FUNDAMENTALS OF AEROSPACE ENGINEERING

ENAS 201

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objectives:
The objective of this course is to familiarize students with the fundamentals of aerospace engineering, including propulsion, flight mechanics, aircraft structures, stability, aerodynamics and space applications as well as the basics of atmospheric and space flight, aircraft design and aviation history.

1 Introduction (5 hours)

1.1 Nomenclature
1.2 History of aerospace
1.3 History of aviation in Nepal
1.4 Current scenario of aerospace and aviation in Nepal
1.5 Theory of flight and equations of motion
1.6 Flight vehicles and their types

2 Atmosphere and Aerodynamics (7 hours)

2.1 Layers and properties of atmosphere
2.2 Pressure and density altitudes
2.3 Types of airspeeds
2.4 Flight parameters
2.5 Types of flows
2.6 Theory of inviscid flows
2.7 Streamlines and related concepts
2.8 Theory of viscous flows, boundary layer and shear stress
2.9 Weather related challenges in flight, and cloud atlas

3 Airfoils and Wings (14 hours)

3.1 Airfoil nomenclature
3.2 Airfoil properties and aerodynamic characteristics
3.3 Lift, drag and moment coefficients
3.4 Angles and forces in flight, generalized equations of motion in a vertical plane
3.5 Finite-wing properties
3.6 Wing geometry and design parameters

3.7 Parts of an aircraft
3.8 Control surfaces and flaps
3.9 Types of drag
3.10 Rotorcraft systems
3.11 Generalized equations of motion of an airplane in vertical and horizontal plane

4 Aircraft Performance and Propulsion (7 hours)

4.1 Types of power plants
4.2 Airbreathing engines
4.2.1 Gas turbine engines, their types and properties
4.2.2 Construction of turbojet, turboprop and turbofan engines
4.3 Non-airbreathing engines
4.3.1 Rocket engines
4.3.2 Space propulsion systems
4.4 Drag equation
4.5 Flight performance: climbing and turning flights
4.6 Drag versus speed polars, level flight and climb solutions
4.7 Absolute and service ceilings

5 Aircraft Structure (4 hours)

5.1 Types of aircraft construction
5.2 Components of fuselage and wing structures
5.3 Function and construction of aircraft structural components
5.4 Application of composite materials in modern aircraft

6 Airplane Stability (4 hours)

6.1 Directions of motion, and stability theory
6.2 Longitudinal, lateral and directional stability criteria
6.3 Functions of control and stability components in aircraft
6.4 Aircraft weight and balance

7 Space Applications (4 hours)

7.1 Kepler's laws
7.2 Orbital elements
7.3 Spacecraft design and trajectories
7.4 Classical orbital elements
7.5 Significant space missions

Tutorial (15 hours)

1. XFLR5 basics: Installation and interface
2. Wing and plane analysis

3. Wing design calculations
4. Stability analysis and advanced techniques
5. X-plane basic setup and flight control
6. Flight planning and using navigation aids
7. Instrument landing system (ILS) and weather adjustments

Practical **(22.5 hours)**

1. XFLR5 training, and design of aircraft components
2. Basic airfoil analysis (2D)
3. Parameter Variation and Performance Analysis
4. X-Plane flight instruction
5. In-Flight Maneuvering and Basic Navigation
6. Practice Flight and Realistic Scenario Simulation

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1 and 7	9	10
2	7	10
3	14	20
4	7	10
5 and 6	8	10
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Anderson, J.D., Mary L. B. (2005). Introduction to flight. Vol. 582. New York, NY, USA: McGraw-Hill Higher Education.
2. Brandt, S.A. (2004). Introduction to Aeronautics: A Design Perspective. AIAA.