INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	**:**	**CONTROL THEORY – APPLICATION TO FLIGHT CONTROL SYSTEMS**
Course Code	**:**	**A72119**
Class	**:**	**IV B Tech I Semester**
Branch	**:**	**AERONAUTICAL ENGINEERING**
Year	**:**	**2018 – 2019**
Course Coordinator	**:**	**Ms. D. Anitha, Assistant Professor, Department of AE**
Course Faculty	**:**	**Ms. D. Anitha, Assistant Professor, Department of AE**

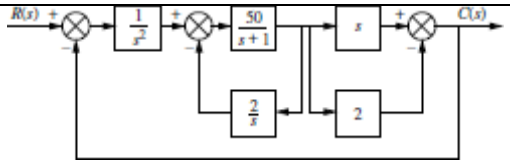
OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner‟s learning process.

S. No	QUESTION	Blooms taxonomy level	Course Outcomes
	UNIT - I **CONTROLSYSTEMS-MODELING, FEEDBACK CONTROL**		
Part - A (Short Answer Questions)			
1	List the components of a control System?	Remember	1
2	Define the terms plant and Process	Understand	1
3	State the advantages and drawbacks of open loop control system?	Understand	1
4	Define linear time invariant system.	Remember	1
5	List the properties of robust system.	Understand	1
6	State two examples of control system?	Remember	1
7	Define dynamical systems and list its components.	Remember	1
8	Define the feedback control systems and List the types of feedback control systems?	Understand	1
9	What are the effects of feedback on stability of control system?	Understand	1
10	Differentiate between System & Control System?	Remember	1
Part - B (Long Answer Questions)			
1	Discuss sensor and list sensors used in aircraft control systems?	Remember	1
2	Differentiate between open and closed loop control system?	Understand	1
3	List out the merits and demerits of non linear system.	Understand	1
4	Discuss the importance of studying control system?	Remember	1
5	Explain the function of control as regulation and tracking.	Understand	1
6	Discuss sensitivity of output to control input in a feedback control system?	Remember	1
7	List the merits of open loop system and Discuss the need for a stable system.	Remember	1
8	Discuss the application of feedback control in control augmentation system and automatic systems?	Understand	1

9	Discuss the rules and conventions of reducing the block diagram of complex systems?	Understand	1
10	List the advantages & disadvantages of positive feedback control systems?	Remember	1
Part - C (Problem Solving and Critical Thinking Questions)			
1	Discuss the purpose and functioning of various filters used in control systems. And How is overall system stability determined?	Remember	1
2	Describe a SISO Single input single output) system and a MIMO (Multiple input and multiple output) system and explain how they are analyzed.	Understand	1
3	Describe non linear system and discuss how they are linearized?	Understand	1
4	Explain the role of feedback in stability augmentation, control augmentation and automatic control with example.	Remember	1
5	Discuss use of transducer, sensor and filter in control system.	Understand	1
6	With example explain the method of modeling dynamical systems using differential equations	Remember	1
7	Discuss modeling and transfer function of different filters used in aircraft control	Understand	1
8	Discuss application of feedback in stability augmentation system.	Understand	1
9	Functionally, how do closed-loop systems differ from open-loop system? Also give three examples of open loop systems.	Remember	1
10	Explain the procedure for analyzing SISO and MIMO system.	Understand	1
UNIT - II **PERFORMANCE- TIME, FREQUENCY AND S-DOMAIN DESCRIPTION**			
Part - A (Short Answer Questions)			
1	Define gain factor, pole and zero?	Remember	2
2	Define characteristic equation with example?	Understand	2
3	What do you understand by feedback gain?	Understand	3
4	Define Nyquist plot and Bode plots?	Remember	2
5	What do you understand by frequency domain?	Understand	3
6	What are the steady state and transient response specified?	Remember	2
7	Define open loop and closed loop control system with example?	Understand	4
8	What are the effects of feedback on stability of control system?	Understand	3
9	What do you mean by frequency transfer function?	Remember	2
10	Define Transfer function of control theory?	Understand	2
Part - B (Long Answer Questions)			
1	Give the expression for the rise time of the step response for second order systems with respect to first order systems?	Remember	3
2	Discuss the relationship between impulse response and transfer function with the suitable example.	Understand	4
3	With example discuss the time domain specifications of second order control system	Understand	2
4	Describe the relation between transfer function and impulse response.	Remember	2
5	Briefly discuss impulse response and indicial response in terms of time frequency performance.	Understand	3
6	Explain the difference between system parameters and characteristic parameters of control systems.	Understand	2
7	What do you understand by gain margin and phase margin with respect to S domain?	Remember	3
8	Explain the methods to convert a time domain to frequency domain?	Understand	2
9	Discuss second order system specifications in time domain.	Remember	3
10	Explain about the different types of transducers and sensors used in control system?	Understand	2
Part - C (Problem Solving and Critical Thinking Questions)			
1	For the given transfer function ,Plot pole-zero in complex s-plane $G(s)= (s^2 +4)(s-1)(s+2) / (s^4+1)(s^3+27)(s^5-32)$	Remember	3

2	 Reduce the block diagram shown in the figure to a single transfer function, G(s) = C(s)/R(s).	Understand	4
3	Discuss the significance of corner frequencies, resonant frequencies and peak gain of a second order system.	Understand	2
4	Explain the experimental method of determining system transfer function by frequency response measurements.	Remember	2
5	Find the poles and zeros of a control system whose transfer function is given by G(s) = (s+3)/ (s^2+7s+12)	Understand	3
6	A control system is defined by the following differential equation. Find the output response y (t) using Laplace transform method. Assuming y(t) and dy(t)/dt are zero at t = 0. $\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 12y(t) = u(t)$ where u (t) is unit step unit.	Remember	2
7	Discuss the significance of band width , resonant frequencies, peak gain in relation to second order system.	Remember	4
8	Transfer function of a control system is s/((s+1)(s+2)). Find the response for the unit step input.	Understand	2
9	Explain the frequency response method of control system design.	Remember	4
10	Discuss the procedure of experimental determination of system transfer functions by frequency response measurements.	Understand	2
UNIT-III **SPECIFICATION OF CONTROLSYSTEM PERFORMANCE REQUIREMENTS- SYSTEM SYNTHESIS- CONTROLLERS- COMPENSATION TECHNIQUES**			
Part - A (Short Answer Questions)			
1	Define steady state error constants.	Remember	5
2	What is the need for comprise in control systems?	Understand	5
3	Define transient state with an example.	Understand	6
4	Write a short note on accuracy?	Remember	5
5	List the specifications in frequency response.	Understand	5
6	Define steady state with an example.	Remember	7
7	What is the scope of optimization?	Understand	5
8	Describe primacy of stability.	Understand	5
9	Define stability in terms of control systems	Remember	5
10	Write a short note on robustness?	Understand	5
11	Differentiate between fist order and second order systems.	Remember	6
12	What are requirements essential for control system performance?	Understand	7
13	Write a short note on speed of response?	Understand	5
14	List the specifications for steady state.	Remember	5
15	Describe the specifications for transient state?	Understand	5
16	Write a short note on second order systems.	Remember	6
17	List the specifications in time and frequency response .	Understand	5
18	How do errors occur in steady state?	Understand	6
19	List the specifications in s domain.	Remember	5
20	Write a short note on first order systems.	Understand	7
1	Write the properties and application of wash-out filter.	Remember	5
2	State Nyquist's criterion with neat sketch.	Understand	5
3	Define Filters and its types?	Understand	5
4	List the types of controllers.	Remember	7
5	What is PI and PD controller?	Understand	6
6	Define adaptive control in terms of controllers?	Remember	5

7	What is the significance of controller?	Understand	5
8	What is compensation and its types?	Remember	5
9	Define lag compensation with the neat sketch?	Understand	5
10	Discuss the application of proportional and integral control.	Understand	7
11	State the non linear control.	Understand	6
12	Discuss the problem with derivative control.	Remember	5
13	Define lead compensation with neat sketch?	Understand	6
14	Differentiate between phase margin and gain margin.	Remember	5
15	State transfer function in terms of control systems	Understand	7
16	List the merits and constraints in nonlinear control.	Understand	6
17	Define integral control with a neat sketch.	Remember	5
18	What does it mean a control system is being mentioned as Robust?	Understand	5
19	How does the PD controller affect the bandwidth of a control system?	Remember	7
20	List the merits in adaptive control.	Understand	5
Part - B (Long Answer Questions)			
1	List the requirements for control system performance and its synthesis	Remember	5
2	Discuss steady state and transient specifications of a second order system and first order system.	Understand	6
3	Differentiate between transient state and steady state with suitable examples and its necessity.	Understand	5
4	List the examples of first order systems with the help of transient state equation and explain it.	Remember	7
5	List the examples of second order system with the help of transient state equation and explain it.	Remember	6
6	List the specifications for Time, Frequency and S domain	Understand	5
7	How the desired input varies with the output and explains the relationship between them.	Understand	5
8	Explain steady state systems and list the specifications with suitable examples in control systems.	Remember	6
9	Explain the design of multi loop feedback systems.	Understand	5
10	Discuss the merits and demerits of proportional integral derivative controller.	Remember	7
1	Discuss Nyquist criterion and the usage of this criterion in the control system.	Remember	5
2	Give the general effects of phase-lead controller on rise and settling time to control the system.	Understand	5
3	What do you mean by compensation through pole zero cancellation in terms of control system?	Understand	7
4	Discuss the functioning of proportional plus derivative control with the suitable example.	Remember	5
5	Discuss the purpose and functioning of lead, lag and wash-out filters and differentiate them with each other.	Remember	6
6	What are the methods of determining the stability of closed loop system and open loop system?	Understand	7
7	How does the PD controller affect the bandwidth of a control system and which errors will occur?	Understand	5
8	Define and discuss the purpose of gain scheduling in the controller and its specifications to control the gain.	Remember	7
9	Describe the compensator? Explain about lead compensator.	Understand	5
10	Explain the procedure for root locus method with the neat sketch.	Remember	6
Part - C (Problem Solving and Critical Thinking Questions)			
1	Explain the control systems and its performance requirements with the suitable examples.	Remember	7
2	List the conflicting requirements for the control system which effects the control system process.	Understand	5
3	Discuss and differentiate between Time and frequency response and explain them with the neat sketch.	Understand	5

4	With the suitable examples Differentiate the first order system from second order system in control theory?	Remember	6
5	Discuss the errors in steady state and transient state of control systems which will happens due to stability.	Understand	7
1	Discuss the type of controllers and explain them in detail	Remember	5
2	List the advantages and disadvantages of Block diagram Reduction technique	Understand	5
3	List the advantages of gain and phase margin with suitable examples	Understand	6
4	Discuss frequency response method of analysis and compensation in control system.	Remember	5
5	Discuss the significance and interpretation of gain margin, phase margin.	Understand	5
UNIT-IV **AIRCRAFT RESPONSE TO CONTROLS-FLYING QUALITIES-STABILITY AND CONTROL AUGMENTATION-AUTO PILOT**			
Part - A (Short Answer Questions)			
1	List out the control surface actuators.	Understand	6
2	Define reversible flight control systems.	Remember	8
3	List the flying quality requirements.	Understand	8
4	Write a short note on Acceleration and Turn rate	Understand	10
5	List the frequency response specifications.	Remember	8
6	Explain the performance of control actuators.	Remember	6
7	Define Flight control system.	Understand	10
8	List the time response specifications.	Understand	6
9	State Zeigler and Nicholos method	Remember	8
10	Define robust control.	Understand	6
Part - B (Long Answer Questions)			
1	Discuss the need for automatic control in the aircraft in terms of flight control systems.	Understand	9
2	Explain the purpose of auto pilot by using the control systems with help of neat sketch.	Remember	8
3	Explain the role of rate feedback in stability augmentation system with the help of neat sketch and its importance.	Understand	11
4	Differentiate between reversible and irreversible control.	Understand	10
5	What do you mean by pilot's opinion rating in the flight control systems and explain it in detail?	Remember	8
6	Draw the block diagram of a pitch attitude hold auto-pilot system and explain it briefly.	Understand	11
7	What is the purpose of stability augmentation system and its importance in the control systems?	Remember	8
8	Bring out the purpose of feedback signals in autopilot system and differentiate it from flight control system.	Understand	9
9	Discus the relationship between flying qualities and aircraft transfer function.	Understand	6
10	Explain how a modern design technique helps in designing SAS (Stability Augmentation System) as well as autopilots	Remember	9
Part - C (Problem Solving and Critical Thinking Questions)			
1	Discuss the flying qualities requirement of an aircraft. What is pilot's opinion rating? and explain the purpose and functioning of pitch, yaw and bank hold auto pilot.	Understand	6
2	Briefly explain the role of displacement and rate feedback in the design of stability augmentation system.	Remember	8
3	List the steps to determine the transfer function of an aircraft to perform the control operations	Understand	6
4	Explain the role of auto-pilot as stability augmenter.	Understand	10
5	Differentiate between stability control system and control augmentation system.	Remember	6
6	Discuss the response of an aircraft to pilot's control input and atmosphere.	Understand	8

7	Discuss the functioning of normal acceleration command maneuvering autopilot.	Remember	6
8	Explain how approximate aircraft transfer function is obtained from control systems.	Understand	8
9	With help of block diagram explain the functioning and components of a displacement autopilot.	Understand	9
10	Briefly explain about the controls that control the Pitching moment and rolling moment in aircraft stability.	Remember	6
UNIT-V MODERNCONTROLTHEORY-STATESPACEMODELING,ANALYSIS			
Part - A (Short Answer Questions)			
1	Discuss the limitation of classical control.	Understand	13
2	What is time invariant linear system?	Remember	14
3	Define matrix transfer function in control system.	Understand	15
4	Illustrate controllability in terms of stability.	Understand	12
5	Define canonical transformation of state equations.	Remember	13
6	Differentiate between controllability and observability	Understand	15
7	Write a short note on state variable and state equation.	Remember	12
8	List out the digital integration rules.	Understand	14
9	Define observability in terms of control theory.	Understand	15
10	Write down the short note on multiple input multiple output systems?	Remember	12
Part - B (Long Answer Questions)			
1	Briefly explain the concept of canonical transformation in terms of classical control theory.	Understand	13
2	Write the advantages and disadvantages of digital control system over analog control system.	Remember	14
3	Differentiate between state variable and state equation in terms of modern control theory.	Understand	15
4	Discuss the process of numerical solution of state equation to solve the error occurs in control theory.	Understand	12
5	Explain about the concept of state space modeling of dynamical systems with the block diagram?	Understand	13
6	Draw the block diagram representation of a generic digital controller and explain it briefly.	Remember	15
7	List the limitations of classical methods of control system modeling and its specifications.	Understand	12
8	Briefly explain about State transition matrix and Matrix transfer function	Understand	14
9	List the properties for the numerical solution of state equations and state variables.	Remember	15
10	State the concept of Digital control in the modern control theory with help of neat sketch.	Understand	12
Part - C (Problem Solving and Critical Thinking Questions)			
1	Discuss the method of modeling dynamical system using state space equations.	Understand	14
2	What is controllability? How do you test the controllability of a system in the modern control systems?	Remember	13
3	Define the state variable and state equations with examples. And Discuss the properties of state transition matrix.	Understand	12
4	Discuss limitation of classical control theory when applied to multiple input multiple output systems.	Understand	13
5	List the advantages and disadvantages of digital control systems with suitable examples.	Remember	14
6	Discuss the advantages of digital control system over analog control system and its usage.	Understand	13
7	Explain the multiple input multiple output systems with the block diagram and its applications.	Remember	14
8	Discuss state space modeling of dynamical system. And list the properties of state –transition matrix.	Understand	13

9	Discuss general form of time invariant linear system.	Understand	15
10	Discuss the significance of Canonical transformation of state equations to solve problems in modern control theory.	Remember	15

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