

IV B.Tech. I Semester Regular Examinations, November -2005
AIRCRAFT DESIGN PRACTICE
(Aeronautical Engineering)

Time: 3 hours**Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

1. Consider 30 odd seater passenger plane powered by Piston-Props. How does it compare with a Turbo-prop powered passenger plane in its design features having similar specifications? Make use of sketches and plots to illustrate your answer. [16]
2. Describe various types of airfoil sections used in aircraft industry. Describe in details 4 digit and 5 digit series of NACA sections. Make use of sketches and plots to illustrate your answer. [16]
3. Consider a new design of airplane, Crew of 6, 250 passengers with 60 Kgs baggage each. Make use of std. data and trends for such designs. Estimate power requirements for a cruise speed of 800 Kms / hr. Assume parameters accordingly. Provide initial size and configuration lay out for this airplane. [16]
4. Compare air load distribution over a straight tapered wing with an elliptic wing. Which one of these is superior and how. Which of these has higher numerical value of Oswald wing efficiency factor. Make use of sketches and plots in support of your answers. [16]
5. (a) Sketch the various configurations of propeller locations along with their advantages and disadvantages.
(b) What factors affect the jet engine nozzle design? How will you go about the integration of a jet engine nozzle? [8+8]
6. What are the various components of drag with respect to a subsonic civil jet aircraft? How will you estimate the various components of drag for such an aircraft? [16]
7. Draw the three views and neatly label the various components of a passenger rotorcraft. Estimate the performance and stability characteristics of rotorcraft and compare them with a short-range passenger aircraft. [16]
8. (a) Explain the development of stress concentration due to holes and notches.
(b) An aircraft in level flight at speed V_0 encounters a sudden vertical gust velocity V_g . Estimate the value of additional load factor due to gust. [8+8]

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1. Consider 30 odd seater passenger plane powered by Piston-Props. How does it compare with a Turbo-prop powered passenger plane in its design features having similar specifications? Make use of sketches and plots to illustrate your answer. [16]
2. What is the effect of stall speed and wing loading on airplane take-off and landing performance on thrust loading, power loading and wing loading? Write down the appropriate expressions in your support. Make use of sketches and plots to illustrate your answer. [16]
3. Consider a new design of airplane, Crew of 3, 6 passengers with 30 Kgs baggage each. Make use of std. data and trends for such designs. Estimate power requirements for a cruise speed of 250 Kms / hr. Assume parameters accordingly. Provide initial size and configuration lay out for this airplane. [16]
4. What are different arrangements of tail surfaces used for airplane design. Discuss as many options available with you along with their relative merits. Make use of sketches and plots in support of your answers. [16]
5. (a) Differentiate between retractable type and non-retractable type of undercarriage.
(b) Write the advantages and disadvantages of bicycle type and tail wheel type of undercarriage. [8+8]
6. Define the following terms and explain how these terms affect the aerodynamic design of a civil jet aircraft:
 - (a) Aerodynamic center
 - (b) Washin and washout
 - (c) Type of undercarriage
 - (d) Downwash [4×4=16]
7. Draw the three views and neatly label the various components of a high subsonic aircraft having rectangular wing planform. Estimate the performance and stability characteristics of this aircraft and compare them with a similar aircraft having swept back wing configuration. [16]
8. (a) Write a note on 'structural instability'.

- (b) The airplane shown in Figure5 weighs 10,000 kg and that the braking force F is 4,000 kg.
- Find the wheel reactions R_1 and R_2
 - Find the landing run if the airplane lands at 150 kmph. [4+12]

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1. Frame specifications for an airplane for medium range with 300 Passengers with a cruise speed of 850 kmph. Make use of sketches and plots to illustrate your answer. [16]
2. How are the $C_l - C_d - \alpha$, characteristics improved by modern low speed airfoil section . Hence describe one such section in use. Make use of sketches and plots to illustrate your answer. [16]
3. Detail out special considerations in the design of a new Executive class airplane with a cruise velocity of 500 Kms / hr, Crew of 4 and Max. Seating capacity of 8. Make use of sketches and plots in support of your answers. [16]
4. Describe air load distribution over an elliptic wing. What results when the plan form departs from elliptic to swept forward? Hence define Oswald's wing efficiency factor and its value for this plan form. Make use of sketches and plots in support of your answers. [16]
5. Differentiate between piston engine and turbofan engine. What factors affect the integration of a piston engine? What procedures will you follow for the integration? [16]
6. (a) How the factors affecting the cost of a civil transport aircraft differ from the cost of a jet fighter aircraft?
(b) How will you analyse the preliminary cost of a basic trainer aircraft? [8+8]
7. Draw the three views and neatly label the various components of a delta wing fighter aircraft. Estimate the performance and stability characteristics of this aircraft and compare them with a conventional fighter aircraft having swept back wing configuration. [16]
8. (a) Sketch and explain the flight envelope for a typical passenger aircraft.
(b) Describe the main features of a 'stressed skin construction'. [10+6]

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1. Frame specifications for an airplane for medium range with 250 Passengers with a cruise speed of 850 kmph. Make use of sketches and plots to illustrate your answer. [16]
2. What are the requirements of supercritical airfoil section for airplanes? Suggest one section How far the requirements are satisfied in an airplane. Make use of sketches and plots to illustrate your answer. [16]
3. Consider a new design of airplane, Crew of 4, with 20 Kgs baggage each. Use a piston- prop engine delivering 200 eshp. Make use of std. data and trends for such designs. Assume parameters accordingly. Provide initial size and configuration lay out for this airplane. [16]
4. Consider a high wing airplane for civil applications. Recommend horizontal and vertical tail arrangement for this airplane, to have positive static margin in longitudinal stability. Make use of sketches and plots in support of your answers. [16]
5. Differentiate between turbofan engine and turboprop engine. What factors affect the integration of a turbofan engine? What procedures will you follow for the integration? [16]
6. Discuss how the following factors affect the aerodynamic design of an aircraft:
 - (a) Powerplant type
 - (b) Fuselage layout [2×8=16]
7. Draw the top views and neatly label the various components of a medium range jet transport aircraft having rectangular, swept forward and swept back wing configuration. Compare the performance and stability characteristics of these configurations. [16]
8. (a) Write a note on 'Failsafe Structures'.
(b) How will you design the tire size of a typical transport aircraft? Explain the factors affecting the tire size design. [6+10]
