Flight dynamics I - Airplane performance - Web course

COURSE OUTLINE

FLIGHT DYNAMICS - I - AIRPLANE PERFORMANCE

1. Introduction.

   Definition and subdivisions of flight dynamics.

   Forces and moments acting on vehicles in flight. .

   Equations of motion and simplification for performance analysis.

2. Earth's atmosphere and International Standard Atmosphere.

3. Drag polar.

   Various types of drags.

   Methods of estimating drag polar.

   Drag polar of vehicles from low speed to hypersonic speeds.

   High lift devices.

4. Review of the variations of thrust or power output and SFC with altitude and velocity for various air breathing engines.

5. Performance analysis.

   Steady level flight - Maximum speed, minimum speed and their variations with altitude.

   Steady climb - Maximum rate of climb, angle of climb and their variations with altitude; absolute ceiling and service ceiling.

   Range and endurance - Breguet formulae; range in constant velocity flight; effect of wind on the range.

   Accelerated level flight.

   Accelerated climb.

NPTEL

http://nptel.iitm.ac.in
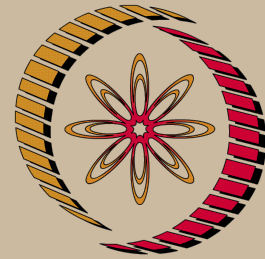
Aerospace Engineering

Pre-requisites:

The student is expected to have undergone courses on:

1. Vectors.

2. Rigid body dynamics.

3. Aerodynamics

4. Aircraft engines.

Additional Reading:

1. Miele, A. "Flight mechanics Vol I" Addison Wesley (1962).

2. Hale, F.J., "Introduction to aircraft performance, selection and design", John Wiley (1984).

3. Anderson, Jr. J.D "Introduction to flight" Fifth edition, McGrawHill, (2005).

Manoeuvres - flight in vertical plane (loop); turn(minimum radius of turn and maximum rate of turn and their variations with the altitude).

V - n diagram.

Flight limitations.

Estimations of take-off distance and landing distance.

6. Examples of estimation of the drag polar and performance of a piston engined and a jet engined airplane.

4. Roskam, J. "Methods for estimating drag polars of subsonic airplanes" published by author 1973.

Coordinators:

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COURSE DETAIL

A Web course shall contain 40 or more 1 hour lecture equivalents.

S.No	Topics	No.of Hours
1	**Chapter 1 :** Introduction	3
2	**Chapter 2 :** Earth's atmosphere	2
3	**Chapter 3 :** Drag polar	7
4	**Chapter 4 :** Engine characteristics	4
5	**Chapter 5 :**Performance analysis I – Steady level flight	4
6	**Chapter 6 :** Performance analysis II – Steady climb,descent and glide	3
7	**Chapter 7 :** Performance analysis III – Range and endurance	3
8	**Chapter 8 :** Performance analysis IV– Accelerated level flight and climb	1

9	**Chapter 9 :** Performance analysis V – Manoeuvres	4
10	**Chapter 10 :** Performance analysis VI – Take-off and landing	3
11	Performance analysis of a piston-engined airplane	3
12	Performance analysis of a subsonic jet transport	3
	Total	**40**

References:

1. Houghton and Carruthers, "Aerodynamics for engineering students", Edward Arnold (1982).

2. McCormick B.W, "Aerodynamics, aeronautics and flight mechanics", John Wiley (1995).

3. Anderson, Jr. J.D "Aircraft performance and design" McGraw Hill International edition (1999).

4. Eshelby , M.E."Aircraft performancetheory and practice" , Butterworth-Heinemann, Oxford,U.K., (2001).

5. Pamadi, B., "Performance, stability, dynamics and control of an airplane", AIAA (2004).

6. Phillips, W.F. "Mechanics of flight" 2nd Edition, John Wiley (2010).