Elements of Aeronautical Engineering		Semester	I/II
Course Code	1BEAE105/205	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course outcome (Course Skill Set)

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

1. Understand the fundamentals of aviation, including the history, classification of aircraft, atmospheric properties, helicopter components, and basic aircraft structures.
2. Explain core aerodynamic principles such as lift, drag, pressure distribution, Mach number, and apply Bernoulli's theorem to solve basic aerodynamic problems.
3. Describe and compare aircraft propulsion systems, including piston engines, turbojets, turbofans, turboprops, ramjets, and scramjets, along with their operating principles and performance.
4. Analyze flight mechanics including aircraft performance parameters (climb, stall, glide, turns), motion equations, stability (static and dynamic), and aircraft maneuvers.
5. Identify and explain key aircraft systems, both mechanical (hydraulics, pneumatics, fuel, oxygen) and electrical (flight controls, instrumentation, navigation, power systems).

Module-1

Introduction to Aircrafts:

History of aviation; Atmosphere and its properties; Classification of aircrafts; Basic components of an aircraft; aircraft axis system; aircraft motions; control surfaces and high lift devices; conventional design configurations; principle of operation of each major part; Helicopters, their parts and functions.

Aircraft Structures and Materials:

Introduction; structural members; general types of construction; monocoque, semi-monocoque and geodesic structures; typical wing and fuselage structure; metallic and non-metallic materials for aircraft application.

Number of Hours: 08

Module-2

Concepts of Aerodynamics:

Significance of speed of sound; airspeed and groundspeed; standard atmosphere; Bernoulli's theorem and its application for generation of lift and measurement of airspeed; forces over wing section, airfoil nomenclature, pressure distribution over a wing section. Lift and drag components – generation of lift and drag; lift curve, drag curve, types of drag, factors affecting lift and drag; center of pressure and its significance; aerodynamic center, aspect ratio, Mach number and supersonic flight effects; simple problems on lift and drag.

Number of Hours:08

Module-3

Aircraft Propulsion:

Aircraft power plants, classification based on power plant and location and principle of operation. Turboprop, turbojet and turbofan engines; ramjets and scramjets; performance characteristics. Aircraft power plants – basic principles of piston, turboprop and jet engines; Brayton cycle and its application to gas turbine engines; use of propellers and jets for production of thrust; comparative merits and limitations of different types of propulsion engines; principle of thrust augmentation.

Number of Hours: 08

Module-4

Flight Mechanics:

Elements of Airplane performance: Equations of motion, aircraft maneuvers; rate of climb, stalling, gliding, and turning. Power curves, correct and incorrect angles of bank; aerobatics, inverted maneuvers, ground effects, Simple numericals.

Static and Dynamic stability: longitudinal, lateral and directional stability; criteria for longitudinal static stability, Neutral point, Static margin.

Number of Hours: 08

Module-5

Introduction to Aircraft Systems: Aircraft systems (Mechanical) – hydraulic and pneumatic systems and their applications; environment control system; fuel system, oxygen system.

Aircraft Systems (Electrical) – flight control system, cockpit instrumentation and displays; communication systems; navigation systems; power generation systems – engine driven alternators, auxiliary power ram air turbine; power conversion, distribution and management.

Number of Hours: 08

Suggested Learning Resources: (Text Book/ Reference Book/ Manuals):

Text books:

1. John D. Anderson, "**Introduction to Flight**", McGraw-Hill Education, 8th edition, 2015, ISBN: 978-0078027673
2. Lalit Gupta and O P Sharma, "**Fundamentals of Flight Vol-I to Vol-IV"**, Himalayan Books. 2006, ISBN:9788170020752
3. A.C. Kermode, **"Mechanics of Flight"**, Pearson Education India, 10th Edition, 1995, ISBN: 9780582237407

Reference books / Manuals:

1. A.C. Kermode, **"Flight without formulae"**, Pearson Education India, 1989. ISBN: 9788131713891.
2. Nelson R.C., **"Flight stability and automatic control"**, McGraw-Hill International Editions, 1998. ISBN 9780071158381. 3.
3. Ian Moir, Allan Seabridge, **"Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration"**, John Wiley & Sons, 2011, ISBN: 978111965006.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101101079
https://nptel.ac.in/courses/101104018
https://ocw.tudelft.nl/courses/introduction-aeronautical-engineering ,
https://ocw.mit.edu/courses/16-00-introduction-to-aerospace-engineering-and-design-spring-2003

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Assessment Structure:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE**, a student must score at least **35% of 50 marks**, i.e., **18 marks**.
- Notwithstanding the above, a student is considered to have **passed the course,** provided the combined total of **CIE and SEE is at least 40 out of 100 marks**.

Continuous Comprehensive Assessments (CCA):

CCA will be conducted for a total of 25 marks. It is recommended to include a maximum of two learning activities aimed at enhancing the holistic development of students. These activities should align with course objectives and promote higher-order thinking and application-based learning.

Learning Activity -1: [Assignments (at RBL3, RBL4, or RBL5 levels), Literature Review, Any other relevant and innovative academic activities like seminar presentations, poster presentation, Crash Investigations, Case Studies based learning activities any two (Marks- 25)

Learning Activity -2 (optional): Course Project using one or more Open Source software like XFLR5, XFoil, PyAero, NeuralFoil, OpenAeroStruct, etc (Marks-25)

Rubrics for Learning Activity (Based on the nature of learning activity, design the rubrics for each activity):

	Superior	Good	Fair	Needs Improvement	Unacceptable
Conceptual Knowledge (PO1, PO2) 5M	Demonstrates in-depth knowledge of aircraft fundamentals; applies across modules accurately	Understands concepts well; minor errors	Basic understanding; limited application	Partial knowledge; fragmented explanations	No understanding demonstrated
Problem Analysis & Application (PO2, PO4) 5M	Identifies problems independently; applies aerodynamics/propulsion equations with logical solutions	Solves familiar problems with minor guidance	Solves only simple/straight forward problems	Struggles to apply concepts; frequent errors	Cannot solve/analyze problems
Design / Tools Usage (PO3, PO5) 5M	Designs/interprets aircraft systems effectively; applies simulations/CFD innovatively	Demonstrates systems understanding; uses tools with guidance	Basic understanding; limited tool use	Incomplete or partial design/system knowledge	No attempt/understanding
Communication & Teamwork (PO9, PO10) 5M	Actively collaborates; delivers structured, clear reports/presentations	Works well in teams; communicates fairly clearly	Limited participation; communicates basic ideas	Poor teamwork; unclear communication	No participation/communication
Lifelong Learning & Professional Awareness (PO12) 5M	Consistently links learning to future aviation trends; shows initiative in self-learning	Identifies relevance; some initiative	Recognizes importance but rarely applies it	Minimal awareness; passive learner	No evidence of learning beyond classroom