Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

Course: Aircraft Design | **Semester: VIIIth**
Program: B.Tech ASE | **Time 3 hrs.**
Course Code: ASEG4004 | **Max. Marks: 100**

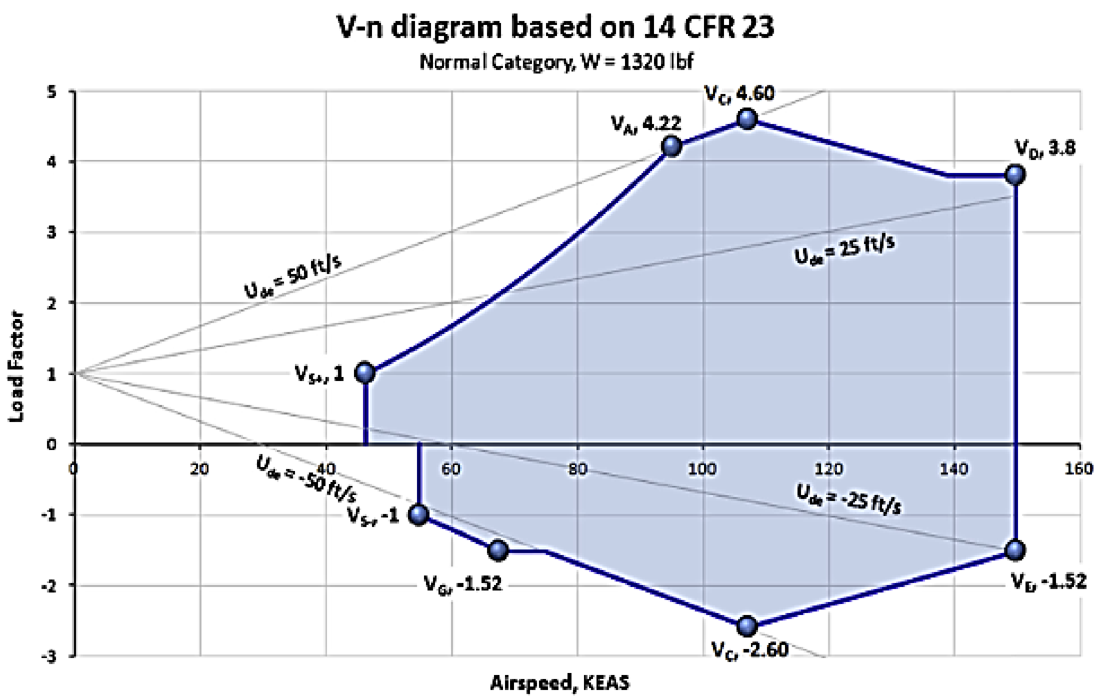
Instructions: Assume the necessary data if not given. Use suitable plots wherever required.

SECTION A (6*5 =30)

S. No.		Marks	CO
Q 1	List the phases in the general process of aircraft design.	**5**	**CO1**
Q 2	What is D.O.C (direct operating cost) and I.O.C (indirect operating cost) and how do they affect the design process?	**5**	**CO1**
Q 3	Mention the aerodynamic factors, which affect the airplane design configuration.	**5**	**CO1**
Q 4	A four-seat trainer is being designed and it is required to carry 300 lbf of baggage in addition to the occupants. Assume a crew of one, 200 lbf/person, and use the ratios We/W0= 0.6875 and Wf/W0=0.13125. For the conceptual design, estimate initial values for: (1) Gross weight. (2) Empty weight. (3) Fuel weight.	**5**	**CO3**
Q 5	Describe the calculation process for drag optimized tail arm length for only horizontal tail and frustum fuselage.	**5**	**CO3**
Q 6	Write down the pros and cons of tadpole fuselage over frustum shaped fuselage.	**5**	**CO3**

SECTION B (5*10=50)

Q 7	Discuss the detailed design process of an aircraft in brief.	**10**	**CO2**
Q 8	Compare the design requirements and specifications for a bomber airplane and interceptor airplane.	**10**	**CO2**
Q 9	A small airplane has a reference area S_{REF} =170 ft^2, an AR of 16, and TR of 0.5. If the tail cone has the dimensions R1=2.5 feet and R2= 0.3 feet, determine l_{HT} for V_{HT}=0.75. Size the HT for an AR of 4 assuming a rectangular planform. Use MGC for c_{ref}	**10**	**CO4**

<table>
<tr><td>Q10</td><td>From the preliminary three-view and the data collection of an airplane, the following data are obtained.
$\mathbf{C_D = 0.00884 + 2.047 * 10^{-6}\, p + 0.053*p^2/ q^2}$, Wing loading based on data collection, $(W/S)_{old}$ = 4000 N/m^2 .The airplane is to be designed to fly at a maximum equivalent airspeed of 131 m/s at an altitude of 11 km.
a) Obtain the optimum wing loading (p) and the corresponding (t_v)min.
b) If a 4% increase is permitted over (t_v)min then determine the range of p
c) If the ratio of the engine thrust at under sea level static condition to that of 11000 m (T_{SL}/T_{11000}) were 4.2, obtain the thrust loading for the airplane.</td><td>10</td><td>CO4</td></tr>
<tr><td>Q 11</td><td>The v-n diagram for an airplane is shown in the following figure.
Discuss the important features (maneuvering and gust both) of the diagram and point out all the important intersection points and lines for normal as well inverted flight.
You can prepare a table to summarize the details.

</td><td>10</td><td>CO5</td></tr>
<tr><td colspan="4" align="center">SECTION-C (1*20=20)</td></tr>
</table>

Q 12	Estimate of the gross weight (W_O) The aircraft specifications are given below. Type: commercial civil transport aircraft with turboprop engine No. of passengers: 300 along with their luggage of 50kg per passenger V_{cruise}: Around 750 kmph at around 4.5 km altitude, Safe range: 2000 km; Service ceiling: 8000 m Balanced field length for take-off : Around 1600 m η_p and BSFC during cruise= 0.85 and 2.7N/kW - hr η_p and BSFC during loiter= 0.75 and 2.7N/kW - hr assume that fuel fraction for taxi, climb, descent and landing are 0.98, 0.97,0.99 and 0.997 respectively, Assume loiter of 30 min and assume empty weight ratio of 0.5 fuel fraction for cruise , $\frac{W_i}{W_{i-1}} = \exp\left\{\frac{-R \times BSFC}{3600\eta_p (L/D)}\right\}$ Fuel fraction for loiter , $\frac{W_{i-1}}{W_i} = \exp\left\{\frac{-E \times BSFC \times V}{1000 \times \eta_p \times (L/D)}\right\}$ Drag polar $C_D = 0.0222 + 0.036\, C_L^2$	**20**	**CO3**