Name: Enrolment No:	UPES UNIVERSITY OF TOMORROW

Supplementary Examination, December 2023

Course: Flight Mechanics-I — **Semester: V**
Program: B.Tech Aerospace Engineering — **Time : 03 hrs.**
Course Code: ASEG3019 — **Max. Marks: 100**
Instructions: Assume any missing DATA.

SECTION A
5Qx4M=20Marks

S. No.		Marks	CO
Q 1	Compare TAS, IAS and CAS airspeeds of Aircraft.	**4**	**CO1**
Q 2	Compare *Parasite* and *Induced* drag forces acting on Aircraft.	**4**	**CO2**
Q 3	Compare expression for lift curve slope for High aspect ratio wing at incompressible and compressible subsonic speeds.	**4**	**CO3**
Q 4	Show that unpowered glide angle of aircraft depends on L/D ratio.	**4**	**CO4**
Q5	Differentiate between TSFC and SFC performance parameters of Aircraft Engines.	**4**	**CO5**

SECTION B
4Qx10M= 40 Marks

S. No.		Marks	CO
Q6	a) Differentiate between *Geometric* and *Geopotentials* altitudes in Standard atmosphere. b) Derive the relation between *geopotential altitude* (*h*) of aircraft.	**10**	**CO1**
Q7	Consider a straight wing of aspect ratio 7 and 3 with a NACA 2412 airfoil lift curce slope 0.105 per deg and Zero-Lift AOA of 6 deg. Assuming low-speed flow, calculateanc compare lift coefficients at an angle of attack 5 deg. For this wing, the span effectiveness (*Oswald Efficiency*) is 0.95.	**10**	**CO2**
Q8	Consider our executive jet, W = 45000 N, S =20 m^2, T = 9000 N and the parabolic drag polar is, $C_D=0.016 + 0.065C_L^2$. Find the max angle of climb, and the climb rate under that condition	**10**	**CO3**
Q9	Consider an aircraft that has a wingspan of 14 m, a wing area of 35 m^2, and a gross weight of 90000 N. In level flight, the lift equals the weight. The aircraft is flying at 100 m/s. Also, the Oswald efficiency factor is 0.85, and the zero-lift drag coefficient is 0.021. *Plot following flight parameter with varying Velocity*: a) lift coefficient b) induced drag coefficient c) total drag coefficient d) induced drag (N) e) zero-lift drag (N) f) total drag (N)	**10**	**CO4**

<table>
<tr><td colspan="4">SECTION-C
2Qx20M=40 Marks</td></tr>
<tr><td>Q10</td><td>Derive Breguet Formula for Range and Endurance of Turbojet Aircraft. Hence, show maximum Range and Endurance conditions for Turbojet aircraft.</td><td>20</td><td>CO5</td></tr>
<tr><td>Q11</td><td>Consider an aircraft with the following properties: W/S = 292 kg/m^2, $W = 4500$ kg, $S = 15m^2$, C_{Lmax}, = 1.5, $\mathbf{n}_{max}$= 6, $C_D = 0.018 + 0.064\, C_L^2$, and T_{max} = 22000 N. Find the extreme turn rate and turn radius, and the speed at which they occur. Are these sustainable turn rates?

OR

a) Show that turn radius of an aircraft during pull-up is given by
$$R = \frac{V^2}{g(n+1)}$$
b) Find the radius of turn in pull-up and pull-down maneuvers for civil transport aircraft having velocity 200 m/s (HINT: use below table for value of n)
<table>
<tr><th>Aircraft Type</th><th>n_{pos}</th><th>n_{neg}</th></tr>
<tr><td>Normal general aviation</td><td>2.5–3.8</td><td>−1−−1.5</td></tr>
<tr><td>Aerobatic general aviation</td><td>6</td><td>−3</td></tr>
<tr><td>Civil transport</td><td>3–4</td><td>−1−−2</td></tr>
<tr><td>Fighter</td><td>6.5–9</td><td>−3−−6</td></tr>
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</td><td>20</td><td>CO4</td></tr>
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