MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

EEE

Must Know Concepts (MKC)

2021-2022

Course Code & Course Name	19ECC14-Control Engineering			
Year/Sem/Sec	III/V/A,B&C			
S.No	**Term**	**Notation (Symbol)**	**Concept/Definition/Meaning/Units/ Equation/ Expression**	**Units**
UNIT-1 SYSTEMS AND THEIR REPRESNTATION				
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	T	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 if they do not have common nodes.	
16.	Masons Gain formula	-	states that the overall gain of the system is $T = 1/\Delta \sum_{k=0}^{n} \Delta kP_k$	
17.	Force balance equation of an ideal mass element	-	F = M d2x /dt2	
18.	Force balance equation of ideal dashpot element.	-	F = B dx /dt	
19.	Force balance equation of ideal spring element.	-	F = Kx	
20.	Servomechanism	-	It is a feedback control system in which the output is mechanical position	
21.	Basic Elements Used For Modeling Mechanical Translational System	-	Mass, spring and dashpot	
22.	Basic elements used for modeling mechanical rotational system	-	Moment of inertia, dashpot with rotational frictional coefficient torsion spring with stiffness	
23.	Thermal capacitance	-	The ratio of change in heat stored and change in temperature	
24.	Synchros	-	Convert an angular motion to an electrical signal	
25.	Motor	-	convert electrical energy into mechanical energy	
UNIT-2 TIME RESPONSE ANALYSIS				
26.	Generator	-	convert the mechanical energy to electrical energy	
27.	Types of Electrical Analogous For Mechanical System	-	Force voltage and force current analogy	
28.	Thermal resistance	-	The ratio of change in temperature and change in heat flow rate	
29.	Transient response	-	When the system changes from one state to another.	
30.	Steady state response	-	Response of the system when it approaches infinity.	
31.	Order of a system	-	It is the order of the differential 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	
34.	Delay time	-	The time taken for response to reach 50% of final value for the very first time	
35.	Rise time	-	The time taken for response to raise from 0% to 100% for the very first time	
36.	Peak time	-	The time taken for the response to reach the peak value for the first time	

37.	Peak overshoot	-	Ratio of maximum peak value measured from the maximum value to final value.	
38.	Settling 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 controllers	-	i.Proportional controller ii. PI controller iii. PD controller iv. PID controller	
41.	Proportional controller (P)	-	Produces a control signal which is proportional to the input error signal	
42.	PI controller	-	Produces a control signal consisting of two terms - one proportional to error signal and the other proportional to the integral of error signal.	
43.	PD controller	-	Produces a control signal consisting of two terms - one proportional to 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	-	The motors used in automatic control systems or in servomechanism	
49.	Tachogenerator	-	Produces an output voltage proportional to its shaft speed	
50.	Centroid	-	The meeting point of the asymptotes with real axis	
UNIT-3 FREQUENCY RESPONSE ANALYSIS				
51.	Dominant pole	-	Pair of complex conjugate pair	
52.	Dominant zeros	-	Located near the imaginary axis	
53.	Frequency response	-	When the input to the system is a sinusoidal signal.	
54.	Different frequency domain specifications	-	i. Resonant peak. ii. Resonant frequency, Bandwidth, Cut-off rate, Gain margin, Phase margin	
55.	Frequency domain plots	-	Polar plot, Bode plot, Nichols plot, M & N circles	
56.	Resonant Peak	-	The maximum value of the magnitude of closed loop transfer function	
57.	Resonant frequency	-	The frequency at which resonant peak occurs	

58.	Bandwidth	-	the range of frequencies for which the system gain is more than 3 dB	
59.	Cut off rate.	-	The slope of the log-magnitude curve 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 system unstable	
62.	Gain margin formula.	-	Gain margin kg = 1 / ΔG(jΔpc)Δ.	
63.	Bode plot	-	It is the frequency response plot of the transfer function of a system.	
64.	Magnitude plot	-	Plot between magnitude in db and log ω for various values of ω.	
65.	Phase plot	-	Plot between phase in degrees and logω for various values of ω.	
66.	Corner frequency	ω_c	The frequency at which the two asymptotic meet in a magnitude plot	
67.	Phase lag	-	A negative phase angle	
68.	phase lead	-	A positive phase angle	
69.	M circles	-	The magnitude of closed loop transfer function with unit feedback can be shown for every value of M.	
70.	N circles	-	The phase of closed loop transfer function with unity feedback can be shown in the form of circles for every value of N	
71.	Nichols chart	-	The chart consisting if M & N loci in the log magnitude versus phase diagram	
72.	Polar plot	-	It is a plot of the magnitude of G(jω) Vs the phase of G(jω) on polar co-ordinates	
73.	Minimum phase system		All poles and zeros will lie on the left half of s-plane	
74.	All pass systems	-	The magnitude is unity at all frequencies	
75.	Non-minimum phase transfer function	-	A transfer function, which has one or more zeros in the right half s – plane	
UNIT-4 STABILITY ANALYSIS & CLASSICAL CONTROL DESIGNTECHNIQUES				
76.	Advantages of Nichols chart	-	To find closed loop frequency response from open loop frequency response.	
77.	Auxiliary polynomial	-	The row of polynomial which is just above the row containing the zeroes	
78.	Asymptotic stability	-	In the absence of the input, the output tends towards zero irrespective of initial conditions.	
79.	Compensator	-	A device inserted into the system for the purpose of satisfying the specifications	
80.	Types of compensators	-	i. Lag compensator ii. Lead compensator iii. Lag-Lead	

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

PLACEMENT TERMINOLOGIES				
126.	Sampling	-	analog signals are sampled at predetermined intervalsto convert into discrete time signals	
127.	Test for controllability and observability	-	Gilbert's test Kaman's test	
128.	State diagram	-	Pictorial representation of the state model of the system	
129.	Mass	M	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 difference for a change in gas flow rate	ohm
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	

Faculty Prepared	Mr.R.Manikandan, Asst. Prof-EEE Mr.M.Dineshkumar,Asst. Prof-EEE Mr.S.Sandhiya,Asst. Prof-EEE	

		Signature

HOD