MUTHAYAMMAL ENGINEERING COLLEGE

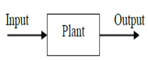
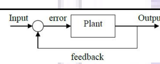
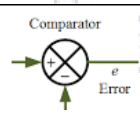
(An Autonomous Institution)

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

MKC

MUST KNOW CONCEPTS

EEE **2021-2022**

Subject		**19EEC06 – CONTROL SYSTEMS**		
Sl. No	**Term**	**Notation (Symbol)**	**Concept/Definition/Meaning/Units/Equation/Expression**	**Units**
UNIT-I : SYSTEMS AND THEIR REPRESENTATION				
1.	Systems		When a number of elements are connected in a sequence to perform a specific function.	
2.	Control system		When the output quantity is controlled by varying the input quantity.	
3.	Reference input		A signal supplied to the control system which represents the desired value of the controlled output.	
4.	Open loop control system		The output is not feedback to the input for correction.	
5.	Closed loop control system.		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.	Comparator		The difference between the - desired (reference) input and the actual measured output.	
8.	Controller		A device (or human or human being) which adjusts the control signals according to a set of predetermined rules.	
9.	Control signal		It is the output of the controller that will be used to bring the output of the system as close to the desired value as possible.	
10.	Error	e	Error is the difference between the actual output and reference input which is fed into the controller to produce a control signal to reduce the error.	
11.	Sensors		The controlled output is measured by sensor. It is a device that measures a variable and converts it into a signal and is usually electrical.	
12.	Transfer function	C(S) / R(S)	Ratio of the Laplace transform of output to input with zero initial conditions.	

13.	Block Diagram		Pictorial representation of the functions performed by each component of the system and shows the flow of signals.	
14.	Signal flow graph		It represents a set of simultaneous algebraic equations.	
15.	Transmittance		It is the gain acquired by the signal when it travels from one node to another node in signal flow graph.	
16.	Sink		It is an output node in the signal flow graph and it has only incoming branches.	
17.	Source		Source is the input node in the signal flow graph and it has only outgoing branches.	
18.	Dash-pot		The friction existing in rotating mechanical system.	
19.	Non touching loop		The loops are said to be non-touching if they do not have common nodes.	
20.	Masons Gain formula	C(S) / R(S)	States that the overall gain of the system is T $= 1/\Delta \sum_{k=0}^{n} \Delta k P_k$	
21.	Force balance equation of an ideal mass element		$F = M\, d^2x / dt^2$	
22.	Force balance equation of ideal dashpot element.		$F = B\, dx / dt$	
23.	Servomechanism		It is a feedback control system in which the output is mechanical position.	
24.	Synchros		Used for the measurement of angular displacement.	
25.	Motor		Convert electrical energy into mechanical energy.	
UNIT-II : TIME RESPONSE ANALYSIS				
26.	Time Response		The output of control system for an input which varies with respect to time.	
27.	Time domain analysis		The response of a dynamic system to an input is expressed as a function of time.	
28.	Transient response		When the system changes from initial to final state.	
29.	Steady state response		Response of the system when time approaches infinity.	
30.	Standard Test Signals		These signals such as step, ramp, parabolic, impulse are used to analyse the performance of the control systems using time response of the output.	
31.	Order of a system		It is the maximum power of S in the denominator polynomial of the transfer function.	
32.	Type of a system		The number of poles located at the origin in the denominator polynomial of the transfer function.	

33.	Damping ratio	ε	Ratio of actual damping to critical damping.	
34.	Time domain specifications		i. Delay time ii. Rise time iii. Peak time iv. Peak overshoot	
35.	Delay time	T_d	The time taken for response to reach 50% of final value for the very first time.	
36.	Rise time	T_r	The time taken for response to raise from 0% to 100% for the very first time.	
37.	Peak time	T_p	The time taken for the response to reach the peak value for the first time.	
38.	Peak overshoot	M_P	Ratio of maximum peak value measured from the maximum value to final value.	
39.	Settling time	T_S	Time taken by the response to reach and stay within specified error.	
40.	Damped Oscillations	ω_d	Oscillations whose amplitude of the body reduces with time.	
41.	Undamped Oscillations	ω_d	Oscillations whose amplitude of the body remains same with time.	
42.	Proportional controller (P)		Produces a control signal which is proportional to the input error signal.	
43.	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.	
44.	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.	
45.	Steady state error		The value of error as time tends to infinity	
46.	Step signal		Value changes from zero to A at t= 0 and remains constant at A for t>0.	
47.	Ramp signal		Value increases linearly with time from an initial value of zero at t=0	
48.	Stepper motor		Transforms electrical pulses into equal increments of rotary shaft motion	
49.	Servomotor		The motors used in automatic control systems or in servomechanism	
50.	Tachogenerator		Produces an output voltage proportional to its shaft speed	
UNIT-III : 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-IV : STABILITY ANALYSIS & CLASSICAL CONTROL SYSTEM DESIGN TECHNIQUES				
76.	Stable		If all the roots of the characteristic equation exist on the left half of the s plane, then the system is stable.	
77.	Stability		A stable system produces a bounded output for a given bounded input.	
78.	Auxiliary polynomial		The row of polynomial which is just above the row containing the zeroes	
79.	Asymptotic stability		In the absence of the input, the output tends towards zero irrespective of initial conditions.	
80.	Compensator		A device inserted into the system for the purpose of satisfying the specifications	

81.	Types of compensators		i. Lag compensator ii. Lead compensator iii. Lag-Lead compensator.	
82.	Phase cross over		The frequency at which, the phase of open loop transfer functions	
83.	Impulse response		The input is given by inverse laplace transform of the system transfer function	
84.	Compensators		Any device which is inserted into the system for the purpose of satisfying the specification, this device is called compensator.	
85.	Lag Compensator		Produces a sinusoidal output having the phase lag when a sinusoidal input is applied.	
86.	Lead Compensator		Produces a sinusoidal output having phase lead when a sinusoidal input is applied.	
87.	Lag-Lead Compensator		Produces phase lag at one frequency region and phase lead at other frequency region.	
88.	Bode plot		It is a graph of the magnitude and phase of a transfer function as frequency varies.	
89.	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.	
90.	Types of compensation		i. Cascade or series compensation ii. Feedback compensa-ation or parallel compensation.	
91.	Nyquist contour		The contour that encloses entire right half of S plane.	
92.	Relative stability.		It is the degree of closeness of the system, it is an indication of degree of stability.	
93.	Root loci		The path taken by the roots of the open loop transfer function when the loop gain is varied from 0 to 1	
94.	Compensating networks		Lead network, Lag network and 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-V : 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 are 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	
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-time signal 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 a hold circuit	
125.	Sampler		The device used to perform sampling is called sampler	
PLACEMENT TERMINOLOGIES				
126.	Sampling		Analog signals are sampled at predetermined intervals to 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	
130.	Spring	K	Elastic deformation of the body	
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.	
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	
142.	Pneumatic capacitance		The ratio of change in gas stored for a change in gas pressure	
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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