

**PART – B (5 × 16 = 80 Marks)**

11. (a) (i) Explain briefly the different types of drag associated with an airplane. (8)
- (ii) An airplane is flying straight and level at a speed which is 'n' times the minimum power speed. Show that the power ratio  $P/P_{min} = (3 + n^4) / 4n$ . Where P is the power required corresponding to flight speed and  $P_{min}$  is the minimum power required at the altitude. (8)

**OR**

- (b) An Aircraft weighing 2,50,000 N has a wing area of 80 m<sup>2</sup>. Its drag polar equation is  $C_D = 0.016 + 0.04 C_L^2$ . Calculate the minimum thrust required for straight and level flight and the corresponding true air speeds at sea level and at an altitude where ( $\sqrt{\sigma} = 0.58$ ). Assume sea level air density to be 1.226 kg/m<sup>3</sup>.

12. (a) (i) Explain with a neat sketch V-n diagram with gust loads. (8)
- (ii) Derive the Breguet Range and endurance equation for a jet aircraft. (8)

**OR**

- (b) Explain with sketches pull up and push over maneuvers of flight and derive the expressions for turn rate and turn radius.

13. (a) (i) Show that  $\delta e_{trim} = - \left[ \frac{C_{m\dot{\alpha}} C_{L\dot{\alpha}} + C_{m\alpha} C_{L_{trim}}}{C_{m\delta} C_{L\alpha} - C_{m\alpha} C_{L\delta}} \right]$  (8)
- (ii) Explain with neat sketches the various types of aerodynamic balancing of a control surface. (8)

**OR**

- (b) Derive an expression for the wing contribution to the pitching moment of an aircraft.

# Flight Dynamics Question Paper

**Terry C. Jones**



## **Flight Dynamics Question Paper:**

*Proceedings of the Berkeley-Ames Conference on Nonlinear Problems in Control and Fluid Dynamics* Louis R. Hunt, Clyde Martin, 1984    **Collection of Technical Papers on Atmospheric Flight Mechanics**, 1974    A Collection of Technical Papers, 1980    AGARD Conference Proceedings North Atlantic Treaty Organization. Advisory Group for Aerospace Research and Development, 1993    **Journal of Dynamic Systems, Measurement, and Control**, 2005    **Hingeless Rotorcraft Flight Dynamics** Kurt H. Hohenemser, 1974 The state of hingeless rotorcraft research and development in the NATO countries as of 1973 is described The scope of this report is limited to flight dynamics as defined in the Preface since most of the hingeless rotorcraft problems have occurred in this area In the Introduction the special place of the hingeless rotorcraft within the family of rotorcraft is considered The chapter on the history of hingeless rotorcraft describes the hingeless rotor research and development of the various rotorcraft manufacturers and the hingeless rotor research at government laboratories and universities A hierarchy of dynamic concepts from isolated blade dynamics to complete rotor body dynamics is introduced The effects of the basic rotor design parameters on flight dynamics are traced and certain hingeless rotorcraft problems are treated in some detail A special chapter is devoted to the alleviation of hingeless rotor flight dynamics problems by feedback control systems Finally analytical modeling techniques mathematical analysis techniques and model and flight testing techniques for hingeless rotorcraft are discussed    **Flow Phenomena in Nature: A challenge to engineering design** Roland Liebe, 2007 Do we have an adequate understanding of fluid dynamics phenomena in nature and evolution and what physical models do we need What can we learn from nature to stimulate innovations in thinking as well as in engineering applications Concentrating on flight and propulsion this unique and accessible book compares fluid dynamics solutions in nature with those in engineering The respected international contributors present up to date research in an easy to understand manner giving common viewpoints from fields such as zoology engineering biology fluid mechanics and physics Contents Introduction to Fluid Dynamics Swimming and Flying in Nature Generation of Forces in Fluids Current Understanding The Finite Natural Vortex in Steady and Unsteady Fluid Dynamics New Modelling Applications in Engineering with Inspirations From Nature Modern Experimental and Numerical Methods in Fluid Dynamics    **Aeronautical Digest**, 1941    **Aerodynamics** Frederick William Lanchester, 1918  
*Aerial Flight: Aerodynamics. 2d ed* Frederick William Lanchester, 1909    *Aeronautical Engineering*, 1988 A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in Scientific and technical aerospace reports STAR and International aerospace abstracts IAA    **Aerodynamics, Constituting the First Volume of a Complete Work on Aerial Flight, Aerodnetics, Constituting the Second Volume ...** Frederick William Lanchester, 1907    Flight, 1910    **An Introduction to the Problem of Dynamic Structural Damping** Paolo Santini, Antonio Castellani, Alfonso Nappi, 1978    **Scientific and**

**Technical Aerospace Reports** ,1993    *Aeronautical Engineering: A Continuing Bibliography*, 1982 *Cumulative Index*  
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## **Table of Contents Flight Dynamics Question Paper**

1. Understanding the eBook Flight Dynamics Question Paper
  - The Rise of Digital Reading Flight Dynamics Question Paper
  - Advantages of eBooks Over Traditional Books
2. Identifying Flight Dynamics Question Paper
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Flight Dynamics Question Paper
  - User-Friendly Interface
4. Exploring eBook Recommendations from Flight Dynamics Question Paper
  - Personalized Recommendations
  - Flight Dynamics Question Paper User Reviews and Ratings
  - Flight Dynamics Question Paper and Bestseller Lists

5. Accessing Flight Dynamics Question Paper Free and Paid eBooks
  - Flight Dynamics Question Paper Public Domain eBooks
  - Flight Dynamics Question Paper eBook Subscription Services
  - Flight Dynamics Question Paper Budget-Friendly Options
6. Navigating Flight Dynamics Question Paper eBook Formats
  - ePub, PDF, MOBI, and More
  - Flight Dynamics Question Paper Compatibility with Devices
  - Flight Dynamics Question Paper Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Flight Dynamics Question Paper
  - Highlighting and Note-Taking Flight Dynamics Question Paper
  - Interactive Elements Flight Dynamics Question Paper
8. Staying Engaged with Flight Dynamics Question Paper
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Flight Dynamics Question Paper
9. Balancing eBooks and Physical Books Flight Dynamics Question Paper
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Flight Dynamics Question Paper
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Flight Dynamics Question Paper
  - Setting Reading Goals Flight Dynamics Question Paper
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Flight Dynamics Question Paper
  - Fact-Checking eBook Content of Flight Dynamics Question Paper
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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