QUESTION BANK

SUBJECT CODE & NAME: AE8501 FLIGHT DYNAMICS

YEAR / SEM : III/V

UNIT I – *CRUISING FLIGHT PERFORMANCE*			
Q.No	**Question**	**BT Level**	**Competence**
PART – A			
1.	Define Induced drag. **Nov/ Dec 2020**	BTL1	Remembering
2.	What is meant by drag polar? **Nov/ Dec 2020**	BTL1	Remembering
3.	Among the piston engines, turboprop engines and turbojet engines, which one is the most suitable engine for low speed aircrafts flying at low altitude? **Nov/ Dec 2021**	BTL2	Understanding
4.	What are the conditions for minimum drag of an aircraft? **Nov/ Dec 2021**	BTL1	Remembering
5.	What is drag polar **Nov/Dec 2018**	BTL1	Remembering
6.	Depict the forces acting on an aircraft during steady flight **Nov/Dec 2018**	BTL1	Remembering
7.	Define absolute ceiling and service ceiling **Nov/Dec 2018**	BTL1	Remembering
8.	Draw the lift curve for symmetric airfoil and cambered airfoil **April/May 2019**	BTL2	Understanding
9.	Define center of pressure. What is zero lift drag? **April/May 2019**	BTL1	Remembering
10.	Plot the variation of lift coefficient and angle of attack and indicate the effect of aspect ratio on this curve? **April/May 2017**	BTL5	Evaluate
11.	What are the factors which decide the flying path of an airplane as a rigid body? **April/May 2017**	BTL1	Remembering
12.	What are the different power plants used in airplanes? Which power plant is most efficient for subsonic airplanes? **April/May 2016**	BTL1	Remembering
13.	Define skin friction drag and pressure drag? **April/May 2016**	BTL1	Remembering
14.	What are the conditions required for maximum drag and minimum power? **April/May 2019**	BTL1	Remembering
15	Draw the lift curve for symmetric airfoil and cambered airfoil **April/May 2019**	BTL5	Evaluate
PART – B			
1.	Derive the condition for minimum drag and power required in straight and level flight. **Nov/ Dec 2020**	BTL1	Remembering
2.	Describe the different types of drag experienced by an aircraft. **Nov/ Dec 2020**	BTL1	Remembering
3.	Derive the rigid body equation of motion for a flight vehicle. **Nov/ Dec 2020**	BTL1	Remembering
4.	Explain how thrust and power varies with change in velocity and altitude **Nov/ Dec 2020**	BTL1	Remembering

5.	Consider an Unmanned Aerial Vehicle (UAV) has the following characteristics: wingspan = 14.85 m, wing area = 11.45 m2, maximum weight 1020 kg, and fuel weight = 295 kg. The power plant is a Rotax four-cylinder, four-stroke engine of 85 horsepower driving a two-blade, variable-pitch pusher propeller. Assume that the Oswald efficiency factor is 0.7, the zero-lift drag coefficient is 0.03, the propeller efficiency is 0.9, and the specific fuel consumption is 0.2 kg, of fuel per horsepower perhour. Calculate the maximum velocity of the Predator at sea level. **Nov/ Dec 2021**	BTL3	Applying
6.	A glider having W = 2000 N, s = 8.0 m2, Aspect Ratio = 16, e = 0.95, and CD0 = 0.015 is launched from a height of 300m. Determine the maximum range, corresponding glide angle, forward velocity, and lift coefficient at sea level. **Nov/ Dec 2021**	BTL3	Applying
7.	Discuss in detail various types of drag in an airplane and methods of minimizing the drag **April/May 2019**	BTL2	Understanding
8.	Derive condition for minimum thrust and power required in straight and level flight **(April/May 2019)**	BTL3	Applying
9.	Derive expression for the equation of motion of a rigid airplane **(Nov/Dec 2018)**	BTL3	Applying
10	With suitable plots explain the variation of thrust and SFC with velocity and altitude for air breathing engines **(Nov/Dec 2018)**	BTL2	Understanding
11.	For an aircraft in straight and level flight. Show that P/Pmin = (3+n4)/4n Where P is power of aircraft **(April/May 2017)**	BTL2	Understanding
12.	Describe different types of drag and their estimation with suitable sketch **(April/May 2018)**	BTL2	Understanding
13.	Considering a steady flight determine the expression for drag polar and thrust required. (ii) Mention the condition for minimum power required for a flight. What are its implications of it? **(April/May 2018)**	BTL2	Understanding
	PART - C		
1.	Explain the relationship between the lift and its drag on an aircraft from low speed to high speeds using drag polar **Nov/ Dec 2020**	BTL2	Understanding
2.	Engine manufacturers are constantly trying to reduce Thrust Specific Fuel Consumption (TSFC) in order to reduce the weight of fuel consumed for a given flight of given time duration. By reducing the fuel weight, the payload weight can be correspondingly increased. However, design changes that result in reductions in TSFC also frequently result in slight increases in the engine weight itself, which will then reduce the payload weight. The break-even point is where the decrease in fuel weight is exactly cancelled out by the increase in engine weight, giving no increase in the payload weight. Designating the new reduced thrust-specific fuel consumption by $(\mathrm{TSFC})_{\mathrm{new}} = (\mathrm{TSFC})\ (1-\varepsilon_f)$ and the new weight of the airplane increased by the increase in engine weight by, $\mathrm{W}_{\mathrm{new}} = \mathrm{W}(1+\varepsilon_w)$ where f □ and w □ are small fractional values, prove that the bre-aekven point for changes in engine weight and TSFC are given by	BTL3	Applying

	$\varepsilon_f = \varepsilon_W\left(1+\frac{W}{W_f}\right) = \varepsilon_W\left[1+(L/D)/(TSFC)t\right]$ where W and Wf are the average weight of the airplane during, cruise and the weight of fuel used during cruise, respectively, both before any design perturbation in engine weight or TSFC, and t is the total cruising time of flight. **Nov/ Dec 2021**		
3.	Describe different types of drag and their estimation with suitable sketch **April/May 2019**	BTL2	Understanding

UNIT II - MANOEUVERING FLIGHT PERFORMANCE			
Q.No	**Question**	**BT Level**	**Competence**
	PART – A		
1	Define range and endurance. **Nov/ Dec 2020**	BTL1	Remembering
2	Define load factor and explain its significance **Nov/ Dec 2020**	BTL1	Remembering
3	What is the condition for maximum endurance of a propeller driven aircraft? **Nov/ Dec 2021**	BTL1	Remembering
4	Why longer ground run is required for aircrafts when aerodrome is situated at higher altitudes? **Nov/ Dec 2021**	BTL2	Understanding
5	Define specific fuel consumption **April/May 2019**	BTL1	Remembering
6	Define stalling speed **April/May 2019**	BTL1	Remembering
7	What is bank angle? **April/May 2018**	BTL1	Remembering
8	What are the main aspects of requirements to be considered in airplane design **April/May 2018**	BTL1	Remembering
9	Write shortly about unpowered flight **April/May 2017**	BTL1	Remembering
10	Write shortly about climbing flight. **April/May 2017**	BTL1	Remembering
11	Define rate of climb. **Nov/ Dec 2017**	BTL1	Remembering
12	Draw TR versus V graph of turbojet airplane and indicate VmaxE and VmaxR.init **Nov/ Dec 2017**	BTL2	Understanding
13	What are the factors affecting the actual efficiency of the propeller **Nov/ Dec 2018**	BTL1	Remembering
14	What are the main aspects of requirements to be considered in airplane design **Nov/ Dec 2018**	BTL1	Remembering
15	Explain empty weight of an aircraft? **Nov/ Dec 2019**	BTL1	Remembering
16	Draw PR versus V graph of turbo propeller airplane and indicate VmaxE and VmaxR. in it **Nov/ Dec 2019**	BTL2	Understanding
	PART – B		
1	Derive the Brequet Range and endurance equation for a jet and propeller aircrafts. **Nov/ Dec 2020**	BTL1	Remembering
2	Explain the terms 1. Radius of turn. (2) 2. Aircraft speed. (2) 3. Load factor. (2) 4. Bank angle. (2) **Nov/ Dec 2020**	BTL1	Remembering
3	Explain V-n diagram with gust loads. **Nov/ Dec 2020**	BTL1	Remembering

4	Estimate the maximum rate of climb of the following airplane flying at sea-level and its angle of climb given: W = 8000 kg, S = 25 m2, CD =0.018+0.16 2 CL , Thrust= 2500 kg. Calculate also the maximum rate of climb at 5 km (density =0.745 kg/m3) with engine thrust as 1800 kg. **Nov/ Dec 2021**	BTL5	Evaluate
5	An airplane weighing 10000 N is going through such a flight at sea-level at a speed of 135 kmph and goes through 90 degrees in 15 seconds The wing loading(W/S) is 1200 N/m2 and at this speed the lift-to-drag ratio is 10. Calculate the radius of turn, load factor, and the power required. **Nov/ Dec 2021**	BTL3	Applying
6	Derive Breguet range equation for a jet engine aircraft and discuss its implications **(April/May 2019)**	BTL2	Understanding
7	Explain with a neat sketch V-n diagram with gust load **Nov/Dec 2018**	BTL1	Remembering
8	Derive an expression for the landing ground run and discuss its implication. Also obtain and expression for flare distance **April/May 2017**	BTL2	Understanding
9	Derive expression for endurance and range for a jet engine **April/May 2018**	BTL2	Understanding
10	What is turning performance and minimum radius of turn? Deduce an expression for turning performance and minimum radius of turn **April/May 2018**	BTL1	Remembering
11	Derive an expression for maximum rate of climb of a propeller airplane and discuss the parameters influencing the same **Nov/Dec 2018**	BTL2	Understanding
12	What are pull- up and pull- down maneuvers? **Nov/Dec 2018**	BTL1	Remembering
	PART – C		
1.	Show that the maximum rate of climb for a propeller driven airplane is R/Cmax=[(ηpr × p)/w]-VR/Cmax[1.155/(L/D)max]. **Nov/ Dec 2020**	BTL3	Applying

UNIT III - *STATIC LONGITUDINAL STABILITY*			
Q.No	**Question**	**BT Level**	**Competence**
	PART – A		
1.	Define the terms maneuverability and controllability in aircraft. **Nov/ Dec 2020**	BTL1	Remembering
2.	Define neutral point. **Nov/ Dec 2020**	BTL1	Remembering
3.	What is meant by a coordinated turn **Nov/ Dec 2021**	BTL1	Remembering
4.	Will the aircraft dynamically stable when it is statically stable? Justify your answer. . **Nov/ Dec 2021**	BTL5	Evaluate
5.	How do you locate the neutral point in an aircraft April/May 2019	BTL2	Understanding

6.	Mention the role of flaps during take-off of an aircraft **April/May 2019**	BTL2	Understanding
7.	What is meant by „degree of freedom" and how many does an aircraft have **April/May 2019**	BTL2	Understanding
8	Define Neutral point of an aircraft. What is its significance **April/May 2019**	BTL2	Understanding
9.	Define static Margin **April/May 2017**	BTL2	Understanding
10.	Indicate the center of gravity of a static flight **April/May 2018**	BTL2	Understanding
11.	What are the criteria for static longitudinal stability **Nov/Dec 2018**	BTL1	Remembering
12.	Mention the significance of hinge moment coefficient **April/May 2018**	BTL1	Remembering
13.	Define elevator hinge moment **Nov/Dec 2018**	BTL1	Remembering
14.	With the help of Cm vs CL curve of an airplane, state the stable, neutral and unstable conditions of it **Nov/Dec 2016**	BTL2	Understanding
15.	Define elevator power and write down the elevator power criterion equation **Nov/Dec 2017**	BTL2	Understanding
	PART – B		
1	Explain the influence of CG location towards the stability criterion of an aircraft. **Nov/ Dec 2020**	BTL2	Understanding
2	Discuss the purpose of different controls in aircraft **Nov/ Dec 2020**	BTL2	Understanding
3	Explain in detail about inherently stable and marginal stable aircrafts. **Nov/ Dec 2020**	BTL2	Understanding
4	Write a short note on: 1. Stick force (2) 2. Stick force gradient (2) 3. Stick force per „g"(2) **Nov/ Dec 2020**	BTL1	Remembering
5	Given the differential equations that follow, $\dot{x_1} + 0.5x_1 - 10x_2 = -1\delta$ $\dot{x_2} - x_2 + x_1 = 2\delta$ where x1 and x2 are the state variables and δ is the forcing input to the system. (i) Rewrite these equations in state space form. (ii) Find the tree response eigen values **(iii)** What do these eigen values tell us about the response of this system? **Nov/ Dec 2021**	BTL3	Applying

6	An airplane has the following stability and inertia characteristics: W=255826 kg, $I_x = 18.6 \times 10^6$ kg.m^2, $I_y = 41.4 \times 10^6$ kg.m^2 $I_z = 58.4 \times 10^6$ kg.m^2, Planform area (S)=510.96 m^2, Wing span (b)=59.64 m, Mean aerodynamic chord=8.32 m, Velocity=85.34 m/s, $C_L = 1.11$, $C_D = 0.102$, lift curve slope=5.7 rad^{-1}, $C_{D\alpha} = 0.66$ rad^{-1}, $C_{m\alpha} = -1.26$ rad^{-1} $C_{mq} = -20.8$ rad^{-1}. (i) Find the frequency and damping ratio of the short- and long-period modes. (ii) Find the time to half-amplitude for each mode (iii) Discuss the influence of the coefficients C_{mq} and $C_{m\alpha}$ on the longitudinal motion. (13) **Nov/ Dec 2021**	BTL3	Applying
7	Derive expression for wing contribution for static longitudinal stability. Also offer your comment on this expression (April/May 2017)	BTL2	Understanding
8	How does the aft position of the tail affect the stability of the aircraft? Support your theory with appropriate derivation (April/May 2019)	BTL2	Understanding
9	What is the need of aerodynamic balancing? Discuss any four methods (Nov/Dec 2018)	BTL1	Remembering
10	Derive the elevator hinge moment to determine the static margin for an aircraft **April/May 2019**	BTL2	Understanding
11	Derive an expression for stick free and stick fixed neutral point **April/May 2017**	BTL2	Understanding
12	Discuss the power effects on static longitudinal stability for both jet and propeller airplane **Nov/Dec 2018**	BTL2	Understanding
13	Derive an expression for elevator angle required to trim the airplane at a particular angle of attack **Nov/Dec 2018**	BTL2	Understanding
	PART – C		
1.	Explain in detail the different modes of Oscillation following a Disturbance? Also explain in detail the various characteristic modes of oscillation involved in stick fixed and stick free dynamic longitudinal stability. **Nov/ Dec 2021**	BTL1	Remembering

UNIT IV - *LATERAL AND DIRECTIONAL STABILITY*			
Q.No	**Question**	**BT Level**	**Competence**
PART - A			
1.	What is dihedral effect? **Nov/ Dec 2020**	BTL1	Remembering
2.	Define adverse yaw and explain how it is controlled by rudder. **Nov/ Dec 2020**	BTL2	Understanding
3.	What is the difference between inherently stable and marginally stable aircraft? **Nov/ Dec 2021**	BTL1	Remembering
4.	Which of the components (viz., fuselage, wings, canards, and control surfaces)of the aircraft structure contributes destabilizing effect to the static longitudinal stability for a conventional aircraft. **Nov/ Dec 2021**	BTL1	Remembering
5.	Define side slip angle **April/May 2019**	BTL1	Remembering
6.	Differentiate stability from controllability **April/May 2019**	BTL1	Remembering
7.	Define dihedral effect **April/May 2019**	BTL1	Remembering
8.	What is the need for a fin in an airplane **April/May 2019**	BTL1	Remembering
9.	Define rudder lock **April/May 2017**	BTL1	Remembering
10	What is aerodynamic balancing of an airplane **April/May 2017**	BTL1	Remembering
11	State the function of a rudder **April/May 2018**	BTL2	Understanding
12	What is aileron reversal? Give its significance **April/May 2018**	BTL1	Remembering
13	Define power of lateral or aileron control. **April/May 2018**	BTL1	Remembering
14	How to avoid rudder lock? **Nov/ Dec 2017**	BTL2	Understanding
15.	What is the criterion to keep the directional stability with stick-free above certain limit or not to lose much? **Nov/ Dec 2017**	BTL1	Remembering
16.	How the floating rudder (stick-free) affects the directional stability? **Nov/ Dec 2016**	BTL2	Understanding
PART – B			
1	Explain the coupling between rolling and yawing in detail. **Nov/ Dec 2020**	BTL1	Remembering
2	Describe requirements of rudder in detail. **Nov/ Dec 2020**	BTL2	Understanding
3	Write short notes on 1. Aileron reversal (3) 2. Rudder lock (3) **Nov/ Dec 2020**	BTL1	Remembering
4	Write short note on one engine inoperative condition in Aircraft. **Nov/ Dec 2020**	BTL1	Remembering

5	The transfer function for an aircraft cruising at an altitude of 9 km and 0.46 Mach follows, Find the natural frequency, damping ratio, damped frequency, and time constant for the short period and phugoid modes **Nov/ Dec 2021**	BTL3	Applying
6	Write a short note on the following: (13) (i) Elevator power (ii) Most forward C.G. for free flight (iii) Stick free neutral point (iv) Aileron reversal **(v)** Aileron control power **Nov/ Dec 2021**	BTL1	Remembering
7	Quantitatively explain the condition of different components of aircraft towards directional stability and explain directional control **April/May 2019**	BTL1	Remembering
8	Briefly explain Aileron reversal, One engine inoperative condition and Rudder lock **April/May 2019**	BTL1	Remembering
9	Discuss the contribution of various components of lateral stability **April/May 2017**	BTL2	Understanding
10	Effect of following to directional stability (i) Wing, (ii) engine power, (iii) vertical fin **April/May 2017**	BTL2	Understanding
11	Deduce expression for directional stability due to wing sweep and rudder control **April/May 2018**	BTL2	Understanding
12	What is weather cocking effect? Mention its characteristics **April/May 2018**	BTL2	Understanding
13	Discuss with suitable example the coupling between rolling and yawing moment **Nov/Dec 2018**	BTL2	Understanding
14	Explain requirements of Rudder in detail **Nov/Dec 2018**	BTL2	Understanding
	PART - C		
1	Describe about coupling and rolling moments in aircraft **Nov/Dec 2018**	BTL2	Understanding
2	Brief on lateral control of aircraft **April/May 2017**	BTL2	Understanding

UNIT V - DYNAMIC STABILITY			
Q.No	**Question**	**BT Level**	**Competence**
PART - A			

1.	Define Autorotation. **Nov/ Dec 2020**	BTL1	Remembering
2.	Define Dutch roll. **Nov/ Dec 2020**	BTL1	Remembering
3.	What is meant by Rudder lock? **Nov/ Dec 2021**	BTL1	Remembering
4.	What is meant by Dutch roll and what is its significance? **Nov/ Dec 2021**	BTL1	Remembering
5.	What is Dutch roll **April/May 2019**	BTL1	Remembering
6.	Define load factor **April/May 2019**	BTL1	Remembering
7.	What are stability derivatives and what is its significance **April/May 2019**	BTL1	Remembering
8.	Represent a system that is statically stable but dynamically unstable **April/May 2017**	BTL2	Understanding
9.	What are the parameters that affect phugoid mode? **April/May 2017**	BTL1	Remembering
10.	List the modes of Stability **April/May 2018**	BTL1	Remembering
11.	Mention the difference between static and dynamic stability **April/May 2018**	BTL1	Remembering
12.	What is keel effect **Nov/Dec 2018**	BTL1	Remembering
13.	What is meant by weather cocking effect?	BTL1	Remembering
14.	What is the need for aerodynamic balancing?	BTL1	Remembering
15.	Distinguish between stability and controllability.	BTL4	Analyze
16.	State two basic requirements of aircraft control surface.	BTL2	Understanding
17.	How to get out of the spin smoothly?	BTL1	Remembering
18.	Briefly explain the spinning of an aircraft.	BTL1	Remembering
19.	Define spiral divergence in dynamic stability?	BTL1	Remembering
20.	What is proposing mode of dynamic motion?	BTL1	Remembering
	PART – B		
1	Explain the following : 1. Stick free condition (4) 2. Spiral divergence (3) 3. Dutch roll (3) 4. Phugoid motion (3) **Nov/ Dec 2020**	BTL1	Remembering
2	Write short notes on: 1. Modes of stability (5) 2. Spin & recovery from spin (5) 3. Autorotation (3) **Nov/ Dec 2020**	BTL1	Remembering

3	The transfer function given below is for one of the longitudinal dynamic responses (SPO) of angle of attack of aircraft (α) for elevator control input $\frac{LT(\alpha)}{LT(\delta_e)} = \frac{-0.8952s - 250.3}{820s^2 + 1633.9s + 6542.9}$ Find the natural frequency and damping ratio for this mode. Using the final value theory or otherwise, find the steady state value of angle of attack in response to step elevator input of 3 deg **Nov/ Dec 2021**	BTL3	Applying
4	The characteristic equation of coupled longitudinal and lateral-Directional aircraft motion is known to be an 8th order equation. A typical set of 8 roots of such a characteristic equation for some flight condition is given below: **Nov/ Dec 2021** $\lambda_{1,2} = -4.4 \pm i65.5,\ \lambda_3 = -2, \lambda_4 = 0.05,\ \lambda_{5,6} = -0.35 \pm i12.5,$ and $\lambda_{7,8} = -1.4 \pm i41.5$ Show these roots in the $\lambda(\eta, \omega)$ plane indicating the nature of c modes of the aircraft, associated with the 3 pairs of complex co roots – period (short/medium/long period) and d (highly/moderately/lightly damped) and the 2 real (highly/negatively damped). Also name the aircraft modes ass with at all the 8 roots including 2 real roots. Obtain the time to ha or time to double T_2 as applicable for all the modes and the peri periodic modes.	BTL3	Applying
5	Explain in detail the phenomenon of autorotation and spin and discuss how the pilot can recover from the situation **April/May 2019**	BTL2	Understanding
6	Quantitatively explain the condition of different components of aircraft towards directional stability and explain directional control **April/May 2019**	BTL1	Remembering
7	Briefly explain Aileron reversal, One engine inoperative condition and Rudder lock **April/May 2017**	BTL2	Understanding
8	Write short note on (i) phugoid mode, (ii) dutch roll, (iii) routh's criterion **April/May 2017**	BTL2	Understanding
9	The statically stabled aircraft may be dynamically stable or	BTL2	Understanding

	unstable. Similarlly dynamically stable aircraft may be statically stable or unstable. Are both statements true? Discuss various stability derivatives relevant to longitudinal dynamic stability **April/May 2017**		
10	Write short notes on (i) Spiral and directional divergence (ii) Stability derivatives in longitudinal dynamics **April/May 2017**	BTL1	Remembering

**********all the best **********