

## MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University) Rasipuram - 637 408, Namakkal Dist., Tamil Nadu



## EEE

## Must Know Concepts (MKC)

2021-2022

Course Code & Course Name Year/Sem/Sec		19ECC14-Control Engineering		
		III/V/A,B&C		
S.No	Term	Notation (Symbol)Concept/Definition/Meaning/Units/ Equation/ Expression		Units
	UNIT-1	SYSTEMS AND	<b>THEIR REPRESNTATION</b>	
1.	Control system	-	When the output quantity is controlled by varying the input quantity	
2.	System	-	When a number of elements are connected in a sequence to perform a specific function,	
3.	Types of control system	-	open loop control system, closed loop control system	
4.	Open loop control system	OLS	The output is not feedback to the input for correction.	
5.	Closed loop control system.	CLS	the output has an effect upon the input quantity	
6.	Feedback	-	Proportional signal is given to input for automatic correction of any changes in desired output	
7.	Components of feedback control system	-	Plant, feedback path elements, error detector and controller	
8.	Transfer function.	TF	Ratio of the Laplace transform of output to input with zero initial conditions.	
9.	Block Diagram	-	Pictorial representation of the functions performed by each component of the system and shows the flow of signals.	
10.	Signal flow graph	-	It represents a set of simultaneous algebraic equations.	
11.	Transmittance	Т	It is the gain acquired by the signal when it travels from one node to another node in signal flow graph.	
12.	Sink	-	It is a output node in the signal flow graph and it has only incoming branches.	
13.	Source	-	Source is the input node in the signal flow graph and it has only outgoing branches.	
14.	Dash-pot		The friction existing in rotating mechanical system	Ns/m

15.	Non touching loop		The loops are said to be non touching	
15.	Non touching loop	-	if they do not have common nodes.	
16.			states that the overall gain of the	
	Masons Gain formula	-	system is $T = 1/\Delta \sum_{k=0}^{n} \Delta k P_k$	
			$1 - 1/\Delta \sum_{k=0} \Delta K K_k$	
17.	Force balance equation of an ideal mass element	-	F = M d2x / dt2	
18.	Force balance equation of ideal dashpot element.	-	$\mathbf{F} = \mathbf{B}  \mathbf{dx}  / \mathbf{dt}$	
	Force balance equation of			
19.	ideal spring element.	-	$\mathbf{F} = \mathbf{K}\mathbf{x}$	
			It is a feedback control system in	
20.	Servomechanism	-	which the output is mechanical	
			position	
	Basic Elements Used For Modeling Mechanical			
21.	Translational System	-	Mass, spring and dashpot	
	Basic elements used for		Moment of inertia,	
22.	modeling mechanical	-	dashpot with rotational frictional	
	rotational system		coefficient torsion spring with stiffness	
			The ratio of change in heat stored and	
23.	Thermal capacitance	-	change in temperature	
24.	Synchros	-	Convert an angular motion to an	
24.			electrical signal	
25.	Motor	-	convert electrical energy into	
			mechanical energy	
	U	NIT-2 TIME RES	PONSE ANALYSIS	
26.	Generator	-	convert the mechanical energy to	
20.			electrical energy	
27.	Types of Electrical Analogous For	-	Force voltage and force current analogy	
27.	Mechanical System		analogy	
20		-	The ratio of change in temperature	
28.	Thermal resistance		and change in heat flow rate	
29.	Transient response	-	When the system changes from one	
	I		state to another.Response of the system when it	
30.	Steady state response	-	approaches infinity.	
21	Orden of the	_	It is the order of the differential	
31.	Order of a system		equation governing the system.	
32.	Damping ratio.	-	Ratio of actual damping to critical	
			damping.	
33.	Time domain specifications	-	i. Delay time ii. Rise time iii. Peak time iv. Peak overshoot	
<u> </u>	Delay time	_	The time taken for response to reach	
34.			50% of final value for the very first	
			time	
25		-	The time taken for response to raise	
35.	Rise time		from 0% to 100% for the very first time	
		_	The time taken for the response to	
36.	Peak time		±	
36.	Peak time		reach the peak value for the first time	

37.   Peak overshoot   -   Ratio of maximum peak value to final value.     38.   Settling time   -   Time taken by the response to reach and stay within specified error.     39.   Need for a controller   -   Time controller is provided to modify the error signal for better control action action action the error signal for better control action controller is. PID controller is. PID controller is. PID controller is grad which is proportional to controller action action action in proportional to the input error signal     40.   Different types of controller of it. PP optices a control signal consisting of two terms - one proportional to error signal and the other proportional to the input error signal on the other proportional to the derivative of error signal and the other proportional to the derivative of error signal and the other proportional to the derivative of error signal and the other proportional to the derivative of error signal and the other proportional to the derivative of error signal and the other proportional to the derivative of error signal.     44.   Steady state error   -   The value of error as time tends to infinity.     45.   Step signal   -   Value charges from zero to A at t= 0 and remains constant at A for t> 0.     46.   Ramp signal   -   -   The value of ror as time tends to infinity.     47.   Stepper motor   -   -   The motors used in automatic control synthemotic entrol synthemotic entrol as themotent and for t> 0.					
Image: setting time     Image: setting time     Image: setting time       38.     Setting time     -     Time taken by the response to reach and stay within specified error.       39.     Need for a controller     -     The controller is provided to modify the error signal for better control action       40.     Different types of controller     -     It Proportional controller ii. PI controller ii. PD controller ii. PD controller iii. PD controller iii. PD controller is provided to mosify of two terms - one proportional to the input error signal on onsisting of two terms - one proportional to error signal.       42.     PI controller     -     Produces a control signal consisting of two terms - one proportional to error signal.       43.     PD controller     -     Produces a control signal consisting of two terms - one proportional to the derivative of error signal.       44.     Steady state error     -     Thus value of error as time tends to infinity.       45.     Step signal     -     Value changes from zero to A at t= 0.       46.     Ramp signal     -     Value changes from zero to A at t= 0.       47.     Stepper motor     -     Transforms electrical pulses into equal increments of rotary shaft motion asystems or in servornechanism       48.     Servomotor     -     Produces a	27		-	Ratio of maximum peak value	
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43.   PD controller   error signal and the other proportional to the derivative of error signal.     44.   Steady state error   -   The value of error as time tends to infinity     45.   Step signal   -   Value changes from zero to A at t= 0 and remains constant at A for t>0.     46.   Ramp signal   -   Value increases linearly with time from an initial value of zero at t=0     47.   Stepper motor   -   Transforms electrical pulses into equal increments of rotary shaft motion     48.   Servomotor   -   Produces an output voltage proportional to its shaft speed     50.   Centroid   -   Produces an output voltage proportional to its shaft speed     51.   Dominant pole   -   Pair of complex conjugate pair     52.   Dominant zeros   -   UNIT-3 FREQUENCY RESPONSE ANALYSIS     53.   Frequency response   -   When the input to the system is a sinusoidal signal.     54.   Different frequency domain plots   -   Polar polo, Bode plot, Nichols plot, M & N circles     55.   Frequency domain plots   -   The maximum value of the magnitude of closed loop transfer frequency.     55.   Frequency domain plots   -   The maximum value of the magnitude of closed lo					
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57 Resonant frequency - The frequency at which resonant	56	Resonant Peak			
57 Resonant frequency - The frequency at which resonant	50.	Kesonant Peak			
<b>N A R R R R R R R R R R</b>					
peak occurs	57.	Resonant frequency	-	1 1	
				peak occurs	

		1	T
58.	Bandwidth	-	the range of frequencies for which the system gain is more than 3 dB
50		_	The slope of the log-magnitude curve
59.	Cut off rate.		near the cut-off
60.	Gain Margin.	-	Amount of gain(in dB) added to the
			system to make the system unstable.
61.	Phase margin	-	Amount of phase lag(in degrees) added to the system to make the
01.	I hase margin		system unstable
62.	Gain margin formula.	-	Gain margin kg = $1 / \Delta G(j\Delta pc)\Delta$ .
63.	Bode plot	-	It is the frequency response plot of
05.	bode plot		the transfer function of a system.
64.	Magnitude plot	-	Plot between magnitude in db and log $\omega$ for various values of $\omega$ .
		_	Plot between phase in degrees and
65.	Phase plot	_	$\log \omega$ for various values of $\omega$ .
66	Comon fragmanay	0	The frequency at which the two
66.	Corner frequency	ω <sub>c</sub>	asymptotic meet in a magnitude plot
67.	Phase lag	-	A negative phase angle
<u> </u>			A positive phase angle
68.	phase lead	-	
	M circles		The magnitude of closed loop
69.		-	transfer function with unit feedback
			can be shown for every value of M.The phase of closed loop transfer
			function with unity feedback can be
70.	N circles	-	shown in the form of circles for every
			value of N
	Nichols chart	-	The chart consisting if M & N loci in
71.			the log magnitude versus phase
		+	diagram It is a plot of the magnitude of G(jω)
72.	Polar plot	-	Vs the phase of $G(j\omega)$ on polar co-
, 2.			ordinates
73.	Minimum phaga quatam		All poles and zeros will lie on the left
75.	Minimum phase system		half of s-plane
74.	All pass systems	-	The magnitude is unity at all
	1		frequencies     A transfer function, which has one or
75.	Non-minimum phase transfer function	-	A transfer function, which has one or more zeros in the right half $s - plane$
			· · · · · · · · · · · · · · · · · · ·
		LISIS & CLASS	ICAL CONTROL DESIGNTECHNIQUES
	Advantages of Nichols		To find closed loop frequency
76.	chart	-	response from open loop frequency
<u> </u>	Auxiliary polynomial	-	response.   The row of polynomial which is just
77.			above the row containing the zeroes
			In the absence of the input, the output
78.	Asymptotic stability	-	tends towards zero irrespective of
			initial conditions.
70	Compensator	-	A device inserted into the system for the purpose of satisfying the
79.			the purpose of satisfying the specifications
00	TT C		i. Lag compensator ii. Lead
80.	Types of compensators	-	compensator iii. Lag-Lead

			compensator.
81.	Phase cross over		The frequency at which, the phase of
			open loop transfer functionsThe input is given by inverse laplace
82.	Impulse response	_	transform of the system transfer
02.	Impulse response		function
			Produces a sinusoidal output having
83.	Lag Compensator	-	the phase lag when a sinusoidal input
			is applied.
	Leed Commenceder		Produces a sinusoidal output having
84.	Lead Compensator	-	phase lead when a sinusoidal input is
			applied.
	Lag-Lead Compensator		Produces phase lag at one frequency
85.	Lag-Lead Compensator	-	region and phase lead at other
			frequency region.
			Improve the steady state behavior of
86.	Use of lag compensator	-	a system, while nearly preserving its
			transient response.
87.	Advantages of Bode plot	_	A simple method for sketching an
07.	Advantages of Bode plot		approximate log curve is available.
			The M contours are the magnitude of
88.	Two contours of Nichols	_	closed loop system in decibels and
	chart		the N contours are the phase angle
			locus of closed loop system.
00			i. Cascade or series compensation ii.
89.	Types of compensation	-	Feedback compensation or parallel
			compensation.
90.	Nyquist contour	-	The contour that encloses entire right
			half of S plane.
91.	Relative stability.	_	It is the degree of closeness of the system, it is an indication of degree
71.	Relative stability.	-	of stability.
		-	The path taken by the roots of the
92.	Root loci		open loop transfer function when the
>=.			loop gain is varied from 0 to 1
			A stable system produces a bounded
93.	Stability.	-	output for a given bounded input
			Lead network
94.	Compensating networks	-	Lag network
			Lag-Lead network
			A linear relaxed system is said to be
95.	BIBO stability	-	BIBO stable, if every bounded input
			produces a bounded output.
96.	Necessary condition for		All the coefficients of characteristic
70.	stability		polynomial be positive
97.	Nyquist stability criterion	_	We can predict the closed loop
<i>)1</i> .	Tyquist stability enterior		stability from open loop data.
98.	Characteristic equation	-	C(s)/R(s)
00	Overlage tel		The roots respect to both real and
99.	Quadrantal symmetry	-	imaginary axis
100.	Magnitude criterion	-	G(s)H(s)=1
	UNIT-5 STATE SPACE	& VARIABLE A	ANALYSIS OF CONTINUOUS SYSTEMS
	State		The condition of a system at any time

			instant.	
102.	State variable	_	Set of variables which describe the state of the system at any time instant	
103.	State space	-	The set of all possible values which the state vector	
104.	Necessities of state space analysis	_	Applicable to MIMO systems.	
105.	State space representation	-	It consist of two equations state equation and output equation	
106.	Phase variables	-	The state variables which are obtained from one of the system variables and its derivatives.	
107.	Controllability	-	A system is said to be completely state controllable	
108.	Observability	-	A system is said to be completely observable	
109.	Modal matrix	-	used to diagonalize the system matrix	
110.	Need for controllability test	-	To find the usefulness of a state variable	
111.	Need for observability test	-	To find whether the state variables are measurable or not.	
112.	Quantization	-	Converting a discrete-time continuous valued signal into a discrete-time discrete valued signal	
113.	Sampled data system	-	If the signals in any part of the system is discrete then the entire system is said to be sampled data system.	
114.	Periodic sampling	_	Sampling of a signal at uniform equal intervals is called periodic sampling.	
115.	Coding	-	Representation of sampled data by n bit binary number is called coding	
116.	Hold circuit	-	Used to convert digital signal into analog signal.	
117.	Aperture time	_	It is the duration of sampling of analog signal	sec
118.	Acquisition time	_	Time taken by an analog to digital converter to sample the signal, to quantize it and to code it.	
119.	Discrete signal sequence	-	Function of independent variable	
120.	Impulse response	-	The output of a system when we provide it with an impulse signal	
121.	Weighting sequence	-	The impulse response of a linear discrete time system	
122.	Zero order hold	-	The effect of converting a discrete- time signal to a continuous- timesignal by holding each sample value for one sample interval.	
123.	First order hold	-	The output of the first order hold is constructed from latest two samples	
124.	Hold mode droop	-	The change in signal magnitude during hold mode of ahold circuit	
125.	Sampler	-	The device used to perform sampling is called sampler	

126.	Sampling	-	analog signals are sampled at predetermined intervalsto convert	
127.	Test for controllability and observability	-	into discrete time signals Gilbert's test Kaman's test	
128.	State diagram	-	Pictorial representation of the state model of the system	
129.	Mass	М	Weight of the mechanical system	kg
130.	Spring	K	Elastic deformation of the body	N/m
131.	Newton's second law of motion	_	The sum of applied force is equal to the sum of opposing forces	
132.	Velocity	V	Vector measurement of the rate and direction of motion.	m/s
133.	DC supply	-	The electric charge (current) only flows in one direction.	
134.	AC supply	-	It is an electric current which periodically reverses direction	
135.	Node	-	It is a point representing a variable or signal	
136.	Branch	-	It is directed line segment joining two nodes	
137.	Mixed node	-	It is a node that has both incoming and outgoing branches	
138.	Open path	-	It starts at a node and ends at another node	
139.	Closed path	-	It starts and ends at same node	
140.	Loop gain	-	It is the product of the branch transmittances of a loop	
141.	Gas flow resistance	-	The rate of change in gas pressure ohm difference for a change in gas flow rate	
142.	Pneumatic capacitance	-	The ratio of change in gas stored for a change in gas pressure	farad
143.	Characteristics of negative feedback	-	Accuracy in tracking steady state value	
144.	Demodulation	-	Reverse process of modulation	
145.	Dwell time	-	The length of the time the vibration reed rest on the fixed contacts	
146.	Inverter	-	Converts DC to AC	
147.	Scalar		Used to multiply a signal by a constant	
148.	Adder	-	Used to add two or more signals	
149.	Integrator	-	Used to integrate the signal	
150.	Observability test	-	Gilbert's test and kalman's test	
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	Signature