UNIT-V

1. A state variable is the smallest set of variables that completely describes the system's behavior.

A) True
B) False
C) Sometimes
D) Cannot be determined
Answer: A

2. The representation of a system using state variables is called:

A) Transfer Function Model
B) Frequency Response Model
C) State Space Model
D) Root Locus Model
Answer: C

3. The standard state equation is:

A) $y = mx + c$
B) $\dot{x} = Ax + Bu$
C) $H(s) = Y(s)/U(s)$
D) $x = Ay$
Answer: B

4. In the state equation $\dot{x} = Ax + Bu$, A is called the:

A) Input Matrix
B) Output Matrix
C) State Matrix
D) Feedforward Matrix
Answer: C

5. In the output equation $y = Cx + Du$, C is known as the:

A) State Matrix
B) Input Matrix
C) Output Matrix

D) Feedback Matrix
Answer: C

6. Diagonalization of a state matrix is possible when:

A) All eigenvalues are distinct and independent eigenvectors exist
B) Matrix is singular
C) Determinant is zero
D) Input is zero
Answer: A

7. The roots of the characteristic equation are called:

A) Zeros
B) Poles
C) Eigenvalues
D) Gains
Answer: C

8. The stability of a continuous-time system depends on:

A) Input only
B) Output only
C) Eigenvalues of A matrix
D) Initial conditions only
Answer: C

9. A continuous-time system is stable if all eigenvalues lie:

A) On the imaginary axis
B) In the right half-plane
C) In the left half-plane
D) At the origin
Answer: C

10. Controllability indicates whether:

A) Output can be measured
B) State variables can be driven to desired values
C) System is stable
D) Transfer function exists
Answer: B

11. Observability indicates whether:

A) States can be measured from outputs
B) Inputs are controllable
C) System is unstable
D) Poles can be shifted
Answer: A

12. The controllability matrix is formed using:

A) A and B matrices
B) A and C matrices
C) B and D matrices
D) C and D matrices
Answer: A

13. The observability matrix is formed using:

A) A and B matrices
B) A and C matrices
C) B and D matrices
D) A and D matrices
Answer: B

14. Pole placement is achieved using:

A) State feedback
B) Open-loop control
C) Frequency compensation only
D) Integral control only
Answer: A

15. State feedback control law is generally written as:

A) $u = Kx$
B) $u = -Kx$
C) $y = Kx$
D) $x = Ku$
Answer: B

16. A discrete-time system is described by:

A) Differential equations
B) Algebraic equations only
C) Difference equations
D) Integral equations
Answer: C

17. The discrete-time state equation is:

A) x(k+1) = Ax(k) + Bu(k)
B) $\dot{x} = Ax + Bu$
C) y = mx + c
D) H(s)=Y(s)/U(s)
Answer: A

18. For a discrete-time system to be stable, all eigenvalues must lie:

A) Outside the unit circle
B) On the unit circle
C) Inside the unit circle
D) At the origin only
Answer: C

19. The z-plane is used in the analysis of:

A) Continuous-time systems
B) Mechanical systems only
C) Discrete-time systems
D) Analog circuits only
Answer: C

20. Which method is commonly used to solve state equations?

A) Matrix Exponential Method
B) Newton-Raphson Method
C) Simpson's Rule
D) Gauss Elimination Only
Answer: A

Fill in the Blanks

1. The mathematical representation using state variables is called the **state space model**.
2. The state equation of a linear system is written as $\dot{\mathbf{x}} = \mathbf{Ax} + \mathbf{Bu}$.
3. In the state equation, matrix **A** is called the state matrix.
4. The output equation is given by $\mathbf{y} = \mathbf{Cx} + \mathbf{Du}$.
5. The process of converting a matrix into diagonal form is called **diagonalization**.
6. The roots of the characteristic equation are known as **eigenvalues**.

7. Stability of a continuous-time system depends on the location of **eigenvalues**.
8. A continuous-time system is stable if all eigenvalues lie in the **left half-plane**.
9. The ability to drive system states to desired values is called **controllability**.
10. The ability to determine system states from outputs is called **observability**.
11. The controllability matrix is formed using matrices **A** and **B**.
12. The observability matrix is formed using matrices **A** and **C**.
13. Pole placement is achieved through **state feedback**.
14. A common state feedback law is $\mathbf{u = -Kx}$.
15. Discrete-time systems are described by **difference equations**.
16. The discrete-time state equation is $\mathbf{x(k+1) = Ax(k) + Bu(k)}$.
17. The variable **k** represents the discrete-time index.
18. Stability of a discrete-time system requires all eigenvalues to lie inside the **unit circle**.
19. The **z-plane** is used for discrete-time system analysis.
20. The matrix exponential **eAt** is used in the solution of continuous-time state equations.