

1. New Age Robotic Systems



Task (Page 34)

Nanobots, at 1 to 100 nanometres, are tiny machines with immense potential in healthcare. They excel in targeted drug delivery, minimizing side effects and enhancing treatment efficacy. Equipped with sensors, nanobots aid early disease detection, improving treatment outcomes. They can perform minimally invasive surgeries at the cellular level, offering precision and less invasiveness. Nanobots also enable continuous monitoring of vital signs, providing real-time data to healthcare professionals. However, ethical considerations, biocompatibility, and privacy concerns must be addressed. Overall, nanobots have the potential to revolutionize healthcare by offering precise diagnostics, targeted treatments, and minimally invasive interventions.



Task (Page 36)

Accept all relevant answers.



Reboot (Page 37)

1. A smart ecosystem refers to an interconnected network of various devices, systems, and entities that work together to create an intelligent and efficient environment. It involves the integration of technology, data, and connectivity to improve the quality of life, enhance sustainability, and optimise resource utilisation.
2. The essential components of a smart ecosystem are:
 - Smart Infrastructure
 - Internet of Things (IoT) Devices
 - Data Analytics and Artificial Intelligence (AI)
 - Integration and Interoperability
 - Sustainability and Resource Optimization
 - Enhanced Quality of Life
 - Collaboration and Stakeholder Engagement



Exercise



Unsolved Questions

SECTION A (Objective Type Questions)

Quiz

- A.** 1. d 2. d 3. a 4. d 5. c
- B.** 1. Driver-assisted cars 2. Weed control robots
3. Rehabilitation Robots 4. Data analytics, AI technologies
5. Autonomous Drones
- C.** 1. False 2. True 3. True 4. False 5. True

SECTION B (Subjective Type Questions)

- A.** 1. New Age Robotic Systems can create engaging and interactive learning environments. They can act as educational aids, answer students' questions, demonstrate concepts through practical examples, and promote critical thinking and problem-solving skills.
2. The components to illustrate the functioning of NARS are:
- i. Term Logic
 - ii. Attention Allocation
 - iii. Inference and Judgment
 - iv. Learning and Anticipation
3. While New Age Robotic Systems have the potential to assist and enhance the learning experience, it's unlikely that they can completely replace human teachers. Human teachers bring unique qualities such as empathy, emotional intelligence, adaptability, and the ability to understand and respond to individual student needs. Robotic systems can play a supportive role by providing additional resources, personalized learning experiences, and automation of certain tasks, but the social and emotional aspects of education are crucial and are best addressed by human educators.
4. Students interested in working with New Age Robotic Systems can pursue various paths:
- a. **Educational Programs:** Enroll in academic programs or courses related to robotics, artificial intelligence, or computer science.
 - b. **Extracurricular Activities:** Join robotics clubs, coding competitions, or other extracurricular activities that involve working with technology.
 - c. **Internships and Research Opportunities:** Seek internships or research positions with organizations and institutions that focus on robotics and AI.
 - d. **Self-learning:** Utilize online resources, tutorials, and platforms to learn programming languages, robotics, and AI concepts independently.



5. Engaging with New Age Robotic Systems can help students develop a variety of valuable skills:
 - a. **Programming Skills:** Learning how to code and program robots or AI systems is a fundamental skill in this field.
 - b. **Problem Solving:** Working with robotics often involves overcoming technical challenges and solving problems creatively.
 - c. **Critical Thinking:** Understanding how robotic systems operate and making decisions based on their outputs fosters critical thinking skills.
 - d. **Collaboration:** Many robotics projects require collaboration, teaching students how to work effectively in a team.
 - e. **Adaptability:** The field of robotics is dynamic, and students will learn to adapt to new technologies and advancements.
 - f. **Creativity:** Designing and implementing robotic solutions often involve creative thinking and innovation.
 - g. **Ethical Considerations:** Working with AI and robotics raises ethical questions, and students can develop an understanding of the ethical implications of technology.
 6. Autonomous drones have applications in various sectors, including film and media for aerial photography, agriculture for crop monitoring, and delivery services for last-mile transportation, ground forces for battle support.
 7. Telepresence robots enable remote patient monitoring, consultation, and healthcare delivery. These robots consist of a mobile base with a screen, camera, and microphone. Healthcare professionals can remotely operate these robots to interact with patients, conduct check-ups, and provide consultations.
 8. A smart ecosystem typically consists of multiple components, including smart infrastructure, Internet of Things (IoT) devices, data analytics, and intelligent systems.
 9. The key features of smart homes that make them increasingly popular and desirable are:
 - i. Connectivity and Control
 - ii. Home Automation
 - iii. Energy Efficiency
 - iv. Enhanced Security
 - v. Convenience and Comfort
 - vi. Home Monitoring and Safety
 - vii. Integration and Compatibility
 10. Agricultural robots or Agribots are designed to automate tasks such as planting, harvesting, monitoring crop health, and precision spraying.
- B.** 1. Crop monitoring robots equipped with various sensors, including cameras, spectrometers, and multispectral imaging systems, assess crop health, detect diseases, and monitor growth



patterns. They capture high-resolution data, enabling farmers to make informed decisions regarding irrigation, fertilization, and pest control. Spraying robots utilize this data to perform targeted and precise spraying of fertilizers, pesticides, or herbicides, minimizing chemical usage and improving cost-effectiveness.

2. Pharmacy robots can be used to accurately sort, package, and label medications. It also reduces the chances of errors and improves efficiency. They can handle high volumes of prescriptions, track inventory, and ensure the right medication is delivered to the right patient at the right time.
3. Robotics has brought significant advancements to the field of medicine and healthcare, offering a wide array of benefits:
 - **Improved Surgical Outcomes:** The precision and enhanced visualization provided by surgical robotics systems result in improved surgical outcomes, such as reduced complications, shorter hospital stays, and faster recovery times for patients.
 - **Increased Surgical Capabilities:** Robotic systems expand the surgical capabilities of healthcare professionals. Surgeons can perform complex procedures with greater ease and precision, reaching anatomical areas that may be challenging to access with traditional surgical approaches.
 - **Reduced Trauma and Pain:** Minimally invasive robotic procedures result in smaller incisions, reduced tissue damage, and less postoperative pain compared to open surgeries. Patients experience faster healing and can return to their normal activities more quickly.
 - **Remote Access to Expertise:** Robotic systems enable teleoperation and remote surgery, allowing surgeons to provide specialized care to patients in remote or underserved areas. Patients can benefit from expert medical opinions and procedures without the need to travel long distances.
 - **Training and Education:** Surgical robotics systems provide a valuable platform for training and education. Surgeons can practice complex procedures in a controlled environment, enhancing their skills and ensuring standardized training across different healthcare institutions.
4. Drones can play a crucial role in environmental monitoring and conservation efforts. They can autonomously survey and collect data on wildlife populations, monitor deforestation, assess the health of ecosystems, and track changes in land use patterns. Autonomous drones provide a cost-effective and efficient means of gathering environmental data over large areas.
5. The key components of NARS to illustrate its functioning are:
 - **Term Logic:** NARS employs a language-like formalism called term logic to represent knowledge. In term logic, statements are expressed using terms, which are composed of concepts and relations.



- **Attention Allocation:** NARS allocates attention to different statements or tasks based on their relevance and importance. The attention allocation process determines the level of processing resources dedicated to each task.
- **Inference and Judgment:** NARS performs both deductive and inductive reasoning to draw conclusions from the available knowledge. Deductive reasoning involves applying logical rules to derive new statements from existing ones. Inductive reasoning involves generalizing from specific instances to form more abstract knowledge. The system evaluates the plausibility of conclusions through a process called judgment, which assigns a degree of truth and reliability to each statement.
- **Learning and Anticipation:** NARS has a learning mechanism called “anticipation and update” that allows it to acquire new knowledge from experience. When faced with a novel situation, NARS generates anticipations or predictions about what might happen. If the actual outcome matches the anticipation, the system reinforces its beliefs. If the outcome contradicts the anticipation, the system updates its knowledge by revising or discarding certain statements.

C. Competency-based/Application-based questions:

1. c. The robot adjusts irrigation and shading based on real-time data, optimising plant care.

Deep Thinking (Page 46)

Do yourself.



Lab Activity

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Do yourself.



Class Activity

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Do Yourself

2. From Robots to Cobots



Task (Page 48)

Vyommitra is an Indian humanoid robot developed by the Indian Space Research Organisation (ISRO). The name “Vyommitra” translates to “Space Friend” in English. It was designed to simulate human functions and interact with astronauts during space missions. Vyommitra was planned to be deployed on India’s Gaganyaan mission, which aims to send Indian astronauts into space. The robot’s purpose includes conducting experiments, providing assistance to astronauts, and monitoring various parameters during the mission.





Task (Page 56)

Robotic surgery, also called robot-assisted surgery, allows doctors to perform many types of complex procedures with more precision, flexibility and control than is possible with conventional techniques. Robotic surgery is usually associated with minimally invasive surgery—procedures performed through tiny incisions



Reboot (Page 57)

1. The first cobot was invented in 1996
2. Which country is the largest robot suppliers in the world?

(This question was printed incorrectly in the book. Please correct it in your textbook)

Ans. South Korea has the largest robot concentration of any country on the planet. There are around 631 robots for every ten-thousand employees in South Korea.

3. Dobot

Exercise



Unsolved Questions

SECTION A (Objective Type Questions)

Quiz

- A.** 1. a. 2. d. 3. c. 4. b. 5. d.
6. b. 7. c. 8. b.

9. (This question was printed incorrectly in the book. Please correct it in your textbook.)

Ques. What is the typical payload capacity of a cobot?

- a. 3-35 kg b. 1-10 kg
c. 10-35kg d. More than 100 kg

Ans. a. 3-35 kg

10. d.
11. Both machine learning and computer vision.
12. Robots are designed to resemble humans.
13. Sensors
14. Computing System.
15. Perception Systems

- B.** 1. Whiz 2. control systems 3. Controllers
4. Machines 5. Actuators



- C. . 1. True 2. False 3. True 4. True 5. True

Section B (Subjective Type Questions)

- A.**
1. Yes, Because a cobot, or collaborative robot, is a robot designed to work safely alongside humans in a shared workspace.
 2. Actuators are responsible for converting electrical or pneumatic signals into physical motion. They enable the robot to move its limbs or other mechanical parts. Examples of actuators include motors, servos, hydraulic systems, and pneumatic systems.
 3. The advantages of using Cobots in industries are:
 - i. **Safety:** Cobots are safe to work alongside humans with slow speeds and soft-stop technology.
 - ii. **Flexibility and Adaptability:** Cobots are lightweight, portable, and easily reconfigurable for diverse tasks and environments.
 - iii. **Ease of Programming:** Cobots have user-friendly interfaces and teach-by-demonstration methods simplify programming.
 - iv. **Enhanced Ergonomics:** Cobots have been designed with human ergonomics in mind, reducing strain on workers.
 - v. **Cost-effectiveness:** Cobots are typically less expensive than traditional robots, making them accessible for small businesses.
 - vi. **Collaboration:** Cobots are specifically designed for easy collaboration with humans, allowing direct interaction in tasks.
 4. Robots require a power source to operate. This can be a battery, fuel cell, or direct electrical connection.
 5. . The first cobot was invented in 1996 by J. Edward Colgate and Michael Peshkin.
- B.**
1. Robots have the ability to dynamically interact with their surroundings. While machines typically follow predefined responses to specific inputs, robots are equipped with sensors like cameras, depth sensors, force sensors, and tactile sensors. These sensors enable robots to detect and respond to various elements such as objects, people, or events within their environment. This enhanced perceptual capability allows robots to perform tasks like navigation, object manipulation, obstacle avoidance, and more sophisticated interactions with humans.
 2. The difference between cobots and traditional robots are as follows:

Application	Cobots	Traditional Robots
Education and learning about robotics	Good Fit: They reduce risk of injury, typically don't need guarding, and tend to have a shallow learning curve.	Mediocre Fit: More time consuming to learn, will require appropriate safety rated sensors and/or guarding higher risk of injury.

High speed work (e.g., case packing or pick and place)	Poor Fit: Lower speed will reduce cycle time and limit the benefits of automation for high-volume products.	Good Fit: These systems are designed to run at high continuous speeds.
Very high accuracy work (e.g., assembling micro circuit boards)	Mediocre Fit: Accuracy varies with cobot models, but in general it is harder to get very high accuracy in a cobot.	Good Fit: Traditional robots are about speed, payload and accuracy so finding one that meets the requirements is frequently much simpler.
High payload work (moving heavy parts)	Not possible with cobots: Cobots typically have a payload capacity between 3 and 35 kilograms.	Good Fit: Traditional robots have payload capacities up to the weight of a car, so payload is usually not a problem.
Force sensitive work	Good Fit: Some cobots have built in force control which can be integrated into the control loop without extra sensors.	Mediocre Fit: Traditional robots can have force control devices added between the tool flange and the end effector, but this is a separate unit and only gives force control at the tool.
Processes in which the robot is working close to a human	Good Fit: Safety and risk assessments must still be considered, but this is a distinguishing cobot feature.	Poor Fit: Not possible without safety systems (e.g., guarding and safety rated switches and sensors) in place.
Explosive environment (e.g., painting)	Not possible for cobots: Currently no explosive environment rated cobots.	Good Fit: Paint robots are readily available for this application.

3. There are various integrated components of Robots:

- **Power Supply:** Robots require a power source to operate. This can be a battery, fuel cell, or direct electrical connection.
- **Actuators:** Actuators are responsible for converting electrical or pneumatic signals into physical motion. They enable the robot to move its limbs or other mechanical parts. Examples of actuators include motors, servos, hydraulic systems, and pneumatic systems.
- **Sensors:** Sensors allow the robot to perceive and interact with its environment. They provide feedback on various physical properties such as position, orientation, proximity,

temperature, pressure, and more. Common types of sensors include cameras, ultrasonic sensors, infrared sensors, tactile sensors, and gyroscopes.

- **Controller / Control System:** The control system consists of hardware and software components that govern the robot's behavior and operations. It processes sensory information, makes decisions, and generates commands for the actuators. The control system can range from simple microcontrollers to complex artificial intelligence algorithms.
 - **Manipulators:** Manipulators are robotic arms or appendages designed to perform specific tasks. They are equipped with joints, linkages, and end-effectors to interact with objects or the environment.
 - **Communication Interface:** Robots often require a communication interface to interact with humans or other systems. This can include displays, buttons, touchscreens, speakers, microphones, and wireless communication modules.
4. The role of Companion Cobots is crucial due to the research findings that highlight the negative impacts of chronic loneliness on older adults, including effects on memory, physical well-being, mental health, and life expectancy. With a growing elderly population, the rise of nuclear families worldwide, longer life expectancies, and the increasing burden of chronic illnesses, Companion Cobots have the potential to provide companionship and alleviate the adverse effects of loneliness on seniors' overall well-being.

C. Competency-based/Application-based questions:

1. To adapt to the planet's environment, the robot's design should consider factors like extreme temperatures, low gravity, and surface conditions. It might need specialized wheels or legs for traction, protective shielding against radiation, and efficient power systems. Sensors for temperature, chemical analysis, and cameras for navigation would be crucial, along with tools for collecting and storing soil samples in the alien terrain.
2. Advantages include enhanced efficiency and speed in delivering goods. Drones can navigate traffic and reach remote or congested areas, significantly reducing delivery times. They also cut down on carbon emissions by optimizing routes and reducing the need for traditional vehicles. It also adds to the brand value of the company deploying these.

Deep Thinking (Page 64)

Do yourself



Lab Activity

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Do yourself



Class Activity

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Do Yourself



3. Components of Robots as A System



Reboot (Page 75)

1. Sun Gear
2. Ring Gear
3. Planetary gears provide several advantages, including high power density, high efficiency, and the ability to handle large torque loads. They also offer precise motion control, low backlash, and the potential for coaxial input and output shafts



Task (Page 92)

For task.....Accept all relevant answers.

Exercise



Unsolved Questions

SECTION A (Objective Type Questions)

Quiz

- A.** 1. a 2. c 3. c 4. d 5. c
6. d 7. a
- B.** 1. Sun Gear 2. GPS and LiDAR
3. Range and Proximity Detection
4. Actuators 5. rack, pinion. 6. Pneumatic rotary
- C.** 1. True 2. False 3. True 4. True 5. True

Section B (Subjective Type Questions)

- A.** 1. GPS is a widely used navigation sensor that utilizes a network of satellites to determine the position, velocity, and time synchronization of a receiver. GPS receivers calculate their position by receiving signals from multiple satellites and analyzing the time delays and positions of those satellites.
2. Infrared (IR) sensors use infrared light to detect the presence and proximity of objects. These sensors emit infrared light and measure the reflection or intensity of the light when it interacts with objects.
3. The various applications of actuators in the field of robotics are Robot Manipulation, Robot Mobility, Industrial Automation, Medical Robotics, Aerospace and Space Exploration, Autonomous Vehicles, Entertainment and Humanoid Robots, and Research and Education.



4. Linear actuators convert electrical, hydraulic, or pneumatic energy into linear motion. Linear actuators are commonly used in applications that require linear movement or positioning.
5. The hydraulic rotary joint allows the flow of hydraulic fluid to the actuator while maintaining a continuous connection.

B. 1. The fundamental functions of gears in mechanical systems are as follows:

- i. **Transmission:** Gears primarily transmit mechanical power from one component to another. They transfer rotational motion and torque from a driving shaft to a driven shaft, allowing the efficient transfer of energy within a system.
 - ii. **Speed Adjustment:** Gears adjust rotational speed between input and output shafts. By employing gears with different numbers of teeth, the speed can be increased or decreased, allowing the system to operate at desired speeds.
 - iii. **Torque Conversion:** Gears are instrumental in converting torque. Torque refers to the rotational force applied to an object. Gears with varying sizes can be combined to increase or decrease the torque output. This feature is crucial for adapting the system to different loads or requirements.
 - iv. **Directional Control:** Gears facilitate the change in the direction of rotational motion. By meshing gears at different angles, such as with bevel gears, the rotational force can be redirected by 90 degrees or to any desired angle. This allows for versatile movement and control in mechanical systems.
 - v. **Gear Reduction and Amplification:** Gears can reduce or amplify rotational speed and torque. This feature allows for adapting the system to specific requirements, such as achieving high torque for heavy lifting or high-speed rotation for fast movements.
 - vi. **Mechanical Advantage:** Gears provide a mechanical advantage by multiplying or magnifying the applied force. The output force can be increased or decreased by employing gears with different diameters relative to the input force. This feature is especially useful in applications requiring additional force to overcome resistance or perform heavy-duty tasks.
2. Contact-type sensors physically come into direct contact with objects or the environment to gather information. They measure parameters by sensing the physical interaction between the sensor and the object. The various examples of contact-type external sensors include tactile sensors, force/torque sensors, and contact probes. Whereas, Non-contact-type sensors do not require physical contact with objects or the environment. They gather information without direct interaction by utilizing different physical principles such as light, sound, or electromagnetic fields.

The various examples of non-contact-type external sensors include cameras, range finders, infrared sensors, and proximity sensors.

3. To link actuators to robotic wheels, several methods can be used based on the type of actuators. Here are some examples:
 - i. **DC Motor-Driven Wheels:** DC motors are frequently used to power wheels in robotics, particularly in mobile robots. By controlling the speed and direction of the motors on each wheel, the robot can achieve movement and navigate its environment. Differential drive and omnidirectional drive configurations are commonly implemented using DC motor-driven wheels.
 - ii. **Stepper Motor-Driven Wheels:** Stepper motors can also be utilized to drive wheels in robots. Stepper motors allow for precise position control and are commonly used in applications that require accurate and repeatable movement, such as robotic platforms used in laboratory settings or precision manufacturing.
 - iii. **Servo Motor-Driven Wheels:** Servo motors can be employed to drive wheels in robotic systems that require precise control over wheel motion. Servo motors offer accurate position feedback and are commonly used in robotic vehicles, drones, or robotic arms where precise movement is crucial.

D. Competency-based/Application-based questions:

- a. Deploying robots equipped with cameras and sensors to monitor traffic conditions and adjust signal timings.

Deep Thinking (Page 98)

Do yourself.



Lab Activity

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Do yourself.



Class Activity

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Do Yourself

4. Visualization, Design and Creation of Components



Task (Page 103)

Accept all relevant answers



Reboot (Page 106)

1. Computer Aided Design
2. Iteration may involve making adjustments to the CAD model and creating subsequent prototypes for further testing.



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Touchpad Robotics & Artificial Intelligence-X (Answer Key) (Ver.1.0)



IMPRINT 1

Exercise



Unsolved Questions

SECTION A (Objective Type Questions)

Quiz

- A.** 1. c 2. c 3. c 4. c 5. c
- B.** 1. CAD. 2. Revolute and Prismatic joints 3. Visualizing
4. performance and functionality. 5. projects
- C.** 1. True 2. False 3. True 4. True 5. False

Section B (Subjective Type Questions)

- A.** 1. The four formats that Tinkercad supports are STL, OBJ, GLTF, and SVG.
2. Computer-Aided Design (CAD) software helps design and create detailed 3D models of robot parts before they are manufactured or assembled.
3. Former Google engineer Kai Backman and Mikko Mononen founded Tinkercad with the intention of making 3D modeling, especially for physical item design, accessible to the general public.
4. The key applications of mechanical blocks in robotics are:
i. Robotic Arm Construction
ii. Mobile Robot Chassis
iii. Grippers and End Effectors
iv. Sensor Mounting and Integration
v. Educational Robotics
5. The combination of these joint types allows for a wide range of motion and flexibility in robotic and mechanical systems, making them highly adaptable for different applications.
- B.** 1. Tinkercad has a strong focus on education and is extensively used in schools and educational institutions. It offers a range of educational resources, tutorials, and projects that help students learn and practice design skills. This supports teaching about design, engineering, and 3D modeling in an interactive and engaging manner, making it a valuable tool for educators and learners alike.
2. The Revolute and Prismatic joints are essential for creating complex and versatile robotic systems and mechanical devices. Many robotic manipulators combine both types of joints to achieve various movements, such as picking up objects, painting, or assembling components on an assembly line. The combination of these joint types allows for a wide range of motion



and flexibility in robotic and mechanical systems, making them highly adaptable for different applications.

D. Competency-based/Application-based questions:

- c. Robot marathons and building robots with enhanced speed and endurance capabilities.

Deep Thinking (Page 110)

Do yourself.



Lab Activity

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Do yourself.



Class Activity

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Do Yourself

5. Integrating Robots as a System



Task (Page 117)

Accept all relevant answers



Reboot (Page 120)

1. Computer Aided Design Tools like Tinkercad can be used for designing Car chassis.
2. Foam Boards are used for constructing the prototype car so that it can be tested and refined without much wastage.
3.
 - Visualization and prototyping skills
 - Tinker Cad Application
 - Assembling, Data collection and analytical skills

Exercise



Unsolved Questions

SECTION A (Objective Type Questions)

Quiz

- A.** 1. d 2. d 3. d 4. d 5. d



- B.** 1. Prototyping 2. wires, connectors. 3. 3D design tool
 4. STL 5. Assembling and Testing
- C.** 1. False 2. False 3. False 4. True 5. True

Section B (Subjective Type Questions)

- A.** 1. Wheeled mobile robots are skilled at navigating disaster-stricken areas, in different terrains, utilizing their wheels for efficient movement. With their sensors and cameras, they can explore debris, locate survivors and transmit real time data to rescue teams.
2. Some popular IDEs for SBC coding include:
- Thonny:** Thonny is a free and open-source IDE for beginners. It is simple to use.
 - Visual Studio Code:** Visual Studio Code is a popular IDE that is used for various programming language. It has many features like code completion, syntax highlighting and debugging tools.
 - Eclipse:** It is powerful tool with large community of users and have wide range of extensions.
3. Some popular single board computers (SBC) are:
- Raspberry Pi:** It offers a range of models with varying capabilities. It is widely used for programming, electronic projects, learning to code, and even basic web browsing.
 - Arduino:** They are microcontrollers and is popular for creating interactive projects, robotics and home automation system.
 - BeagleBone:** BeagleBone boards provide a combination of microcontroller capabilities and Linux-based computing. They are useful for real-time processing and general purpose computing.
 - Odroid:** They are known for their performance with various operating systems. They are used for media centres, gaming and other multimedia applications.
4. Resources that are required for constructing the prototype race car are as follows:
 Foam board, hobby motors, wires, connectors, batteries, and switches. You should also have the appropriate tools such as pencil, scissors, rulers, and assistance for utility knives, and hot glue guns for construction.
- Software tool that is used for designing the car chassis is Tinkercad that helps us to dive into the world of Computer Aided Design. It is an online 3D design tool.
5. Following are the key components required for building a race car:
- Foam boards (for constructing the prototype car)
 - 3V-9V hobby motors
 - Wires and connectors (for electrical connections)
 - Batteries and battery holders
 - Switches



- Wheels
- Axles
- Straws (for axle holders)
- Pulleys
- Rubberbands (for drive belts)
- Optional Hop-Up Parts (assortment of wheels, better motors, bearings for axles, metal axles, etc)
- Stopwatches
- Various crafting materials (e.g., markers, stickers, tape) for branding and decorating the car
- Computer to access Tinkercad or Fusion 360 from the browser for designing the car chassis
- 3D printer or access to a 3D printing service to print the car chassis
- Tools (e.g., scissors, utility knife, ruler, wire cutters, hot glue, soldering iron) for construction and assembly

- B.** 1. Tinkercad offers a variety of tools and features within its workspace to facilitate 3D design and modeling. Here are some of the key tools you can find in Tinkercad alongwith the features they offer:
- Basic Shapes:** These are the building blocks of your design. Tinkercad offers a range of basic shapes like cubes, spheres, cylinders, cones, and more.
 - Shape Generators:** These tools allow you to create more complex shapes using customizable parameters. Examples include the Hole, Tube, and Roof generators.
 - Import:** You can import existing 3D models or SVG files into your Tinkercad workspace to incorporate them into your design.
 - Align:** This tool helps you align/position objects precisely within your design, ensuring everything fits together properly.
 - Group/Ungroup:** Grouping allows you to combine multiple shapes into a single object, while ungrouping allows you to separate them again.
 - Duplicate:** Easily create copies of objects within your design.
 - Mirror:** This tool allows you to create mirrored copies of objects, useful for achieving symmetry in your designs.
 - Ruler/Grid:** Helps you measure distances and align objects more accurately.
 - Workplane:** Tinkercad allows you to work on different planes within your design, making it easier to create complex shapes.
 - Text:** Add text to your designs using various fonts and sizes.

- k. **Color:** Apply colors to different parts of your design to enhance its visual appeal.
 - l. **Export:** Once you're done with your design, you can export it in various file formats for 3D printing or further editing in other software as an STL file.
 - m. **Navigation:** It helps to review the design from different angles.
2. Key steps that are involved in using Tinkercad for designing the car chassis
- a. Start by creating an account on Tinkercad if you haven't already done so. Once you're logged in, you'll be greeted with a blank canvas where you can start your design.
 - b. Use the basic shapes available in Tinkercad, such as boxes or cylinders, to create the main structure. Click on the desired shape, drag it onto the workplane, and resize it by dragging its handles.
 - c. Combine and manipulate the shapes to form the base of your car chassis. Use the alignment and grouping tools in Tinkercad to position and join the shapes together. Experiment with different configurations and dimensions to achieve the desired design.
 - d. Add additional features and details to your car chassis, such as cutouts for the motors, spaces for the axles, bearings, or any aerodynamic elements you want to incorporate.
 - e. As you design, consider the dimensions and compatibility of your car chassis with the existing components, such as the motors, wheels, and battery holder. Make sure there is enough space and proper alignment for these components to fit in the final assembly.
 - f. Once you are satisfied with your car chassis design, review it from different angles using the navigation tools in Tinkercad. Make any necessary adjustments or refinements to ensure a well-balanced and functional design. Keep in mind as you design that print time is a factor in the price of your car. The longer it takes to print, the budget will be more. Try to design it in a simple way so that it takes less print time.
 - g. When your car chassis design is complete, you can export it as an STL file, which is a standard file format for 3D printing. Save the STL file to your computer or a removable storage device, as you will need it for the next step of the project.
3. Wheeled mobile robots are skilled at navigating disaster-stricken areas, utilising their wheels for efficient movement. They are equipped with sensors and cameras. They can also explore debris, locate survivors, and transmit real-time data to rescue teams. These robots are versatile in traversing different terrains and making them valuable tools for identifying survivors and aiding in rescue efforts in unsafe environments.

Beyond their mobility, the capabilities of wheeled mobile robots extend to facilitating seamless communication. They can act as intermediaries between survivors and responders. These robots bridge gaps in language, geography, and urgency. They are offering reassurance and expediting the delivery of essential supplies. Their tireless efforts not only enhance the safety of both survivors and human rescue teams but also underscore the potential of robotics to revolutionise disaster response strategies and maximise the chances of successful outcomes in the face of adversity.

D. Competency-based/Application-based questions:

- a. Both the assertion and reasoning are true and the reasoning is the correct explanation of the assertion.

Deep Thinking (Page 126)

Do yourself.



Lab Activity

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Do yourself.



Class Activity

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Do Yourself