

IV B.Tech. II Semester Regular Examinations, April/May -2006
AIRCRAFT DESIGN
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Elaborate with sketches and plots design features of the following airplanes
 - i. DC-3 and
 - ii. Boeing 737What are your comments and observations on these configurations. [8]
- (b) Explain the design features of a turbo-prop powered and a turbo-fan powered airplane. Do you notice some similarities? Where do you find outstanding advantages and for which of the two? [8]
2. (a) What are the plus points of a tandem seat trainer over a side by side seat trainer and vice versa. Make use of sketches and diagrams to elaborate aerodynamic and structural features of these two types of airplanes. [8]
- (b) Elaborate design and structural features of TEJAS, the HAL built LCA. Comment on the use of materials used for manufacturing this military airplane. [8]
3. (a) You are required to submit a proposal for an executive jet airplane with minimum cabin noise. Prepare broad specifications with description and 3 views. If you could support it with existing designs/airplanes? [8]
- (b) Compare a high wing commercial airplane configuration with a low wing configuration. What are the aerodynamic and structural features of these two types of airplanes. [8]
4. (a) A light airplane for initial training of pilots is to be designed and manufactured out of the two types namely
 - i. semi-cantilever high wing configuration and
 - ii. full cantilever low wing configuration. Which of the above you recommend as CEO of the factory from cost of manufacturing and maintenance? [8]
- (b) An airplane is to be designed for performance optimization. Following two options are available for same gross wing area
 - i. Straight wing with elliptic planform and
 - ii. Straight wing with constant chord with elliptic tips.Elaborate your answer in a professional way. [8]
5. Design a preliminary 3 view lay out for a light UAV for a V_{max} of 75 kmph, W_{gross} of 100 Kgs and weight of airborne equipment is 20 Kgs. A pusher type piston engine of 18 IHP weighing 6.5 Kgs is readily available. Keep the C_{Do} as 0.025. Select

suitable Airfoil section and wing geometry for this unmanned airplane. Assume missing data and follow proper design procedure for this problems. [16]

6. Elaborate on the types of intakes for a single engine military airplane. Make use of sketches and diagrams to illustrate the layout details of the jet engine and aerodynamics of the starting in each case. [16]
7. Make use of sketches and plots to illustrate the structural layout details of an all metal wing. Hence explain the occurrence of and resistance of aerodynamic loads, torsional and divergence moments. [16]
8. Describe various types of landing gear arrangements deployed in airplanes. What are the distinct advantages of one category over that in the others. Illustrate with sketches and diagrams. Comment on a sea plane and its landing and take-off. [16]

IV B.Tech. II Semester Regular Examinations, April/May -2006
AIRCRAFT DESIGN
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Make use of representative sketches/diagrams to compare the design features of
 - i. Boeing 727 , and
 - ii. Boeing 737.Which of the above is superior to the other in its own way. [8]
- (b) Compare the aerodynamic, structural and propulsion aspects of HAL built Avro-748 and NAL designed SARAS airplane. Make use of sketches/diagrams representing these two airplanes. [8]
2. (a) The famous F-86 Sabre Jet of US origin was used by enemy in 1965 for air attacks over Indian territories. It was comprehensively trounced by Gnat airplane of IAF. Which way the IAF Gnat proved superior to the enemy plane? Illustrate with design features of these two historic military airplanes. [8]
- (b) Explain the generation of lift in case of TEJAS, the Indian LCA and IAF's DPSA Jaguar airplane. Make use of sketches and plots. [8]
3. (a) Consider wing-tail configurations of two airplanes as below:
 - i. IL-76 High wing and high tail
 - ii. VC-10 Low wing and high tailExplain with sketches / plots and aerodynamics, which of the two is capable of avoiding Super stall. [8]
- (b) You are to decide one of the following air intake system for a single engined Jet fighter
 - i. Normal shock supersonic inlet
 - ii. Two shock conical spike type inlet.Provide your expert technical evaluation to the design team and recommend one. Make use of setches/diagrams in your support. [8]
4. (a) Put up a preliminary design proposal for a basic light trainer airplane with following broad requirements;
 - i. Low cost of manufacturing
 - ii. Low cost of maintenance
 - iii. Short take-off and landing run
 - iv. Side by side seatsFrame specifications along with basic 3 view. [8]

- (b) Describe with sketches/diagrams various arrangements of horizontal and vertical tails used on airplanes of different classifications. [8]
5. A light UAV is to be designed for carrying an instrument/equipment load of 25 Kgs. Its max. velocity is 75 kmph. A pusher type piston-prop weighing 6.5 Kgs, capable of delivering 18 BHP is readily available.
- (a) Work out gross weight for an endurance of 4 hrs
(b) Carry out weight break down analysis
(c) Prepare preliminary design of the wing
(d) Work out major dimensions, and
(e) Prepare a 3 view drawing.
Be reasonable to assume data reqd. with justification. [16]
6. What are the factors to be studied for deciding the location of power plants on an airplane. Describe with sketches/diagrams. Hence explain the aerodynamics and aerothermodynamics of the jet engines located in pylons located beneath the wing. Comment on this arrangement for other benefits. [16]
7. Illustrate with sketches/diagrams the lay out and structural features of an all metal Swept back wing of a large commercial jetliner (say Boeing 777). Explain as much of the lay out and the arrangement of the wing-fuselage attachment. [16]
8. What are different arrangements/lay outs of landing gears for airplanes. Illustrate with sketches and plots. Hence illustrate the functioning of an oleo strut. [16]

IV B.Tech. II Semester Regular Examinations, April/May -2006
AIRCRAFT DESIGN
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) What are the special features of a VTOL airplane Sea Harrier. Describe these with sketches and plots. [8]
(b) Compare a Pusher type arrangement of power plant on an airplane with a tractor type arrangement. What are the advantages and penalties? Explain with an example each. [8]
2. (a) Describe the FLYING WING airplane (of Northrop origin). How does this airplane get its static/dynamic longitudinal stability. Illustrate with sketches / diagrams and plots. [8]
(b) What is understood by the term STEALTH TECHNOLOGY. Name one such airplane and explain its stealth action. [8]
3. Bring out your choice of the location of the wing of an airplane from the following:
(a) High wing
(b) Low wing
(c) Mid wing
design for a commercial, long range, jetliner. Argue on the basis of aerodynamics, structures, propulsion and other considerations. Make use of sketches / diagrams and plots to support your choice. [16]
4. Describe with representative sketches / diagrams, various tail plane configurations deployed on airplanes for stability purposes. Explain from aerodynamics why twin vertical tails are often employed on high speed airplanes having swept back wings with high maneuverability. [16]
5. Prepare a conceptual design with preliminary weight estimate and weight break down, 3 views of an airplane with the following initial specifications;
5 passengers + 1 crew, carry bag of 15 Kgs allowed per passenger
(a) Maximum level speed at mid-cruise weight = 400 kpmh
(b) Range = 2000 kms
(c) Abs.ceiling = 8000 m
(d) Rate of climb at sea level = 350 m/min
(e) Stalling speed = 120 kmph
(f) Landing distance = 670 m

- (g) Take off distance = 760 m
- (h) Power plant: Conventional piston engine with constant speed propeller - one number. [16]
6. What are possible locations of Jet engines on an airplane (both civil and military). Illustrate each of these with sketches / diagrams of existing / past airplanes. Describe merits of each option. [16]
7. Describe the structural lay out and details of an all metal fuselage of a commercial jetliner (of A-320 type) with low wing attachment. Hence illustrate the complete role of each structural member in providing strength and stiffness in resisting air loads, dead loads and the moments at the wing and tail attachments. Make use of sketches/diagrams to bring home your points. [16]
8. (a) Describe various types of shock absorbers used for different kinds of LGs of airplanes. Make use of sketches and diagrams to illustrate your answer. [8]
- (b) Explain the design methodology for calculating / designing loads for the nose and main landing gears of a commercial airplane (say A-320). Make use of sketches and plots for explaining your points. [8]

★ ★ ★ ★ ★

IV B.Tech. II Semester Regular Examinations, April/May -2006
AIRCRAFT DESIGN
(Aeronautical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Make use of representative sketches /diagrams to describe the design features of F16 illustrating its
 - i. aerodynamics
 - ii. structure
 - iii. power plant and the air intake. [8]
- (b) What are the salient design features of HAL designed and built Pushpak trainer. Make use of sketches and plots.. [8]
2. Explain with representative sketches/diagrams aerodynamics, structures and propulsion of Supersonic commercial jetliner CONCORDE.
 - (a) Which technical/engineering factors were its strong points?
 - (b) What forced CONCORDE to retire from service? [16]
3. (a) Explain the role of Aircraft mock-up in the design and development of a new airplane. Illustrate with emphasis on structural arrangement, layout and systems deployment. [8]
- (b) What should be the design features of a low cost trainer airplane requiring minimum maintenance and operational cost? [8]
4. (a) You are working at the head of an airplane design team. Put up a proposal for the design and development of a state of the art AJT for a newly formed Air force of some country. Take care of at least 25 years from the induction period. [8]
- (b) Explain the distinct advantages of a high wing airplane over that a low wing airplane. [8]
5. You are to frame a proposal for the conceptual design of a four seater airplane for high way police surveillance. The basic minimum requirements projected are;
 - (a) Cruise velocity of 250 kmph at an altitude of 1500 m
 - (b) 350 Hp piston-prop engine
 - (c) TO run (from unprepared runway) of ~ 100 m
 - (d) State of the art radio and satellite communication equipment ~ 50 kgs
 - (e) Nose wheel type fixed LG

- (f) All metal (plus composites) rugged structure
Prepare an initial conceptual design with Wg and weight break down. Work out its performance and 3 views. [16]
6. You are to select a configuration for the design of a new jet liner to cruise at a super-critical Mach number range from
- (a) Low (t/c) straight wing, supercritical section, canard / conventional tail
 - (b) Swept back wing, supercritical section, canard / conventional tail
 - (c) Swept fwd wing, supercritical section, canard / conventional tail
 - (d) Ogive wing like that of Anglo-French Concorde
Work out the aerodynamics and structural stability of each option and then make appropriate recommendation. Make frequent use of sketches and diagrams. [16]
7. Elaborate with sketches and diagrams, layout details of an all metal wing for a high speed airplane. Explain the resistance of bending and torsional loads and resulting moments coming on the wing during its service. [16]
8. (a) Write a detailed note on the Velocity load factor diagram and its importance in the structural design of wing. [8]
- (b) Discuss details of LG retraction. Explain it for the case of low wing design.[8]

★ ★ ★ ★ ★