Chapter 4 Review Questions Answer Key

1. Name at least three of the common ways we group industrial robots.

   A: The common groupings for industrial robots include power source, drive type, work envelope, and application.

2. Why is payload a characteristic we might use to further refine robots within a grouping?

   A: Payload is the amount of weight the robot can move and thus sets the limitations of the system.

3. What are the three main types of power sources used for industrial robotics?

   A: Electricity, hydraulic and pneumatic power.

4. What is a DC brush and what is the danger associated with this component?

   A: DC brushes are made of carbon and transfer the electricity from the power wires going into the motor to the rotating portions of the motor. Because they are in contact with the rotating portion of the motor, they do wear down over time and generate sparks that could become an ignition hazard under the right conditions, such as a robot painting parts with a flammable paint.

5. Describe the operation of a stepper motor.

   A: Stepper motors move a set portion of the rotation with each application of power; the more steps per rotation the finer the position control.

6. What are some of the costs associated with using a hydraulic robot?

   A: Hydraulic leaks, cost of oil, fire hazard, increased maintenance, and increased noise.

7. What is the primary difference between hydraulics and pneumatics?

   A: Hydraulics uses a non-compressible liquid; pneumatics uses a compressible gas.

8. Where is pneumatic power used extensively in the robotics world?

   A: One area where pneumatics has really taken root is in tooling. Pneumatics is the go to power source for grippers, drills, sprayers, and vacuum systems in industry, thus the reason that many electrical robots use pneumatic tooling.

9. What are the benefits of a Cartesian work envelope?

   A: These robots are popular for loading and unloading parts as well as moving materials over large distances, with the system often mounted over the equipment they serve, which saves floor space.

10. What are the pros and cons of a cylindrical geometry robot?

    A: These systems are good for reaching deep into machines, save on floor space, and tend to have the rigid structure needed for large payloads. The only downside is the loss of Y-axis travel, but the addition of a mobile base can take care of that.

11. What is the work envelope of an articulated geometry robot?

    A: A spherical type envelope that is constrained by the construction of the robot.

12. Which geometry is the most common for robots and why?

    A: Articulated is the most common due to the flexibility of the design and the fact that it can replicate a wide range of human motions.

13. What is the difference between a SCARA robot and a horizontally base-jointed arm?

    A: The horizontally base-jointed arm has the linear axis as axis two instead of three and these robots also tend to have a normal minor axis complement of two or three vs. the single rotational of the traditional SCARA types.

14. What is the tradeoff inherent in the work envelope of the delta robot?

    A: These systems sacrifice a large portion of their work envelope for speed and the benefit of over the work mounting.

15. Describe the operation of a direct drive robot.

    A: This design couples the robot directly to the output shaft of the motor and there is a one to one ratio of movement.

16. What is the difference between a chain-driven and belt-driven system?

    A: Chain drives use sprockets, which have teeth designed to fit into the links of the chain, instead of pulleys and a chain, usually made of metal, which connects the drive sprocket to the driven sprocket.

17. Define the motion of the last gear in a transmission that has an even number of gears. Define the motion of the last gear in a transmission that has an odd number of gears.

    A: If there is an even number of total gears in a drive system, the last gear will rotate opposite the input gear. If there are an odd number of total gears in a system, the last gear will turn in the same direction as the input gear.

18. How is it possible for compound gear systems to have both drive and driven gears on the same shaft?

    A: The second or one of the multiple gears of a compound gear setup serves as the power source for a completely new gear train, thus making it the drive gear for that transmission system.

19. What are the benefits of harmonic drives?

    A: This system can generate torques up to 320:1 and has no backlash.

20. What is the ISO definition of an industrial robot?

A: An industrial robot is an actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks.

21. What are the categories used by ISO for industrial robot classification?

    A: Possible answers include: linear robots, SCARA robots, articulated robots, parallel robots, and cylindrical robots.

22. What is the focus of ISO/TS 15066?

    A: ISO/TS 15066 focuses on working safely with collaborative robots.