Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

Course: Avionics System Design **Semester: 8**

Program: B.Tech Aerospace Engineering (Avionics) **Time : 03 hrs.**

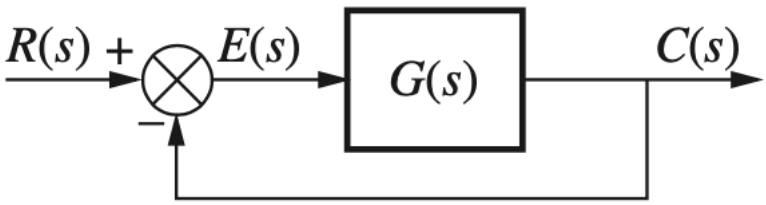
Course Code: AVEG4007P **Max. Marks: 100**

Instructions:

1. Please read each question carefully and then proceed to answer it.
2. Answer all questions.
3. Use figures and diagrams wherever necessary.
4. Scientific calculator is allowed.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Justify with a practical example how Principal Component Analysis (PCA) is used in avionics system design and computer vision applications?	**4**	**CO3**
Q 2	Compose a list of flight parameters displayed on a primary flight display (PFD) of a head-down display along with its function, present in a civil aircraft.	**4**	**CO2**
Q 3	Briefly discuss the application of Routh Hurwitz criterion in designing a longitudinal autopilot of an aircraft.	**4**	**CO1**
Q 4	List down the reason for using a magnetometer with an accelerometer and gyroscope in an inertial measurement unit (IMU) of an aircraft?	**4**	**CO3**
Q 5	Write down an expression for the damping ratio (ζ) of a second order system and compute the damping ratio for the system given below $\frac{25}{S^2 + 7.8S^1 + 25}$	**4**	**CO1**

	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Illustrate the application of linear regression analysis with a simple example. Explain how a best fit line is estimated for a given set of input and output variable.	**10**	**CO2**
Q 7	Elucidate with relevant equations the objective of fusing accelerometer and gyroscope using complementary filter in an IMU of an unmanned aerial vehicle?	**10**	**CO3**
Q 8	Develop a MATLAB or Python based program to estimate orientation of an aircraft using an accelerometer and gyroscope independently. Point out the angle that could not be accurately deduced when using these two sensors and state the reason for it.	**10**	**CO2**
Q 9	Draw the Bode plot for the system shown below where $$G(s) = \frac{(s+3)}{(s+2)(s^2+2s+25)}$$  **Or** Create a flowchart that depicts various steps involved in a Root Locus analysis of an avionics control system. Additionally, for the control system given below, apply the flowchart developed to obtain the root locus response $$\frac{1}{S^2 + 2S^1}$$ Draw approximate Root Locus response on your answer sheets.	**10** **Or** **10**	**CO4** **Or** **CO4**

SECTION-C (2Qx20M=40 Marks)			
Q 10	Describe the application of Quaternions based transformations in attitude estimation of an aircraft. Write the corresponding equations and steps involved in the process of Quaternions based transformations. Illustrate Quaternions method by scripting a MATLAB program that uses equations to convert Quaternions to Euler angles of fixed reference frame.	**20**	**CO4**
Q 11	Elaborately describe the use of Singular Value Decomposition (SVD) and Principal Component Analysis (PCA) in data reduction techniques. Explain one practical example for each technique. **Or** Discuss the purpose of a Kalman Filter in estimating the instantaneous attitude information of an aircraft. Also, elucidate the three famous steps involved in the algorithm when applied to fuse the data from an IMU. Write down the different matrices involved in the filtering algorithm.	**20** **Or** **20**	**CO1** **Or** **CO1**