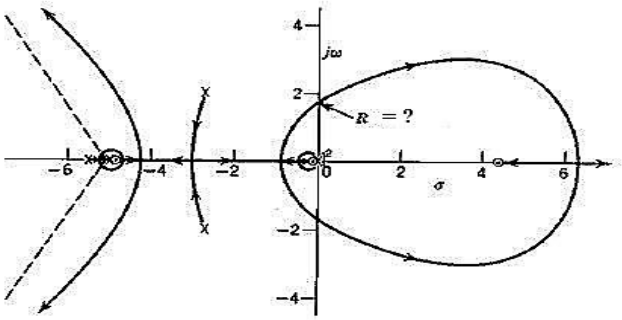
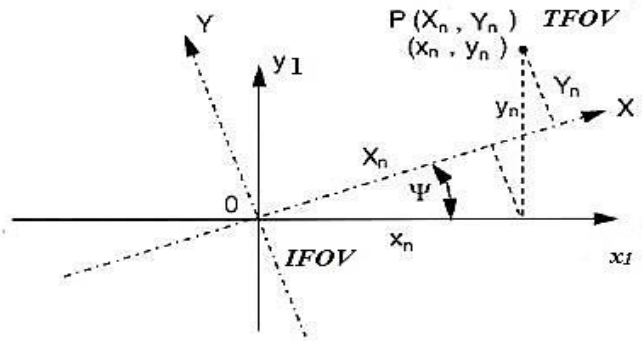
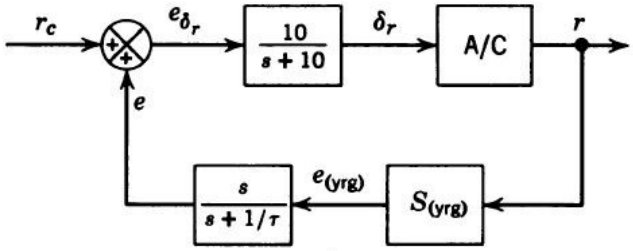
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

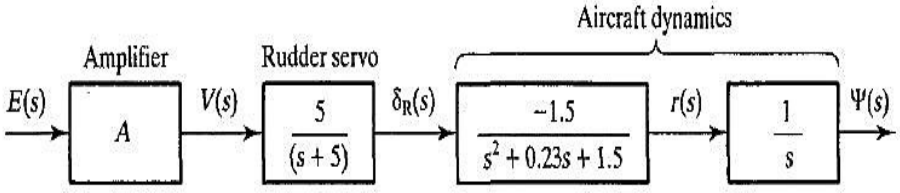
Course: Avionics System Design **Semester: VIII**
Program: B. Tech ASE+AVE
Time: 03 hrs. **Max. Marks: 100**

Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point answers are expected.
The Question paper has three sections: Section A, B and C, Section B and C have internal choices.

SECTION A : All question carries 4 marks each (5X4 =20)

S. No.	Questions	Marks	CO
Q 1	Draw and explain the Fly-By-Wire Flight control system.	**4**	**CO1**
Q 2	Define the RTCA-DO 160 Electromagnetic Tests required for avionics system.	**4**	**CO2**
Q 3	For given system, find the transfer function, where U(s) is the input and Y(s) is the output T(S) = Y(S) / U(S) $\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix} u$ $y = [1 \quad 0 \quad 0]\mathbf{x}$	**4**	**CO3**
Q 4	Discuss the principles of Directional Gyro's and Vertical Gyro's in Lateral Autopilot design.	**4**	**CO4**
Q 5	Write short notes on modular concept unit of ARINC 600 LRU for civil transport aircraft.	**4**	**CO5**
	SECTION B: All question carries 10 marks each, Q9 have internal choice		
Q 6	Construct the Bode plot for the system having (Using Semi-Log Graph) $G(s) = \frac{K e^{-0.2s}}{s(s+2)(s+8)}$ Determine the Gain margin equal to 2db & Phase margin equal to 45^0	**10**	**CO1**
Q 7	Design the Landing Glide slope controller from Figure (1). **S_c=10, k =27, 3600 S_c / R,** $\dot{d} = \frac{U}{57.3}(\gamma + 2\frac{1}{2})^0$	**10**	**CO3**

	 To determine the following a) Geometry of glide slope problem b) Effect of beam narrowing c) Velocity, U = 280 ft/see, Find the Range to the station.		
Q 8	For given Figure (2) Head-Up Display coordinate of point **P** with respect to display axis OX & OY, Field of view (FOV) axis Ox_1 & Oy_1  Aircraft HUD CRT diameter 50mm, diameter of collimating lens 150mm and distance of virtual image of collimating lens from pilot's eyes 500mm the required effective focal length 140mm to determine the total angular coverage of the CRT imagery which can be seen by moving the observer's eye position and angular coverage of the imagery which can be seen by the observer at any specific instant.	**10**	**CO2**
Q 9	Design the Block diagram of the Dutch roll damper from Figure 3, S_{rg} = 1.04,  $[TF]_{(A/C)(\delta_r;r)} = \frac{-1.38(s^2+0.05s+0.066)}{(s-0.004)(s^2+0.38s+1.813)}$	**10**	**CO4**
	(Or)		
Q 10	Write the MATLAB Programming for lateral autopilot from Figure 3. Time constant 5 sec and Find the closed loop transfer function.	**10**	**CO4**
	SECTION-C : All question carries 20 Marks, Q12 have internal choice		
		20	**CO5**

Q 11	Design the Avionics power system design a) MIL-STD-704E , 115V, 400Hz power system b) MIL-STD-704E, 28V, dc power system c) MIL-STD-704E, 270V, dc power system Various voltage conditions with suitable waveform.		
Q 12	Design a closed loop system using linear state variable feedback for the open loop system shown in Fig 3. The desired dominant complex poles of the closed loop system must have a damping ratio of not less than 0.45. And in response to a unit step input the peak overshoot of the response of the closed loop system must not exceed 20 per cent and must not occur later than 0.15 s after the step has been applied. The complete response must have settled in 0.4 s.  Fig (3) (a) Draw a root locus diagram for the aircraft system of Figure 4. (b) If A = 0.04 calculate the values of the poles of the system **(Or)**	**20**	**CO4**
Q 13	The aircraft using only its elevator for control, has an optimal pitch control system for which the feedback gain matrix, K, is given by: K = [0.0184 - 0.0855 - 2.905 - 14.0351], The actuator dynamics have been ignored. It is found, however, that only the pitch rate and pitch altitude can be measured on the aircraft. (a) Show how the motion variables ***u*** and ***w*** may be reconstructed if the elevator deflection can be measured also. (b) Draw a block diagram of this complete flight control system. Include all the gains involved in your scheme.	**20**	**CO4**

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Name of the School (Please tick, symbol is given)	:	**SOE**	✓	**SOCS**		**SOP**	
Programme	:	**B.Tech ASE+AVE**					
Semester	:	**VIII**					
Name of the Course	:	**Avionics System Design**					
Course Code	:	**AVEG 421**					
Name of Question Paper Setter	:	**M Raja**					
Employee Code	:	**40000908**					
Mobile & Extension	:	**8938817363**					

Note: Please mention additional Stationery to be provided, during examination such as Table/Graph Sheet etc. else mention "NOT APPLICABLE":

3. **Graph Sheets**
4. **Semi-Log Sheets**

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Time of Examination	:	
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Note: - Pl. start your question paper from next page

Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
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Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point answers are expected.
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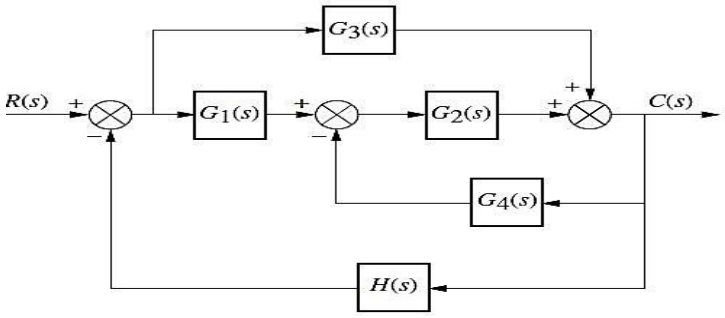
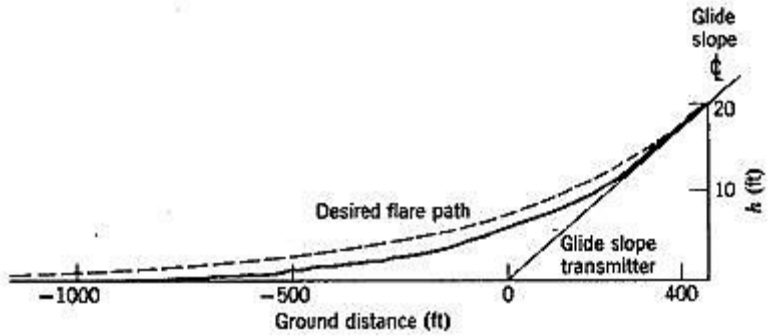
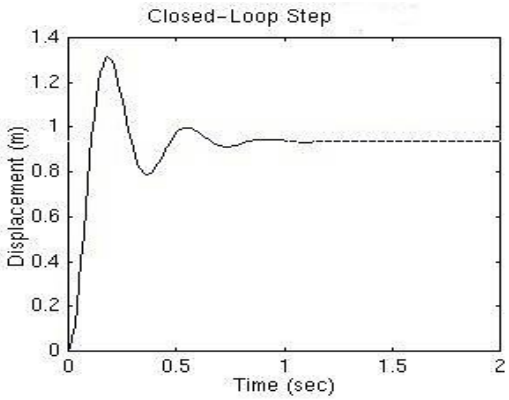
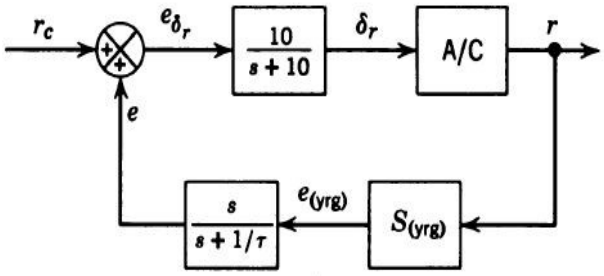
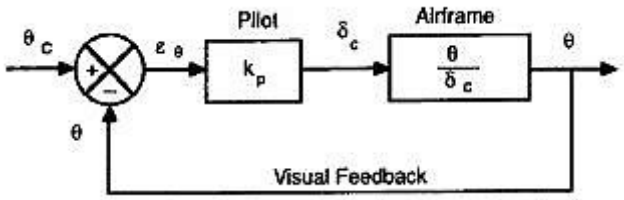
SECTION A : All question carries 4 marks each (5X4 =20)

S. No.	Questions	Marks	CO
Q 1	Differentiate between Fly By Wire Vs. Fly By Light	**4**	**CO1**
Q 2	Discuss about the EMI affected by avionics system? Draw and explain the graph between frequencies Vs. Wavelength.	**4**	**CO2**
Q 3	For the Given Figure (1) linear control system with feedforward path, Find $\frac{C(s)}{R(s)}$ 	**4**	**CO3**
Q 4	Briefly explain the wash-out circuit? Describe the Magnetic bearing Vs Gem-magnetic bearing.	**4**	**CO4**
Q 5	Write short notes on modular concept unit of DOD-STD-1788 LRU for Military transport aircraft	**4**	**CO5**

SECTION B: All question carries 10 marks each, Q9 have internal choice

Q 6	Draw the Bode log-magnitude and phase plots for the system using semi-log Graph. $G(s) = \frac{(s+20)}{(s+1)(s+7)(s+50)}$	**10**	**CO1**
Q 7	For the Given Figure (2) Landing Flare controller **S_c = 3 deg /(ft/sec) , $\dot{h}_r$ = -0.6h**	**10**	**CO3**

	 To determine the following (a) Geometry of flare path (b) Automatic flare controller		
Q 8	The modeling equation of this system is $\frac{X(s)}{Y(s)} = \frac{1}{MS^2+bS+k}$ Let M = 1kg, b = 10 N.s/m, k = 20 N/m, F(s) = 1 displacement X(s) and the input F(s) the output given by unit step input from Figure (3).  To introduce the PID controller and obtained the system with no overshoot, fast rise time, and no steady-state error.	**10**	**CO2**
Q 9	Explain the Block diagram of the Dutch roll damper Figure (4). S_{rg} = 1.04,  $[TF]_{(A/C)[\delta_r;r]} = \frac{-1.38(s^2+0.05s+0.066)}{(s-0.004)(s^2+0.38s+1.813)}$ **(Or)**	**10**	**CO4**
Q 10	Write the MATLAB Programming for lateral autopilot from Figure 4. Time constant	**10**	**CO4**

	5 sec and Find the closed loop transfer function.		
SECTION-C : All question carries 20 Marks, Q12 have internal choice			
Q 11	Design the Avionics power system design a) DO 160C ac momentary power interruption test b) DO 160C ac Normal surge voltage test c) DO 160C dc momentary power interruption test d) DO 160C dc abnormal surge voltage test Various voltage conditions with suitable waveform.	**20**	**CO5**
Q 12	The Wright "Flyer" was statically and dynamically unstable. However, because the Wright brothers incorporated sufficient control authority into their design they were able to fly their airplane successfully. Although the airplane was difficult to fly the combination of the pilot and airplane could be made to be a stable system. The closed loop pilot is represented  $\frac{\theta}{\delta_e} = \frac{11.0(s+0.5)(s+3.0)}{(s^2+0.72s+1.44)(s^2+5.9s-11.9)}$ Pure gain, K_p and the pitch attitude canard deflection. Determine the root locus plot of the closed loop system. For what range of pilot gain is the system stable. **(Or)**	**20**	**CO4**
Q 13	The aircraft using only its Aileron for control, has an optimal pitch control system for which the feedback gain matrix, K, is given by: K = [0.0184 - 0.0855 - 2.905 - 14.0351], The actuator dynamics have been ignored. It is found, however, that only the roll rate can be measured on the aircraft. (a) Show how the motion variables ***v*** and ***w*** may be reconstructed if the Aileron deflection can be measured also. (b) Draw a block diagram of this complete flight control system. Include all the gains involved in your scheme.		**CO4**