UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	FLIGHT MECHANICS
COURSE CODE	:	BDU20603
PROGRAMME	:	2BDC
EXAMINATION DATE	:	JUNE 2016/JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

Q1 Given an airplane having data as follow:

- Aircraft weight $W = 80000$ N
- Wing area reference $S = 24$ m^2
- Drag polar coefficients C_D : $C_D = 0.02 + 0.06\, C_L^2$
- The maximum lift coefficients $C_{Lmax} = 1.6$
- Engine Thrust $T = 180000$ N

The atmospheric data gives:

- At sea level, the air density $\rho = \rho_{S.L} = 1.225 \frac{kg}{m^3}$ and
- at altitude $h = 10000$ m $\rho = \rho_{10000} = 0.413 \frac{kg}{m^3}$.

Calculate :

(i) Stalling speeds at sea level and at 10 km altitude.

(5 marks)

(ii) Lift and drag coefficient at the $(C_D / C_L)_{min}$ and $(C_D / C_L^{3/2})_{min}$ respectively

(10 marks)

(iii) The required minimum thrust T_{rmin}, the required minimum power P_{rmin}, if the aircraft flies at sea level

(10 marks)

(iv) Maximum and minimum speed in steady level flight at sea level.

(10 marks)

Q2 An airplane with aircraft weight $W = 180000$ N has a wing area of 45 m^2 and drag polar given by $C_D = 0.017 + 0.05C_L^2$. This airplane flies at the flight speed 540 km per hour and flight altitude $h = 3000$ m. The air density ρ at $h = 3000$ m is equal to 0.909 kg/m^3. If at this flight speed, aircraft has a rate of climb 2000 m/minute, determine the thrust and power which are required to fly in this flight condition.

(20 marks)

Q3 A glider weighing 4905 N has a wing area of 25 m^2, $C_{DO} = 0.012$, wing aspect ratio $A = 16$ and efficiency Oswald $e = 0.87$. Determine:

(i) The minimum angle of glide, minimum rate of sink and corresponding speeds under sea level standard conditions

(ii) The greatest duration of flight and the greatest distance that can be covered when glided from a height of 300 m. Neglect the changes in density during glide. Assume air density $\rho = 1.225$ kg/m^3.

(20 marks)

Q4 A jet airplane having a weight of 441 450 N and wing area of 110 m^2 has a tricycle type landing gear. Its C_{Lmax} with flaps is 2.7 and other data as given as follows :

The take-off speed $V_1 = 1.16\ V_{stall}$
The transition speed $V_2 = 1.086\ V_1$
The lift coefficient C_L during ground run is 1.15
The drag polar with landing gear and flaps is $C_D = 0.044 + 0.05C_L^2$
Thrust variation during take-off can be approximated as :

$$T = 128500 - 0.0929\ V^2$$

where V is the km/hour
gravitational acceleration g = 9.8 $m/sec.^2$

Take-off takes place from a level and dry concrete runway (μ=0.02).

Determine:

i. The ground run distance S_1 and the required time for ground run t_1.
(10 marks)

ii. The transition distance S_2 and the required time for the transition phase t_2
(10 marks)

Iii The climb distance to reach 15 m screen height and the time taken for it.
(5 marks)

- END OF QUESTION -