University of Mumbai

CONTROL SYSTEM DESIGN

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MCQ

1.	Which of the following state space representation is most suitable for designing a system to estimate the state variables?
Option A:	Observer canonical form
Option B:	Controller canonical form
Option C:	Parallel form
Option D:	Cascade form
2.	Dominant closed loop poles of a given system is at -3±j7. The objective of the continuous compensator design is to reduce the peak time by a factor of 2 with the same settling time. Then the new damping ratio is
Option A:	0.21
Option B:	0.39
Option C:	0.65
Option D:	0.43
3.	With regard to the filtering capacity the lead compensator and lag compensator are respectively
Option A:	Low pass and high pass filter
Option B:	High pass and low pass filter
Option C:	Both high pass filter
Option D:	Both low pass filters
4.	State feedback controller in state space is required if
Option A:	System is not controllable
Option B:	Transient response to be improved
Option C:	steady state error to be decreased
Option D:	state is not available
5.	Which one of the following statements is not true?
Option A:	A phase-lag compensation network decreases the system bandwidth and slows down the transient response
Option B:	A phase-lag network reduces the steady-state error and suppresses high frequency noise
Option C:	A phase-lead network increases the bandwidth and is used to obtain fast transient response
Option D:	A phase-lead network decreases the bandwidth and slows down the transient response
6.	Steady state error can be decreased by using
Option A:	State feedback Controller
Option B:	Observer

Option C:	Integral Controller
Option D:	Estimator
7.	By inspection, observability of a system can be determined if it is represented in
Option A:	Controller canonical form
Option B:	Observer canonical form
Option C:	Parallel form
Option D:	Cascade form
8.	In a bode magnitude plot, which one of the following slopes would be exhibited at high frequencies by a 4th order all-pole system?
Option A:	-80dB/decade
Option B:	-40 dB/decade
Option C:	40 dB/decade
Option D:	80 dB/decade
9.	Constant settling time points in z-plane is a
Option A:	Horizontal line
Option B:	Vertical line
Option C:	Circular
Option D:	Radial
10.	A phase lead compensating network
Option A:	Decreases the system bandwidth
Option B:	Speeds up dynamic response
Option C:	Reduces the steady-state error
Option D:	Slows down transient response
11.	A system is said to be______________ if it is possible to transfer the system state from any initial state to any desired state in finite interval of time
Option A:	Controllable
Option B:	Observable
Option C:	Cannot be determined
Option D:	Controllable and observable
12.	Which of the following sentence is not correct?
Option A:	State variables has to be estimated if the system is not controllable.
Option B:	Pole placement technique can be applied only when the system is controllable.
Option C:	State feedback controller does not improve the steady state error
Option D:	Observer dynamics is much faster than the controller
13.	How many poles are required at z=1 for a pulsed transfer function G(z) to make the steady state error finite with ramp input?
Option A:	One
Option B:	Two
Option C:	Three
Option D:	Zero
14.	The overall transfer function from block diagram reduction for cascaded blocks is

Option A:	Sum of individual gain
Option B:	Product of individual gain
Option C:	Difference of individual gain
Option D:	Division of individual gain
15.	The overall transfer function of two blocks in parallel are
Option A:	Sum of individual gain
Option B:	Product of individual gain
Option C:	Difference of individual gain
Option D:	Division of individual gain
16.	Bounded input and Bounded output stability notion concerns with
Option A:	A system under influence of input
Option B:	A system not under influence of input
Option C:	A system under influence of output
Option D:	A system not under influence of output
17.	What is the z-transform of the signal $x[n] = a^n u(n)$?
Option A:	X(z) =1/(z-1)
Option B:	X(z) = 1/(1-z)
Option C:	X(z) = z/(z-a)
Option D:	X(z) = 1/(z-a)
18.	The open loop transfer function G(s) of a plant has 3 poles: one at origin and the other two at -1. The constant %OS line intersect the Root locus at A where A=-0.4+j2. Evaluate the settling time corresponding to the current dominant poles.
Option A:	2
Option B:	7.85
Option C:	8
Option D:	1.57
19.	Number of zeros and poles for a PID controller is
Option A:	poles=2, zeros=2
Option B:	poles=2,zeros=1
Option C:	poles=1,zeros=1
Option D:	poles=1,zeros=2
20.	For a system with G(s)=$\frac{5(s+1)}{s(s+2)(s+4)}$, what will be the initial slope for the Bode magnitude plot?
Option A:	0 dB/decade
Option B:	-40dB/decade
Option C:	-20 dB/decade
Option D:	20dB/decade
21.	With regard to the filtering capacity the lead compensator and lag compensator are respectively
Option A:	Low pass and high pass filter
Option B:	Both high pass filter

Option C:	Both low pass filters
Option D:	High pass and low pass filter
22.	Which of the following statement is incorrect?
Option A:	lag compensator always stabilizes unstable system
Option B:	lag compensator reduces steady state error
Option C:	lead compensator reduces settling time
Option D:	lead compensator increases order of system
23.	Which of the following is/are represents the lag compensator?
Option A:	(s + 2) / (s + 1)
Option B:	(s + 2) / (s + 5)
Option C:	(s + 5) / (s + 6)
Option D:	(s + 12) / (s + 13)
24.	Inverse z-transform of the system can be calculated using
Option A:	Partial Fraction Method
Option B:	Long Division Method
Option C:	Basic Formula of Z-Transform
Option D:	Synthetic Division Method
25.	In lag compensator the damping ratio, gain and steady state error (e_{ss}) are
Option A:	Decreases, Decreases and Increases
Option B:	Decreases, Increases and Increases
Option C:	Increases, Increases and Decreases
Option D:	Increases, Decreases and Decreases
26.	The number of root locus branches which do not terminate at zeros is given by
Option A:	Number of zeros
Option B:	Number of poles
Option C:	Number of poles + Number of zeros
Option D:	Number of poles - Number of zeros
27.	Root locus diagram exhibit which of the following
Option A:	Response of system to step input
Option B:	Frequency response of system
Option C:	Poles of system for set of parameter values
Option D:	Bandwidth of system
28.	The characteristic equation of a closed loop system is s (s + 1) (s + 2) + K = 0, The centroid of the asymptotes in root locus will be
Option A:	1
Option B:	-1
Option C:	3
Option D:	-3

29.	Given a unity feedback system with G(s) = K / s (s + 10), the value of K for damping ratio of 0.7 is
Option A:	7.14
Option B:	1.4
Option C:	51
Option D:	10
30.	In frequency domain the speed of response is measured in terms of
Option A:	Resonant frequency
Option B:	Bandwidth
Option C:	Resonant peak and bandwidth
Option D:	Maximum peak overshoot
31.	Following is component of digital control system
Option A:	Controller
Option B:	Processor
Option C:	ADC and DAC
Option D:	Signaling
32.	If the transfer function of a phase lead compensator is (s + a) / (s + b) and that of a lag compensator is (s + p) / (s + q), then which one of the following sets of conditions must be satisfied?
Option A:	a > b, p > q
Option B:	a > b, p < q
Option C:	a < b, p < q
Option D:	a < b, p >q
33.	Which of the following are the not characteristics of the closed loop systems?
Option A:	It does not compensate for disturbance
Option B:	It reduces the sensitivity of plant parameter variations
Option C:	It does not involve output measurements
Option D:	It does not have the ability to control the system transient response
34.	Which mechanism in control engineering implies an ability to measure the state by taking measurements at output?
Option A:	Controllability
Option B:	Observability
Option C:	Differentiability
Option D:	Adaptability
35.	Bilinear transformation s=$\frac{2(z-1)}{T(z+1)}$ can be used in Digital system to get the analogous continuous systems for determining -------------
Option A:	Only Stability
Option B:	Digital Compensator design based on the designed Analog one
Option C:	Only Transient analysis
Option D:	Only Steady state analysis

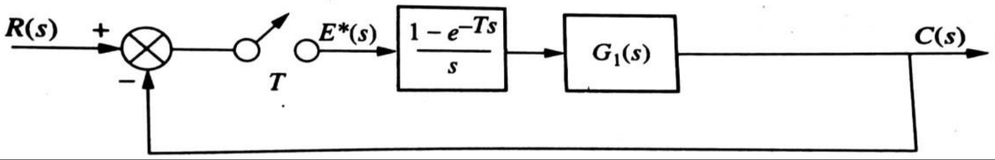
36.	Which one of the following is the correct expression for the transfer function of an electrical RC phase lag compensating network?
Option A:	RCs / (1+ RCs)
Option B:	RC / (1+ RCs)
Option C:	1 / (1+ RCs)
Option D:	RCs / (s+ RC)
37.	The unity feedback transfer function is G(s) = K / [(s + 1) (s + 2) (s + 3)] , breakaway point lie between
Option A:	-1 and -2
Option B:	-2 and -3
Option C:	0 and -1
Option D:	1 and 2
38.	A pulsed transfer function in the forward path of the unity feed back system is G(z)=K(z+2)/((z-1)(z-0.5)). Decide the range of K for which system is stable?
Option A:	0<K<0.15
Option B:	0<K<0.35
Option C:	0<K<0.5
Option D:	0<K<0.25
39.	Which of the following system is observable but not controllable?
Option A:	Parallel representation with B=[1 ; 1 ; 1] and C=[1 1 1]
Option B:	Parallel representation with B=[0; 1 ; 1] and C=[1 1 1]
Option C:	Parallel representation with B=[1 ; 1 ; 1] and C=[1 0 1]
Option D:	Parallel representation with B=[1 ; 0 ; 1] and C=[1 1 0]
40.	A lag compensator
Option A:	Speeds up the transient response of system
Option B:	Deteriorate steady state behaviors of the system
Option C:	Improves steady state behaviors and speeds up the transient response of the system
Option D:	Improves steady state behaviors and preserves the transient response of the system
41.	Which of the following compensator connected in cascade with the system will improve the steady state response?
Option A:	$\frac{(s+3)}{(s+10)}$
Option B:	$\frac{(s+.02)}{(s+.001)}$
Option C:	$\frac{(s+0.002)}{(s+0.01)}$
Option D:	$\frac{(s+0.01)}{(s+0.03)}$
42.	The integral controller
Option A:	Increases the steady state error
Option B:	Decreases the steady state error

Option C:	Increases the noise and stability
Option D:	Decreases the damping coefficient
43.	Which of the following system provides excellent steady state response
Option A:	Lead compensator
Option B:	Lag compensator
Option C:	Proportional + Differential controller
Option D:	Proportional + Integral controller
44.	Zero-order-hold system can be modeled as
Option A:	$\frac{(1-e^{-Ts})}{s}$
Option B:	$\frac{(1+e^{-Ts})}{s}$
Option C:	$\frac{(1-e^{Ts})}{s}$
Option D:	$\frac{(1+e^{Ts})}{s}$
45.	By inspection, observability of a system can be determined if it is represented in
Option A:	Controller canonical form
Option B:	Observer canonical form
Option C:	Parallel form
Option D:	Cascade form
46.	The pulsed transfer function of a system is 10/((z+1)(z-0.8)).When operated as a unity feedback system, the steady state error to a unit step input will be
Option A:	Finite
Option B:	Zero
Option C:	infinity
Option D:	Cannot determine
47.	Dynamics of observer is ------------ that of the controller
Option A:	Slower than
Option B:	Faster than
Option C:	Same as
Option D:	Not comparable with
48.	A controller to be designed for the following open loop plant G(s) =10(s+100)/((s+10)(s+20)) to yield a 10% overshoot and a settling time of 0.1 sec assuming that the plant is represented in the phase variables form. Choose the best pole location from the following options to achieve this desired transient characteristic.
Option A:	-40 + j54.6, -40 -j 54.6, -400
Option B:	-40 + j54.6, -40 -j 54.6, -100
Option C:	-40 + j44.6, -40 -j 44.6, -100
Option D:	-40 + j44.6, -40 -j 44.6, -400
49.	Which of the following digital compensator is not physically realizable?
Option A:	$\frac{10(z+1)(z+2)}{(z+0.3)(z+0.2)(z-0.5)}$

Option B:	$\frac{10z(z+1)(z+2)}{(z-0.3)(z-0.5)}$
Option C:	$\frac{10(z+4)(z+2)}{(z+0.3)(z-0.5)}$
Option D:	$\frac{10(z+0.4)(z+0.2)}{(z+0.3)(z+0.5)}$
50.	During the lag compensator design with Bode-plot it is observed that the frequency corresponds to PMrequired -180 +10 is 4.5rad/sec. At this frequency magnitude of the uncompensated system is 15dB. Then the zero of the lag compensator corresponds to -------
Option A:	0.45 rad/sec
Option B:	0.25rad/sec
Option C:	0.18 rad/sec
Option D:	0.15 rad/sec
51.	The objective of the continuous compensator design is to reduce the settling time by a factor of 2 with the same damping ratio. One of the dominant closed loop poles of the system with the required damping ratio is at -5-j4. Then the new peak time is
Option A:	8sec
Option B:	10sec
Option C:	0.31sec
Option D:	0.39sec
52.	Which of the following system is controllable but not observable?
Option A:	A= $\begin{bmatrix} -5 & 0 \\ 0 & -2 \end{bmatrix}$ B= $\begin{bmatrix} 2 \\ 0 \end{bmatrix}$ and C= $\begin{bmatrix} 1 & 5 \end{bmatrix}$
Option B:	A= $\begin{bmatrix} -5 & 0 \\ 0 & -2 \end{bmatrix}$ B= $\begin{bmatrix} 2 \\ -3 \end{bmatrix}$ and C= $\begin{bmatrix} 0 & 5 \end{bmatrix}$
Option C:	A= $\begin{bmatrix} -5 & 0 \\ 0 & -2 \end{bmatrix}$ B= $\begin{bmatrix} 0 \\ -3 \end{bmatrix}$ and C= $\begin{bmatrix} 0 & 5 \end{bmatrix}$
Option D:	A= $\begin{bmatrix} -5 & 0 \\ 0 & -2 \end{bmatrix}$ B= $\begin{bmatrix} 2 \\ -3 \end{bmatrix}$ and C= $\begin{bmatrix} 2 & 5 \end{bmatrix}$
53.	Settling time of a digital system in z-domain is at 0.2 with sampling time T=0.1. What is the radius of the constant Ts circle on z-plane?
Option A:	7.392
Option B:	0.135
Option C:	7.132
Option D:	0.394
54.	A pulsed transfer function in the forward path of the unity feedback system is G(z)=K(z+3)/((z-0.2)(z-0.5)). What is the range of K for which the system is stable?
Option A:	0<K<0.25
Option B:	0<K<0.5
Option C:	0<K<0.3
Option D:	0<K<0.125

55.	A pulsed transfer function in the forward path of the unity feedback system is G(z)=K(z+3)/((z-0.2)(z-0.5)).Let the root locus of this system meet the desired % overshoot curve in z-plane at 0.3+j0.557. Then what is the gain K at that point?
Option A:	0.2
Option B:	0.1
Option C:	0.3
Option D:	0.4
56.	Tustin transformation can be used in digital system for------
Option A:	Analyzing the transient response
Option B:	Checking stability
Option C:	Designing Compensator
Option D:	Analyzing the steady state response
57.	What is the steady state error for the digital system with forward transfer function G(z)= 0.13(z+2)/((z−1)(z−0.6)) with ramp input, if the sampling time T=0.5sec ?
Option A:	0
Option B:	2.12
Option C:	1.95
Option D:	2.05
58.	Number of zeros and poles for a PI controller is
Option A:	pole=0, zeros=1
Option B:	pole=1, zeros=1
Option C:	pole=1, zeros=0
Option D:	pole=1, zeros=2
59.	For a system with G(s)= $\frac{5(s+8)}{s(s+3)(s+40)}$, what will be the slope for the Bode magnitude plot when 10 < w <20 rad/sec?
Option A:	0 dB/decade
Option B:	20dB/decade
Option C:	-40 dB/decade
Option D:	-20dB/decade
60.	How many poles are required at z=1 for a pulsed forward transfer function G(z) to make the steady state error zero with parabolic input?
Option A:	One
Option B:	Two
Option C:	Three
Option D:	Zero

DESCRIPTIVE QUESTIONS

1	Design a suitable lead compensator by using Root Locus technique for a system with unity feedback and having open loop transfer function $G(S) = \frac{K}{S(S+1)(S+4)}$ to meet the specification, Damping ratio ξ=0.5 and ωn=2 rad/sec.
2	Design a suitable lag compensator by using Root Locus technique for a system with unity feedback and having open loop transfer function $G(S) = \frac{K}{S(S+1)(S+4)}$ to meet the specification, Damping ratio ξ=0.5 , Kv >= 5 sec^{-1} and Settling time = 10 sec.
3	For the plant $G(S) = \frac{10}{S(S+1)}$. Design a lead compensator by using Bode plot technique to meet the specification, Kv = 20 sec^{-1}, P.M. = 50° and G.M. >= 10 db.
4	For the plant $G(S) = \frac{20(S+5)}{S(S+1)(S+4)}$. Design the phase variable feedback gains to yield 9.5% overshoot and a settling time of 0.74 second.
5	For step, ramp, and parabolic inputs , find the steady state error for the feedback control system if G1(s) = 10 / S (S+1) 
6	Develop a flowchart for the digital compensator defined by $$G_c = \frac{X(z)}{E(z)} = \frac{Z + 0.5}{Z^2 - 0.5Z + 0.7}$$
7	Design a suitable lead compensator by using Root Locus technique for a system with unity feedback and having open loop transfer function $G(S) = \frac{K}{S(S+1)(S+4)}$ to meet the specification, Damping ratio ξ=0.5 and ωn=2 rad/sed.
8	Explain the components of digital control system with neat diagram.
9	Explain the design procedure of compensator using state space analysis with equations.
10	Compare and Explain in detail Controllability and Observabilty with examples.
11	Compare lead, lag and lead lag compensator with examples.
12	Explain the Steps to design Lag Compensator using Bode plot.
13	Consider the following transfer function: G(s) = $\frac{(s+6)}{(s+3)(s+8)(s+10)}$. If the system is represented in cascade form design a controller to yield a closed loop response of 10% overshoot with a settling time of 1 sec. Design the controller by first transforming the plant to phase variables. Draw the plant representation in cascade form with the controller gains.
14	For a unity feedback system with G(s)=$\frac{K}{s(s+10)(s+200)}$ design a lag compensator using Bode-plot so that the system operates with a 20% overshoot and a static error constant of 100. Draw the compensated Bode-plot to verify the performance after the design.
15	Given T(z) = $\frac{N(z)}{D(z)}$ where D(z) = $z^4 + z^3 - 2z + 0.5$, use the Routh- Hurwitz criterion to find the number of z-plane poles of T(z) inside, outside and on the unit circle. Is the system stable?
16	Implement a PID controller with the transfer function as $G(s) = \frac{(s+0.1)(s+5)}{s}$. Draw the circuit after determining the component values.

17	Draw the implementation for the digital compensator, defined by Gc(z) = $\frac{(z+0.3)}{z^2-0.2z+0.8}$
18	Given a point on the z-plane, how can one determine the associated percent overshoot, settling time, and peak time?
19	Consider a unity feedback system with feed forward transfer function $G(s) = \frac{K(s+6)}{(s+2)(s+3)(s+5)}$. It is operating with a dominant-pole damping ratio of 0.707. Using Root-locus, design a PD controller so that the settling time is reduced by a factor of 2. Draw the compensated Root-locus and verify the performance.
20	Design an observer for the plant G(s) = $\frac{1}{(s+5)(s+13)(s+20)}$ represented in cascade form. Transform the plant to observer canonical form for the design. Then transform the design back to cascade form. The characteristic polynomial for the observer to be $s^3+600s^2+40{,}000s+1{,}500{,}000$.