Code No: 07A62104 **R07** **Set No. 2**

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
FLIGHT VEHICLE DESIGN
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define and explain - mission fuel, reserve fuel and trapped fuel.
   (b) Define and explain - Mission segment weight fraction and total mission weight fraction. How are they related?
   (c) Define specific fuel consumption for turbo jet engines and piston engines. [5+6+5]

2. Write short notes, with neat sketches, on
   (a) Guidelines for longitudinal control lines for fuselage,
   (b) Isobars on wing and wing design,
   (c) Supersonic area rule,
   (d) Compression lift in supersonic flight [4+4+4+4]

3. Define the following terms and explain how these terms affect the aerodynamic design of a civil jet aircraft.
   (a) Lift/Drag ratio
   (b) Centre of gravity
   (c) Canard wing configuration
   (d) Area rule. [4+4+4+4]

4. Frame relevant specifications for a airplane for medium range (2,000 km) with three hundred (300) passengers with a cruise speed of 850 kmph. Illustrate your answer using sketches and graphs. [16]

5. (a) Derive the expression for turn rate in level flight ($d\psi$ / dt) in terms of velocity and 'n', the load factor.
   (b) Derive the expression for load factor, 'n', in terms of T/W (Thrust to weight ratio) and W/S (Wing loading). [8+8]

6. Describe the air load distribution over an elliptic wing. What is the effect of changing the wing plan form to swept forward? Define Oswald's efficiency factor and its value for this plan form. Make use of sketches and graphs to support your answer. [16]

7. Describe the parameters to be evaluated while verifying the preliminary design of an aircraft. [16]

8. (a) Explain leading edge suction.
   (b) Explain Oswald's efficiency factor (e)
   (c) Derive the expression for maximum value of K (Drag - due - to - lift factor).
   [4+4+8]

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Code No: 07A62104 **R07** **Set No. 4**

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
FLIGHT VEHICLE DESIGN
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Prove that in the case of a gliding flight, the lift - to - drag ratio is the inverse of the tangent of the glide angle.
   (b) Assuming the gliding angle to be small, derive the expression for sink rate of the aircraft.
   (c) Derive the expression for minimum sink rate. [4+6+6]

2. Describe the lift distribution over an elliptic wing. What is the effect of changing the wing plan form from elliptic to rectangular? Hence define Oswald's wing efficiency factor'e'. What is its value for a rectangular plan form of the wing? Draw neat sketches to explain the answers. [16]

3. Explain the major differences in the designs of the fuselages of a fighter and a bomber plane. Justify your answer. Draw neat sketches. [16]

4. Write short notes, with neat sketches, on
   (a) Leading edge suction of an airfoil
   (b) Drag - due - to - lift factor (K)
   (c) Oswald's efficiency factor (e)
   (d) Ground effect on induced drag [4+4+4+4]

5. Detail out the considerations in the design of a passenger airplane with a cruise velocity of 500 km / hour, crew of 6 and 100 passengers, with 50 kg baggage each. Draw neat sketches and graphs in support of your answer. [16]

6. (a) Match the following statements:

Statements A	Statements B
A1. Maximum lift co - efficient	B1. lift dependent
A2. Cruise	B2. Stall
A3. Induced drag	B3. shock induced
A4. Wave drag	B4. proportional to lift-to-drag ratio
A5. Range	B5. Level flight

   (b) True or False? Write 'T' for true and 'F' for false against the following statements:
      i. For static stability of an aircraft in pitch, center - of - gravity must lie ahead of the neutral point.
      ii. Engine specifications primarily depend on the climb thrust requirement.

iii. Horizontal tail contributes to pitch stability of aircraft.

iv. Wing sweep can be used to delay drag divergence.

v. High thickness to chord ratio airfoil is usually preferable for the wing root for high bending stiffness. [16]

7. Explain clearly.

   (a) What is meant by technology availability in the context of aircraft design.

   (b) How overly optimism affects the design of aircraft.

   (c) How utter pessimism affects the design of aircraft.

   (d) Which path you would choose between b and c above, and why? [4+4+4+4]

8. (a) Derive the Breguet Range equation R = (V/C) (L/D) ln (W_{i-1} / W_i)for airplane. Explain all the terms involved.

   (b) An aircraft has a range of 6,000 km at a cruising speed of 900 kmph. It is powered by a Jet engine with a specific fuel consumption of 0.015 grams per Newton per second. The maximum value of (L/D) is 16. Compute the ratio of the take-off fuel weight to take-off total weight. Stop the calculations after one or two iterations. [8+8]

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Code No: 07A62104 **R07** **Set No. 1**

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
FLIGHT VEHICLE DESIGN
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Make the conceptual sketch of a supersonic stealth bomber.
   (b) Describe the means of reducing radar detectability of a bomber? [8+8]

2. Describe the various types of landing gear. If you are designing a high subsonic airliner, which type of landing gear would you go for? Justify your answer. [16]

3. (a) List seven important performance and mission requirements of an airplane, at the stage of conceptual design.
   (b) Explain in detail, how the design parameters of the airplane are affected by the above requirements. [6+10]

4. (a) Define static 'trim' condition for an aircraft.
   (b) Show with the help of neat diagrams the various pitching moments acting on an aircraft.
   (c) Write the expressions for the pitching moments of an aircraft about the c.g. (centre of gravity) comprising the various moments acting on the aircraft. [4+6+6]

5. (a) Draw a reference (trapezoidal) wing.
   (b) Explain how an elliptic wing is superior to a trapezoidal wing.
   (c) What are the advantages of selecting a trapezoidal wing over an elliptic wing?
   (d) Explain the effect of taper of the wing on drag. [16]

6. Draw the sketch of a supersonic fighter aircraft. Determine the area at each cross section along the length of the aircraft. Show the cross-section area in a graphical form as a function of the length - wise location of the section. [16]

7. Draw three views of a two seater aircraft (seats arranged side by side) with a piston engine, and neatly label the various components. Explain how the performance and stability characteristics of the aircraft are estimated. [16]

8. (a) Discuss the historical trend of t/c (thickness to chord ratio) versus Mach number for an aircraft. Draw the pertinent graphs.
   (b) Would you prefer a high t/c (thickness to chord ratio) or low t/c for a supersonic aircraft?
   (c) For M = 2, the historical trend indicates t/c (thickness to chord ratio) = 0.04. Discuss why it was used. What are the advantages and disadvantages of high t/c? [16]

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Code No: 07A62104 **R07** **Set No. 3**

III B.Tech II Semester Regular/Supplementary Examinations,May 2010
FLIGHT VEHICLE DESIGN
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Discuss the different aspects dealt with in preliminary design and detail design. Explain in detail, various steps involved in both the stages of design. [16]

2. Write 'T' for True and 'F' for False against the following statements.
   (a) Wing location on the fuselage has no effect on the airplane pitch stability.
   (b) Airplanes can be asymmetric about the longitudinal plane
   (c) Wing sweep can delay drag divergence
   (d) Fuel depletion has no effect on airplane stability in pitch.
   (e) Larger span wing airplanes are often faced with aeroelastic phenomena. [16]

3. Make a preliminary, dimensioned, sketch of a typical military cargo aircraft with near loading cargo hold. [16]

4. Write short notes, with neat sketches, on
   (a) Winglet design guidelines,
   (b) Wing fillet,
   (c) Determination of wetted area of an aircraft,
   (d) Determination of volume of an aircraft. [4+4+4+4]

5. (a) What is spin?
   (b) Draw the sketches of various tail configurations that have been used to help the aircraft to recover from spin and explain how they are good for the job. [8+8]

6. Detail out special considerations in the design of a new Executive class airplane with a cruise velocity of 600 km / hour, crew of 4 and seating capacity of 10 passengers. Draw neat sketches and graphs in support of your answer. [16]

7. (a) Write the expressions for the pitching moments of an aircraft about the c.g. (centre of gravity) comprising the various moments acting on the aircraft.
   (b) Derive the expression for the distance of the neutral point (from the nose of the fuselage)
   (c) Write short notes on
      i. static margin

ii. aerodynamic centre [4+4+8]

8. (a) Define approach speed and touch-down speed. Also, express them in terms of stall speed V_{stall}.

   (b) Define the landing distance for a civil general aviation aircraft, transport aircraft (airliner), and military aircraft as per FAR (Federal Aviation Regulations of US).

   (c) Derive the wing loading W/S, for a jet aircraft for cruise as a function of dynamic pressure and parasite drag coefficient.

   (d) What is obstacle clearance distance? How does it depend on the type of aircraft? Explain. [4+4+4+4]

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