END SEMESTER EXAMINATIONS (DECEMBER 2021/JANUARY 2022) - QUESTION PAPER - PART A (Copy)

COURSE CODE : ICE 4052
COURSE NAME : Nonlinear Control Systems
SEMESTER : VII
DATE OF EXAM : 24/12/2021
DURATION : 45 + 5 minutes

Instructions for Students:
(1) ANSWER ALL THE QUESTIONS.
(2) EACH QUESTION CARRIES 1 MARK.
(3) SELECT THE MOST APPROPRIATE ANSWER
(4) YOU ARE INSTRUCTED TO INFORM THE INVIGILATOR AFTER SUBMISSION OF THIS FORM IN THE CHAT SECTION.

* Required

* This form will record your name, please fill your name.

1

STUDENT NAME: *

2

REGISTRATION NUMBER: *

The value must be a number

3

Conditions of _____ are necessary and sufficient condition for the asymptotic stability of the system.
(1 Point)

- All of the above
- Sign definiteness
- Krasovaskii's method
- Variable gradient method

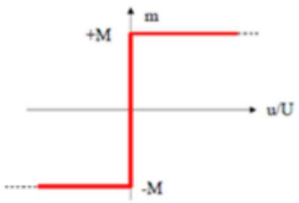
4

If G is the open-loop transfer function of the system and N is the describing function of a single nonlinearity in the forward path. Then the condition under which we would have sustained oscillations in the system will be:
(1 Point)

- G*N=1
- G*N=0
- G*N=-1
- G>=N

5

For the nonlinear characteristics shown as in below figure, what is the describing function?
(1 Point)



- M/Pi
- 2M/Pi
- 4M/Pi
- 3M/Pi

6

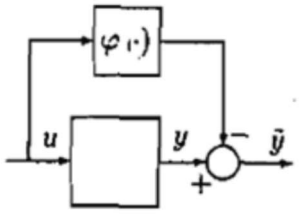
For state feedback stabilization of the system given below, which of the following condition is not necessary.
(1 Point)

$$\dot{x} = f(x, u)$$

- f(0,0)=0 in the domain D
- f(x,u) is continuously differentiable in domain D
- x=0 and u=0 is a part of the domain D
- Origin is not a part of the domain D

7

What is the type of passive system represented by the below figure?
(1 Point)



- Output-feedback passive
- Lossless passive
- Feedback passive
- Input-feedforward passive

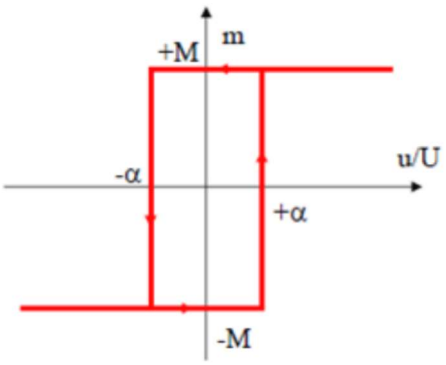
8

A nonlinear system produces an output, W as the cube of its input X. Assume the input to be a sinusoidal signal and nonlinear output has an odd function characteristic. The term b1 in the output W is _____.
(1 Point)

- 1
- 3A^2/4
- 0
- 3A^3/4

9

The relationship between input and output for a system is shown below. Identify the correct type of nonlinearity.
(1 Point)



- Relay with hysteresis
- Relay with saturation
- Hysteresis
- Backlash

10

Because of imperfection in the design of switching surface and delays sliding mode control suffers from _____.
(1 Point)

- Chattering
- Bifurcations
- Limit cycle
- Chaos

11

What is the condition for the system to become lossless?
(1 Point)

- if u^T y >=
- if u^T y >= 0
- if u^T y <=0
- if u^T y=0

12

A nonlinear system produces an output, W as the cube of its input X. Assume the input to be a sinusoidal signal and nonlinear output has an odd function characteristic. The describing function for the nonlinear component can be obtained as _____.
(1 Point)

- c. 4A^3/3
- 3A^2/4
- d. 4A^2/3
- 3A^3/4

13

For nonlinearities which are characterized as single valued, *N* is real and therefore the plot of -*1/N* will always lies on the _____.
(1 Point)

- First and second quadrant
- First quadrant
- Real axis
- Imaginary axis

14

In a stable control system backlash can cause which of the following?
(1 Point)

- Underdamping
- Poor stability at reduced values of open loop gain
- Low-level oscillations
- Overdamping

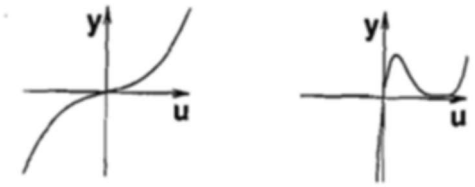
15

Which of the following is not considered to be a formulation of control problem?
(1 Point)

- Feedback linearization
- Tracking
- Stabilizing
- Disturbance rejection

16

Which of the following statement is correct with respect to the below figure?
(1 Point)



- Both are characteristics of non-passive resistor
- Both are characteristics of passive resistor
- Both are characteristics of nonlinear non-passive resistor
- Both are characteristics of nonlinear passive resistor

17

Which of the following is not a property of Lyapunov function?
(1 Point)

- It is a scalar function
- It is a unique function for a given system
- It is a positive definite, at least in the neighborhood of origin
- Its time derivative is non-positive

18

Which of the following control methods can ensure asymptotic regulation under all parameter perturbations that do not destroy the stability of the closed loop system?
(1 Point)

- Sliding control
- Gain scheduling control
- Lyapunov control
- Integral control

19

The describing function for a system with static non-linearity dependent only on _____.
(1 Point)

- Phase of the input sinusoidal signal.
- Polarity of the input sinusoidal signal.
- The amplitude of the input sinusoidal signal.
- Frequency of input sinusoidal signal

20

If the relative degree is coming out to be greater than the order of the system, which of the following statement is correct.
(1 Point)

- System would not be controllable
- Improper system
- System model is not valid
- System is unstable

21

Consider the following statements.

1. Nonlinear systems have unique equilibrium point
2. Describing function method is used for the prediction of limit cycles in nonlinear systems.
3. Describing function method is an approximated analysis.

Which of these statements are correct?
(1 Point)

- 2 and 3
- 1 and 2
- 1 and 3
- 1,2 and 3

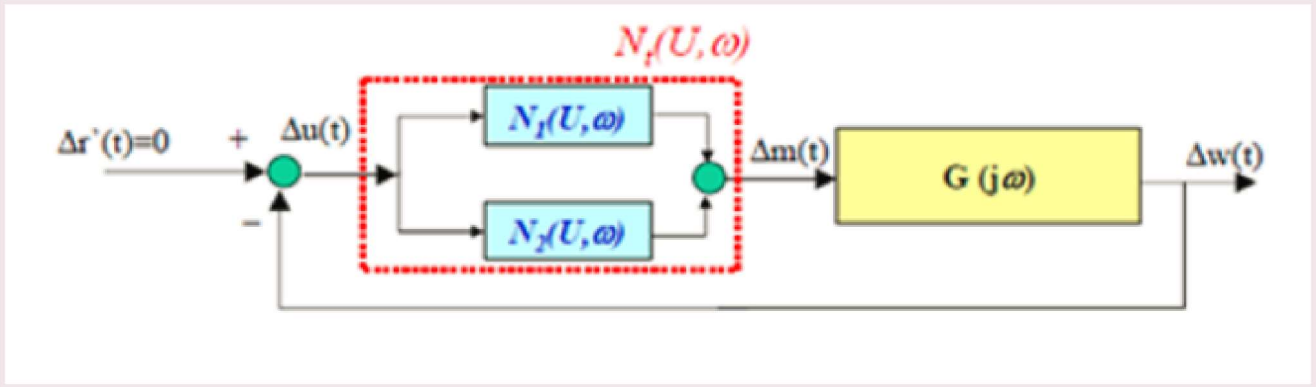
22

A nonlinear system produces an output, W as the cube of its input X. Assume the input to be a sinusoidal signal and nonlinear output has an odd function characteristic. The term a1 in the output W is _____.
(1 Point)

- 0
- 3A^3/4
- 1
- 3A^2/4

23

For the closed loop system shown below, the loop has to be rearranged in such a way that Nt=_____ in order to perform the describing function analysis.
(1 Point)



- N1*N2
- None of the above
- N1-N2
- N1+N2

24

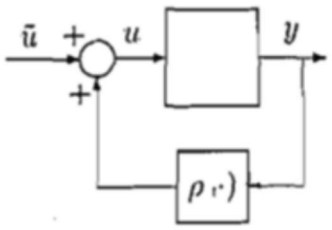
Which of the following statement is not completely correct with respect to limit cycle in nonlinear systems?
(1 Point)

- Causes wear and failure in mechanical systems
- Causes instability of the equilibrium point
- Causes loss of accuracy in regulation
- Causes the controller design to become complex

25

What is the type of passive system represented by the below figure?

(1 Point)



- Feedback passive
- Strictly passive
- Output-feedback passive
- Input-feedback passive

26

Which of the following control methods can extend the validity of the linearization approach to a range of operating points?
(1 Point)

- MRAC control
- Robust control
- Sliding control
- Gain scheduling control

27

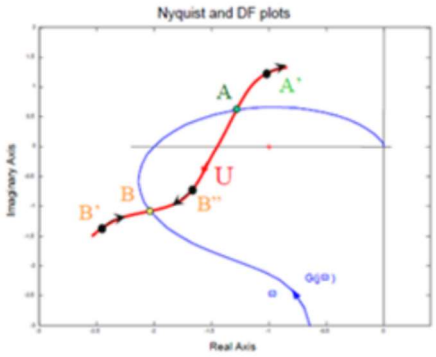
Which of the following statement is more suitable for the control law defined as? (1 Point)

$$u = \frac{1}{x_2 + 1}(v - f_1)$$

- The control law is not valid.
- The control law is uniformly defined
- The control law is defined everywhere, except at the singularity points.
- The control law is globally defined.

28

Analyze the given figure and select the FALSE statement for the given scenario.
(1 Point)



- Point B' is stable system
- Point B is a limit cycle
- Point B" is stable system
- Point A' is stable system

29

The state feedback stabilization problem for the system is the problem of designing a feedback control law such that the origin is _____.
(1 Point)

- Uniformly asymptotically stable
- All of the above
- Marginally stable
- Lyapunov stable

30

For the nonlinear system given below, the relative degree is _____.
(1 Point)

$$\begin{aligned}\dot{x}_1 &= -ax_1 + u \\ \dot{x}_2 &= -bx_2 + k - cx_1x_3 \\ \dot{x}_3 &= \theta x_1x_2 \\ y &= x_3.\end{aligned}$$

- 2
- 4
- 1
- 3

31

The points at which derivatives of all the state variables are zero are _____.
(1 Point)

- Initial condition
- Nonsingular points
- Singular points
- Origin

32

The part of the system dynamics which has been rendered unobservable in the input-output linearization is called as _____.
(1 Point)

- ◯ Internal dynamics
- ◯ Inverse dynamics
- ◯ Zero dynamics
- ◯ Uncontrollable state