INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECRTICAL AND ELECTRONICS ENGINEERING

DEFINITIONS AND TERMINOLOGY

Course Name	:	**CONTROL SYSTEMS**
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OBJECTIVES

I	To help students to consider in depth the terminology and nomenclature used in the syllabus.
II	To focus on the meaning of new words / terminology/nomenclature

DEFINITIONS AND TERMINOLOGYQUESTION BANK

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
UNIT - I					
1	What is a system?	A system consists of a number of components connected together to perform a specific function.	Understand	CLO1	CAEE009.01
2	What is a control system?	When the output quantity is controlled by varying the input quantity then the system is called control system.	Understand	CLO1	CAEE009.01
3	What are the two major types of control system	open loop and closed loop system.	Understand	CLO1	CAEE009.01
4	Define open loop control system	The control system in which the output quantity has no effect upon the input quantity are called open loop control system.	Remember	CLO1	CAEE009.01
4	What are the components of feedback control system?	The components of feedback control system are plant , feedback path elements, error detector and controller.	Understand	CLO1	CAEE009.01
5	Define transfer function.	The T.F of a system is defined as the ratio of the Laplace transform of output to Laplace transform of input with zero initial conditions.	Remember	CLO2	CAEE009.02
6	What are the basic elements used for modeling mechanical translational system?	Mass, spring and dashpot.	Understand	CLO3	CAEE009.03
7	Write the force balance equation of ideal spring element	F=Kx.	Remember	CLO3	CAEE009.03
8	What are the analogous quantity for Mass Element in F-V analogy	Mass M- Inductance L.	Understand	CLO3	CAEE009.03
9	What are the analogous quantities for Force and Velocity in F-I analogy	Force –current Velocity-voltage.	Understand	CLO3	CAEE009.03
10	What are the analogous quantities for Force and Velocity in F-V analogy	Force -Voltage Velocity-Current.	Understand	CLO3	CAEE009.03

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
12	Write the force balance equation of an ideal mass element.	$F = M\, d^2x/dt^2$	Understand	CLO3	CAEE009.03
13	What is servomechanism?	The servomechanism is a feedback control system in which the output is mechanical position.	Understand	CLO2	CAEE009.02
14	Write the force balance equation of ideal dashpot element	$F = B\, dx/dt$.	Understand	CLO3	CAEE009.03
15	Why negative feedback is invariably preferred in closed loop system?	The negative feedback results in better stability in steady state and rejects any disturbance signals.	Understand	CLO1	CAEE009.01
16	What is Reference input?	It is the actual signal input to the control system.	Remember	1	CAEE009.01
17	What is a system?	A system is a combination of components that act together to perform a specific goal.	Remember	1	CAEE009.01
18	What is Controlled variable (output)?	The quantity that must be maintained at prescribed value.	Remember	1	CAEE009.01
19	What is Disturbance?	An unwanted input signal that affects the output signal.	Remember	1	CAEE009.01
20	What is Open-Loop control system?	A system in which the output has no effect on the input action. In other words, the output is neither measured nor fed back for comparison with the input. One practical example is a washing machine. Adv: 1) The open-loop control system is easier to build because system stability is not a major problem. 2) It is sensitive to external disturbances.	Remember	1	CAEE009.01
21	Define Closed-Loop Control System?	A system in which the output has an effect on the input quantity in a way that can maintain the desired output value. An example is a room temperature control system. Adv: 1) The use of feedback makes the system response insensitive to external disturbances and internal variations in system parameters. 2) More complicated and more expensive comparing with Open-Loop.	Remember	1	CAEE009.01
22	Define Control unit (dynamic element)	The unit that reacts to an actuating signal to produce a desired output. This unit does the work of controlling the output and thus may be a power amplifier.	Remember	1	CAEE009.01

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23	Define Feedback control system.	The unit that provides the means for feeding back the output quantity, or a function of the output, in order to compare it with the reference input.	Remember	1	CAEE009.01
24	Define Actuating signal	The signal that is difference between the reference input and the feedback signal if actuates the control unit in order to maintain the output of the desired value.	Remember	1	CAEE009.01
25	Define The sensor or measuring element	It is a device that converts the output variable into another suitable variable, such as a displacement, pressure, voltage, etc.	Remember	1	CAEE009.01
26	Define the actuator	It is a power device that produces the input to the plant according to the control signal so that the output signal will approach the reference input signal.	Remember	1	CAEE009.01
27	Define Automatic Controllers	An automatic controller compares the actual value of the plant output with the reference input (desired value), determines the deviation, and produces a control signal that will reduce the deviation to zero or to a small value.	Remember	1	CAEE009.01
28	Define Transfer function	The function of a linear time invariant differential equation system is defined as the ratio of Laplace transform of the output(response function) to the Laplace transform of the input(drive function) under the assumption that all initial conditions are zero.	Remember	2	CAEE009.02
29	What is Synchro?	A Synchro is a device used to convert an angular motion to an electrical signal or vice versa.	Remember	3	CAEE009.03
30	What is servomotor?	The motors used in automatic control systems or in servomechanism are called servomotors. They are used to convert electrical signal into angular motion.	Remember	3	CAEE009.03
UNIT – II					
1	What are the basic elements in Block Diagram?	The basic elements of block diagram are blocks, branch point and summing point.	Understand	CLO4	CAEE009.04
2	What is a signal flow graph?	A signal flow graph is a diagram that represents a set of simultaneous algebraic equations	Understand	CLO4	CAEE009.04
3	Define non touching loop	The loops are said to be non touching if they do not have common nodes	Remember	CLO4	CAEE009.04
4	Define self loop	A feedback loop consisting of only one node is called self loop.	Remember	CLO4	CAEE009.04
5	What is transient response?	The transient response is the response of the system when the system	Understand	CLO5	CAEE009.05

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
		changes from one state to another.			
6	What is an order of a system?	The order of a system is the order of the differential equation governing the system	Understand	CLO5	CAEE009.05
7	Define Damping ratio.	Damping ratio is defined as the ratio of actual damping to critical damping	Remember	CLO5	CAEE009.05
8	Define Rise time.	The time taken for response to raise from 0% to 100% for the very first time is rise time	Remember	CLO5	CAEE009.05
9	Define Settling time.	Settling time is defined as the time taken by the response to reach and stay within specified error.	Remember	CLO5	CAEE009.05
10	What is step signal?	The step signal is a signal whose value changes from zero to A at t= 0 and remains constant at A for t>0.	Understand	CLO5	CAEE009.05
11	Define Steady state error	The steady state error is defined as the value of error as time tends to infinity.	Remember	CLO6	CAEE009.06
12	What are the three constants associated with a steady state error?	i. Positional error constant ii. Velocity error constant iii. Acceleration error constant	Understand	CLO6	CAEE009.06
13	What is the need for a controller?	The controller is provided to modify the error signal for better control action.	Understand	CLO6	CAEE009.06
14	What is Proportional controller?	It is a device that produces a control signal which is proportional to the input error signal.	Understand	CLO6	CAEE009.06
15	Define branch point	A branch point is a point from which the signal from a block goes concurrently to other blocks or summing points.	Remember	4	CAEE009.04
16	Define summing point	A circle with a cross is the symbol that indicates a summing operation. The plus or minus sign at each arrowhead indicates whether that signal is to be added or subtracted	Remember	4	CAEE009.04
17	Define block diagram	A block diagram of a system is a pictorial representation of the functions performed by each component and of the flow of signals.	Remember	4	CAEE009.04
18	Define open loop transfer function	The ratio of the feedback signal B(s) to the actuating error signal E(s) is called the open-loop transfer function.	Remember	4	CAEE009.04

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19	What is a signal flow graph?	A signal flow graph is a diagram that represents a set of simultaneous algebraic equations .By taking L.T the time domain differential equations governing a control system can be transferred to a set of algebraic equations in s-domain.	Remember	5	CAEE009.05
20	What is transmittance?	The transmittance is the gain acquired by the signal when it travels from one node to another node in signal flow graph	Remember	5	CAEE009.05
21	What is sink and source?	Source is the input node in the signal flow graph and it has only outgoing branches. Sink is a output node in the signal flow graph and it has only incoming branches.	Remember	5	CAEE009.05
22	Define non touching loop.	The loops are said to be non touching if they do not have common nodes.	Remember	5	CAEE009.05
23	Define Masons Gain formula.	Masons Gain formula states that the overall gain of the system is T = 1/ Δk Pk k-No.of forward paths in the signal flow graph. Pk- Forward path gain of kth forward path Δk =1-[sum of individual loop gains] +[sum of gain products of all possible combinations of two non touching loops]-[sum of gain products of all possible combinations of three non touching loops]+… k - for that part of the graph which is not touching kth forward path.	Remember	5	CAEE009.05
24	What is servomechanism?	The servomechanism is a feedback control system in which the output is mechanical position (or time derivatives of position velocity and acceleration)	Remember	3	CAEE009.03
25	Define transient response?	The transient response is the response of the system when the system changes from one state to another.	Remember	6	CAEE009.06
26	Define steady state response?	The steady state response is the response of the system when it approaches infinity.	Remember	6	CAEE009.06
27	What is an order of a system?	The order of a system is the order of the differential equation governing the system. The order of the system can be obtained from the transfer function of the given system	Remember	6	CAEE009.06
28	Define Damping ratio.	Damping ratio is defined as the ratio of actual damping to critical damping.	Remember	6	CAEE009.06
29	Define Delay time.	The time taken for response to reach 50% of final value for the very first time is delay time.	Remember	6	CAEE009.06
30	Define peak overshoot.	Peak overshoot is defined as the ratio of maximum peak value measured from the maximum value to final value	Remember	6	CAEE009.06

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31	Define Settling time.	Settling time is defined as the time taken by the response to reach and stay within specified error.	Remember	6	CAEE009.06
32	Define Steady state error.	The steady state error is defined as the value of error as time tends to infinity	Remember	6	CAEE009.06
33	What is step signal?	The step signal is a signal whose value changes from zero to A at t= 0 and remains constant at A for t>0.	Remember	6	CAEE009.06
34	What is ramp signal?	The ramp signal is a signal whose value increases linearly with time from an initial value of zero at t=0.the ramp signal resembles a constant velocity.	Remember	6	CAEE009.06
35	What is Proportional controller?	It is a device that produces a control signal which is proportional to the input error signal.	Remember	9	CAEE009.09
36	What is PI controller?	It is a device that produces a control signal consisting of two terms - one proportional to error signal and the other proportional to the integral of error signal.	Remember	9	CAEE009.09
37	What is PD controller?	PD controller is a proportional plus derivative controller which produces an output signal consisting of two time - one proportional to error signal and other proportional to the derivative of the signal.	Remember	9	CAEE009.09
UNIT – III					
1	Define stability.	A system is said to be stabile if every bounded input results in a bounded output.	Understand	CLO7	CAEE009.07
2	What is Routh stability criterion?	Routh criterion states that the necessary and sufficient condition for stability is that all of the elements in the first column of the routh array is positive	Remember	CLO7	CAEE009.07
3	What is characteristic equation?	The denominator polynomial of C(S)/R(S) is the characteristic equation of the system	Remember	CLO7	CAEE009.07
4	What is auxiliary polynomial?	The auxiliary polynomial is the equation corresponding to the row just above the row of all zeros.	Remember	CLO7	CAEE009.07
5	What is the time constant of the system indicate	Time constant of the system indicate, how fast the system reaches the final value	Remember	CLO7	CAEE009.07
6	Define Relative stability	Relative stability is the degree of closeness of the system, it is an indication of strength or degree of stability	Remember	CLO7	CAEE009.07
7	What are root loci?	The path taken by the roots of the open loop transfer function when the loop gain is varied from 0 to 1 are called root loci.	Remember	CLO8	CAEE009.08

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8	What is a dominant pole?	The dominant pole is a complex conjugate pair which decides the transient response of the system.	Remember	CLO8	CAEE009.08
9	What are break away and break in points?	At break away point the root locus breaks from the real axis to enter into the complex plane. At break in point the root locus enters the real axis from the complex plane.	Understand	CLO8	CAEE009.08
10	What are asymptotes?	Asymptotes are the straight lines which are parallel to root locus going to infinity and meet the root locus at infinity.	Understand	CLO8	CAEE009.08
12	What is centroid?	The meeting point of the asymptotes with the real axis is called centroid	Understand	CLO8	CAEE009.08
13	What are the effects of adding a zero to a system?	Adding a zero to a system increases peak overshoot appreciably	Understand	CLO9	CAEE009.09
14	How to find the crossing point of root locus in imaginary axis?	By Routh Hurwitz criterion	Understand	CLO9	CAEE009.09
15	What is impulse response?	The impulse response of a system is the inverse Laplace transforms of the system transfer function.	Understand	CLO8	CAEE009.08
16	Define stability.	A linear relaxed system is said to have BIBIO stability if every bounded input results in a bounded output.	Remember	7	CAEE009.07
17	What is Routh stability criterion?	Routh criterion states that the necessary and sufficient condition for stability is that all of the elements in the first column of the routh array is positive. If this condition is not met, the system is unstable and the number of sign changes in the elements of the first column of routh array corresponds to the number of roots of characteristic equation in the right half of the S-plane.	Remember	7	CAEE009.07
18	What is magnitude criterion?	The magnitude criterion states that s=sa will be a point on root locus if for that value of S, magnitude of G(S)H(S) is equal to 1. |G(S)H(S)| = K(product of length of vectors from open loop zeros to the point s=sa)/ (product of length of vectors from open loop poles to the point s=sa) = 1.	Remember	7	CAEE009.07
19	What are the effects of adding a zero to a system?	Adding a zero to a system results in pronounced early peak to system response thereby the peak overshoot increases appreciably.	Remember	8	CAEE009.08
20	What is a dominant pole?	The dominant pole is a pair of complex conjugate pair which decides the transient response of the system.	Remember	8	CAEE009.08
21	What are root loci?	The path taken by the roots of the open loop transfer function when the loop gain is varied from 0 to 1 are called root loci.	Remember	8	CAEE009.08

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22	What is limitedly stable system?	For a bounded input signal if the output has constant amplitude oscillations, then the system may be stable or unstable under some limited constraints such a system is called limitedly stable system.	Remember	7	CAEE009.07
23	What is a principle of argument?	The principles of arguments states that let F(S) are analytic function and if an arbitrary closed contour in a clockwise direction is chosen in the S-plane so that F(S) is analytic at every point of the contour. Then the corresponding F(S) plane contour mapped in the F(S) plane will encircle the origin N times in the anti clockwise direction, where N is the difference between number of poles and zeros of F(S) that are encircled by the chosen closed contour in the S-plane.	Remember	8	CAEE009.08
24	What are break away and break in points?	At break away point the root locus breaks from the real axis to enter into the complex plane. At break in point the root locus enters the real axis from the complex plane. To find the break away or break in points, form a equation for K from the characteristic equation and differentiate the equation of K with respect to s. Then find the roots of the equation dK/dS = 0. The roots of dK/dS = 0 are break away or break in points provided for this value of root the gain K should be positive and real.	Remember	8	CAEE009.08
25	What is centroid?	The meeting point of the asymptotes with the real axis is called centroid. The centroid is given by Centroid = (sum of poles – sum of zeros) / (n-m) n-number of poles, m-number of zeros.	Remember	8	CAEE009.08
26	What is angle criterion?	The angle criterion states that s=sa will be the point on the root locus if for that value of S the argument or phase of G(S)H(S) is equal to an odd multiple of 180°. (Sum of the angles of vectors from zeros to the point s=sa)- (Sum of the angles of vectors from poles to the point s=sa) = ±180°(2q + 1)	Remember	8	CAEE009.08
27	How will you find the root locus on real axis?	To find the root loci on real axis, choose the test point on real axis. If the total number of poles and zeros on the real axis to the right of this test point is odd number then the test point lie on the root locus. If it is even then the test point does not lie on the root locus.	Remember	8	CAEE009.08
28	What is characteristic equation?	The denominator polynomial of C(S)/R(S) is the characteristic equation of the system.	Remember	8	CAEE009.08
29	What is auxiliary polynomial?	In the construction of routh array a row of all zero indicates the existence of an even polynomial as a factor of given characteristic equation. In an even polynomial the exponents of S are even integers or zero only. This	Remember	8	CAEE009.08

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		even polynomial factor is called auxiliary polynomial. The coefficients of auxiliary polynomial are given by the elements of the row just above the row of all zeros.			
UNIT - IV					
1	What is frequency response?	A frequency response is the steady state response of a system when the input to the system is a sinusoidal signal.	Understand	CLO10	CAEE009.10
2	List out the different frequency domain specifications	The frequency domain specifications are i. Resonant peak. Resonant frequency.	Understand	CLO10	CAEE009.10
3	Define Resonant frequency (fr)	The frequency at which resonant peak occurs is called resonant frequency	Remember	CLO10	CAEE009.10
4	What is Bandwidth?	The Bandwidth is the range of frequencies for which the system gain is more than 3 dB.	Remember	CLO10	CAEE009.10
5	Define Cut off rate.	The slope of the log-magnitude curve near the cut-off is called cut-off rate. The cut off rate indicates the ability to distinguish the signal from noise.	Remember	CLO10	CAEE009.10
6	Define Gain Margin	The Gain Margin,k_g is defined as the reciprocal of the magnitude of the open loop transfer function at phase cross over frequency	Remember	CLO10	CAEE009.10
7	Define Phase cross over.	The frequency at which, the phase of open loop transfer functions is called phase cross over frequency Δpc.	Remember	CLO10	CAEE009.10
8	What is Phase margin?	The Phase margin is the amount of phase lag at the gain cross over frequency required to bring system to the verge of instability	Remember	CLO10	CAEE009.10
9	What is Bode plot?	The Bode plot is the frequency response plot of the transfer function of a system	Understand	CLO10	CAEE009.10
10	Define Corner frequency.	The frequency at which the two asymptotic meet in a magnitude plot is called Corner frequency	Remember	CLO10	CAEE009.10
11	What is Nyquist contour?	The contour that encloses entire right half of S plane is called Nyquist contour.	Remember	CLO11	CAEE009.11
12	What are the main advantages of Bode plot?	A simple method for sketching an approximate log curve is available.	Understand	CLO12	CAEE009.12
13	Define Gain cross over frequency	The Gain cross over frequency Δgc is the frequency at which the magnitude of the open loop transfer function is unity.	Understand	CLO12	CAEE009.12

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14	If the gain of the open loop system is doubled, the gain of the system is:	Not effected as the gain of the system is not dependent on the overall gain of the system.	Understand	CLO12	CAEE009.12
15	What is the size of radius in Nyquist contour?	For Nyquist contour, the size of radius is ∞.	Understand	CLO12	CAEE009.12
16	What is frequency response?	A frequency response is the steady state response of a system when the input to the system is a sinusoidal signal	Remember	10	CAEE009.10
17	Define Resonant Peak (Δr)	The maximum value of the magnitude of closed loop transfer function is called Resonant Peak.	Remember	10	CAEE009.10
18	Define Resonant frequency (Δf)	The frequency at which resonant peak occurs is called resonant frequency.	Remember	10	CAEE009.10
19	What is Bandwidth?	The Bandwidth is the range of frequencies for which the system gain is more than 3 dB. The bandwidth is a measure of the ability of a feedback system to reproduce the input signal noise rejection characteristics and rise time.	Remember	10	CAEE009.10
20	Define Cut off rate.	The slope of the log-magnitude curve near the cut-off is called cut-off rate. The cut off rate indicates the ability to distinguish the signal from noise.	Remember	10	CAEE009.10
21	Define Gain Margin.	The Gain Margin, kg is defined as the reciprocal of the magnitude of the open loop transfer function at phase cross over frequency.	Remember	12	CAEE009.12
22	Define Phase cross over frequency.	The frequency at which, the phase of open loop transfer functions is called phase cross over frequency Δpc.	Remember	12	CAEE009.012
23	What is Phase margin?	The Phase margin is the amount of phase lag at the gain cross over frequency required to bring system to the verge of instability	Remember	12	CAEE009.12
24	Define Gain cross over frequency.	The Gain cross over frequency Δgc is the frequency at which the magnitude of the open loop transfer function is unity.	Remember	12	CAEE009.12
25	What is Bode plot?	The Bode plot is the frequency response plot of the transfer function of a system. A Bode plot consists of two graphs. One is the plot of magnitude of sinusoidal transfer function versus log Δ. The other is a plot of the phase angle of a sinusoidal function versus log Δ.	Remember	11	CAEE009.11
26	Define Corner frequency.	The frequency at which the two asymptotic meet in a magnitude plot is called Corner frequency.	Remember	11	CAEE009.11
27	State Nyquist stability criterion.	If the Nyquist plot of the open loop transfer function G(s) corresponding to the Nyquist control in the S-plane encircles the critical point –1+j0 in the	Remember	11	CAEE009.11

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		counter clockwise direction as many times as the number of right half S-plane poles of G(s),the closed loop system is stable			
28	What is Nyquist contour?	The contour that encloses entire right half of S plane is called Nyquist contour.	Remember	11	CAEE009.11
29	Define Relative stability.	Relative stability is the degree of closeness of the system, it is an indication of strength or degree of stability.	Remember	11	CAEE009.11
30	Define polar plot?	The Polar plot is a plot, which can be drawn between the magnitude and the phase angle of $G(j\omega)H(j\omega)$ by varying ω from zero to ∞.	Remember	11	CAEE009.11
UNIT - V					
1	What are the advantages of state space analysis?	It can be applied to non-linear as well as time varying systems. It can be applied for MIMO systems also. The state variables selected need not necessarily be the physical quantities of the system.	Understand	CLO13	CAEE009.13
2	What are phase variables?	system variables and its derivatives are called phase variables	Understand	CLO13	CAEE009.13
3	Define state variable	The minimal set of variables which can describe the system status are known as state variables	Remember	CLO13	CAEE009.13
4	Is the state model unique for a given transfer function?	State model is not unique	Understand	CLO13	CAEE009.13
5	What is controllability?	A system is said to be completely state controllable if it is possible to transfer the system state from any initial state $X(t_0)$ at any other desired state X(t), in specified finite time by a control vector U(t).	Understand	CLO14	CAEE009.14
6	What is observability?	A system is said to be completely observable if every state X(t) can be completely identified by measurements of the output Y(t) over a finite time interval.	Understand	CLO14	CAEE009.14
7	Define state	Status of the system is called state.	Remember	CLO13	CAEE009.13
8	What is the state model	State equation and output equation is called state model	Understand	CLO13	CAEE009.13
9	What is similarity transformation?	The process of transforming a square matrix A to another similar matrix B by a transformation $P^{-1}AP = B$ is called similarity transformation. The matrix P is called transformation matrix.	Understand	CLO14	CAEE009.14

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
10	What is meant by diagonalization?	The process of converting the system matrix A into a diagonal matrix by a similarity transformation using the modal matrix M is called diagonalization.	Understand	CLO14	CAEE009.14
11	What is modal matrix?	The modal matrix is a matrix used to diagonalize the system matrix	Understand	CLO14	CAEE009.14
12	What are the three types of Compensators?	Lag compensator, lead compensator and Lag-Lead compensator	Understand	CLO15	CAEE009.15
13	What is the use of lag compensator?	Improve the steady state behavior of a system, while nearly preserving its transient response.	Understand	CLO15	CAEE009.15
14	What is a compensator?	A device inserted into the system for the purpose of satisfying the specifications is called as a compensator.	Understand	CLO15	CAEE009.15
15	When lag lead compensator is required?	The lag lead compensator is required when both the transient and steady state response of a system has to be improved.	Understand	CLO15	CAEE009.15
16	State sampling theorem.	A continuous time signal can be completely represented in its samples and recovered back if the sampling frequency $Fs \geq 2Fmax$ where Fs is the sampling frequency and Fmax is the maximum frequency present in the signal.	Remember	13	CAEE009.13
17	What is periodic sampling?	Sampling of a signal at uniform equal intervals is called periodic sampling.	Remember	13	CAEE009.13
18	What are phase variables?	The phase variables are defined as the state variables which are obtained from one of the system variables and its derivatives.	Remember	13	CAEE009.13
19	Define state variable.	The state of a dynamical system is a minimal set of variables (known as state variables) such that the knowledge of these variables at t-t0 together with the knowledge of the inputs for $t > t0$, completely determines the behavior of the system for $t > t0$.	Remember	14	CAEE009.14
20	What is controllability?	A system is said to be completely state controllable if it is possible to transfer the system state from any initial state X(t0) at any other desired state X(t), in specified finite time by a control vector U(t).	Remember	15	CAEE009.15
21	What is observability?	A system is said to be completely observable if every state X(t) can be completely identified by measurements of the output Y(t) over a finite time interval.	Remember	15	CAEE009.15

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22	What is Nyquist rate?	The Sampling frequency equal to twice the highest frequency of the signal is called as Nyquist rate. fs=2fm.	Remember	13	CAEE009.13
23	What is similarity transformation?	The process of transforming a square matrix A to another similar matrix B by a transformation P-1 AP = B is called similarity transformation. The matrix P is called transformation matrix.	Remember	14	CAEE009.14
24	What is meant by diagonalization?	The process of converting the system matrix A into a diagonal matrix by a similarity transformation using the modal matrix M is called diagonalization.	Remember	14	CAEE009.14
25	What is modal matrix?	The modal matrix is a matrix used to diagonalize the system matrix. It is also called diagonalization matrix. If A = system matrix. M = Modal matrix And M^{-1} =inverse of modal matrix. Then M^{-1} AM will be a diagonalized system matrix.	Remember	14	CAEE009.14
26	What is a compensator?	A device inserted into the system for the purpose of satisfying the specifications is called as a compensator.	Remember	15	CAEE009.15
27	Define Phase lag and phase lead.	A negative phase angle is called phase lag. A positive phase angle is called phase lead.	Remember	15	CAEE009.15
28	Define phase lead compensator?	A system which has one pole and one dominating zero (the zero which is closer to the origin than all over zeros is known as dominating zero.) is known as lead network. If we want to add a dominating zero for compensation in control system then we have to select lead compensation network.	Remember	15	CAEE009.15
29	Define phase lag compensator?	A system which has one zero and one dominating pole (the pole which is closer to origin that all other poles is known as dominating pole) is known as lag network. If we want to add a dominating pole for compensation in control system then, we have to select a lag compensation network.	Remember	15	CAEE009.15
30	Define phase lag-lead compensator?	With single lag or lead compensation may not satisfy design specifications. For an unstable uncompensated system, lead compensation provides fast response but does not provide enough phase margins whereas lag compensation stabilize the system but does not provide enough bandwidth. So we need multiple compensators in cascade.	Remember	15	CAEE009.15

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