

Reg. No. :

Question Paper Code : 50089

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Sixth Semester

Aeronautical Engineering

AE 8604 – AIRCRAFT DESIGN

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List the different categories of military aircraft.
2. Sketch the front view of a cantilever low wing monoplane.
3. Name the sources for aircraft design data.
4. With a neat sketch, indicate wing incidence and tail incidence angles.
5. Define 'thrust specific fuel consumption' and state its units.
6. For what aircraft type should a piston engine be recommended?
7. State the importance of a low fuselage fineness ratio.
8. Write about airfoil selection for supersonic aircraft.
9. What are the phases of an aircraft take-off?
10. How should the oleo strut unit of a landing gear be designed?

PART B — (5 × 13 = 65 marks)

11. (a) (i) State the aim of the project feasibility study phase of the aircraft design process. Discuss the work that is carried out in this phase. (6)
(ii) Following the preliminary design stage of an aircraft, detailed design studies are carried out. Explain the objectives and different phases involved in the detailed design phase. (7)

Or

(b) The specifications or design requirements of an airplane are decided by its function. Discuss the requirements for the following aircraft. (13)

- long range passenger aircraft
- cargo aircraft
- fighter aircraft

12. (a) How is the first estimate of aircraft gross weight obtained? How is the estimate of the gross weight refined? What are the various aircraft weight fractions? Write down typical weight fraction values for a 60-seater passenger aircraft designed to cruise at 500 kmph at 4.5 km altitude with a range of 1300 km. (13)

Or

(b) (i) Define thrust loading and explain its significance. Explain thrust loading optimization procedure. Are there advantages of high thrust/weight ratio? (7)

(ii) Outline the preliminary design procedure of an aircraft using a flowchart. (6)

13. (a) Compare the performance aspects between turbofan and turbojet engine. What is the role of the bypass ratio? For what aircraft type should a turbojet engine be selected, and why? (13)

Or

(b) Discuss choice of power-plant type for a typical large passenger aircraft designed to fly at subsonic speed. Explain your choice. How do we evaluate power plant performance? (13)

14. (a) (i) State the purpose of a V-n diagram. How is a V-n diagram of an aircraft obtained? (7)

(ii) With examples, write about FAR/CAR requirements for an aircraft and explain the importance of these requirements. (6)

Or

(b) (i) List the loads acting on an aircraft fuselage. How are bending moment and shear forces diagrams of an aircraft fuselage obtained? (7)

(ii) Write about materials used in modern aircraft construction, and the properties of these aircraft materials. (6)

15. (a) With respect to the landing gear unit of an aircraft, discuss how the following parameters are decided upon — type of landing gear, wheel size, number of wheels, tyre pressure, landing gear location, wheel base, wheel tread. How is landing gear performance evaluated? (13)

Or

(b) Neatly sketch and label the parts of an aircraft main landing gear unit. Write about the design aspects of each landing gear component. (13)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Define the static margin of an aircraft and explain its role in aircraft design. (5)
- (ii) Write about aircraft lateral stability and explain design requirements for adequate lateral stability. Explain vertical tail sizing of an aircraft with respect to lateral stability. (10)

Or

- (b) A regional transport airplane with turboprop engine has the following specifications: (15)

No. of passengers: 60

V_{cruise} : 520 kmph at around 4 km altitude

Safe range: 1300 km

For this aircraft, write about how the following parameters are selected/optimised: Airfoil type, wing span, wing sweep, wing chord at root and tip, aspect ratio, dihedral angle, power plant rating, operational empty weight, maximum fuel weight, diving speed and maximum rate of climb.

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