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.

MUST KNOW CONCEPTS

MKC

MDE

2021-2022

Course Code & Course Name : 19MDC05 & Control System for Physiological Systems

Year/Sem : III/V

S.No.	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
			UNIT I : CONTROL SYSTEM MODELING	
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	B	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 $T = 1/\Delta \sum_{k=0}^{n} \Delta k P k$	-
17.	Force balance equation of an	-	$F = M\, d^2x / dt^2$	-

	ideal mass element			
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 II : 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.	ξ	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	t_d	The time taken for response to reach 50% of final value for the very first time	Secs
35.	Rise time	t_r	The time taken for response to raise from 0% to 100% for the very first time	Secs

36.	Peak time	t_p	The time taken for the response to reach the peak value for the first time	Secs
37.	Peak overshoot	-	Ratio of maximum peak value measured from the maximum value to final value.	-
38.	Settling time	t_s	Time taken by the response to reach and stay within specified error.	Secs
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)	P	Produces a control signal which is proportional to the input error signal	-
42.	PI controller	PI	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	PD	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 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	ωc	The frequency at which the two asymptotic meet in a magnitude plot	rad/sec
67.	Phase lag	-	A negative phase angle	Degree
68.	phase lead	-	A positive phase angle	Degree
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				
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	-	Denominator Polynomial of the Transfer Function	-
99.	Quadrantal symmetry	-	The roots respect to both real and imaginary axis	-
100.	Magnitude criterion	-	G(s)H(s)=1	-
UNIT V STATE VARIABLE ANALYSIS AND BIOMEDICAL APPLICATIONS				
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	-	Applicable to MIMO systems.	-

	analysis			
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.	sec
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 QUESTIONS		
126.	Sampling	-	analog signals are sampled at predetermined intervals to convert into discrete time signals	-
127.	Test for controllability and	-	• Gilbert's test • Kaman's test	-

	observability			
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	-

Name of the Faculty Prepared **Signature**

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HoD