

EC4.402: Introduction to UAV Design: Assignment I

- Total 10 marks (7+3).
- Answer all the questions.
- Due date: March 20, 2021.
- 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 multi-rotor UAV used for package delivery meeting the following specifications.

- Endurance = 30 min.
- Range = 5 Km.
- Payload weight = 1 Kg.
- Payload dimension (L×W×H) = 0.5 m. × 0.5 m × 0.2 m.
- Flying altitude = 60 m from ground.
- Climb and descent rates = 2 m/s and 3 m/s.

The following aspects of conceptual design phase must be elaborated:

- CONOPS
- Requirement specifications
- Market survey (minimum of 2 UAVs)
- Sizing and layout (draw a brief sketch showing the parts and dimensions)
- Component identification
- Analysis
- Optimize the design for maximizing the endurance while meeting the rest of the specifications.

Q.2) The transfer function of a dynamical system with output $y(t)$ and input $u(t)$ is given below.

$$\frac{y(s)}{u(s)} = G(s) = \frac{4}{s^2 + 3s + 10} \quad (1)$$

Design a PID controller for the above system to meet the following requirements.

- Steady-state output $y_{ss} = y_r$, for $y_r(s) = \frac{2}{s}$.
- $y(t)$ must reach 90% of the y_r (i.e. $0.9 \times 2 = 1.8$) before 6 seconds.
- The peak value of output ($y(t)$) must not exceed a magnitude of 2.2.

NB: You can use MATLAB to plot the responses and root locus.