

Advanced Robotics Principles

Robotics · Answer Key · 25 Questions

1. In a robotic arm, what is the primary function of a Denavit-Hartenberg (D-H) parameter set?

- A) To calculate motor torque efficiency
- B) To describe the geometric relationship between adjacent links**
- C) To calibrate the tactile sensor feedback loop
- D) To determine the maximum electrical power consumption

2. Which control loop architecture calculates the error as the difference between the setpoint and the measured process variable?

- A) Open-loop control
- B) Feed-forward control
- C) PID control**
- D) Bang-bang control

3. What is the purpose of the 'Jacobian matrix' in robotic manipulator kinematics?

- A) To map joint velocities to end-effector velocities**
- B) To determine the material fatigue of the robotic chassis
- C) To optimize the wireless signal transmission frequency
- D) To store the memory addresses of the firmware

4. In sensor technology, what physical phenomenon does an LVDT (Linear Variable Differential Transformer) measure?

- A) Light intensity
- B) Displacement**
- C) Atmospheric pressure
- D) Chemical composition

5. Which type of motor is most commonly used in robotics for high-precision positioning where the rotation is divided into individual steps?

- A) Brushed DC motor
- B) Induction motor
- C) Stepper motor**
- D) Universal motor

6. What is the term for the set of all possible positions and orientations an end-effector can reach?

A) Configuration space

B) Workspace

C) Singularity point

D) Joint limit zone

7. In inverse kinematics, what is a 'singularity' in a robotic arm?

A) A configuration where the robot loses one or more degrees of freedom

B) The exact moment the battery power depletes

C) A state where the robot exceeds its maximum speed

D) The point where the robot reaches its maximum load capacity

8. Which communication protocol is most frequently used for intra-robot communication between microcontrollers and sensors due to its 'master-slave' I2C-like efficiency?

A) USB 3.0

B) RS-232

C) CAN bus

D) HDMI

9. What does the 'Degrees of Freedom' (DoF) of a robotic system represent?

A) The number of independent joints or axes of movement

B) The voltage range of the power supply

C) The number of lines of code in the software

D) The speed of the processor

10. In an H-bridge motor driver circuit, what is the primary purpose of the 'flyback' (or freewheeling) diodes?

A) To increase the current flow

B) To protect the circuit from voltage spikes when the motor stops

C) To convert DC to AC current

D) To measure the rotational speed

11. Which type of robot configuration is specifically defined by three prismatic joints aligned with Cartesian axes?

A) SCARA robot

B) Delta robot

C) Gantry robot

D) Articulated robot

12. What is the primary function of an encoder in a robotic joint?

- A) To convert electrical signals into physical heat
- B) To provide feedback on the position or speed of the motor**
- C) To increase the gear ratio of the transmission
- D) To act as a secondary power source

13. Which control strategy focuses on the response of the system based on the history (integral) and the rate of change (derivative) of the error?

- A) Proportional control
- B) PID control**
- C) On-Off control
- D) Logic gate control

14. What is the main advantage of a SCARA (Selective Compliance Assembly Robot Arm) robot design?

- A) High flexibility in all six directions
- B) Rigidity in the vertical axis while being compliant in horizontal planes**
- C) Ability to operate underwater
- D) Minimal requirement for electrical shielding

15. In computer vision for robotics, what is the 'Canny' algorithm primarily used for?

- A) Color correction
- B) Edge detection**
- C) Image compression
- D) Facial recognition

16. Which mechanical component is used to convert the high-speed, low-torque output of a motor into low-speed, high-torque motion?

- A) Transistor
- B) Gearbox**
- C) Potentiometer
- D) Capacitor

17. What does 'PWM' stand for in the context of robotic motor speed control?

- A) Pulse Width Modulation**
- B) Power Wave Modulation
- C) Phase Wire Measurement
- D) Proportional Weight Monitor

18. In robot path planning, what is the 'A*' (A-star) algorithm primarily designed to solve?

- A) Collision detection
- B) Shortest path finding**
- C) Motor heat dissipation
- D) Sensor calibration

19. Which type of sensor detects the presence of an object without physical contact by using an electromagnetic field?

- A) Limit switch
- B) Inductive proximity sensor**
- C) Force transducer
- D) Strain gauge

20. What occurs in a 'deadlock' state within a multi-robot system?

- A) Batteries are fully drained
- B) Each robot is waiting for another to perform an action, resulting in total inactivity**
- C) The sensors provide faulty data
- D) The communication frequency exceeds the threshold

21. What is the primary purpose of a 'Watchdog Timer' in a robot's embedded system?

- A) To record the time of operation
- B) To reset the system if the software hangs or freezes**
- C) To measure the battery discharge rate
- D) To act as a secondary CPU

22. Which law defines the relationship between force, mass, and acceleration, essential for calculating robot dynamics?

- A) Ohm's Law
- B) Newton's Second Law**
- C) Hooke's Law
- D) Kirchhoff's Law

23. What is a 'cobot' designed to do?

- A) Operate independently in space without human oversight
- B) Work collaboratively with humans in a shared workspace**
- C) Function solely in hazardous chemical environments
- D) Perform surgical tasks with zero human supervision

24. Which material is most commonly used for robotic structural links due to its high strength-to-weight ratio?

A) Lead

B) Aluminum alloy

C) Pure copper

D) Oak wood

25. In the context of robotic gripper design, what is 'under-actuation'?

A) A system with more actuators than joints

B) A system where there are fewer actuators than degrees of freedom

C) A system that requires no power to function

D) A system that relies entirely on magnetic adhesion