Cylinder containing Sphere, Triangle etc.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

CFD LAB

Course Code: ASE2612 **CreditUnits: 01**

Course Contents:

This laboratory work includes study/development of computer modeling of physical objects /systems and solution of basic flow problems. Following aspects are to be covered:

1. Modeling a 2D object with structured mesh using GAMBIT software.
2. Modeling a 2D object with unstructured mesh using GAMBIT software.
3. Modeling a 3D object with structured mesh using GAMBIT software.
4. Solving a simple 2D flow problem using FLUENT software.
5. Solving a simple 2D axisymmetric flow problem using FLUENT software.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

SENSORS AND SYSTEMS

Course Code: ASE2606 **CreditUnits: 03**

Course Objective:
The overall objective of this course is to provide high caliber engineering students with an in-depth understanding of strategic, tactical and operational issues relating to sensors used in space vehicles worldwide. On completion of the course, the students will be equipped with the state-of-the-art concepts, methods, techniques and tools to allow them to understand the inertial navigation.

Course Contents:
Module I:Introduction to Modern Navigation
Navigation Definition, Types of Navigation, Inertial Sensors and System Evolution

Module II: Autonomous Inertial Navigation Principle and frame reference, Geometry of Earth, Gravitation and Gravity, Gimbaled Platform Navigation, Strap down Navigation, Comparison between the three Transformation Schemes

Module III: Satellite Navigation System
Global Positioning System, Range Measurements and Navigation Solution, Differential Operation, Satellite Integrity Monitoring, Features of GLONASS, Comparison between INS and SNS

Module IV: Accelerometers
Operating Principle, Open loop pendulous Accelerometer, limitations, closed loop pendulous accelerometer, pendulous versus non-pendulous comparison

Module V: Gyros
Gyro principle of operation, Single Degree of freedom Rate Gyro, Free Gyro, Dynamically Tuned Gyro, Hemispherical Resonator Gyro, Ring Laser Gyro

Module VI: Micro Electromechanical Inertial Sensors
Micro fabrication, Micro Electromechanical Accelerometers, Micro Electromechanical Gyros, Scaling effects in micro inertial sensors

Module VII: Inertial System Technology
Gimbaled Platform Technology, Strap down System Technology, Navigational error propagation, Redundant Inertial Systems, Software engineering

Module VIII: Applications
Inertial Navigation System for Satellite Launch Vehicles, Inertial Systems for Satellite, Airborne Remote Sensing, Azimuth Determination in oil drilling, Metrology and angular Measurement, Airborne telescope pointing, Rail track alignment measurement, Detection of Earthquakes

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:
- Modern Inertial Sensors and Systems by Amitava Bose, Somnath Puri, Paritosh Banerjee PHI

MECHATRONICS

Course Code: ASE2607 **CreditUnits: 03**

Course Objective:

Course Contents:

Module I: Introduction

Measurement systems, control systems, Microprocessor-based controllers, Sensors and tranducers, Signal conditioning processes.

Module II: Actuation Systems

Pneumatic and hydraulic actuation systems, Directional control valves, pressure control valves, process control valves.

Module III: System Models

Mathematical models, Mechanical system building blocks, modeling dynamic systems, First order systems, Second order systems.

Module IV: Principles of Feedback & Intelligent Control

Control Systems, Open & Closed loop control Systems, Controllers, Artificial Neural Network.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- W. Bolton, "Mechatronics", Pearson Education Ltd., 2003.
- Mohammad Ali Mazidi Janice GillispierMazidi, "The 8051 Microcontroller", Pearson Education Inc., 2004.
- Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson Asia P. Ltd., Singapore, 1998.
- Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2001.
- Charles H. Roth, "Jr. Fundamentals of Logic Design", Jaico Publishing House, 2001.
- "HMT Mechatronics", Tata McGraw Hill Publishing Co. Ltd., 2001.
- DevdasShetty, Richard A. Kolk "Mechatronics System Design", Thomson Asia Pvt. Ltd., Singapore, 2001.
- A.K. Tayal, "Instrumentation & Mechanical Measurements", Galgotia Publication Pvt. Ltd., 2003.
- D. RanaDurgaiah, "Fluid Mechanics & Machinery", New Age Int. Publishers, 2004.
- NitaigourPremchandMahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill Publishing Co.Ltd, 2003.
- Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 2nd Edition, Prentice Hall, 2001.

SPACE FLIGHT NAVIGATION AND GUIDANCE

Course Code: ASE2608 **CreditUnits: 03**

Course Objective:
The objective of this course is to

- Provide introductory knowledge to the students regarding the basic science and principles as applicable to navigation of interplanetary flight vehicles in atmosphere, space and around planetary bodies
- Provide education to the students about the various navigation, guidance and communication systems and subsystems of different types of spacecraft

Course Contents:
Module I:Navigation on earth's surface
Basic principle of navigation & position fixing, Air navigation radio aids, Flight management for situational awareness

Module II: Newton's Laws Applied to Navigation
Math tools, Geodetics and basic reference frames, Simplified Aerospace Vehicle Equation, Fundamental of Navigation Equation, Inertial Navigation system solution- A preview, Global position system solution –a preview.

Module III: Inertial Navigation sensors & systems
Aircraft gyroscopic Flight Instruments, Inertial platform mechanizations, Attitude-heading reference systems

Module IV: Kalman Filter Inertial Navigation System
Flight applications, Kalman filter discrete case derivation, Kalman filter divergence

Module V: Global Positioning System
Principle of operation, Global-positioning system segments, Selective availability, Global positioning system error sources & error modeling, International Satellite navigation system

Module VI: High Accuracy Navigation using GPS
Global positioning system aiding inertial navigation system, Differential global positioning system, wide augmentation

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

Text & References:

- Integrated Navigation and Guidance Systems by PANIEL J. BIEZAD AIAA Education series

Syllabus - Seventh Semester

INTRODUCTION TO AVIONICS

Course Code: ASE2701 **CreditUnits:03**

Course Objective:
The objective of this course is to provide introductory knowledge to the students about the various avionics systems and technology used in flight vehicles. This course provides technical education to the students about the various avionics systems and subsystems, their functions, supporting technologies and avionic system design considerations.

Course Contents:
Module I: **Avionics Technology**
Importance of role of avionics, Avionics environment, Microelectronics devices, Data bus integrationof aircraft, Fiber optic buses, LRU architecture for avionics packaging, software, environmental effects, difference in avionics architecture of commercial and military aircraft

Module II: **Man Machine Interface**
Head up display, Helmet mounted display, Head down display, Display technology

Module III: **Air Data Sensing**
Use of pitot static probe, static probe to derive air data indications;Role of Air Data Computer (ADC),Magnetic Sensing, Magnetic Heading Reference System (MHRS),Inertial Sensing, Position Gyros, Rate Gyros, Accelerometers, Radar SensingRadar Altimeter (RADALT), Doppler Radar, Weather Radar

Module IV: **Fly-by-Wire Flight Controls**
Inertial sensors, Navigation systems, Automatic Direction Finding, Very High Frequency Omni-Range (VOR), Distance Measuring Equipment (DME), Tactical Air Navigation (TACAN), VORTAC (VOR+TACAN), Satellite Navigation System-Global Positioning System (GPS), Differential GPS, Instrument Landing System (ILS), Transponder Landing System (TLS), Microwave Landing System (MLS), Astronavigation Communication,HF, U/VHF, Satellite Communication, Air Traffic Control (ATC) Transponder, Traffic Collision & Avoidance System (TCAS), Identification Of Friend & Foe (IFF)

Module V: **Auto-pilot and Flight Management System**
Longitudinal, Lateral &direction Autopilot, Avionics systems integration, unmannedair vehicles

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:
- Civil Avionics Systems-Ian Moir, Allan Seabridge, AIAA Education Series
- Introductionto to Avionics Systems by RPG Collinson, Springer
- Principles of Avionics by Albert Helfrick

FLIGHT DYNAMICS

Course Code: ASE2702 **CreditUnits:03**

Course Objective:
This course is designed to make the students understand the complexities of airplane and rocket dynamics. The six degree of freedom trajectory analysis of rocket along with stability and control aspects will be discussed. A comprehensive analysis of aircraft motion and stability will be stressed upon in this course.

Course Contents:
Module I: Introduction
Fundamentals of vectors, Particle and rigid body kinematics: Fixed frame of reference, rotating frame of reference, Choice of axes: principal axes, stability axes, body axes, Transformation of coordinates

Module II: Aircraft Equations of Motion
General equations of unsteady motion of airplane: Force equations in moving frame, Moment equations in moving frame, Orientation and position of the airplane: Principle Rotation, Euler angles, Euler rates, Transformation matrix, External forces, Angular velocities equations in moving frame, Velocities equations in moving frame, Flight simulation of powered and unpowered flights

Module III: Small Disturbance Theory
Linearized equations of aircraft motion: Control fixed longitudinal directional equations, control fixed lateral directional equations, Stability criteria, Stability analysis of linearized equations of motion, Airplane longitudinal motion: Short period approximation, Phugoid approximation, Airplane lateral motion: Spiral approximation, Roll approximation, Dutch roll approximation, Sample calculation on longitudinal and lateral motion approximations

Module IV: Stability Derivatives
Expressions for $Cx, and\ Cz$. The α Derivatives: $Cx_{\alpha}, Cz_{\alpha}, Cm_{\alpha}$. The u Derivatives: Cx_{u}, Cz_{u}, Cm_{u}. The q Derivatives: Cz_{q}, Cm_{q}. The $\dot{\alpha}$ Derivatives: $C_{L\dot{\alpha}}, C_{m\dot{\alpha}}$. The β Derivatives: $C_{y\beta}, C_{l\beta}, C_{n\beta}$. The p Derivatives: C_{yp}, C_{lp}, C_{np}. The r Derivatives: C_{yp}, C_{lp}, C_{np}.

Module V: Fundamentals of Rocket Dynamics
Classification of rockets, Flight performance of single stage rocket, Design parameters, Performance in terms of design parameters, Flight performance of multi-stage rocket

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Etkin, B., "Dynamics of Flight" 3rd Edition, John Wiley & Sons, Inc.
- Meriam, J. L., "Dynamics" John Wiley & Sons, Inc.
- Nelson, R. C., "Flight Stability and Automatic Control", McGraw-Hill
- Roy, A. E., "Foundation of Astrodynamics", Macmillan.
- Kaplan, M. H., "Spacecraft Dynamics and Control", John Wiley & Sons, Inc.

AIRCRAFT DESIGN

Course Code: ASE2709 **CreditUnits:03**

Course Objective:
This course is to make the students understand various design requirements, including those laid down by the DGCA, both structural and aerodynamic design considerations, for different types of airplanes and how the design of an airplane is guided by its performance requirements as covered by the V-n diagram for both civil and military type airplanes.

Course Contents:
Module I: Introduction to Aircraft Design
Aircraft design, requirements and specifications, airworthiness requirements, Weight and its importance, Aerodynamic and structural design considerations, Classifications of airplane, Concept of configuration design, special features

Module II: Air Loads in Flight
Symmetrical maneuvering loads in flight, Load factor, V-n diagram, Gust loads, Estimation of gust loads, Structural effects

Module III: Wing Design Considerations
Selection of airfoil and planform, Span wise air loads variation, BM and SF, Design principles for the structure of all metal, stressed skin wing (Civil and Military airplane)

Module IV: High Lift Systems
Airfoil's maximum lift coefficient, Leading and trailing edge devices, Effect of sweep back, Deep stall, Effect of Re, Propulsive lift, V/STOL configurations

Module V: Conceptual Design of Airplane and Layout
Preliminary aerodynamic design of an airplane for a given set of specifications (Civil/Mil), Preparation of 3-views and layout, Estimation of take-off, landing, climbing and cruise performance, Flight envelope

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Daniel P Raymer, "Airplane Design- A Conceptual Approach", AIAA Education Series, 1999.
- D. Stinton, "The Design of Airplane", GRANADA, UK, 2000.
- Nikolai L.M., "Fundamentals of Aircraft Design", Univ. of Dayton Ohio, 1975.

AIRCRAFT PERFORMANCE

Course Code: ASE2710 **CreditUnits:03**

Course Objective:
This course is designed to make the students understand the characteristics of a standard atmosphere, how the flying bodies perform in the available atmospheric conditions, the interplay of aerodynamic forces to maintain the flying object in steady and accelerated flight and perform maneuvers and are subjected to control at different flying speeds.

Course Contents:
Module I: Standard Atmosphere
Standard atmosphere, relation between Geopotential and Geometric altitudes, pressure, temperature and density altitudes, Relation for stratosphere and troposphere, Stability of atmosphere, aero-thermodynamics, Measurement of air-speed: true airspeed, indicated airspeed and equivalent airspeed, Airspeed indicator

Module II: Aerodynamic Drag
Drag and its effects, Types of drag and affecting factors,Drag polar, Compressibility drag, Design for minimum drag, Estimation of drag of complete airplane, Terminal velocity

Module III: Aerodynamic Characteristics
Force and Moments coefficients dimensional analysis, Pressure distribution over 2D airfoil, Variation with angle of attack, Center of pressure, Aerodynamic center and connected problems, Lift, Drag and moment coefficients; Relations between lift and drag, Estimation of these characteristics from measured pressure distributions, Variation of aerodynamic coefficients with Reynolds Number and Mach Number, Effect of span, Aspect ratio, plan form, sweep, taper and twist on aerodynamic characteristics of a lifting surface, Delta wing aerodynamics

Module IV: Airplane Performance in Steady Flight
Straight and Level flight, stalling speed; Variation of drag with flight, Speed conditions for minimum drag, minimum power conditions; Power at other speeds, Gliding flight, Shallow and steep angles of glide; Sinking speed, Minimum sinking speed, Time of descent, Climbing flight at shallow angles, Correction for steep angles, Time to flight, Maximum rate of climb

Module V: Airplane Performance in Accelerated Flight
Take-off and landing, Calculations of take-off ground run, Take-off distances, Minimum ground run, assisted take-off, Calculation of landing ground run, Range and endurance and problems connected with them

Module VI: Maneuvers
Introductory comments on spins and stalls; turning flight, Maneuvers in 3D space

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- Dommasch, D.O., Sherby S.S. & Connolly TF, "Airplane Aerodynamics", 4th Ed. Pitman Publishing Group
- Houghton E.L. and Brock, A.E "Aerodynamics for Engineering Students", Edward Arnolds.
- Richard S. Shevell, "Fundamentals of Flight", 3rd Ed. Prentice Hall.
- John D. Anderson, "Introduction to Flight", McGraw Hill, 3rd Ed.
- Bertin J.J. and Smith M.L., "Aerodynamics for Engineers", 2nd Ed., Prentice Hall.
- Perkins C.D. and Hage R.E., "Airplane Performance, Stability and Control", John Wiley, 1949.

SUMMER INTERNSHIP EVALUATION-II

Course Code: ASE2735 **CreditUnits:03**

Objective:
There are certain phases of every Intern's professional development that cannot be effectively taught in the academic environment. These facets can only be learned through direct, on-the-job experience working with successful professionals and experts in the field. The internship program can best be described as an attempt to institutionalize efforts to bridge the gap between the professional world and the academic institutions. Entire effort in internship is in terms of extending the program of education and evaluation beyond the classroom of a university or institution. The educational process in the internship course seeks out and focuses attention on many latent attributes, which do not surface in the normal classroom situations. These attributes are intellectual ability, professional judgment and decision-making ability, inter-disciplinary approach, skills for data handling, ability in written and oral presentation, sense of responsibility etc.

Guidelines
In order to achieve these objectives:

- **Each student will be allotted a supervisor** for proper guidance.
- **Student will first submit details of company, external guide, project title to coordinator/supervisor as per given schedule.**
- For internal assessment purpose, students will submit an industry feedback and a progress report.
- Student will maintain a file (**Internship File/Project Report**) which he/she will submit after completion of internship. **Further, coordinator will provide NTCC project guidelines and sample to help in preparation of file.** The Internship File aims to encourage students to keep a personal record of their learning and achievement throughout the Programme. It can be used as the basis for lifelong learning and for job applications. Items can be drawn from activities completed in the course modules and from the workplace to demonstrate learning and personal development. The File will assess the student's analytical skills and ability to present supportive evidence, whilst demonstrating understanding of their organization, its needs and their own personal contribution to the organization.

The **layout guidelines** for the Project Report

1. File should be in the following specification

- A4 size paper
- Spiral Binding
- **Font**

For normal text Font Type and Size must be- Times New Roman, 12 pt. The minimum font size of materials within a table or a figure can be 10 point.

- **Margins**

A margin of 3.75 cm (1½ inch) is to be given on the binding edge while on the other sides it is to be 2.5 cm (1 inch). The text of the report, including headings, figures, tables, and notes, but excluding page numbers, must be accommodated within the page area.

- **Line Spacing**

The line spacing in the main text must be between one-and-a-half (1.5). Single line spacing should be given for figure captions, table titles, figure legends, and footnotes. Equations, tables, figures, and quotations should be set off from the main text with adequate space (not less than the normal line spacing adopted for the main text). Two consecutive paragraphs should be separated by a spacing which must be larger than the line spacing adopted for the text.

- **Tables and Figures**

Each sketch, drawing, graph and photograph should have a figure number and title below the figure etc. Numbering should be sequential, chapter wise. For instance, if there are 24 figures chapter 3

spread over all of its sections the figure numbers run from Figure 3.1 through Figure 3.24. In figures experimental data should typically be represented by centered symbols, and theoretical data by continuous curves.
Each table should have a table number and caption above the table. Numbering should be sequential, chapter wise, as in the case of Figure numbers. For instance, if there are 18 tables in chapter 3 the table numbers run from Figure 3.1 through Figure 3.18.

Make sure that figures and tables are complete in other respects such as legends, references (if any) and coordinate labels with units. Each figure and table must be explicitly referred to in the text and located where its first reference occurs, preferably after the reference.

- **Drawings**

All engineering drawings must conform to relevant Standards and should include a title block. If drawings are large they should be included at the back of the report in a separate pocket. In case drawings are made using CAD packages, a CD ROM should be included which contains all the files and details of the packages used.

- **Equations**

The numbering of equations should be sequential, chapter wise. Numbered equations must be explicitly referred to in the text.

2. Report Size: The maximum number of pages of the Report should be preferably between 50-80 pages.

3. Report Layout: The report should contain the following components
Front Page
Declaration
Student Certificate (University)
Certificate (Company)
Acknowledgement
Abstract
Contents
List of Figures
List of Tables
Company Profile (optional)
Chapters
Appendices(optional)
References / Bibliography

The above components are described below:
1. **The Title Page**-- Format will be given by coordinator/supervisor.
2. **Declaration by the Students-**This is page number (i), the beginning of the small case Roman numeral page numbers. The student has to give a declaration to the effect that the data used for the work, the work depicted in the report, and the written material contained in the report are not copied from others and that due permission has been taken from, and due credit has been given to, the sources whenever they are used.
3. Certificate-This is page number (ii). It is given by the Institute. The certificate will be signed by the Faculty Supervisor(s) before the viva-voce after verifying the format and by the Head of the Department after review with the Supervisor(s).
4. Company Certificate: This is a certificate, which the company gives to the students.
5. Contents-This is page number (iii). The table of Contents should be titled just Contents (not Table of Contents). Try to fit it into one or two pages.
6. Acknowledgement-This is page number (iv). Keep this brief and avoid using informal language. This page must be signed by the candidate.
7. Abstract and **Keywords-**This is page number (v). The abstract (preferably one page) should contain the context/relevance of the problem at hand, a description of what was done and a gist of the significant observations/results.
The keywords (maximum 6) are a hint that what is contained in the report.

8. Company Profile: A Company Profile corresponds to a file with company-specific data. Company data can be stored there and included in a booking when needed.

9. **Chapters**—Introduction, Literature Review/Background Study etc. as given by coordinator/supervisor.

10. **References / Bibliography** --This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

ASSESSMENT OF THE INTERNSHIP FILE

Continuous Internal Assessment consists of topic relevance, progress report and industry feedback on company letterhead. Final Assessment includes viva, presentation, execution and report marks.

Examination Scheme:

Components	**IF**	**PR**	**R**	**E**	**V**	**FP**
Weightage (%)	20	20	15	15	15	15

V – Viva, IF – Industry Feedback, FP – Final Presentation, R – Report, PR-Progress Report, E-Execution

INDEPENDENT STUDY

Course Code: ASE2711 **CreditUnits:02**

This is an elective, self-directed course to investigate aemerging areasof IT and Computer Science like Mobile Operating System, Cloud Computing, or from Current Research Areas etc. The primary goal of the course is to provide students with research exploration of a specific topic of interest to the individual student under the advisement of an instructor who will monitor and critique the student's progress.

Independent study provides students with the opportunity to work one-on-one with a Faculty on a particular topic. The student and faculty should discuss the aims and content of the study and present the proposal to Head of Department. The independent study proposal should include the study's title, theme, readings, work to be submitted, and syllabus. Faculty and student should meet for a minimum number of 2 hours per week. Student will give a seminar after completion of study.

TERM PAPER

Course Code: ASE2731 **CreditUnits:02**

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

Guidelines for Term Paper

The procedure for writing a term paper may consist of the following steps:

1. Choosing a subject
2. Finding sources of materials
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

1. Choosing a Subject

The subject chosen should not be too general.

2. Finding Sources of Materials

a) The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
b) Begin by making a list of subject-headings under which you might expect the subject to be listed.
c) The sources could be books and magazine articles, news stories, periodicals, scientific journals etc.

3. Collecting the Notes

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

a) Get facts, not just opinions. Compare the facts with author's conclusion.
b) In research studies, notice the methods and procedures, results & conclusions.
c) Check cross references.

4. Outlining the Paper

a) Review notes to find main sub-divisions of the subject.
b) Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

5. Writing the First Draft

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

a) statement of purpose
b) main body of the paper
c) statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main idea.

6. Editing &Preparing the Final Paper

a) Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
b) Read the paper to ensure that the language is not awkward, and that it "flows" properly.
c) Check for proper spelling, phrasing and sentence construction.
d) Check for proper form on footnotes, quotes, and punctuation.
e) Check to see that quotations serve one of the following purposes:
    (i) Show evidence of what an author has said.
    (ii) Avoid misrepresentation through restatement.
    (iii) Save unnecessary writing when ideas have been well expressed by the original author.
f) Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

Term papers should be composed of the following sections:

1) Title page
2) Table of contents
3) Introduction
4) Review
5) Discussion&Conclusion
6) Bibliography
7) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

Discussion

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

Conclusion

The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

a) summary of question posed
b) summary of findings
c) summary of main limitations of the study at hand
d) details of possibilities for related future research

Bibliography

From the very beginning of a research project, you should be careful to note all details of articles gathered. The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography. The key to a good bibliography is consistency. Choose a particular convention and stick to this.

Bibliographical Conventions:

Monographs

Crystal, D. (2001), Language and the internet, Cambridge: Cambridge University Press

Edited Volumes

Gass, S/Neu, J. (eds.) (1996), Speech acts across cultures, Challenges to communication in a second language, Berlin/ NY: Mouton de Gruyter.

[(eds.) is used when there is more than one editor; and (ed.) where there is only one editor. In German the abbreviation used is (Hrsg.) for Herausgeber].

Edited Articles

Schmidt, R./Shimura, A./Wang, Z./Jeong, H. (1996), Suggestions to buy: Television commercials from the U.S., Japan, China, and Korea. In: Gass, S./Neu, J. (eds.) (1996), Speech acts across cultures. Challenges to communication in a second language, Berlin/ NY: Mouton de Gruyter: 285-316.

Journal Articles

McQuarrie, E.F./Mick, D.G. (1992), On resonance: A critical pluralistic inquiry into advertising rhetoric. Journal of consumer research 19, 180-197.

Electronic book

Chandler, D. (1994), Semiotics for beginners [HTML document]. Retrieved on [5.10.01] from the World Wide Web, http://www.aber.ac.uk/media/Documents/S4B/.

Electronic Journal Articles

Watts, S. (2000) Teaching talk: Should students learn 'real German'? [HTML document], German as a Foreign Language Journal [online] 1, Retrieved [12.09.00] from the World Wide Web, http://www.gfl-journal.com/

Other Websites

Verterhus, S.A. (n.y.), Anglicisms in German car advertising. The problem of gender assignment [HTML document], Retrieved on [13.10.01] from the World Wide Web, http://olaf.hiof.no/~sverrev/eng.html

Unpublished Papers

Takahashi, S./DuFon, M.A. (1989), Cross-linguistic influence in indirectness: The case of English directives performed by native Japanese speakers. Unpublished paper, Department of English as a Second Language, University of Hawai'i at Manoa, Honolulu

Unpublished Thesis/ Dissertations

Möhl, S. (1996), Alltagssituationen im interkulturellen Vergleich: Realisierung von Kritik und Ablehnung im Deutschen und Englischen. Unpublished MA thesis, University of Hamburg

Walsh, R. (1995), Language development and the year abroad: A study of oral grammatical accuracy amongst adult learners of German as a foreign language. Unpublished PhD dissertation, University College Dublin

Appendix

The appendix should be used for data collected (e.g. questionnaires, transcripts, etc.) and for tables and graphs not included in the main text due to their subsidiary nature or to space constraints in the main text.

Examination Scheme:

Dissertation:	75
Viva voce	25
Total:	**100**

PROJECT

Course Code: ASE2732 **CreditUnits:02**

Methodology

Topics of project are to be based on the latest trends, verifying engineering concepts /principals and should involve elementary research work. The projects may involve design, fabrications, testing, computer modeling, and analysis of any engineering problem. On completion of the practical training the students are to present a report covering various aspects learnt by them and give a presentation on same.

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

Project File

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period where the researcher is not working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The project file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the file should be comprehensive and includes:

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

Layout Guidelines for the Project File

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Assessment of the Project File

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following assessment objectives:

- Range of research methods used to gain information
- Execution of research
- Data analysis (Analyse Quantitative/ Qualitative information)
- Quality Control
- Conclusions

Assessment Scheme:
Continuous Evaluation:
40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:
60% (Based on the documentation in the file, final report layout, analysis and results, achievement of objectives, presentation/ viva)

Syllabus - Eighth Semester

VIBRATION ENGINEERING

Course Code: ASE2809 **Credit Units: 03**

Course Objective:
This course is designed to provide adequate knowledge to analyze one-degree and multi-degree of freedom systems of vibrations using different methods to find out their natural frequencies and frequency/ amplitude responses.

Course Contents:
Module I: Scope of Vibration
Important terminology and classification, Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition, Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and center of percussion, Damped vibrations of single degree of freedom systems, Viscous damping, underdamped, critically damped and overdamped systems, Logarithmic decrement, Vibration characteristics of Coulomb damped and Hysteretic damped systems

Module II: Forced Vibrations of Single Degree of Freedom Systems
Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support

Module III: Vibration Isolation and Transmissibility
Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation

Module IV: System with Two Degrees of Freedom
Principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber

Module V: Many Degrees of Freedom Systems
Exact analysis, Approximate methods, Rayleigh's, Dunkerley's, Stodola's and Holzer's methods, Vibrations of continuous systems, Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:
- Mechanical Vibrations, Rao S.S., Pearson Education.
- Mechanical Vibrations and Noise Engineering, Ambekar A.G., Prentice Hall India.
- Mechanical Vibrations, Grover G.K., Nem Chand and Brothers.
- Theory of Vibrations with Applicaion, Thomson and Dahleh, Pearson Education.
- Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw-Hill, New Delhi.
- Principles of Vibration, Benson H.Tongue, Oxford Publcation

VIBRATION ENGINEERING LAB

Course Code: ASE2810 **CreditUnits:01**

List of Experiments

To perform any 8 of the following experiments:

1. To find the viscosity of the given fluid using the concept of vibrations.
2. To determine the co-efficient of friction between two materials using the method vibrations and also draw a graph between the co-efficient of friction and the speed of the rollers.
3. Investigation of the node and anti-node position for the cantilever.
4. Investigation of the node and anti-node position for simply supported beam.
5. Investigation of the node and anti-node position for a fixed end beam.
6. Determine experimentally the load on a beam with different end conditions and compare it with actual load and discuss the results.
7. Test the given structure for its vibrational stability.
8. Determine experimentally the spring stiffness and dampers required structure to a specific degree from the given vibrating body and test it experimentally.
9. To determine experimentally the whirling speed of shaft for a given system.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

MAJOR PROJECT

Course Code: ASE2837 **Credit Units: 08**

Methodology

Topics of project are to be based on the latest trends, verifying engineering concepts /principals and should involve elementary research work. The projects may involve design, fabrications, testing, computer modeling, and analysis of any engineering problem. On completion of the practical training the students are to present a report covering various aspects learnt by them and give a presentation on same.

Guidelines for Project File and Project Report

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

Project File

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period where the researcher is not working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

Project Report

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

- **Title or Cover Page**
  The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.
- **Acknowledgement(s)**
  Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.
- **Abstract**
  A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.
- **Table of Contents**
  Titles and subtitles are to correspond exactly with those in the text.

- **Introduction**

  Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.
- **Materials and Methods**

  This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.
- **Results and Discussion**

  Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

  Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

  While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

  Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.
- **Conclusion(s) & Recommendations**

  A conclusion should be the final section in which the outcome of the work is mentioned briefly.

  Check that your work answers the following questions:
  - Did the research project meet its aims (check back to introduction for stated aims)?
  - What are the main findings of the research?
  - Are there any recommendations?
  - Do you have any conclusion on the research process itself?
- **Implications for Future Research**

  This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.
- **Appendices**

  The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
- **References**

  References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

  Examples

  For research article

  Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic*Escherichia coli* O157: H7. *ClinMicrobiol Infect*, **8** (suppl 1): 116–117.

  For book

  Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

Layout Guidelines for the Project File & Project Report

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Assessment of the Project File and the Project Report
Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.
The Project should fulfill the following assessment objectives:

- Range of Research Methods used to oASEin information
- Execution of Research
- Data Analyses (Analyse Quantitative/ Qualitative information)
- Quality Control
- Conclusions

Assessment Scheme:

Continuous Evaluation:
40% (Based on punctuality, regularity of work, adherence to plan and methodology,refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:
60% (Based on the Documentation in the file, Final report layout, analysis andresults, achievement of objectives, presentation/ viva)

INTRODUCTION TO AUTOMATIC FLIGHT CONTROL

Course Code: ASE2851 **CreditUnits:03**

Course Objective:
This course is designed to provide adequate knowledge to analyse one-degree and multi-degree of freedom systems of vibrations using different methods to find out their natural frequencies and frequency / amplitude responses.

Course Contents:
Module I: Introduction
Open Loop and Closed Loop (Feed Back) control systems. Types of feedback control systems. Laplace's transform

Module II: Feedback Control Systems
Transfer function of linear systems. Impulse response of linear systems, Block diagrams of feedback control systems, Multivariable systems. Block diagram algebra

Module III: Analysis of Feedback Control Systems
Typical test input signals, Time domain performance characteristics of feedback control systems. Effects of derivative and integral control, Steady State response of feedback control system-steady State error, Frequency response.

Module IV: System Stability
Routh-Hurwitz Criterion, the Root Locus Method

Module V: Auto-pilots
Longitudinal Auto Pilots: Brief description through Block diagrams and Root Locus of Displacement, Auto Pilot, Pitch orientation Control System, Acceleration control system

Module VI: Miscellaneous
Fly-By-Wire control system, Instrument Landing System

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- John H. Blackelock, "Automatic Control of aircraft and Missiles", John Wiley and Sons, 2nd Ed.1990
- Perkins C.D. and Hage R.E., "Airplane Performance Stability and Control", John Wiley and Sons.
- Bernard Etkins, "Dynamics of Flight Stability and Control", John Wiley & Sons, 2/Ed 1989
- Robert C. Nelson, 'Flight Stability and Automatic Control", McGraw Hill Co, 1989.
- Pallet H.J., "Automatic Flight Control", B.S. Professionals Books, Oxford, 3rd Ed, 1987
- Benjamin C. Kuo, "Automatic Control Systems," Prentice Hall of India, 1992

ROCKETS & MISSILES

Course Code: ASE2803 **CreditUnits:03**

Course Objective:
This course is aimed to provide to the students' knowledge rockets/missiles, their performance, stability and control. The course also covers methods of stabilization and mathematical treatment of stability and control and maneuverability.

Course Contents:
Module I: General Information
Difference between Rocket and missile, Type of Rockets and missiles, Satellite launch vehicles

Module II: Aerodynamic Characteristics of Airframe Components
Introduction, Bodies of revolution, Different fore-body shapes, Summary of characteristics of bodies of revolution, Base pressure, Aerodynamic control, Jet control

Module III: Performance of Missiles and Rockets
Introduction, Various types of drags, Boost glide trajectory, Graphical solution, Boost sustainer trajectory, Long range cruise trajectory, Long range ballistic trajectory, Powered and un-powered flight, Brief description of Fin Stabilized and spin stabilized and spin stabilized Rockets and their force systems, Thrust misalignment

Module IV: Stability and Control
Longitudinal: Two degrees of freedom Analysis, Complete Missile Aerodynamics with forward and rear control, Static stability margin
Directional: Introduction, Cruciform configuration, Body wind and Tail contribution on directional control
Lateral: Induced roll, Internal control and design consideration for cruciform and Monowing, Damping in roll

Module V: Maneuvering Flight
Introduction, Flat turn for cruciform and mono-wing, Pull-ups, Relationship of maneuverability and static stability margin

Module VI: Dynamic Stability
Equation of motion, Longitudinal dynamic degree of freedom, Classical solution, Lateral dynamics

Module VII: Miscellaneous
Launching problems, Re-entry and recovery of space vehicles, Modern Concepts, Manned Missions, Current topics

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:

- S.S Chin, "Missile Configuration Design" McGraw Hill
- Davis Follin and Blitzer, "Exterior Ballistics of Rockets", Van Nostrand
- Seifert and Brown, "Ballistic Missiles and Space Vehicle Systems", John Wiley
- Seifert (Edited by), "Space Technology", John Wiley

HEAT TRANSFER

Course Code: ASE2805 **CreditUnits:03**

Course Objective:
This course aims to provide the students essential knowledge on various modes of heat transfer and its application in solving problems related to aero-thermodynamics of rockets and launch vehicles. Specifically this course would deal with aero-thermal design and analysis of various rocket systems.

Course Contents:
Module I: Conduction Heat Transfer
Introduction – Steady state, heat conduction in one and two dimensions and one-dimensional unsteady state heat conduction

Module II: Heat Transfer by Convection
Basic equations, Boundary Layers, Forced Convection, External and Internal flows and Natural Convection

Module III: Radiation Heat Transfer
Thermal radiation and emissive power, Basic Laws, Properties of surfaces, Engineering Treatment of Gas Radiation, View factors

Module IV: Boiling and Condensation

Module V: Analysis of Heat Exchangers

Module VI: Design of Thermal Protection Systems
Thermal Protection, System design for rocket nozzles, Combustion chamber, Re-entry heating analysis, Design of thermal protection for re-entry module

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att.: Attendance

Text & References:
- J. P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997
- A. Bejan, Heat Transfer, John Wiley, 1993