1. (25%) A turbojet aircraft is flying in a vertical plane as shown in Fig. 1. In order to examine the flight conditions of the aircraft, please carry out the following questions.

   (a)(8%) Write down the equations of motion for the aircraft.

   (b)(9%) If the aircraft is in a steady-state level flight, determine the flight speed of the aircraft in terms of the appropriate parameters. (Assume it is in parabolic drag polar)

   (c)(8%) From above, resolve the necessary condition(s) such that the flight speed has, at least, a solution. Discuss the physical meaning as well.

2. (25%) A triple-wing airplane is shown in Fig. 2. That is, the airplane has a geometry of canard-wing-tail combination. Apply the necessary assumptions to answer the following problems.

   (a)(10%) Find the total moment coefficient of the aircraft with respect to the center of gravity.

   (b)(15%) Discuss the possibilities of the stability of the aircraft.

3. (27%) For the aircraft whose pitching moment coefficient equation is given as

$$C_M = 0.09 - 0.25\, C_L - 0.025\, De$$

   Where De is positive downward in degrees.

   (a)(6%) Determine the static stability and the static margine.

   (b)(6%) Locate the neutral point, NP, with respect to the design location of the C.G.

   (c)(7%) If the maximum elevator deflections are +20 deg. and -25 deg., respectively, and if the landing flare lift coefficient is 2.3, locate the most forward C.G. position with respect to the design C.G. location.

   (d)(8%) What is the maximum allowable C.G. shift (from NP to the most forward position) in terms of the mac.

4. (23%) The non-dimensional, linearized longitudinal equations of motions for stick fixed is given as

$$(2\mu D - C_{x_u})\hat{u} - C_{x_\alpha}\alpha + C_{L_0}\theta = 0$$

$$(2C_{L_0} - C_{z_u})\hat{u} + (2\mu D - C_{z_{\dot\alpha}} - C_{z_\alpha})\alpha - (2\mu + C_{z_q})D\theta = 0$$

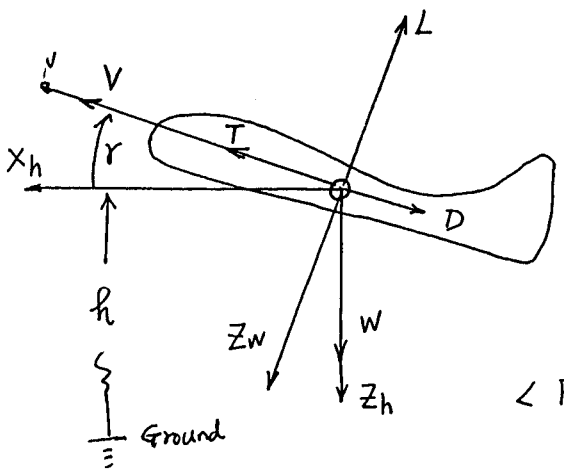
$$-C_{m_u}\hat{u} - (C_{m_{\dot\alpha}}D + C_{m_\alpha})\alpha + (i_B D^2 - C_{m_q}D)\theta = 0$$

If an aircraft is flying at the conditions as following, please answer the following questions.

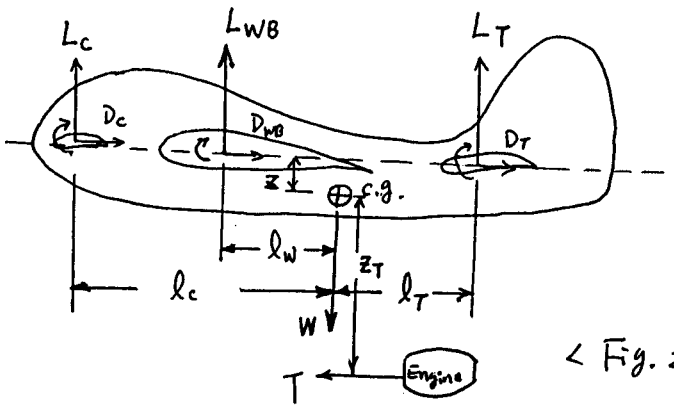
$C_{L_0} = 0.25$	$C_{z_\alpha} = -4.90$	$C_{z_q} = 0$
$C_{D_0} = 0.0188$	$C_{m_u} = 0$	$C_{m_{\dot\alpha}} = -4.20$
$C_{x_u} = -0.0376$	$C_{z_{\dot\alpha}} = 0$	$\mu = 272$
$C_{x_\alpha} = 0.14$	$C_{m_q} = -22.9$	$i_B = 1900$
$C_{z_u} = 0$	$C_{m_\alpha} = -0.488$	

(a) (8%) Is the aircraft statically stable? Why?

(b) (15%) Determine the eigenvalues of the short-period mode and the Hugoid mode. Discuss theirs stability and physical meanings.



< Fig. 1 >



< Fig. 2 >