UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	AIRCRAFT SYSTEMS
COURSE CODE	:	BDU 20402
PROGRAMME CODE	:	BDC
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWER **FOUR (4)** QUESTIONS **ONLY.** 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) State the differences between hydraulic and pneumatic systems, and list three examples of each system found in aircraft.

(6 marks)

(b) Constant force F_1 applied at the handle of an SASI pump shown in **Figure Q1(b)** is 100 lb. The pump is connected to a hydraulic system under the maximum pressure of 1000 psi. If the piston stroke per cycle is 0.2 ft, calculate:

(i) The number of cycles, n needed to pump 300 cubic inches of fluid into the system.

(3 marks)

(ii) The mechanical advantage of the pump. Assume that the pressure acting on the piston surface is maximum.

(5 marks)

(c) The 500 kg load on the hydraulic lift shown in **Figure Q1(c)** is to be raised by pouring oil (ρ= 780 kg/m^3) into a thin tube. Determine how high h should be in order to begin to raise the weight. Note that $\theta = 30^{\circ}$.

(11 marks)

Q2 (a) State the source from which the compressed air is obtained to support the operation of all pneumatic systems in an aircraft.

(4 marks)

(b) "Good lubricity and good heat dissipation are two important properties of hydraulic fluids." Elaborate the statement.

(10 marks)

(c) Air enters a compressor with a stagnation pressure of 100 kPa and a stagnation temperature of 27°C. It is compressed to a stagnation pressure of 900 kPa. Assuming the air as an ideal gas, and the compression process to be isentropic:

(i) Sketch a schematic diagram based on these information.

(3 marks)

(ii) Determine the power input (in kW) to the compressor for a mass flow rate of 0.02 kg/s. Given the specific heat at constant pressure, c_p = 1.005 kJ/kg.K.

(8 marks)

Q3 (a) The Boeing 737-800 is descending from an altitude 30,000 ft to 3000 ft at rate 1000 fpm. At altitude 30,000 ft, the cabin is pressurising at level 6000 ft. The pilot wants the cabin pressure to be at 1000 ft when aircraft reaches 3000 ft. Calculate the ideal rate of descend for the cabin pressure.

(9 marks)

(b) Explain the function of tyre as a part of the landing gear configuration. Discuss various alternatives to hydraulic shock absorber used in the landing gear of most light aircrafts.

(7 marks)

(c) The criteria for a landing gear retraction are as follows:

Force Requirements = 5000 lb
Distance moved = 2 ft
Time required = 10 s

(i) Determine the mechanical power required in watt.

(3 marks)

(ii) If the pressure p in the system is 2100 psi, obtain the flow rate requirement Q in gpm.

(3 marks)

(iii) Find the hydraulic horsepower if the system has an efficiency of 0.5.

(3 marks)

Q4 (a) In an aircraft lubrication system, oil at 20°C flows from the sump through the engine where the temperature of the oil increases rapidly to 80°C. If the specific heat capacity of the engine oil at constant pressure is 2100 J/(kg °C) and its mass is 0.3 kg, determine the heat energy absorbed.

(8 marks)

(b) A 0.5 kg heat exchanger fin which made up of aluminium alloy decreases in its temperature from 180°C to 100°C. By taking the specific heat capacity of aluminium alloy at constant pressure to be 0.92 kJ/(kg°C), calculate the heat released by the fin.

(8 marks)

(c) A SASI hydraulic system hand pump is shown in **Figure Q1(b)**. Suppose that the force delivered is $F_1 = 100$ lb at a distance $D_1 = 20$ inches from the pump handle pivot, and $D_2 = 1$ inch is the distance between the pivot and

the pump piston. If the piston area on which the oil acts is $A = 2$ in^2, obtain the maximum pressure developed.

(9 marks)

Q5 (a) Give the most important characteristics of lubricant oil. Discuss your answer.

(5 marks)

(b) In a Cessna 182S air-conditioning system, 15 m^3/s of air at a temperature of 27 °C pass over an evaporator which reduces its temperature to 13°C. The air is then blown over a reheater, which increases its temperature to 18°C. Obtain:

(i) The amount of air handled by the blower;

(5 marks)

(ii) The quantity of the supplied air.

(5 marks)

(c) The centers of gravity at point A, B, and C for airplane fuselage, left wing, and right wing, respectively as shown in **Figure Q5(c)** are influenced by an unequal distribution of fuel in the wing tanks. If these components have mass M_A, M_B and M_C, respectively, where M_A:M_B:M_C = 11:4:3, and M_B = 4000 kg, determine the normal reactions of the wheels D, E, and F on the ground.

(10 marks)

- END OF QUESTIONS -

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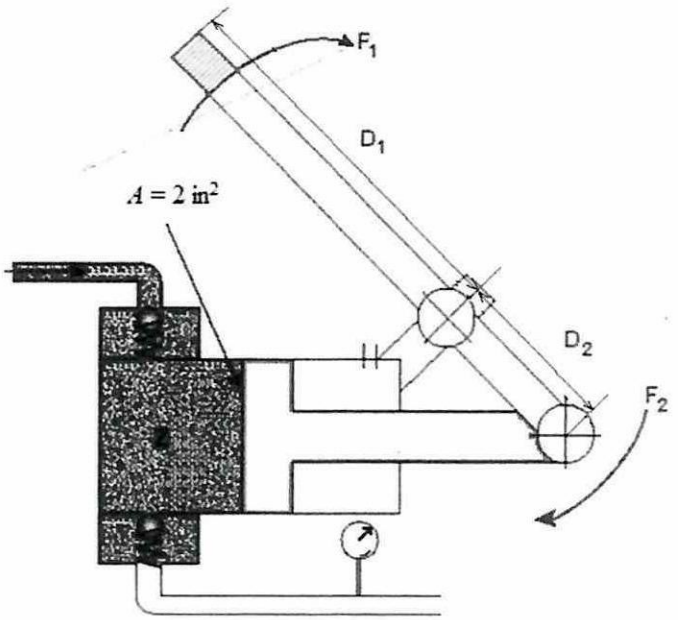

Figure Q1(b)

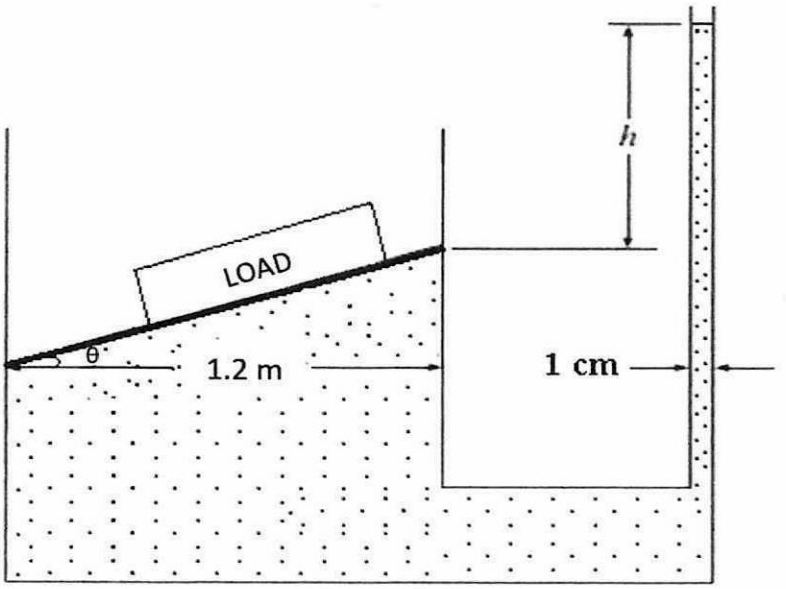

Figure Q1(c)

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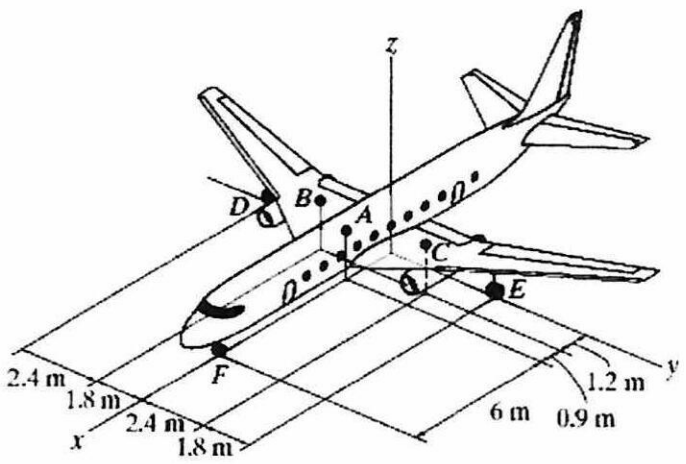

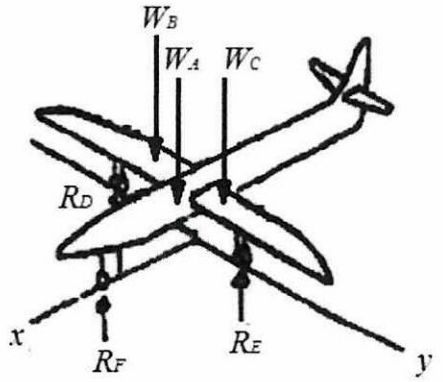

Figure Q5(c)