



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	CONCEPTUAL DESIGN OF FLIGHT VEHICLES
Course Code	:	A62115
Class	:	III B. Tech II Semester
Branch	:	Aeronautical Engineering
Year	:	2017 – 2018
Course Coordinator	:	Ms. M Snigdha, Assistant Professor, Dept of AE
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OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

S No	Question	Blooms Taxonomy Level	Course Outcomes
UNIT - I			
OVERVIEW OF THE DESIGN PROCESS, SIZING FROM A CONCEPTUAL SKETCH/AIRFOIL AND GEOMETRY SELECTION, THRUST TO WEIGHT RATIO, WING LOADING			
Part - A (Short Answer Questions)			
1	Describe the design wheel for conceptual design with configuration rearrangements?	Remember	1
2	Define the specific fuel consumption for high-bypass turbofan?	Remember	1
3	Define the specific fuel consumption for low-bypass turbofan?	Understand	1
4	Describe the mission segment fraction for climb?	Understand	1
5	Describe the mission segment fraction for landing?	Remember	1
6	Define the mission segment weight fraction for warm-up and takeoff?	Understand	1
7	Draw the mission profile for general aviation aircraft?	Remember	2
8	How to calculate take off gross weight for twin turboprop aircraft?	Understand	2
9	Define static trim condition for an aircraft?	Remember	2
10	Discuss takeoff weight build-up?	Understand	2
Part - B (Long Answer Questions)			
1	Describe conceptual sketch for a supersonic stealth bomber?	Understand	1
2	Derive the equation for Breguet's range equation for endurance with	Remember	1

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	graphs?		
3	Explain types of stall acting on different types of airfoils? Explain with neat sketch?	Understand	2
4	Discuss airfoil thickness ratio for critical mach number at supersonic flow over the wing?	Remember	2
5	Explain lift/drag ratio, center of gravity, canard wing configuration and area rule affecting the aerodynamic design of a civil jet aircraft?	Understand	2
6	Discuss wing sweep, aspect ratio, taper ratio, wing incidence? With neat sketches?	Remember	2
7	Describe the parameters to be evaluated while verifying the preliminary design of an aircraft?	Understand	2
8	Explain wing vertical location with respect to fuselage acting on wing positions?	Understand	2
9	Describe the important performance and mission requirements of an airplane, at the stage of conceptual design?	Remember	2
10	Explain different types and shapes of wing tips with neat sketches?	Understand	2
Part - C (Problem Solving and Critical Thinking Questions)			
1	Explain the different phases of aircraft design? Explain With neat sketches?	Understand	2
2	Explain in detail Conceptual design phase in Aircraft design? Explain With neat sketches?	Remember	2
3	Elaborate range? How it is useful to design process? Explain With an example?	Understand	2
4	Elaborate Endurance? How it is useful to design process? Explain With an example	Understand	2
5	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?	Remember	2
6	Explain thrust to weight ratio for propeller aircraft? Explain With neat sketch?	Understand	2
7	Discuss the different aspects for preliminary design and detail design and various steps involved in both the stages of design? Explain in detail?	Remember	2
8	Explain the empty weight fraction table for General aviation-twin engine, Twin turboprop, Military cargo/ bomber, Jet fighter aircraft?	Understand	2
9	Explain the types of mission profiles for sizing ?explain with neat sketches	Understand	2
10	Explain winglet design guidelines, wing fillet, determination of wetted area of an aircraft, determination of volume of an aircraft? With neat sketches?	Remember	2
UNIT - II			
INITIAL SIZING & CONFIGURATION LAYOUT			
Part – A (Short Answer Questions)			
1	Discuss tail volume coefficient for general aviation -twin turboprop aircraft?	Understand	3
2	Define fixed engine sizing for an military cargo / bomber aircraft?	Understand	3
3	Define Rubber engine sizing for an general aviation-single engine?	Remember	3
4	Discuss leading edge suction of an airfoil?	Understand	3
5	Discuss tail geometry for tail and taper aspect ratio for vertical tail for fighter aircraft?	Remember	3
6	Define drag-due –to-lift factor (k)? With neat sketch?	Understand	3
7	Discuss tail volume coefficient for military cargo/bomber aircraft?	Remember	3
8	Define tail geometry for taper aspect ratio for vertical tail for sailplane aircraft?	Knowledge	3

S No	Question	Blooms Taxonomy Level	Course Outcomes
9	Describe tail arrangement configurations for tandem wing?	Understand	2
10	Define aspect ratio for twin turboprop in propeller aircraft?	Remember	2
Part - B (Long Answer Questions)			
1	Explain wing loading for different aircrafts –jet fighter, sailplane, twin turboprop?	Understand	3
2	Derive equation for thrust to weight ratio for propeller –powered aircraft?	Remember	4
3	Explain power loading and horsepower to weight of thrust to weight ratio associated with jet-engine aircraft?	Understand	4
4	Explain thrust matching for cruise condition, takeoff condition and climb condition?	Understand	4
5	Explain in detail about wetted area plot? Explain with neat sketches and graphs?	Understand	3
6	Derive the equation for sustained turn rate for maximum load factor at flight condition?	Understand	3
7	Explain in detail about volume distribution plot? Explain with neat sketches and graphs?	Remember	4
8	Explain flat wrap fuselage lofting? Explain with neat sketches?	Understand	4
9	Explain in detail radar delectability, infrared delectability? With an example?	Remember	3
10	Explain winglet design, isobar tailoring for shock suppression? Explain With neat sketch?	Understand	4
Part – C (Problem Solving and Critical Thinking Questions)			
1	Derive the equation for rubber Engine sizing of an aircraft with neat sketches?	Understand	2
2	What are the advantages and disadvantages of pusher and tractor Engine?	Remember	4
3	Discuss in detail the most commonly employed methods to assess the fuel tank volume?	Understand	4
4	Explain in detail refined sizing an aircraft? With neat sketches?	Remember	4
5	Explain the major differences in the designs of the fuselage of a fighter and bomber plane. Justify your answer? With neat sketches?	Understand	4
6	Explain in detail productibility considerations and maintainability considerations?	Remember	4
7	Explain weapons carriage for military aircraft and gun installation? Explain with neat sketches?	Understand	4
8	Derive the expression for turn rate in level flight ($d\psi/dt$) in terms of velocity and 'n', load factor?	Remember	4
9	Explain passenger compartment for an commercial aircraft? Explain With neat sketches?	Understand	4
10	Explain the factors involved in deciding the location of the wing with Respect to the fuselage? Explain in detail?	Remember	4
UNIT-III			
PROPULSION & FUEL SYSTEM INTEGRATION, LANDING GEAR & SUBSYSTEMS			
Part - A (Short Answer Questions)			
1	Define nozzle integration for fixed convergent?	Understand	5
2	Define nozzle integration variable convergent?	Remember	5
3	What do you mean by “Podded Engine in aircraft systems?	Understand	5
4	Describe engine cooling provisions?	Remember	3
5	Define axial compressor, pressure variations in the incoming air	Understand	5
6	Define Jet engine locations at “Nose” and “Chin”?	Remember	5
7	Draw the diagram for turbo-prop engine?	Understand	5

S No	Question	Blooms Taxonomy Level	Course Outcomes
8	Draw the diagram for turbojet engine?	Remember	2
9	Define jet engine integration for aircraft	Understand	5
10	Discuss inlet geometry for turbojet engine?	Remember	5
11	Discuss inlet geometry for turbofan engine?	Understand	2
12	Define flush inlet geometry?	Remember	5
13	Define subsonic inlet for a jet engine?	Remember	5
14	Define supersonic inlets for internal and mixed shocks?	Understand	5
15	Draw the diagram for converging-diverging ejector?	Remember	5
16	Draw the diagram for Oleo shock absorber?	Remember	5
17	Draw the diagram for gear retraction geometry?	Understand	5
18	Draw the diagram for hydraulic system?	Remember	2
19	Define electrical system of aircraft?	Understand	2
20	Define attached shock wave?	Remember	2
21	Define Turbo shaft engine?	Understand	5
22	Define wave drag?	Remember	5
23	Define tire sizing?	Understand	2
24	Define gear load?	Remember	5
25	Define shock absorbers for rigid axle?	Remember	5
26	Define shock absorbers for levered bungee?	Understand	2
27	Define shock absorbers for oleo shock-strut?	Remember	2
28	Define stroke determination?	Remember	5
29	Define oleo sizing?	Remember	5
30	Define pneumatic system?	Understand	2
31	Define avionics weight for bombers?	Remember	2
32	Draw the diagram for castoring wheel geometry?	Remember	5
33	Draw the diagram for tricycle landing gear?	Remember	2
34	Draw the diagram for multi-bogey landing gear?	Understand	5
35	Draw the diagram pneumatic system?	Remember	2
36	Draw the diagram centrifugal turbojet?	Remember	5
37	Draw the diagram boundary layer diverter?	Remember	2
38	Discuss types of nozzles?	Understand	2
39	Discuss fuel system?	Remember	5
40	Discuss wheel load geometry?	Remember	2
41	Draw the diagram for solid-spring gear sizing?	Remember	5
42	Discuss EPU and APU?	Understand	2
43	Discuss the subsystems of aircraft?	Remember	5
44	Draw the diagram for seaplane geometry?	Understand	5
45	Draw the diagram for single main landing gear?	Remember	2
46	Draw the diagram for axial –flow turbojet?	Understand	2
47	Draw the diagram for turbofan?	Remember	5
48	Define dynamic breaking load	Understand	2

S No	Question	Blooms Taxonomy Level	Course Outcomes
Part – B (Long Answer Questions)			
1	Explain shock absorbers for rubber bungee, oleo shock-strut, and levered bungee?	Understand	5
2	Explain takeoff ground roll, landing ground roll? Explain With neat sketches?	Remember	5
3	Explain castoring – wheel geometry? With neat sketches?	Understand	6
4	Explain auxiliary emergency power for high speed aircraft? Explain With neat sketch?	Understand	6
5	Explain gear-retraction geometry? With neat sketches?	Remember	6
6	Explain piston engine installation for pusher propeller updraft cooling? Explain with neat sketches?	Understand	6
7	Explain the working of a Turbo shaft engine? With a neat sketch?	Remember	6
8	Define hydraulic system, pneumatic system, electrical system? Explain With neat sketch?	Understand	6
9	Explain landing gear arrangements for tail dragger, quadric-cycle, and multi-bogey?	Remember	6
10	Explain the landing gear arrangements for multi-wheel main landing gear with neat sketch?	Understand	6
Part – C (Problem Solving and Critical Thinking Questions)			
1	Explain the different jet engine inlet locations (podded Engines)? Explain With neat sketch?	Understand	6
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	Understand	6
3	Explain in detail piston-engine performance with neat sketches?	Remember	6
4	Derive the expression for force equations for an aircraft in steady climb? Explain With neat sketch?	Understand	6
5	Derive the expression for subsonic lift-curve slope and supersonic lift-curve slope? Explain with graphs?	Understand	6
6	Explain briefly Oswald span efficiency method with neat sketches?	Remember	6
7	Explain the advantages and disadvantages of bicycle type and tail wheel Type?	Understand	6
8	Explain the different jet engine inlet locations Conformal engines)? With neat sketch?	Understand	6
9	Explain the working principle of conformal engine? With neat sketches?	Remember	6
10	Explain the 'Integral fuel system' integration in a fighter jet? With neat sketch?	Understand	7
UNIT-IV			
BASELINE DESIGN ANALYSIS- AERODYNAMICS & PROPULSION, STRUCTURES & WEIGHT AND BALANCE			
Part – A (Short Answer Questions)			
1	Define split flap, slotted flap, plain flap, triple slotted flap?	Understand	7
2	Define skin friction coefficients for clean supersonic cruise aircraft?	Remember	7
3	Define the drag polar for a symmetric airfoil?	Understand	7
4	Define skin friction coefficients for bomber and civil transport?	Remember	7
5	Define the drag polar cambered airfoil?	Remember	7
6	Define skin friction coefficients for military cargo (high upsweep fuselage)?	Understand	7
7	Define flat –plate skin friction coefficient for turbulent flow?	Remember	7
8	Define leakage and protuberance drag at high pressure zones?	Knowledge	7

S No	Question	Blooms Taxonomy Level	Course Outcomes
9	Discuss supersonic skin friction drag?	Remember	7
10	Discuss supersonic parasite drag?	Understand	7
Part – B (Long Answer Questions)			
1	Describe the maneuver loads acting on an aircraft and its $V - n$ diagram?	Remember	7
2	Compare the drag polar of a symmetric airfoils and a cambered airfoil?	Understand	8
3	Explain in detail 'load factor' and 'gust load factor'. Explain their importance during the design of an aircraft?	Remember	7
4	Derive the expressions for $C_{L\alpha}$ for the subsonic phase, C_{Lmax} for a low aspect ratio wing, $C_{L\alpha}$ for the supersonic phase?	Understand	8
5	Compare air load distribution over a rectangular wing with an elliptic Wing? Which one of these is superior and how?	Remember	9
6	Explain air loads on lifting surfaces, inertial loads, landing gear loads? Explain with neat sketches?	Understand	9
7	Describe the maneuver loads acting on an aircraft? Explain With neat sketch?	Understand	7
8	Derive the expression for the thrust - to - weight ratio of an aircraft in steady level flight in terms of lift to drag ratio (L/D), Wing loading (W/S), K (drag - due - to - lift factor), and other relevant parameters?	Remember	7
9	Explain briefly elliptical wing distribution? Explain with neat sketch?	Understand	8
10	Describe 'Landing gear loads' acting upon an airfoil? With neat sketch?	Remember	9
Part – C (Problem Solving and Critical Thinking Questions)			
1	Describe Load distribution on wing - ideal and actual, Weight distribution on wing - ideal and actual, load paths in aircraft?	Understand	9
2	Compare air load distribution over a rectangular 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? Hence define Oswald's wing efficiency factor and its value for this plan form. Make use of sketches and plots?	Remember	8
3	Explain material selection for fuselage with neat sketch?	Knowledge	8
4	Derive the expression for installed engine thrust corrections for supersonic military aircraft?	Remember	9
5	Explain part power operation for turbojet and turbofan engines with neat sketches?	Understand	8
6	Explain the piston –engine performance for four-stroke Otto cycle reciprocating engine with neat sketches?	Remember	9
7	Explain in detail leading-edge-suction method with neat sketch?	Understand	9
8	Explain in detail piston-prop thrust corrections for propeller efficiency? Explain with neat sketch?	Remember	7
9	Explain the block diagram for installed thrust methodology?	Understand	7
10	Explain the different types of loads categories for an aircraft with neat sketch?	Understand	7
UNIT-V			
BASELINE DESIGN– STABILITY & CONTROL, PERFORMANCE AND CONSTRAINT ANALYSIS			
Part - A (Short Answer Questions)			
1	Discuss longitudinal static stability?	Remember	7
2	Define fuselage and nacelle pitching moment?	Understand	7
3	Discuss dynamic characteristics in baseline design?	Remember	7
4	Discuss ground effect on trim conditions?	Understand	8
5	Define sizing matrix plot and carpet plot is plotted?	Understand	7

S No	Question	Blooms Taxonomy Level	Course Outcomes
6	Discuss static lateral-directional stability for pitching moment?	Remember	7
7	Define stick-free longitudinal stability analysis for smaller aircrafts?	Understand	7
8	Discuss how cost estimating method is done?	Understand	7
9	Define balanced field length, level turn, steady roll, inertia coupling?	Remember	7
10	Define dynamic stability of the aircraft with damping forces?	Remember	7
Part - B (Long Answer Questions)			
1	Derive the equation for minimum thrust required for level flight?	Understand	8
2	Derive the equation for steady level flight of an aircraft?	Remember	8
3	Derive the equation for minimum power required for level flight?	Understand	7
4	Describe range optimization for jet engine?	Remember	8
5	Describe range optimization for propeller engine?	Understand	9
6	Derive the equation for loiter endurance of an aircraft?	Remember	8
7	Explain loiter optimization for propeller engine?	Understand	7
8	Distinguish between steady climbing and descending flight?	Remember	8
9	Derive the equations for energy-maneuverability methods?	Understand	9
10	Derive the equations for balanced field length for total takeoff distance?	Remember	8
Part – C (Problem Solving and Critical Thinking)			
1	Distinguish between static stability and dynamic stability? Explain with example?	Understand	7
2	Derive the equation for longitudinal static stability and control for an aircraft?	Remember	6
3	Derive the equation for lateral static stability and control for an aircraft?	Understand	7
4	Solve the problem for antisubmarine turbo jet aircraft is designed for loiter of three hours at distance of 3,000 km from the base. The crew weighs 400 kg and payload a distance of 3,000 km from the base. The crew weighs 400 kg and payload weigh 4600 kg. The aircraft cruises at Mach 0.6 at an altitude of 10 km, where the speed of sound can be taken to be 300 m/s. The maximum value of (L/D) is 16. Calculate the omission fuel weight fraction of the aircraft if the specific fuel consumption is 0.015 grams per Newton per second	Remember	7
5	Explain the following terms and explain how these terms affect the aerodynamic design of a civil jet aircraft Tail plane incidence, Angle of attack of wing, Cross winds, Slenderness ratio of fuselage?	Understand	7
6	Explain steady level flight, minimum thrust required for level flight, range and loiter endurance?	Remember	8
7	Define Level turning flight, instantaneous turn rate and Sustained turn rate.	Remember	7
8	Discuss the energy maneuverability methods of optimal climb Trajectories and turns.	Understand	8
9	Explain how flight testing affects the cost of an aircraft? Explain With example	Understand	7
10	Explain how direct and indirect operating cost of a Boeing 777 aircraft?	Remember	6

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