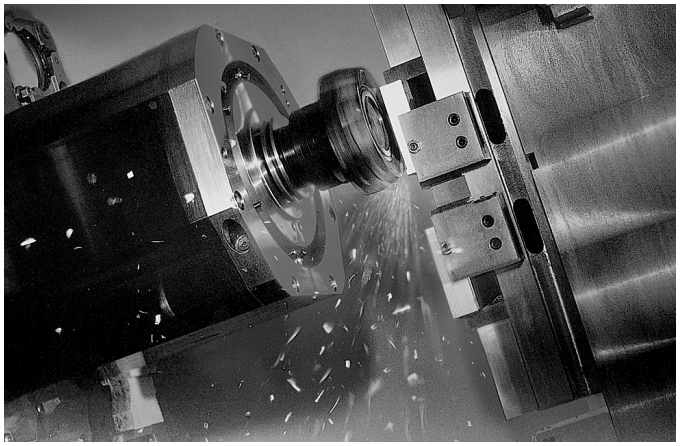


Chapter 22

Automated Manufacturing

LEARNING OBJECTIVES

After studying this chapter, students will be able to:

- Define the term "automation."
- Describe several automated production systems.
- Define the term "industrial robot."
- Discuss the use of robotics in automated production systems.

INSTRUCTIONAL MATERIALS

Text: pages 423–434
Test Your Knowledge Questions, page 433
Workbook: pages 123–126
Instructor's Resource: pages 293–302
Guide for Lesson Planning
Research and Development Ideas
Reproducible Masters:
22-1 Flexible Machining Cell
22-2 Work Envelope of a Robot
22-3 Robot Configuration
22-4 Laminated Object Manufacturing Process
22-5 The Stereolithography Process
22-6 Test Your Knowledge Questions
Color Transparency (Binder/CD only)

GUIDE FOR LESSON PLANNING

Have the class read and study the chapter. Review the assignment using the reproducible masters as overhead transparencies and/or handouts. Discuss the following:

- The meaning of the term *automation.*
- Flexible manufacturing systems (FMS). Use Reproducible Master 22-1.
- Definition of a robot.
- How robots are used in automation.
- Design of a robot. Use Reproducible Masters 22-2 and 22-3.
- Robotic applications.
- Safety in automated manufacturing.
- Why rapid prototyping techniques have been developed.
- The Laminated Object Manufacturing (LOM) process. Use Reproducible Master 22-4.
- The stereolithography process. Use Reproducible Master 22-5.
- Other rapid modeling techniques.
- The future of automated manufacturing.

Technical Terms

Review the terms introduced in the chapter. New terms can be assigned as a quiz, homework, or extra credit. The following list is also given at the beginning of the chapter.

computer integrated manufacturing (CIM)
flexible manufacturing system (FMS)
Fused Disposition Modeling (FDM)
Just-in-Time manufacturing (JIT)
Laminated Object Manufacturing (LOM)
manipulator
robot
smart tooling
stereolithography
work envelope

Review Questions

Assign *Test Your Knowledge* questions. Copy and distribute Reproducible Master 22-6 or have students use the questions on page 433 and write their answers on a separate sheet of paper.

Workbook Assignment

Assign Chapter 22 of the ***Machining Fundamentals Workbook.***

Research and Development

Discuss the following topics in class or have students complete projects on their own.

1. The advent of automation is frequently thought of as the "Second Industrial Revolution." Develop a research paper on the *first* Industrial Revolution with emphasis on working conditions, living conditions, and wages. Compare them with the working conditions, living conditions, and wages that exist today.
2. Design a bulletin board on automation.
3. Develop a program for a CNC lathe.
4. Demonstrate the operation of a CNC lathe.

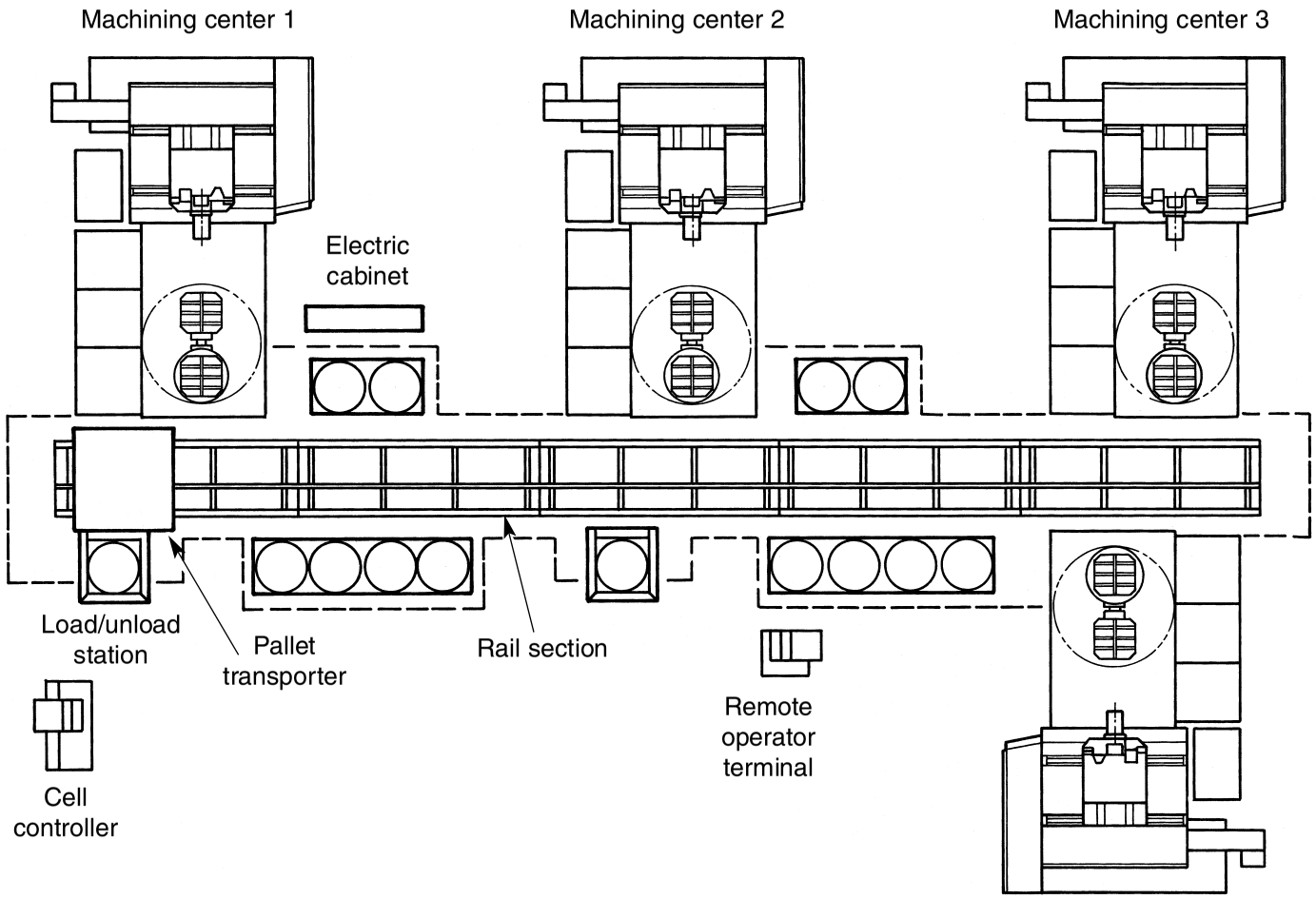
TEST YOUR KNOWLEDGE ANSWERS, Page 433

1. Automation is a system for the continuous automatic production of a product.
2. Electronically, hydraulically, mechanically, pneumatically, or in combination.
3. Any order: making, inspecting, assembly, testing, packaging.
4. a. Flexible Manufacturing System
   b. Computer Integrated and Manufacturing System
   c. Flexible Machining Cell
   d. Computer Numerical Control
   e. Computer Aided Design/Computer Aided Manufacturing
   f. Laminated Object Manufacturing
5. loaders
6. a. Smart tooling involves the use of cutting tools and work-holding devices that can be readily reconfigured to produce a variety of shapes and sizes within a given part family.
   b. JIT, or Just-in-Time, is a system that eliminates the need for large inventories of materials and parts. They are scheduled for arrival at the time needed and not before.
   c. Robots are programmable, multifunctional manipulators designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.
7. The work envelope of a robot is the volume of space defined by the reach of the robot arm in three-dimensional space.
8. Student answers will vary but may include three of the following: to work in hazardous and harsh environments; perform tedious operations; for precision operations; handling heavy materials.
9. Student answers will vary but may include three of the following: Laminated Object Manufacturing (LOM); Stereolithography; Fused Disposition Modeling (FDM); Direct Shell Production Casting (DSPC).
10. laser

WORKBOOK ANSWERS, Pages 123–126

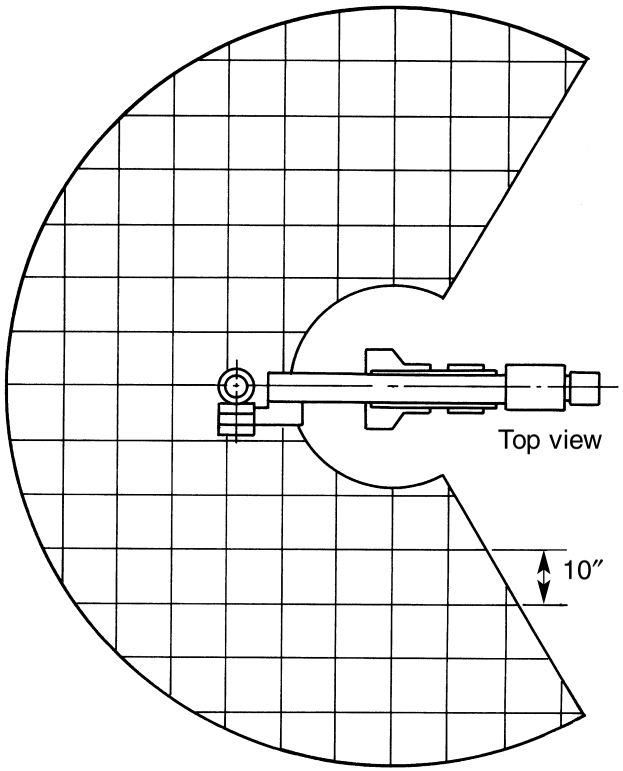
1. d. All of the above.
2. Flexible Machining Cell (FMC)
3. d. All of the above.
4. immediately
5. Parts and materials are scheduled for arrival at the time needed and not before.
6. Production can be reduced or stopped by weather delays or strikes.
7. A. Performs computations for controlling the movement of the arm and wrist to the proper location.
   B. May be hydraulic, pneumatic, or electric.
   C. The articulated arm of the robot. The end of the arm is fitted with a wrist capable of angular and/or rotational motion.
   D. Device attached to the robot wrist for specific applications, such as a gripper, welding head, or spray gun.
8. Evaluate individually. Refer to Sections 22.4.2 and 22.4.3.
9. Evaluate individually. Refer to Section 22.4.1.
10. d. All of the above.

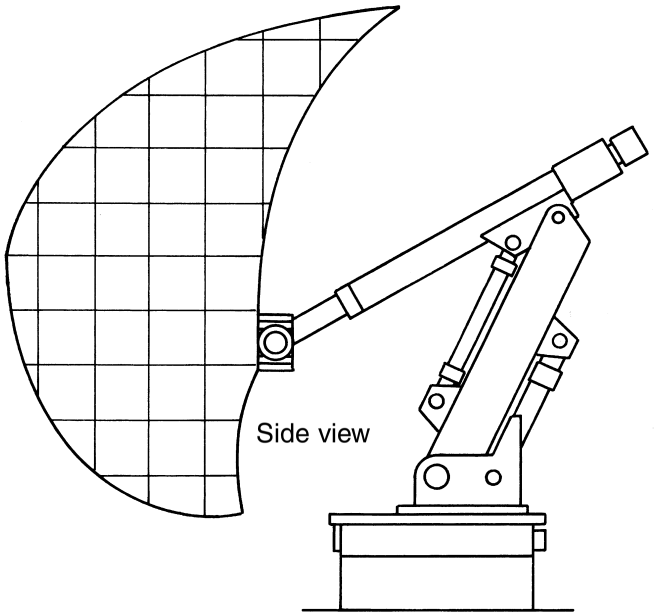
Flexible Machining Cell



Flexible manufacturing cell that uses a pallet transporter to link the machines. A cell controller automatically queues work for immediate delivery to the next machine available.

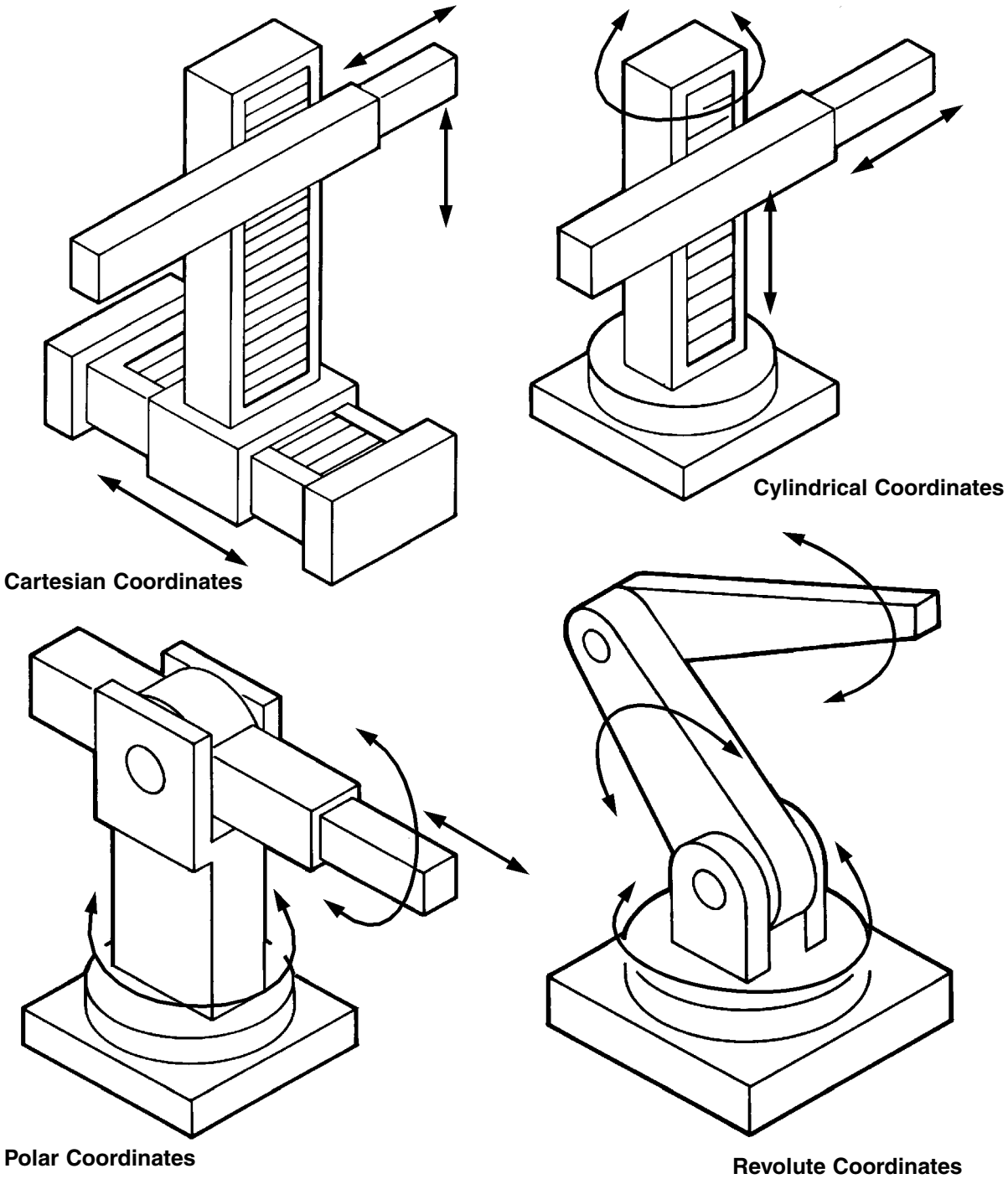
Work Envelope of a Robot



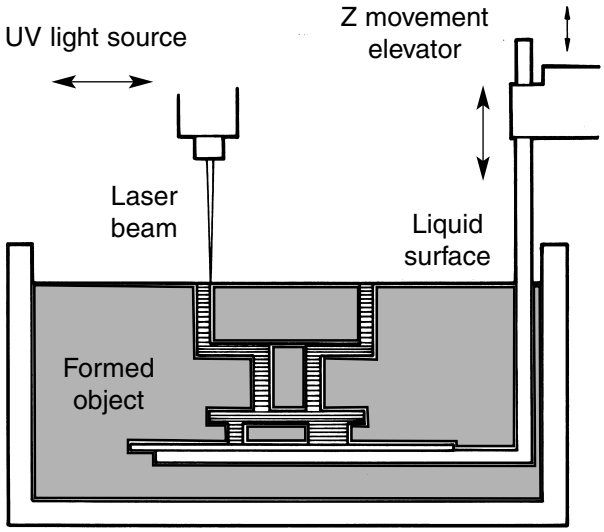


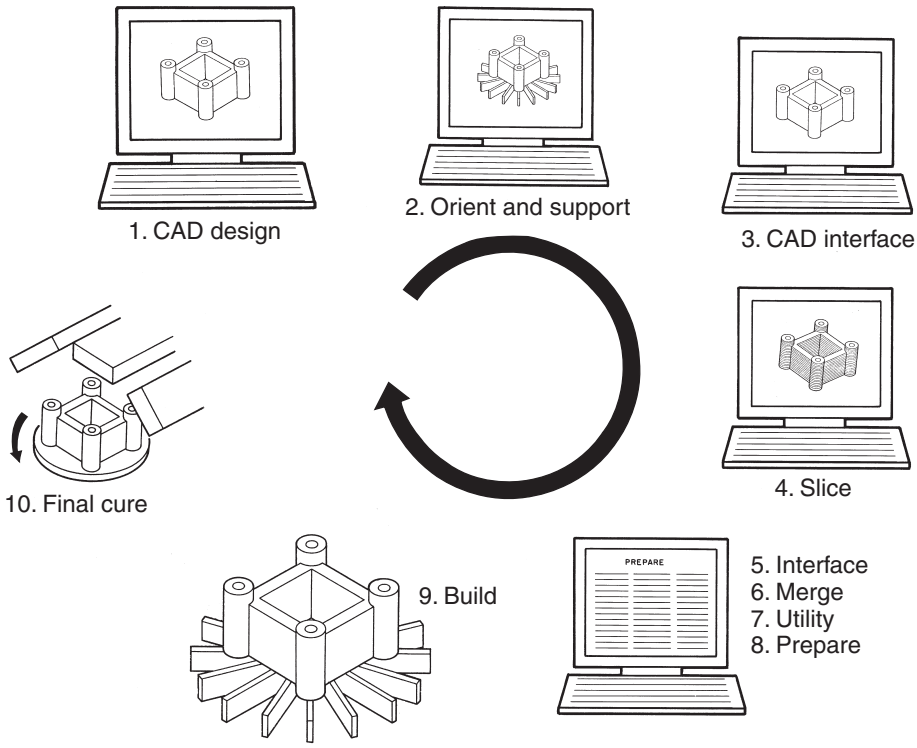
The work envelope of a robot is the volume of space defined by the reach of the robot arm in three dimensions.

Robot Configuration

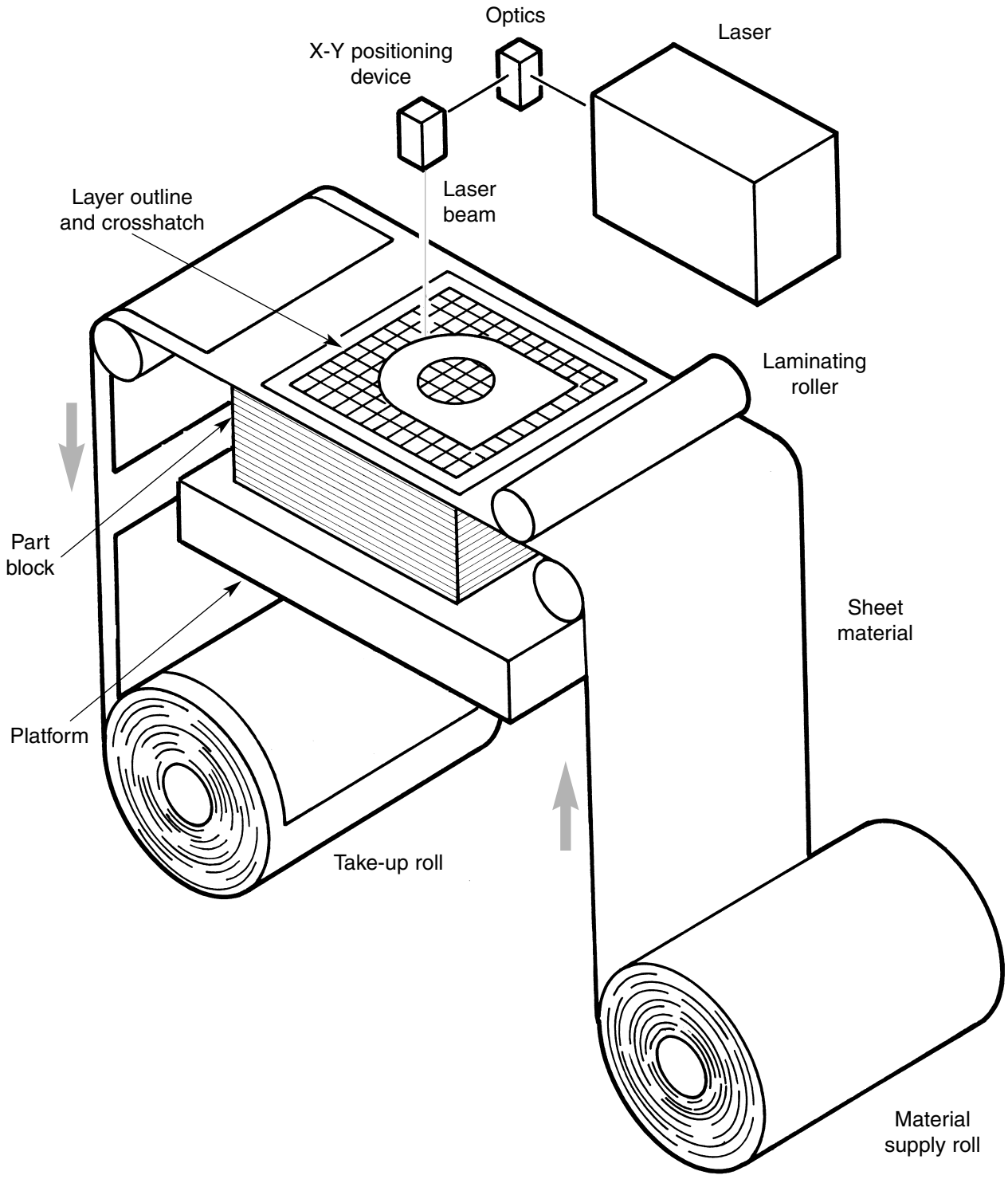


The Stereolithography Process





Laminated Object Manufacturing Process



Automated Manufacturing

Name: _____ Date: _____ Score: _____

1. What is automation? _____

   _____

   _____

2. How are the machines in automation activated? _____

   _____

   _____

3. List the five basic manufacturing processes that automated machines can perform.

   _____

   _____

   _____

   _____

   _____

4. What do the following acronyms stand for in their relation to automation? (An acronym is a word formed using the initial letters of words in a phrase. For example: RPM stands for revolutions per minute.)

   a. FMS: _____

   b. CIM: _____

   c. FMC: _____

   d. CNC: _____

   e. CAD/CAM: _____

   f. LOM: _____

5. In a flexible machining cell, specially designed _____ are often used to place workpieces in a machine. 5. _____

6. Explain the following terms:

   a. Smart tooling: _____

   _____

   b. JIT: _____

   _____

   c. Robot: _____

   _____

   _____

Name: _____

7. In robotics, what is meant by the term "work envelope"? _____

_____

_____

8. List three current uses of the robot._____

_____

_____

_____

9. List three techniques that are now available for the rapid prototyping of a CAD design.

_____

_____

_____

10. In several of the rapid prototyping systems, a _____ is used to harden a thin layer of material as the object is built up. 10. _____