EC4.402: Introduction to UAV Design: Assignment III

- *Total 20 marks (14+3+3).*

- *Answer all the questions.*

- *Due date: April 30, 2022.*

- *Assume any data if found missing and mention your assumption in the answer.*

- *MATLAB, PYTHON programming can be used (no need to submit the codes). But need to show equations and results for 1 iteration of design.*

Q.1) Design a fixed-wing UAV used for 3D mapping meeting the following specifications.

a) Endurance =60 min.
b) Area of operation = 10 Km radius.
c) Cruise speed = 20 m/s.
d) Flying altitude = 100 m from ground.
e) Climb and descent rates = 2 m/s.

The following aspects of conceptual design phase must be elaborated:
i) CONOPS (1 mark)
ii) Requirement specifications (1 mark)
iii) Market survey (minimum of 2 UAVs) (1 mark)
iv) Airfoil selection, sizing (wing, horizontal tail, vertical tail, control surfaces) (6 marks)
v) Component identification (1 mark)
vi) Performance analysis (2 marks)
vii) Optimize the design for maximizing the range while meeting the rest of the specifications. (2 marks)

Q.2) Compute the performance of the following airfoils using XFLR software for a Reynolds number of 5,00,000. (3 marks)
i) S1223
ii) E220
iii) MH45
Parameters to be considered are C_l, $\frac{C_l}{C_d}$, C_m.

Q.3) For the airfoils given in **Q.2)**, perform the following MCDM analysis,
1) Weighted Sum Model (WSM)
2) Weighted Product Model (WPM)
3) AHP (analytic hierarchy process)
The criteria list is given by $C_1 = C_l$, $C_2 = \frac{C_l}{C_d}$, $C_3 = C_m$ and the relative weights for them are given by $W_1 = 0.3$, $W_2 = 0.35$, $W_3 = 0.35$.