KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B. Sc. Engineering 4th Year Special Backlog Examination, 2018

ME 4021
(Flight Dynamics)

Time: 3 Hours | Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any missing.

SECTION-A

1(a) Explain with neat sketch the different wing shapes that are used in modern airplane and discuss the reasons behind these differences. 17

1(b) Classify the basic structural components of a modern aircraft and explain them with neat sketches. 18

2(a) Write short note on stall of an airfoil. 08

2(b) State and explain the Daniel Bernoulli's principle. 12

2(c) Explain how down wash create induced drag in finite wing? Derive an expression for the induced drag co-efficient for elliptic lift distribution. 15

3(a) Define stability in context to airplane. What are the different types of stability needed for an airplane? Describe in details. 15

3(b) A wing body model is tested in a sub-sonic wind tunnel. The lift is found to be zero at a geometric angle of attack $\alpha = -1.5°$. At $\alpha = 5°$, the lift coefficient is measured as 0.52. Also, at $\alpha = 1°$ and 7°, the moment coefficients about the center of gravity are measured as -0.01 and 0.05 respectively. The center of gravity is located at 0.35C. Calculate the location of the aerodynamic center and the value at $C_{m,ac}$. 20

4(a) Prove that the minimum thrust required (TR), aerodynamically corresponds to equal to zero lift and drag due to lift. ($C_{D,0} = C_{D,i}$). 15

4(b) Estimate the lift off distance at sea level for the airplane having the following characteristics: 20
Wing span = 16.25 m, wing area = 29.5 m^2, Oswald efficiency factor = 0.81, weight = 82965 N, $C_{D,0} = 0.02$, $C_{L,max} = 1$, $\phi = 0.76$ and the airplane is powered by two turbofan engines of 15280 N thrust each at sea level ($\rho_\infty = 1.225$ kg/m^3).

SECTION-B

5(a) How can flap increases lift coefficient? State with neat sketch other high lift generating devices. 15

5(b) Derive the Breguet formula for propeller driven airplane and hence show that endurance depends on altitude whereas rang is independent of altitude. 20

6(a)	Deduce the expression of turn rate for pull up and pull down turning. How turn rate and turn radius affect the maneuvering performance?	18
6(b)	How does elevator deflection change the moment about center of gravity of an airplane? Calculate the elevator angle to trim.	17
7(a)	Describe the mechanism of thrust production in two alternate explanations and use the explanations to derive the fundamental thrust equation for jet engines.	17
7(b)	Deduce the expression for total pitching moment about the center of gravity.	18
8(a)	What is meant by detonation? Classify the detonation engines. Write down the advantages and applications of pulse detonation engine.	10
8(b)	Briefly explain the fundamentals of rotating detonation engine.	10
8(c)	Deduce the expression for specific impulse I_{SP} in terms of pressure and temperature of initial and exit conditions.	15

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