Task 3:

Electric motors are electrical machines which convert the electrical energy into mechanical energy and use the motor's magnetic field and electric current passed via a wire winding to generate the required force in the form of torque on the motor's shaft. The most common types of motors are described below:

Asynchronous AC motor:

AC Motors convert electrical energy to mechanical energy (rotational motion) by the interaction of magnetic fields and conductors. Also known as induction motors, it never rotates at synchronous speed so it is called asynchronous motor. It consists of a stator, stationary outer drum, and the rotor, the rotating inner portion attached to the motor shaft.

Synchronous AC motor:

The stator and rotor are one of the main components in such motors where the frequency of the supply current and the rotation of the shaft are synchronized. Its applications can be found in analog electric clocks, timers, etc where correct time is required.

Brushed DC motor:

DC motors use wound coils of wire to create a magnetic field. It consists of a brush system, commutator, winding, magnet, core plates, etc. The contact of brush and commutator helps in change of polarity that cause a rotational movement of the shaft.

Brushless DC motor:

Unlike the brushed DC motors, these don't have a mechanical commutator and brushes, instead the magnetic field of the stator is rotated by using electronic commutation. Three phase brushless motors are most commonly used.

Stepper motor:

A stepper motor is nothing but brushless DC which divides the rotation of shaft into a number of equal steps. There can be multiple stators and steps in order to achieve precision in rotor movement.

Servo motor:

Such motors are used to produce torque and velocity based on the received control signal. It consists of actuators (linear/rotary) that allows for control of angular or linear position

Task 2:

Manipulators:

da Vinci Surgical System:

https://www.youtube.com/watch?v=QksAVT0YMEo

It consists of a surgeon's console and a patient-side cart with three to four interactive robotic arms controlled from the console. It is enabled by the computer processors in the system which perform numerous safety checks for enhanced precision required in surgery.

Mobile robots:

Automated Guided Vehicles:
https://www.youtube.com/watch?v=y0mEYIBFOPM

Early versions of AGVs follow a visual line painted or embedded in the floor or ceiling or an electrical wire in the floor. With advancement of AI and computer vision the robots can easily move around avoiding anu obstacle in its path.

Aerial robots:

Northrop Grumman Bat

https://www.youtube.com/watch?v=bc6yCb5IfuQ

It is an unmanned aerial vehicle (UAV), commonly known as a drone. Pilot is not required for such robotic system and it can be controlled remotely via a computer interface. It is designed to have a lower than average visual and radar cross-section profile.

Underwater robots:

AUV A9 M

https://www.youtube.com/watch?v=kT-GsQ5ff2o

It is an autonomous underwater vehicle (AUV). Such robots travel underwater without requiring input from an operator. In case of AUV A9 M, its acoustic and magnetic signatures are minimized in order not to trigger any underwater mines when doing the mine warfare survey.

Soft robots:

Soft robotic fish:

https://www.youtube.com/watch?v=BSA_zb1ajes

Soft robotics mimics living organisms move and adapt to their surroundings. In case of robotic fish, each side of the fish's tail is bored through with a long, tightly undulating channel. Carbon dioxide released in the fish's abdomen causes the channel to inflate resulting in bending of the tail in the opposite direction.

Micro robots:

Cornell microscopic robots

https://www.youtube.com/watch?v=nNn4Lpd4uBM

These are micron-sized shape robots and have memory actuators that enable atomically thin two-dimensional materials to fold themselves into 3D configurations. They need a quick jolt of voltage for the material to bend and hold its shape, even after the voltage is removed.

Hybrid robots:

Bionic legs:

https://www.youtube.com/watch?v=kaFiwC1xh2Y&t=283s

It is a robotic system controlled by a computer consisting of both electronic and biological elements. When a person puts on their bionic limb and flexes the muscles above or below the limb, sensors will react to produce the appropriate movement. It basically work by detecting signals from the user's muscles.