AEA-601 Aircraft Design

AEA-601	Aircraft Design	2L:1T:0P	3 Credits	3Hrs/Week

Course Preambles:

- Familiarize students with the important issues and methodologies of aircraft design.
- Illustrate the process of aircraft synthesis as an outcome of the integration of the disciplines of aerodynamics, performance, stability and control, propulsion, structures and aero elasticity.
- Develop the ability to function as a member of a team in a design setting; including the ability to conduct a peer review of the other team members.

Course Outcomes:

- After completing this course students will be able to:
- Perform preliminary design of a complete aircraft based on the specifications provided.
- Performing a detailed preliminary design of a complete aircraft.

Unit-1: Preliminaries (10 Hours)

Aircraft Design Requirements, specifications, role of users. Aerodynamic and Structural Consideration, Importance of weight. Airworthiness requirements and standards. Classifications of airplanes. Special features of modern airplane. Air Loads in Flight: Symmetrical measuring loads in flight, Basic flight loading conditions, Load factor, Velocity - Load factor diagram, gust load and its estimation, Structural limits.

Unit-2: Airplane Weight Estimation (10 Hours)

Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach. Basic Wing Design: Selection of airfoil selection, influencing factors. Span wise load Distribution and plan form shapes of airplane wing. Stalling take-off and landing Considerations. Wing drags estimation. High lift devices. Structural Design: Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials. Structural aspects of design of airplane, Bending moment and shear force diagram. Design principles of all metal stressed skin wing for civil and military applications.

Unit-3: Landing Gears (10 Hours)

Different kinds of landing gears, and associated arrangement for civil and military airplanes. Preliminary calculations for locating main and nose landing gears.

Unit-4: Integration of Structure and Power Plant (10 Hours)

Estimation of Horizontal and Vertical tail volume ratios. Choice of power plant and various options of locations, considerations of appropriate air-intakes. Integration of wing, fuselage, empennage and power plant. Estimation of center of gravity.

Unit-5 Introduction of advanced concepts: (5 Hours)

Supercritical Wings, relaxed static Stability, controlled configured vehicles, V/STOL aircraft and rotary wing vehicles. Design and layout of flying controls and engine controls.

References:

- Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992.
- John D Anderson (Jr.), Airplane Performance and Design, mcgraw Hill.
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AEA-601	Aircraft Design	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiment:

- Comparative configuration study of different types of airplanes.
- Comparative study on specification and performance details of aircraft.
- Preparation of comparative data sheets.
- Work sheet layout procedures.
- Comparative graphs preparation and selection of main parameters for the design.
- Preliminary weight estimations, selection of main parameters.
- Power plant selection, Airfoil selection, Wing tail and control surfaces.
- Preparation of layouts of balance diagram and three view drawings.
- Estimation of various Drags.
- Detailed performance calculations and stability estimates.

Lab Outcome:

- Student able to understand can develop the basic concept of any aircraft design.
- All students will learn the design of an Airplane for given preliminary specifications.

AEA-602 Aircraft Stability & Control

AEA-602	**Aircraft Stability & Control**	**2L:1T:0P**	**3 Credits**	**3Hrs/Week**

Course Preambles:

- To introduce the concept of Stability and control of Aircraft.
- To impart knowledge about various Aircraft motions and related stability.
- To introduce the concept of dynamic stability of Aircraft.

Course Outcomes:

After completing the course the student will be able to

- Understand the degree of freedom of aircraft system.
- Analyse the static stability Behaviour of the aircraft.
- Understand the dynamic longitudinal stability of aircraft.
- Perform the dynamic analysis to determine stability of aircraft.
- Estimate the requirement of control force and power plant.
- Assess the motion of unstable aircraft and related modes of instability.

Unit 1: Historical perspective (10 Hours)

Aerodynamic Nomenclature, Equilibrium conditions, Definition of static stability, Definition of longitudinal static stability, stability criteria, Contribution of airframe components: Wing contribution, Tail contribution, Fuselage contribution, Power effects Propeller airplane and Jet airplane Introduction, Trim condition. Static margin. Stick fixed neutral points. Longitudinal control, Elevator power, Elevator angle versus equilibrium lift coefficient, Elevator required for landing, Restriction on forward C.G. range.

Unit 2: Static Longitudinal Stability& Static Directional Stability (10 Hours)

Control-Stick free Introduction, Hinge moment parameters, Control surface floating characteristics and aerodynamic balance, Estimation of hinge moment parameters, The trim tabs, Stick-free Neutral point, Stick force gradient in unaccelerated flight, Restriction on aft C.G. Introduction, Definition of directional stability, Static directional stability rudder fixed, Contribution of airframe components, Directional control. Rudder power, Stick-free directional stability, Requirements for directional control, Rudder lock, Dorsal fin. One engine inoperative condition. Weather cocking effect.

Unit 3: Lateral Stability (10 Hours)

Introduction, definition of Roll stability. Estimation of dihedral effect, Effect of wing sweep, flaps, and power, Lateral control, Estimation of lateral control power, Aileron control forces, balancing the aileron. Coupling between rolling and yawing moments. Adverse yaw effects. Aileron reversal. Definition of Dynamic longitudinal stability. Types of modes of motion: long or phugoid motion, short period motion. Airplane Equations of longitudinal motion.

Unit 4: Yawning and Rolling Stability (10 Hours)

Derivation of rigid body equations of motion, Orientation and position of the airplane, gravitational and thrust forces, Small disturbance theory. Aerodynamic force and moment representation, Derivatives due to change in forward speed, Derivatives due to the pitching

velocity, Derivatives due to the time rate of change of angle of attack, Derivatives due to rolling rate, Derivatives due to yawing rate.

Unit 5: Control (5 Hours)

Routh‟s criteria. Factors affecting period and damping of oscillations. Effect of wind shear. Flying qualities in pitch. Cooper-Harper Scale. Response to aileron step-function, side-slip excursion. Dutch roll and Spiral instability. Auto- rotation and spin. Stability derivatives for lateral and directional dynamics.

Reference:

- Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley Son Inc, New York, 1988.
- Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2007.

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AEA-602	**Aircraft Stability & Control**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

- Introduction to flight testing (V-n diagram).
- Evaluation of glider drag polar.
- Evaluation of cruise and climb performance of a small airplane.
- Observations of airplane dynamic modes and stall characteristics.
- Introduction to GPS based navigation.
- Introduction to auto-pilot.

Lab Outcome:

- Student can able to use the V-n diagram, drag polar chart.
- Student can able to understand the functioning of autopilot, GPS based navigation and able to evaluate the cruise and climb performance of a small airplane.

Program Elective - II

AEA-603(A) Aircraft Rules and Regulation

AEA-603(A)	**Aircraft Rules and Regulation**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Course Preambles:

- Familiarize students with the important terms and rules related with DGCA, ICAO.
- To impart the knowledge on the scope and purpose of Air rules and regulation

Course Outcomes:

- After completing this course students will be able to:
- Identify the flight operations between different altitudes
- Differentiate the runway restrictions and limitations.

Unit-1: C.A.R. Series 'A and B' C.A.R. Series A (12Hours)

Procedure for Civil Air Worthiness Requirements and Responsibility Operators Vis- À-Vis Air Worthiness Directorate Responsibilities of operators / owners-Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations & safety oversight of engineering activities of operators.

Unit-2: C.A.R. Series 'C' and 'D' C.A.R. Series 'C' (12Hours)

Defect Recording, Monitoring, Investigation and Reporting Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.

C.A.R.SERIES_D' – and Aircraft Maintenance Programmes

Reliability Programmes (Engines); Aircraft maintenance programme & their approval; on condition maintenance of reciprocating engines; TBO–Revision programme; Maintenance of fuel and oil uplift and consumption records –Light aircraft engines.

Unit-3: C.A.R. SERIES E AND'F' (12Hours)

C.A.R. SERIES E–Approval of Organization

Approval of organizations in categories A, B, C, D, E, F, & G - Requirements of infrastructure at stations other than parent base.

C.A.R.SERIES_F'–Airworthiness and Continued Air Worthiness

Procedure relating to registration of aircraft; Procedure for issue/revalidation of Type Certificate of aircraft & its engines/propeller; Issue/revalidation of Certificate of Airworthiness.

Unit-4: C.A.R. SERIES 'L'&'M" (12Hours)

Issue of AME License, its classification and experience requirements, Mandatory Modifications/Inspections.

Unit-5: C.A.R. SERIES 'T'&'X' (12Hours)

Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. Registration Markings of aircraft; Weight and balance control

of an aircraft; Provision of first aid kits & Physician‟s kit in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of tax permit.

Reference:

- Aeronautical Information Circulars (relating to Airworthiness) from DGCA 2000.
- Aircraft Manual (India) Volume‖–Latest Edition, the English Book Store, 17-1, Connaught Circus, New Delhi

AEA-603(B) Wind Tunnel Techniques

AEA-603(B)	Wind Tunnel Techniques	3L:1T:0P	4 Credits	4Hrs/Week

Course Preambles:

- To provide knowledge of various types of wind tunnels and test techniques.
- To introduce the basic concepts of measurement of pressure, velocity, forces and moments on models.
- To provide knowledge of various flow visualization techniques

Course Outcomes:

After completing this course students will be able to:

- Choose proper high speed wind tunnel for required test.
- Choose correct model for wind tunnel testing
- Estimate the forces and moments for given model
- Arrive the pressure, velocity and temperature using measurement techniques
- Choose the proper flow visualization techniques

Unit 1: Principles of Model Testing (12Hours)

Buckingham Theorem – Non-Dimensional Numbers – Scale Effect Types of Similarity.

Unit 2: Wind Tunnels (12Hours)

Classification – Special problems of Testing in Subsonic, Transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

Unit 3: Calibration of Wind Tunnels (12Hours)

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.

Unit 4:Wind Tunnel Measurements (12Hours)

Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances.

Unit 5: Flow Visualization Techniques (12Hours)

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.

References:

- Rae, W.H. and Pope, A. “Low Speed Wind Tunnel Testing”, John Wile Publication, 1914.
- Pope, A., and Goin, L., “High Speed wind Tunnel Testing”, John Wiley, 1915.

Program Elective - III

AEA-604 (A) Fuel & Combustion

AEA-604 (A)	Fuel & Combustion	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- To build up knowledge of the concepts and theories of a of classical fuel combustion.
- To develop understanding of the basic principles and concepts of advanced fuel combustion and control process.

Course Outcomes:

- After completing this course students will be able to:
- Students with the required skills for analyzing thermal cycles.
- Students will get understand fundamental physical and chemical principles regarding formation and control of air pollutants in industrial and technological processes.

Unit 1: Characterization (12Hours)

Fuels –Types and Characteristics of Fuels –Determination of Properties of Fuels –Fuels Analysis –Proximate and Ultimate Analysis –Moisture Determination –Calorific Value –Gross& Net Calorific Values –Calorimetry-DuLong‟s Formula for CV Estimation –Flue gas Analysis –Orsat Apparatus –Fuel, Ash Storage & Handling -Spontaneous Ignition Temperatures.

Unit 2: Solid Fuels & Liquid Fuels (12Hours)

(a) Solid Fuels Types –Coal Family –Properties –Calorific Value –ROM, DMMF, DAF and Bone Dry Basis–Ranking –Bulk & Apparent Density –Storage –Washability –Coking & Caking Coals –Renewable Solid Fuels –Biomass –Wood Waste –Agro Fuels –Manufactured Solid Fuels.

(b) Liquid Fuels Types –Sources –Petroleum Fractions –Classification –Refining –Properties of Liquid Fuels: Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number -Alcohols –Tar Sand Oil –Liquefaction of Solid Fuels.

Unit 3: Gaseous Fuels (12Hours)

Classification –Composition & Properties –Estimation of Calorific Value –Gas Calorimeter –Rich & Lean Gas –Wobbe Index –Natural Gas –Dry & Wet Natural Gas –Stripped NG –FoulandSweet NG –LPG –LNG –CNG –Methane –Producer Gas –Gasifiers –Water Gas –TownGas –Coal Gasification –Gasification Efficiency –Non-Thermal Route –Biogas –Digesters –Reactions –Viability –Economics.

Unit 4: Combustion: Stoichiometry & Kinetics (12Hours)

Stoichiometry –Mass Basis and Volume Basis –Excess Air Calculation –Fuel & Flue Gas Compositions –Calculations –Rapid Methods –Combustion Processes –Stationary Flame –Surface or Flameless Combustion –Submerged Combustion –Pulsating & Slow Combustion Explosive Combustion-Mechanism of Combustion –Ignition & Ignition Energy –Spontaneous Combustion –Flame Propagation –Solid, Liquid and Gaseous Fuels Combustion –Flame Temperature –Theoretical, Adiabatic & Actual –Ignition Limits –Limits of Inflammability.

Unit 5: Combustion Equipment's (12Hours)

Coal Burning Equipment's –Types –Pulverized Coal Firing –Fluidized Bed Firing –Fixed Bed and Recycled Bed –Cyclone Firing –Spreader Stokers –Vibrating Grate Stokers –Sprinkler Stokers –Traveling Grate Stokers –Oil Burners –Vaporizing Burners –Atomizing Burners –Design o burners –Gas Burners –Atmospheric Gas Burners –Air Aspiration Gas Burners –Burners. Classification according to Flame Structures –Factors Affecting Burners & Combustion.

References:

- Samir Sarkar, "Fuels & Combustion", Second Edition, Orient Longman, 1990.
- Bhatt, "Vora Stoichiometry‟, Second Edition, Tata Mcgraw Hill, 1984.
- Blokh AG, "Heat Transfer in Steam Boiler Furnace", Hemisphere Publishing Corp., 1988.

- Civil Davies, “Calculations in Furnace Technology”, Pergamon Press, Oxford, 1966.
- Sharma SP, Mohan Chander, “Fuels & Combustion”, Tata Mcgraw Hill, 1989.

AEA-604(B) Maintenance of Radio & Communication Systems

AEA-604(B)	**Maintenance of Radio & Communication Systems**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Course Preambles:

- To study the electrical cable and resistors.
- To know the various types of antennas and battery
- To understand the basic radio systems.

Course Outcomes:

- This course provides the students deep knowledge Satellite Communications and its application to aircraft.
- At the end of course, students will should able to work on ac and dc measuring instruments.
- The course will focus on various types of antennas.

Unit 1: Electrical Cable and Resistors (12Hours)

Basics of the application and identification of electrical cables used in Aircraft radio installation, crimping and soldering techniques, bonding continuity and insulation tests. Composition, performance (stability and tolerance) and limitations of the fixed resistors and varistors (carbon composition, carbon film, wire wound and metallic film).

Unit 2: AC and DC Measuring Instruments (12Hours)

Electrical power distribution systems, the operation and construction of static inverters, rotary inverters and transformer rectifier units. Basics of interference caused by electrical and ignition system to radio apparatus, methods of minimizing or suppressing such interference, bonding and screening.

Unit 3: Construction and Identification of Various Types of Antennas (12Hours)

The voltage and current distribution along antenna of various length; characteristics of ground planes. Very high frequency (VHF) and high frequency (HF) airborne communications; frequency bands allocation; the methods of propagation and the ranges expected, both day and night; calculation of approximate range of communication (line of sight) with given data. The performance levels expected and specifications of typical airborne HF and VHF communication systems; the principle of operation, installation practices and procedures, functioning of the operating controls and indications and maintenance of typical HF and VHF communication transceivers. Theory of operation, performance level and specifications of an Audio Integration System.

Unit 4: Battery (12Hours)

Working principles and testing of Lead Acid and Nickel Cadmium and Silver Zinc batteries Principles, Characteristics and operation of the under mentioned systems: Automatic Direction Finder (ADF) Systems, Very High Frequency (VHF) Omni, Directional Range System.

Unit 5: Basic Radio Systems (12Hours)

Instrument Landing Systems, Weather Radar Systems, Microwave Devices, Air Traffic Control (ATC) Transponder System, Omega Navigation System, Radio Altimeter Systems, Cockpit Voice Recorder. Distance Measuring Equipment, Doppler Navigation System, Microwave Landing System, GPWS, And Emergency Locator Transmitters. Computers, Simulators. Flight Control Systems. Basics of state-of-the-art communication and navigation systems. Principles of Satellite Communications and its application to aircraft.

Reference:

1. RF Hansforde, Heywood and Company London: Radio Aids to Civil Aviation.

2. George Kannedy: Electronic Communication System, McGraw Hill
3. Brian Kendal: Manual of Avionics, Blackwell.

Open Core Elective-II

AEA-605 (A) Product Design & Development

AEA-605 (A)	Product Design & Development	3L:0T:0P	3 Credits	3Hrs/Week

Course Preambles:

- Familiarize students with the Product design, development and management process over whole product life cycle.
- To understand Methodology for product design, development and management
- To know Lean new product introduction
- To build the relationship of tangible product and brand
- To know the Marketing and product specification.

Course Outcomes:

- After completing this course students will be able to:
- Identify and analyse the product design and development processes in manufacturing industry.
- Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
- Analyse, evaluate and apply the methodologies for product design, development and management.

Unit 1: Introduction to Product Design (12Hours)

Applications, Relevance, Product Definition, Scope, Design definitions, the role and nature of design, Old and new design methods, Design by evolution vs design by innovation. Examples such evolution of bicycle, safety razor etc. Need based development, Technology based developments. Physical reliability& Economic feasibility of design concepts

Unit 2: Morphology of Design (12Hours)

Divergent, Transformation and Convergent phases of product design, Identification of need, Analysis of need, Design criteria, Functional aspects, Aesthetics, ergonomics, form (structure). Shape, size, color, Creativity, Mental blocks in creativity, Removal of blocks, Ideation Techniques.

Unit 3: Transformations stage of design (12Hours)

Brainstorming &Synaptic, Morphological techniques, Utility concept, Utility value, Utility index, Economic aspects of design, Fixed and variable costs, Break-even analysis, Product Appraisal Information and literature search, patents, standards and codes, Environment and other safety considerations in product design.

Unit4: Reliability (12Hours)

Reliability considerations in product design, Bath tub curve, Reliability of systems in series and parallel. Failure rates, MTTF and MTBF, Optimum spares from reliability consideration.

Unit5: Design of displays and controls (12Hours)

Man-Machine interface, Compatibility of displays and controls, Ergonomic aspects of design, Anthropometric data and its importance in design.

References:

- Product Design & Manufacturing - A.K.Chitale & R.C.Gupta, Prentice Hall. Engg . Product Design -C .D. Cain, Bussiness Books.
- Industrial design for Engineers –W .H. Mayall, Itiffe.
- Product Design & Decision Theory - M.K. Starr - Prentice Hall

AEA-605 (B) Management and Entrepreneurship

AEA-605 (B)	Management and Entrepreneurship	3L:T:0P	3 Credits	3Hrs/Week

Course Preambles:

- Understanding basic concepts in the area of entrepreneurship,
- Understanding the role and importance of entrepreneurship for economic development,
- Developing personal creativity and entrepreneurial initiative,
- Adopting of the key steps in the elaboration of business idea,
- Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

Course Outcomes:

- Identify the elements of success of entrepreneurial ventures,
- Consider the legal and financial conditions for starting a business venture,
- Evaluate the effectiveness of different entrepreneurial strategies, specify the basic performance indicators of entrepreneurial activity,

Unit 1: Management & Planning (12Hours)

Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management &Administration, Management as a Science, Art & Profession Nature, Importance and Purpose Of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.

Unit 2: Organizing and Staffing (12Hours)

Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees –meaning, Types of Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control (Definition only), Nature and Importance of Staffing, Process of Selection and Recruitment.

Unit 3: Entrepreneurship (12Hours)

Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Entrepreneur – An Emerging Class, Comparison between Entrepreneur and Entrepreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship**.**

Unit4: Modern Small Business Enterprises (12Hours)

Role of Small Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry.

Unit 5: Project Management (12Hours)

Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents,

Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation.

References:

- Principles of Management–P. C. Tripathi, P. N. Reddy–Tata McGraw Hill,
- Dynamics of Entrepreneurial Development & Management Vasant Desai Himalaya Publishing House.
- Management Fundamentals- Concepts, Application, Skill Development-Robers Lusier Thomson.

AEA-606 Minor Project

AEA-606	Minor Project	0L:0T:4P	2 Credits	4Hrs/Week

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Analyze the dynamic response and the calibration of few instruments
- Learn about various measurement devices, their characteristics, their operation and their limitations
- understand statistical data analysis
- Understand computerized data acquisition.
- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Write comprehensive report on Minor project work.

Guidelines:

- Minor Project should cater to a small system required in laboratory or real life.
- After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and Preambles of Minor project.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
- The student is expected to exert on design, development and testing of the proposed work as per the schedule.
- Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.