Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	AIRCRAFT SYSTEMS
COURSE CODE	:	BDX 21003
PROGRAMME CODE	:	BDX
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ONE (1)** QUESTION **ONLY** IN PART A. 2. ANSWER **ALL** QUESTIONS IN PART B 3. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 4. 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

PART A

Q1 (a) Discuss various alternatives to hydraulic shock absorbers used in the landing gear of most large aircraft.

(4 marks)

(b) Batteries are the source of many headaches for pilots of general aviation airplanes. Describe the content of the Nickel-Cadmium battery and propose FOUR (4) preventive maintenance actions to prolong the battery life.

(7 marks)

(c) A SASI hydraulic system hand pump is shown in **Figure Q1(c)**. Suppose that the force delivered is F_1 = 100 lb at a distance D_1 = 20 inches from the pump handle pivot and that D_2 = 1 inch is the distance between the pivot and the pump piston. If the piston area on which the oil acts is $A = 2\ \text{in}^2$, obtain the maximum pressure developed.

(9 marks)

Q2 (a) Due to an unequal distribution of fuel in the wing tanks, the centres of gravity are at points A, B, and C for the airplane fuselage, left wing, and right wing, respectively, as shown in **Figure Q2(b)**. If these components have weights W_A = 225 kN, W_B = 40 kN, and W_C = 30 kN, respectively, determine the normal reactions of the wheels D, E, and F on the ground.

(9 marks)

(b) A battery is a device that converts electrical energy from the alternator into chemical energy. There are two kinds of batteries used in aircraft electrical systems: Lead-acid and Nickel-Cadmium. Compare the characteristics of these two batteries

(6 marks)

(c) Sketch an aircraft hydraulic system and discuss the main function of two main components in a hydraulic system.

(5 marks)

Part B

Q3 (a) Describe the function of the flap and differentiate the THREE (3) types of flaps

(8 marks)

(b) The structures of the helicopter are designed to give the helicopter its unique flight characteristics. Explain and sketch the mechanism of the pitch in helicopter movement

(4 marks)

(c) Explain and sketch the aircraft roll and yaw motion mechanism in terms of part's control and pilot's control

(8 marks)

Q4 (a) Structural monitoring and inspection are crucial in the aviation industry. Inspection is conducted periodically to maintain the airworthiness of the aircraft. Propose FOUR (4) Non-destructive Test (NDT) to run the inspection

(4 marks)

(b) A heating system in aircraft provides a comfortable and safe condition in the cabin. Differentiate the operation mechanism of combustion heaters and radiant panels

(6 marks)

(c) Differentiate the takeoff and landing operation in high altitude airports.

(10 marks)

Q5 (a) In an aircraft's air conditioning system, the main compressor delivers the air at 5 bar and 200°C. The bled air taken from the compressor is passed through a heat exchanger so that the temperature of the air leaving the heat exchanger is 45°C and the pressure is 4.5 bar. The air leaving the heat exchanger passes through the cooling turbine and then supplied to the cabin at 1 bar. The pressure loss between the cooling turbine and cabin is 0.2 bar. If the rate of flow of air through the cooling turbine is 20 kg/min, determine the following:

(i) The actual temperature of the air leaving the cooling turbine.

(4 marks)

(ii) The power delivered to the ram air, which is passed through the cooling turbine.

(2 marks)

Assume that the isentropic efficiency of the cooling turbine is 75% and no loss of heat from the air between the cooling turbine and cabin. Take $\gamma = 1.4$ and $C_p = 1$ kJ/kgK. Refer to the T-S diagram in **Figure Q5(a)**.

(b) 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.

(3 marks)

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

(3 marks)

(d) Describe the P-V diagram of the Ideal Otto cycle employed in an aircraft piston engine

(8 marks)

Q6 (a) The Boeing 737-800 is descending from an altitude of 30,000 ft to 3000 ft at a rate of 1000 fpm. At an altitude of 30,000 ft, the cabin is pressurising at a level of 6000 ft. The pilot wants the cabin pressure to be at 1000 ft when the aircraft reaches 3000 ft. Calculate the ideal rate of descending for the cabin pressure.

(8 marks)

(b) A pressurisation system ensures the comfort and safety of crew and passengers when flying at high altitudes. This is done by controlling the cabin pressure and the air exchange from the inside of the aircraft to the outside. Explain TWO (2) benefits an aircraft obtains when flying at a high altitude.

(4 marks)

(c) Describe and sketch the dissimilarity between engine-driven vacuum pump system operation and venture tube system operation of an aircraft.

(8 marks)

- END OF QUESTION –

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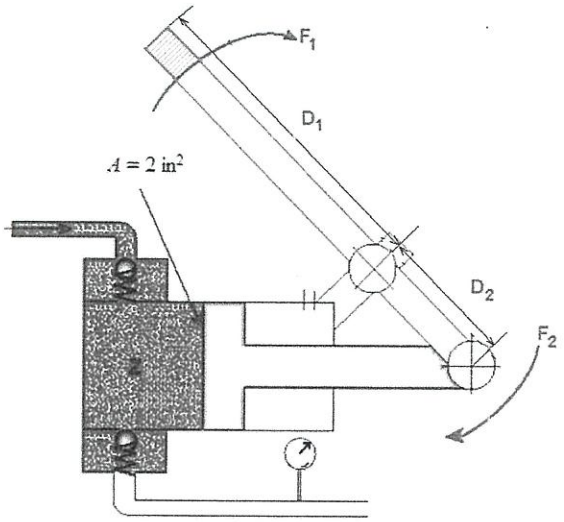

Figure Q1(c)

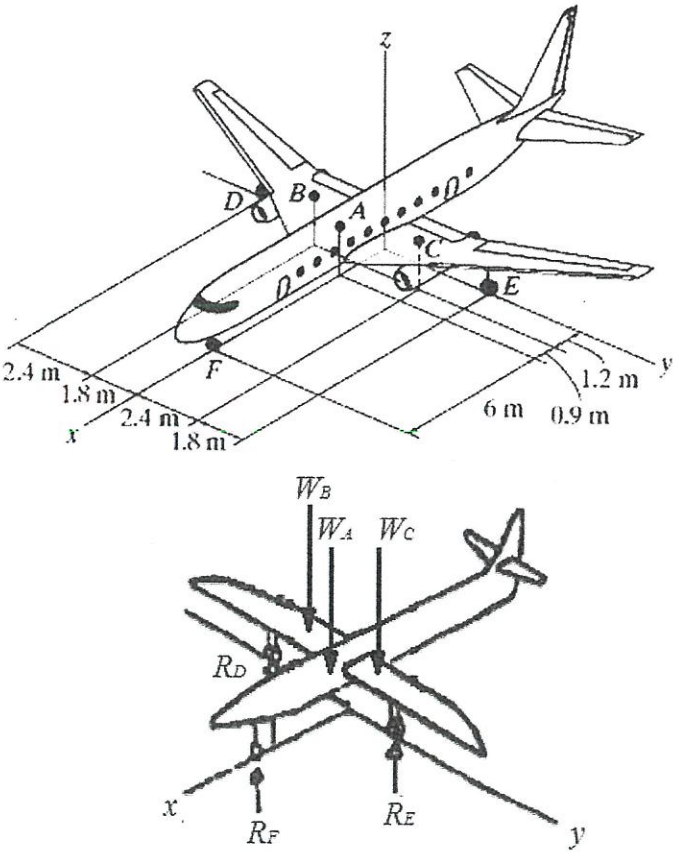

Figure Q2(b)

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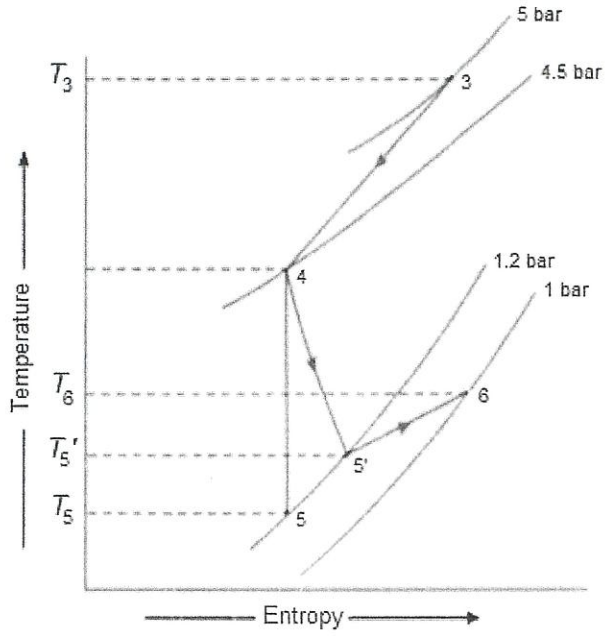

Figure Q5(a)