**Topic: Robotics**

Reading Time: 20 mins

**·        Note\* Highlight important/core points while reading**

·        Read the content and write the answers given in the document in your words, to get the solid grip on topic.

**What is Robotics?**

Robotics is the field of **engineering and computer science** that focuses on **designing, building, and programming robots** to perform various tasks. Robots are **automated machines** that can be controlled manually or work autonomously using **sensors, microprocessors, and actuators**. They are widely used in **factories, homes, warehouses, military applications, and entertainment**.

**Three Laws of Robotics**

The **Three Laws of Robotics**, created by science fiction writer **Isaac Asimov**, are basic ethical principles for robotic behavior:

1. **A robot may not injure a human being or, through inaction, allow a human being to come to harm.**
2. **A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law.**
3. **A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.**

These laws ensure that robots remain **safe, controlled, and beneficial** to humans.

**Applications of Robotics**

**1. Robotics in Factories**

Robots are used in **manufacturing and assembly lines** to improve efficiency and accuracy. Examples include:

·         **Welding parts together** – Robots use **high precision welding** to join metal parts in car production.

·         **Spray-painting panels** – Used in **automobile factories** to paint car exteriors evenly.

·         **Fitting windscreens** – Robots ensure **proper alignment and sealing** of car windshields.

·         **Cutting out metal parts** – CNC (Computer Numerical Control) robots cut metal with **high accuracy**.

·         **Bottling and labeling plants** – Robots **fill, cap, and label bottles** in food and pharmaceutical industries.

·         **Warehouse automation** – Robots **scan, pick, and transport** items efficiently.

**Example:** Amazon warehouses use robots to **find and move packages** automatically.

**2. Robotics in the Home**

Robots are becoming common in households for **automation and convenience**. Examples include:

·         **Autonomous floor sweepers** – Robot vacuums like **Roomba** clean floors automatically.

·         **Autonomous lawn mowers** – Robots cut grass **without human supervision**.

·         **Ironing robots** – Devices like **Dressman** press and **iron clothes** automatically.

·         **Pool cleaning robots** – Clean pools by removing **debris and algae**.

·         **Automatic window cleaners** – Use suction and sensors to **clean glass surfaces**.

·         **Entertainment robots** – **AI-powered companion robots** interact with humans for fun or emotional support.

**Example:** Sony’s **Aibo** is a robotic dog that interacts with owners using **AI technology**.

**3. Robotics in Drones**

Drones, also called **Unmanned Aerial Vehicles (UAVs)**, are used for various purposes:

·         **Reconnaissance** – Drones **capture aerial images** for military surveillance and disaster assessment.

·         **Parcel delivery** – Companies like **Amazon** use drones for **fast delivery of packages**.

·         **Agriculture** – Drones **spray pesticides and monitor crops**.

·         **Search and rescue** – UAVs help locate **missing persons** in remote areas.

·         **Disaster response** – Drones assess damage after earthquakes, floods, and fires.

**Example:** **DJI drones** are widely used for **photography, filmmaking, and mapping**.

**A-Rated Questions/Answers By Examiner**

**Q1: What is a robot?**

**Answer:** A robot is a **programmable machine** that can **perform tasks automatically** using **sensors, microprocessors, and actuators**. Robots can be controlled manually or work autonomously.

**Q2: State the Three Laws of Robotics.**

**Answer:**

1. A robot may not **harm a human** or allow harm to occur through inaction.
2. A robot must **follow human orders**, unless it conflicts with the First Law.
3. A robot must **protect itself**, unless this conflicts with the First or Second Law.

**Q3: Give two examples of how robots are used in factories.**

**Answer:**

1. **Welding metal parts** together in car manufacturing.
2. **Spray-painting panels** on vehicles to ensure even coverage.

**Q4: How are robots used in homes?**

**Answer:** In homes, robots are used for:

·         **Vacuuming floors** (robot vacuum cleaners).

·         **Cutting grass** (autonomous lawn mowers).

·         **Cleaning windows** (automatic window cleaners).

**Q5: What is a drone, and how is it used?**

**Answer:** A **drone (UAV)** is an **unmanned aerial vehicle** that can be **remotely controlled or fully autonomous**. Drones are used for:

·         **Military surveillance** (taking aerial photos).

·         **Parcel deliveries** (Amazon drone delivery).

·         **Search and rescue** (finding missing people).

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6. What are the main components of a robot, and what are their functions?**

**Q7. Explain how robots improve efficiency in warehouse automation.**

**Q8. What is an autonomous robot? Give an example.**

**Q9. Describe two ways drones are used in agriculture.**

**Q10. Identify one advantage and one disadvantage of using robots in manufacturing.**

**6. Answer:**A robot consists of the following key components:

1. **Sensors** – Detect environmental changes (e.g., cameras for vision, proximity sensors for obstacle detection).
2. **Microprocessor** – Acts as the robot’s "brain," processing data and making decisions.
3. **Actuators** – Convert electrical signals into physical movement (e.g., motors to move robotic arms).

**7. Answer:**Robots improve warehouse automation by:

* **Scanning and identifying packages** using barcode scanners and AI-powered vision systems.
* **Picking and transporting items** with robotic arms and conveyor systems.
* **Reducing human errors** in sorting, packaging, and inventory management.  
  Example: **Amazon’s warehouse robots** sort and transport parcels efficiently, reducing delivery times.

**8. Answer:**An **autonomous robot** is a machine that can perform tasks without human intervention by using AI, sensors, and microprocessors.  
Example: **A self-driving car** uses cameras, radar, and AI to navigate roads safely without a driver.

**9. Answer:**

1. **Crop Monitoring** – Drones take aerial images to analyze crop health and detect diseases.
2. **Pesticide Spraying** – Drones distribute pesticides evenly over large farmlands, reducing manual labor.

**10. Answer:**  
**Advantage:**

* Robots work **faster and more accurately** than humans, increasing productivity in factories.

**Disadvantage:**

* **High initial cost** – Purchasing and maintaining robots can be expensive for businesses.

## ****Topic: Characteristics of a Robot****

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**Characteristics of a Robot**

A **robot** is a **programmable machine** that can perform tasks **automatically** or under **human control**. Robots are used in **manufacturing, medicine, military, homes, and various industries**.

**1. Ability to Sense Their Surroundings**

* Robots use **sensors** (light, pressure, temperature, acoustic, infrared) to detect their environment.
* **Sensor data is sent to a microprocessor** for decision-making.

Sensors allow robots to:

* Recognize **size, shape, or weight** of objects.
* Detect **temperature** (hot or cold objects).
* Identify **obstacles** to avoid collisions.

**Example:** Self-driving cars use **cameras and LiDAR sensors** to detect pedestrians and obstacles.

**2. Have a Degree of Movement**

* Robots move using **wheels, cogs, pistons, gears, and motors**.
* They can **turn, twist, grip, lift, or move** objects.
* They use **mechanical structures** like **actuators and circuit boards**.

**End effectors** (special attachments) allow robots to:

* **Weld** (used in car manufacturing).
* **Spray** (painting in industries).
* **Cut** (precision cutting in factories).
* **Lift** (used in warehouses and construction).

**Example:** Robotic arms in car assembly **weld, paint, and fit** parts with accuracy.

**3. Programmable**

* Robots have a **controller (brain)** that processes **sensor data** and determines actions.
* Controllers are **programmable**, meaning robots can perform **specific tasks** automatically.

**Example:** Industrial robots are **pre-programmed** to assemble **products efficiently**.

**Robotics vs. Artificial Intelligence (AI)**

Many robots **do not have AI** because they perform **repetitive tasks** without needing **human-like intelligence**.  
AI allows robots to **learn and adapt**, making them **more flexible** in performing different tasks.

* **Example of non-AI robots:** Factory robots that **weld and paint** without learning new tasks.
* **Example of AI-powered robots:** **Self-driving cars** that **learn road conditions and improve driving decisions**.
* **Software Robots vs. Physical Robots**

**Software robots are not physical robots** but programs that perform **automated tasks**.  
Examples of software robots:

* **Web crawlers (search engine bots)** – scan and categorize websites.
* **Chatbots** – interact with users (e.g., customer support AI).
* **Physical robots are real-world machines** that perform **physical tasks**.
* **Independent vs. Dependent Robots**

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| --- | --- | --- |
| **Type** | **Description** | **Example** |
| **Independent Robots** | Work without human control (autonomous). | Self-driving cars, Mars Rover, robot vacuum cleaners. |
| **Dependent Robots** | Work with human interaction. | Robotic arms in car factories, remote-controlled drones. |

**A-Rated Questions/Answers By Examiner**

**Q1: How do robots sense their environment?**

**Answer:** Robots use **sensors** (light, pressure, temperature, acoustic, infrared) to detect objects, measure temperature, and avoid obstacles.

**Q2: What is the function of end effectors in robots?**

**Answer:** End effectors are **attachments** that allow robots to **weld, spray, cut, and lift** objects.

**Q3: How do independent robots differ from dependent robots?**

**Answer:**

* **Independent robots** work **autonomously** (e.g., self-driving cars).
* **Dependent robots** require **human control** (e.g., robotic arms in factories).

**Q4: Give two examples of software robots.**

**Answer:**

1. **Web Crawlers** – scan and categorize websites for search engines.
2. **Chatbots** – respond to users in online customer support.

**Q5: Why don’t all robots use AI?**

**Answer:** Many robots perform **repetitive tasks** that don’t require **learning or adaptation**, so they **do not need AI** (e.g., welding robots in car factories).

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6. Why do robots need sensors, and how do they help in decision-making?**

**Q7. What is the difference between physical robots and software robots?**

**Q8. How do actuators help robots move?**

**Q9. Explain the role of controllers in programmable robots.**

**Q10. What is the main difference between AI-powered robots and non-AI robots?**

**6. Answer:**Robots need sensors to **detect their environment** and make decisions based on the data collected.

* Sensors help robots **identify obstacles**, **measure temperature**, **recognize objects**, and **detect movement**.
* The sensor data is sent to a **microprocessor**, which processes it and determines the appropriate action.  
  **Example:** A self-driving car uses LiDAR sensors to detect pedestrians and avoid collisions.

**7. Answer:**

* **Physical robots** are **machines** that perform tasks in the real world (e.g., robotic arms in factories, self-driving cars).
* **Software robots** are **programs** that automate digital tasks (e.g., chatbots, web crawlers).

**8. Answer:**Actuators **convert electrical signals into physical movement** by controlling parts like wheels, gears, and motors.

* They allow robots to **lift, turn, grip, and push objects**.
* Actuators work with sensors and microprocessors to perform tasks.  
  **Example:** A robotic arm in a factory uses actuators to **assemble car parts**.

**9. Answer:**A **controller** acts as the **robot’s brain** by processing sensor data and determining actions.

* It is **programmable**, meaning instructions can be changed to perform specific tasks.

Some robots have **AI-powered controllers** that allow them to **learn and adapt**.  
**Example:** A robotic vacuum cleaner follows programmed cleaning paths based on sensor input.

**10. Answer:**

* **AI-powered robots** can **learn and adapt** to new situations (e.g., self-driving cars improve driving decisions over time).
* **Non-AI robots** perform **repetitive, pre-programmed tasks** without learning (e.g., industrial robots that weld or paint).

## ****Topic: The role of robots and their advantages and disadvantages****

Reading Time: 20 mins

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**The Role of Robots and Their Advantages & Disadvantages**

Robots are machines programmed to perform tasks with high precision and efficiency. They play a crucial role in various sectors, helping to automate processes, increase productivity, and reduce human effort in repetitive or hazardous jobs.

**1. Industry**

Robots are widely used in manufacturing industries for assembling, welding, painting, and quality control.

**Working**

* **Automated Assembly Lines:** Robots perform tasks like assembling car parts, circuit boards, and appliances with speed and accuracy.
* **Welding & Painting:** Industrial robots are used in car manufacturing plants to perform welding and spray painting.
* **Quality Inspection:** Robots use cameras and sensors to detect product defects.

**Advantages**

* Faster production and efficiency
* Reduces human errors and improves quality
* Can work in hazardous environments

**Disadvantages**

* High initial cost
* Job losses for human workers
* Requires maintenance and skilled workers for operation

**2. Transport**

Autonomous robots and AI-driven vehicles are transforming the transport industry.

**Working**

* **Autonomous Vehicles:** Self-driving cars use sensors, cameras, and AI to navigate roads.
* **Drones:** Used for delivery services and monitoring traffic.
* **Robotic Traffic Control:** AI-powered robots help manage traffic in busy cities.

**Advantages**

* Reduces human driving errors
* Improves efficiency in goods transport
* Can operate in dangerous environments

**Disadvantages**

* Expensive technology
* Cybersecurity risks (hacking)
* Ethical concerns about AI decision-making

**3. Agriculture**

Robots in agriculture help automate tasks like planting, harvesting, and irrigation.

**Working**

* **Autonomous Tractors & Harvesters:** Robots plow fields and harvest crops.
* **Drones for Monitoring:** Drones scan large farms to check crop health.
* **Automated Irrigation:** AI-powered systems optimize water usage.

**Advantages**

* Increases food production
* Reduces labor costs
* Efficient use of water and fertilizers

**Disadvantages**

* High cost of robots and maintenance
* Not affordable for small-scale farmers
* Requires training to operate

**4. Medicine**

Robots assist in surgeries, rehabilitation, and patient care.

**Working**

* **Surgical Robots:** Perform precise operations like heart or brain surgery.
* **Rehabilitation Robots:** Help disabled patients regain movement.
* **Hospital Assistance:** Robots deliver medicine and assist nurses.

**Advantages**

* More accurate surgeries
* Reduces workload on doctors and nurses
* Can operate in remote areas using telemedicine

**Disadvantages**

* Expensive technology
* Technical failures can be dangerous
* Lacks human empathy in patient care

**5. Domestic (Home) Use**

Robots are used for cleaning, security, and personal assistance.

**Working**

* **Cleaning Robots:** Vacuum cleaners like Roomba clean floors autonomously.
* **Smart Assistants:** AI devices like Alexa control smart homes.
* **Security Robots:** AI-powered cameras detect intruders.

**Advantages**

* Saves time and effort
* Improves home security
* Assists elderly or disabled individuals

**Disadvantages**

* Expensive for some households
* Privacy concerns (AI devices recording data)
* May not fully replace human effort

**6. Entertainment**

Robots are used in movies, gaming, and theme parks.

**Working**

* **AI Game Characters:** Smart robots in video games create realistic experiences.
* **Animatronics:** Robots in theme parks entertain visitors.
* **Social Robots:** Humanoid robots interact with people in exhibitions.

**Advantages**

* Creates new entertainment experiences
* Enhances video game AI
* Reduces costs in film production (robotic CGI)

**Disadvantages**

* Can replace human performers
* Ethical concerns about AI-generated media

Expensive technology

|  |  |  |
| --- | --- | --- |
| **Type** | **Description** | **Example** |
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**A-Rated Questions/Answers By Examiner**

**Q1. What are two advantages of using robots in industry?**

**Answer:**

1. Robots improve production speed and efficiency by performing tasks without fatigue.
2. They reduce human errors, ensuring better quality control.

**Q2. How do robots contribute to the medical field?**

**Answer:**Robots assist in surgeries by increasing precision, help in patient rehabilitation, and automate hospital tasks like delivering medicine.

**Q3. What is a disadvantage of using robots in agriculture?**

**Answer:**One disadvantage is that robots are expensive to buy and maintain, making them less accessible to small-scale farmers.

**Q4. Name one way robots are used in transport and explain how it works.**

**Answer:**Self-driving cars use sensors, cameras, and AI algorithms to navigate roads and avoid obstacles without human intervention.

**Q5. How can domestic robots improve everyday life?**

**Answer:**Domestic robots, such as robotic vacuum cleaners and smart assistants, save time by performing household chores and providing security.

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6. Why are robots widely used in industry?**

**Q7. What is one major disadvantage of using robots in medicine?**

**Q8. Explain how robots help in agriculture.**

**Q9. How do robots enhance home security?**

**Q10. What is one ethical concern related to AI in entertainment?**

**6. Answer:**Robots are used in industry because they **increase efficiency, reduce human error, and perform repetitive tasks with high precision**.

* They are used in **automated assembly lines**, **welding**, **painting**, and **quality inspection**.
* They **work faster** and **can operate in hazardous environments** where humans cannot.

**7. Answer:**One major disadvantage is that **medical robots are expensive**, making them difficult for smaller hospitals to afford.

* Additionally, **technical failures** in surgical robots **can be dangerous** to patients.

**8. Answer:**Robots improve farming by **automating tasks** such as:

* **Autonomous tractors & harvesters** – Plow fields and collect crops efficiently.
* **Drones** – Scan fields to monitor crop health.
* **Automated irrigation** – Uses AI to control water and fertilizer use.  
  This helps **increase food production** and **reduce labor costs**.

**9. Answer:**

* **AI-powered cameras** detect intruders and send alerts.
* **Smart assistants** control smart locks and monitor security systems.
* **Security robots** patrol homes and recognize suspicious activity.

This improves **safety and peace of mind** for homeowners.

**10. Answer:**One ethical concern is that **AI-generated media** and **robotic performers** may **replace human actors and artists**, leading to job losses.

* AI can **create realistic digital characters**, which may reduce opportunities for real performers in movies and games.