BRAINWARE UNIVERSITY

Term End Examination 2022
Programme – M.Tech.-RA-2022
Course Name – Advanced Control System in Robotics
Course Code - PCC-MIRA102
(Semester I)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Neural networks can be used in different fields. such as -

a) Classification b) Data processing
c) Compression. d) All of the above

(ii) Which of the following is an indirect adaptive control method

a) Self-Tuning Regulator b) Model Reference Adaptive System
c) Gain Scheduling d) Dual control

(iii) A state space realisation is stabilisable if

a) Eigen values of A are stable b) Unstable Eigen values of A are real
c) Unstable Eigen values of A are controllable d) stable Eigen values of A are controllable

(iv) Lyapunov stability is valid for

a) Autonomous systems b) Non-autonomous system
c) Forced system d) Stable system

(v) A system is said to be completely observable, if

a) any of the state variables affects some output b) any of the state variables affects all the output
c) all the state variables affects all the outputs d) none of these

(vi) Feedback control system is basically _______________

a) Band pass filter b) Band stop filter
c) High pass filter d) Low pass filter

(vii) The given matrix is [4 -4 2;-4 5 -2;2 -2 1]

a) positive semidefinite b) negative semidefinite
c) positive definite d) negative definite

(viii) If A=[-0.5 0;0 2],B=[0;1],then

a) system is controllable b) system is uncontrollable

c) system is undefined

d) none

(ix) If A=[1 0;1 1] the e^At will be

a) [e^t 0;te^t e^t]

b) [0 e^t ; e^t te^t]

c) [e^t 0 ; e^t te^t]

d) [te^t 0 ; e^t e^t]

(x) Fuzzy logic is :

a) Used to respond to questions in a humanlike way

b) A new programming language used to program animation

c) The result of fuzzy thinking

d) A term that indicates logical values greater than one

(xi) V(x)=x1x2+x2^2 is

a) positive semidefinite

b) negative semidefinite

c) indefinite

d) negative definite

(xii) V(x)=x1^2+2x2^2

a) positive definite

b) negative definite

c) positive semidefinite

d) negetive semidefinite

(xiii) A major part of the automatic control theory applies to the:

a) Casual systems

b) Linear Time invariant systems

c) Time variant systems

d) Non-linear systems

(xiv) G(s)=K/(s+1)(s+1)(s^2+1)

a) A=[0 1 0 0;0 0 1 0;0 0 0 1;-2 -3 -2-2]

b) A=[0 1 0 0;0 0 1 0;0 0 0 1;-3 -3 -3 -2

c) A=[0 1 0 0;0 0 1 0;0 0 0 1;-2 -2 -3 -3

d) A=[0 1 0 0;0 0 1 0;0 0 0 1;-2 -3 -3 -3

(xv) A robot is a __________

a) Computer-controlled machine that mimics the motor activities of living things

b) Machine that thinks like a human

c) Machine that replaces a human by performing complex mental processing tasks

d) Type of virtual reality device that takes the place of humans in adventures

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Develop self tuning regulator (STR) with suitable block diagram. (3)
3. Establish the profile of membership function for a fuzzy set called "Tall men". Take your own values for different heights. (3)

4. Explain fuzzification and defuzzification method. (3)

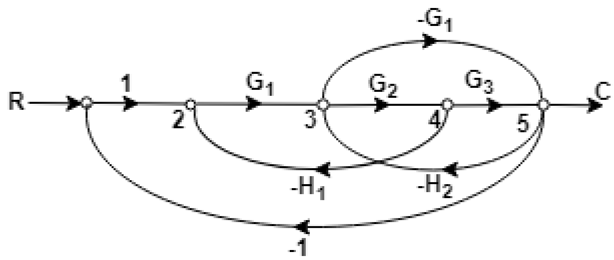
5. Find the stability of the system whose characteristic equation is given by (3)

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

6. Explain state, state variables, state vector and state space. Write down the advantage of state space techniques. (3)

OR

Identify the transfer function from SFG. (3)



Group-C

(Long Answer Type Questions) 5 x 6=30

7. Draw the Bode plot for the transfer function given below and find out gain margin, phase margin and stability of the system from the graph. (5)

$$G(s)=\frac{50}{s(1+0.25s)(1+0.1s)}$$

8. Using Nyquist Stability Criterion, determine whether the unity feedback closed-loop system having open-loop transfer function is stable or not. (5)

$$G(s)=\frac{1}{s(1+2s)(s+1)}$$

9. Consider the following matrix (5)

$$\dot{x}=\begin{bmatrix}0 & 1\\ -6 & -5\end{bmatrix} \text{and } x(0)=\begin{bmatrix}1\\ 0\end{bmatrix}$$

Evaluate the State Transition Matrix and also determine x(t).

10. Find the extremal trajectories for (5)

$$J(x)=\int_0^{t_1}(4t\dot{x}-3x^2)dt$$

in the following cases

$$t_1 = 1\,, x(0) = 1, x(t_1) = 2$$

11. Write down the properties of state transition matrix. State Controllability and observability. (5)
12. The differential equation that represents a system is given below. Obtain the block diagram representation of the state model. (5)

$$\frac{d^3y(t)}{dt^3}+6\frac{d^2y(t)}{dt^2}+11\frac{dy(t)}{dt}+6y(t)=r(t)$$

OR

Determine the state feedback gain matrix so that close loop poles of the following system are (5) located at -2, -5, & -6.

$$\dot{x}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -30 & -11\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u(t), y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}.$$

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