JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
II Year B.Tech. AE - II Sem   L T/P/D C
                         4 - / /- 4
(A42105) FLIGHT MECHANICS - I

Objectives:

To acquaint the student with the methods of aircraft performance analysis.

UNIT - I

Introduction to Aircraft Performance- the Force Systems of The Aircraft: The role and design mission of an aircraft. Specification of the performance requirements and mission profile. Importance of performance analysis, estimation, measurement, operational safety and economy. Scheduled performance and operational performance of aircraft. The Standard Atmosphere. Off-standard and design atmosphere. Measurement of air data. Air data computers.

Equations of motion for performance - the aircraft force system. Lift, drag, side force. Total airplance drag- estimation, drag reduction methods. The propulsive forces - the thrust production engines, power producing engines, variation of thrust, propulsive power andspecific fuel consumption with altitude and flight speed. The minimum drag speed, minimum power speed. Aerodynamic relationships for a parabolic drag polar.

UNIT - II

Cruise Performance: Maximum and minimum speeds in level flight. Range and endurance with thrust production, and power producing engines. Cruise techniques - constant angle of attack, constant Match number; constant altitude, methods- comparision of performance. The effect of alternative fuel flow laws, weight, altitude and temperature on cruise performance. Cruise performance with mixed power-plants.

UNIT - III

Climb, Descent and Manoeuvre Performance: Climb and descent techniques, safety considerations, performance analysis- maximum climb gradient, climb rate. Energy height and specific excess power, optimal climbs - minimum time, minimum fuel climbs. Measurement of climb performance. Descent performance in aircraft operations. Effect of wind on climb and descent perfomance.

Accelerated motion of aircraft - equations of motion- the manoeuvre envelope. Longitudinal manoeuvres- the pull-up, push over manoeuvres. Lateral manoeuvres- turn performance- turn rates, turn radius- limiting factors. Instantaneousand sustained turns, specific excess power, energy turns. Manouvre boundaries, Manoeuvre performance of military aircraft, transport aircraft.

UNIT - IV

Take-off And Landing- Safety Requirements - Flight Planning: Estimation of take-off distances. The effect on the take-off distance, of weight, wind, runway conditions, ground effect. Take-off performance safety factors. Estimation of landing distances - the discontinued landing, baulked landing. Air safety procedures and requirements on landing performance.

UNIT - V

Aircraft Performance Measurement and Data Handling - Application of Performance Data: Purpose of performance measurment in flight. Flight testing- principal performance variables - weight, altitude and ambient temperature (WAT). Parametric performance data analysis. Dimensional analysis. Measurement of cruise, climb, take-off and landing performance- data reduction- equivalent weight method. Corrections for weight and temperature.

Operational performance data for flight planning- take-off field performance, runway correction, aircraft datum performance (WAT) charts, determination of the maximum take-off weight. Performance summary for fleet selection - the block performance, payload-range diagram . Route analysis and optimisation. Operational analysis procedure.

TEXT BOOKS

1. Eshelby, M.E., Aircraft Performance; Theory and Practice, AIAA Education Series, AIAA, 2000, ISBN: 1-56347-398-4.

2. Brandt, S.A, et. al., Introduction to Aeronautics: A Design Perspective, Second Edition, AIAA Education Series, AIAA, 2004, ISBN: 1-56347-701-7.

3. Anderson, J.D. Jr., Aircraft Performance and Design, International edition, McGraw Hill, 1999, ISBN: 0-07-001971-1.

REFERENCES

1. Dole, C.E., Flight Theory and Aerodynamics: a Practical Guide for Operational Safety, Wiley Interscience, 1981, ISBN: 0-471-09152-9.

2. McCormick, B.W, Aerodynamics, Aeronautics and Flight Mechanics, second edition, John Wiley, 1995, ISBN: 0-471-57506-2.

3. Shevel, R.S., Fundamentals of Flight, second edition, Pearson Education, 1989, ISBN: 81-297-0514-1.

4. Raymer, D.P., Aircraft Design: A Conceptual Approach, third edition, AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.

5. Yechout, T.R. et al., Introduction to Aircraft Flight Mechanics, AIAA Eduction Series , AIAA, 2003, ISBN: 1-56347-577-4.

Outcome:

The student should be able to esimate the performance of given aircraft and apply the performance data to flight planning.