Chapter 1

1. What is a plant layout?
   a. Plant layout is the organization of the company’s physical facilities to promote the efficient utilization of equipment, material, people, and energy.

2. What is a facility design?
   a. Facility design includes plant location, building design, plant layout, and material handling.

3. What is material handling?
   a. Material handling is defined simply as moving materials.

4. Explain how the cost reduction formula is used in the manufacturing design process.
   a. The cost reduction formula is in fact a word, not a mathematical formula. It consists of six question regarding everything that can happen to a part as is moves through the facility. The questions are: why, who, where, what, when, and how. The purpose it to determine whether any given step can be eliminated, combined with another operation, moved to a different point in the sequence of the operation, or simplified. This procedure requires that you study the product in order to identify every step in the process and that you are able to justify the necessity of each step.

5. Material handling accounts for what percent of injuries and what percent of operating costs?
   a. 50%
   b. 40-80%

6. List the goals of manufacturing facilities design and material handling.
   a. Minimize cost.
   b. Optimize quality.
   c. Promote the efficient utilization of
      1. People
      2. Equipment
      3. Space
      4. Energy
   d. Provide for employees’
      1. Convenience
      2. Safety
      3. Comfort
   e. Control project costs.
   f. Achieve production start date.

7. What is a mission statement?
   a. A mission statement is a simple statement of quantity, quality product, and cost goals used to keep our minds on track.
8. What two items in Figure 1-1 are behind schedule?
   a. Items 10 and 11 (product 1670)
9. What is the value of a manufacturing design procedure?
   a. This approach is a systematic approach that results (like magic) in a great plant layout.
10. List the manufacturing facilities design procedure.
    a. The 24 steps (pages 11-13)
11. What are the five types of manufacturing facilities design projects?
    a. New plant, new product, design change, cost reduction, and retrofit.
12. What is the difference in procedure between a new facility design and a retrofit?
    a. It is best to treat both retrofit and new facility design similarly until the final layout and to make as few compromises as possible.
13. What are lean manufacturing and lean thinking?
    a. Lean manufacturing, Lean Enterprise, or lean production, often simply, "lean", is a production philosophy that considers the expenditure of resources in any aspect other than the direct creation of value for the end customer to be wasteful, and thus a target for elimination.
    a. Japanese word for waste
    b. Japanese word for constant, or continuous improvement. Kaizen is done by a team of employees or by a single employee.
    c. A signal board that communicates the need for material and visually tells the operator to produce another unit or quantity. Usually a small card inserted into a plastic envelope.
    d. This is the line stop method indicator board located above the production lines that serves as a visual control. If a problem occurs, an operator is required to stop the line.
15. Define simulation and explain why you think a simulation can be an important tool in facilities design.
    a. Simulation is a technique by which a real life situation can be mimicked. In the area of facilities planning, it can be used to play variety of what if games or scenarios. For example, how adding or deleting a piece of machinery or personnel may affect the overall outcome of the line or the facility.
16. Explain how you would incorporate various ISO 9000 requirements into the facilities planning process.
    a. A major aspect of ISO 9000 is to complete documentation and data collection. Various facilities planning tools will satisfy this requirement.
17. What do you believe is meant by a “random” process? Give an example of a random occurrence on the factory floor and how simulation can be helpful in understanding such a phenomenon.
    a. Random processes are those occurrences that take place without prior warning or planning such as machine breakdown. Simulation can be used both to understand and prepare better for these events.
18. Are you familiar with any automatic data capture technology? Where and how do you see that such technology may be applied in the facilities planning process?
   a. The most common of these devices are the wands and scanners used at the checkout counters in the grocery stores. In the plant, they can be incorporated in various activities such as material handling to track inventories, WIP, equipment status, and so on.

19. On the average, a facility undergoes some “layout design changes” once every 18 months. What would necessitate such changes?
   a. Such changes are necessitated as the result of product changeovers; production volume increase or decreases; and adding, changing, or deleting various operations and processes to the shop floor activities.

Chapter 2

1. As you embark upon the design of your manufacturing facilities, what data would you seek from the following sources, and how would this information affect your planning? Briefly discuss
   a. Marketing
   b. Product Design
   c. Management Policy

2. What information does marketing provide?
   a. Selling price, sales volume, seasonality, and replacement parts.

3. What is takt time (R value)?
   a. The plant rate in decimal minutes (how fast workers must produce every part).

4. What is included in a takt time (R value) calculation?
   a. Working minutes, efficiency history, downtime, and the number of units to produce.

5. Why is the R value so important?
   a. It determines the speed of the entire plant.

6. What information do designers get from the product design department?
   a. Blueprints, parts list or bill of materials, and model shop samples.

7. What information does management policy provide?
   a. Investment policy, inventory policy, startup schedule, make or buy decision, organizational chart, and feasibility studies.

8. What is a make or buy decision?
   a. Figure 2-6 shows a list of parts that the company will make and a list of parts that it will buy.

9. Who is in competition with the fabrication department? Why?
   a. Purchasing, because they will buy the part if it is cheaper on the outside.

10. What are six causes of muda?
    1. Over Production
2. Inventory
3. Motion
4. Waiting
5. Transportation
6. Over-Processing
7. Scrap, Reworks, and Defects

11. Explain how to use the indented bill of materials.
   a. The indented bill of materials shows various levels of assembly and subassemblies and the required parts that form various components. See page 30.

12. What is the difference between an indented and flat bill of materials?
   a. In addition to data provided by the flat bill of materials, the indented bill of materials shows the hierarchy of parts and components.

13. Why is the additional information provided by the indented bill of materials important?
   a. It can be used to construct the assembly chart and it can aid in visualizing the overall relationship between parts and assemblies.

14. Explain the concept of concurrent engineering. How does it relate to facilities planning?
   a. It deals with concurrent planning of all aspects of product development, design, and manufacturing. The concept can be used in facilities planning to develop the proper relationship among various departments.

What are time standards used for?
   a. To determine the number of machines and operators, direct labor cost, assembly line balancing, and scheduling; evaluate individual performance and incentive wages; and develop human resource budget.

2. What is the definition of a time standard?
   a. The time required to perform a task by a qualified, well-trained operator, working at a normal pace, doing a specific task.

3. What three numbers make up a time standard?
   a. Time standards are communicated by decimal minutes, pieces per hour, and hours per piece.

4. What is productivity? How is it measured for individuals?
   a. Productivity is defined as output divided by input. Labor productivity = earned hours divided by actual hours.

5. What are the five techniques of setting time standards?
   a. Predetermined time standard systems, stopwatch method, work sampling, standard data, expert opinion, or historical data.

6. Which technique would be used when no workstation is available?
   a. Predetermined time standards system.

7. Which technique is the most popular?
   a. Stopwatch or time study

8. Which technique would be used for maintenance work?
   a. Work sampling or expert opinion.

9. Which is the best technique for setting time standards?
10. Which technique is both a method and a time study technique?
   a. Predetermined time standards system.

11. What are the three basic levels of productivity?
   a. 60%, 85%, and 120%

12. Define takt time.
   a. Takt time is the amount of time available to produce one unit in order to meet the product schedule.

13. How many machines would you buy and how many people should you hire if 3,000 units are needed per shift in a 75 percent efficient plant that has 10 percent downtime? The machine time standard is .284 minute. How much will a unit cost to produce if the operator earns $15 per hour? How many units will be produced per shift? What is the takt time?
   a. Pg. 412

14. Define measured or observed time, normal time, and standard time.
   a. Measured observed or time is the result of the time study, the amount of time a particular operator has taken to perform a task. Normal time is the observed time adjusted by the pace rate or the operator’s rating. Standard time is the normal time after allowances have been added.

15. What is meant by allowances and what are the most common types of allowances?
   a. Allowances are given for nonproductive factors such as fatigue, operator personal needs, and unavoidable delays to make the time standards practical.

16. How does standard time differ from normal time?
   a. Standard time = normal time + allowances.

18. Given a 10-hour shift, if a total of 20 minutes is allowed for breaks and a 10-minute cleanup period is given at the end of the shift, determine the takt time. Assume 85 percent efficiency. During this shift, 2,500 units are to be built.
   a. Pg. 412

19. The average observed (measured) time for an operation is given as .570 minute. The operator is rated at 95 percent. Allow a total of 15 percent for PF&D. If the direct labor wages are $12 per hour, determine normal time, standard time, pieces per hour, hours per 1,000 pieces, standard direct labor cost per unit, and direct labor cost per unit as produced by this operator.
   a. .542
   b. .637
   c. 94
   d. 10.63
   e. $.127
   f. $.134

20. Three operations are performed on a part. If these operations produce 1, 3.5, and .5 percent scrap, respectively, determine the number of blanks required to begin the process if 5,000 finished units are required.
   a. 5,260.
Chapter 4

1. What is process design?
   a. Determining how you are going to make each part, with what equipment, what time standard, tools, sequence of assembly, and so on.

2. What are the two categories of process design?
   a. Fabrication and assembly/packout.

3. What is a route sheet?
   a. A sequence of operations to make a part.

4. What information is included on a route sheet?
   a. Part number, part name, quantity to produce, operation numbers, operation description, machine numbers, machine games, tooling needed, and time standard.

5. What determines how many machines to buy?
   a. How many units per day are needed, what machine runs what parts, and what is the time standard for each operation.

6. Which time standard (decimal minute, pieces per hour, or hour per unit) compares to takt time?
   a. Decimal Minute

7. What is an assembly chart?
   a. The assembly chart shows the sequence of operations in putting the product together.

8. What information is needed to calculate an assembly line conveyor speed?
   a. Number of units needed per minute times the distance between the leading edge of one unit and the next unit.

9. What additional information is needed to calculate paint conveyor speed?
   a. Hook spacing and parts per hook.

10. What are the eight purposes of assembly line balancing?
    a. Equalize work, identify bottlenecks, establish line speed, determine number of workstations, determine product cost, establish percent load of each person, assist in layout, and reduce production costs.

11. Rebalance Figure 4-11 by adding a fourth packout person and make a subassembly out of SA3. Then answer the following:
    a. What is the total hours per unit? .06618
    b. How many units per shift will be made at 100 percent? 3,104
    c. How many people are now used? 25.44
    d. What is the new 100 percent station? A1
    e. Is this a better balance? Yes, because the total hours per unit is less.
    f. How much money is saved if you produce 700,000 units per year and the employees are paid $10.00 per hour? $23,030 per year.

12. What are the primary layout orientations?
    a. Mass production and job shop.

13. Explain how adding personnel to a line can reduce cost per unit.
a. Adding stations to bottleneck operations often results in reduction in idle time, hence a reduction in cost per unit. If the 100% (bottleneck) station has considerably more work than the next closely loaded station, adding another person here may reduce the average station time. With 10 people on the line, this would require a 10% difference. With 100 people, only 1% difference between the highest average station time and the second highest average time is necessary to pay for an additional person.

   a. In process-oriented layout, similar equipment are grouped together (job shop); in product-oriented layout, machines are arranged to accommodate specific operation sequence per the routing sheets.

15. Define group technology and explain how it is implemented.
   a. Group technology takes advantage of similarity in part geometry and processes without regard to part’s final destiny. This is done so that these parts can be processed as a group.

16. Explain the concept of work cell.
   a. A group of machine may form a “cell” to perform a series of operations more efficiently. This may work best with the group technology concept.

**Chapter 5**

1. Define flow line.
   a. The path a part takes through a plant.

2. What does flow analysis try to do?
   a. Minimize distance traveled, backtracking, cross traffic, and cost.

3. What are the two basic groups of low analysis techniques?
   a. Fabrication and total plant.

4. What are the fabrications of individual parts flow analysis techniques?
   a. String diagram, multicolumn process chart, from-to chart, and process chart.

5. What are the three techniques of total plant flow?
   a. Flow diagram, operations chart, and flow process chart.

6. Flow Process charts combine what two techniques?
   a. Operations chart and process chart.

7. Why is flow analysis and design for human resources as important as that for material?
   a. Arguments can be given for worker efficiency, reducing walking distances, safety, and so on.

8. What is FactoryFLOW and what does it attempt to do?
   a. FactoryFLOW is a software program that aids with various aspects of flow analysis.

9. What are the advantages of computer-aided flow analysis? What are the possible disadvantages?
   a. Faster and more efficient. Analysis can be performed in real time without actually rearranging the facility. Major problems can arise from inaccurate or incomplete input into the systems.
Chapter 6

1. What are the six activity codes and for what do they stand?
   a. A= absolutely necessary that these two departments be close to each other
   b. E= especially important
   c. I= important
   d. O= ordinary importance
   e. U= unimportant
   f. X= undesirable

2. From where do these codes come?
   a. These codes are set as a result of discussions with managers and other personnel.

3. What are reason code? Why are they used? How are they used?
   a. A reminder as to why a particular relationship code was assigned.

4. Why do you need a worksheet?
   a. A worksheet helps transfer information from the activity relationship diagram to the dimensionless block diagram without committing errors.

5. What is a template?
   a. Templates in this case aid with the construction of the dimensionless block diagram. They are inch squares with the closeness codes in the proper place.

Chapter 7

1. Where do you start on workstation design? Why?
   a. Anywhere, because you will always make improvements so the first sketch will be wrong.

2. What is the starting point of workstation design? Why?
   a. The cheapest way to get into production because any additional expense must be cost-justified.

3. What must be included in a workstation design?
   a. See Page 205

4. What are the principles of motion economy?
   a. Guidelines for efficient and effective workstation designs.

5. What is effectiveness?
   a. Doing right things.

6. What is efficiency?
   a. Doing things right.

7. What is the extra 50 percent space added to the workstation requirement?
   a. Aisles, work in process, and small miscellaneous extra room.

8. It is said that “A good job, like a good machine, must be designed.” Explain this statement. What does it mean in terms of workstation design?
a. Attention to motion economy, worker and equipment efficiency, human factor considerations all account for a well-designed job.

9. Define ergonomics and explain its importance to workstation design.
   a. Ergonomic considerations will result in designing the workstation to “fit” the human body rather than attempting to fit the human body to the workstation.

10. What is anthropometry? What are the anthropometric considerations in work design?
    a. Physical dimensions and measurements of the human body. Designing work and workstations while keeping these physical attributes in mind.

Chapter 8

1. What are auxiliary services (support services)?
   a. Receiving, stores, warehouse, shipping, maintenance, tool room, and utilities.

2. What do shipping and receiving have in common?
   a. Similar people, equipment, and space requirements.

3. What are the advantages of a common receiving and shipping department?
   a. Common equipment personnel, spaces are used, and reduced facility costs.

4. What are the disadvantages?
   a. Space congestion and material flow.

5. Should a company have only one receiving area?
   a. No! What is most efficient?

6. What effect does the trucking industry have on receiving and shipping docks?
   a. Morning delivery and afternoon pickup is standard.

7. What is LTL?
   a. Less than truckload quantity (common carrier business) uses break bulk stations.

8. Why would you use common carriers?
   a. Only one (or a few) trucks would show up in the morning instead of many truck showing up around the clock.

9. What are the functions of a receiving department?
   a. Page 225

10. What is a Bates log?
    a. A sequential numbering stamp and system to record the order of receiving.

11. What is a Julian calendar date?
    a. The actual day number of the year, January 1 being number 1 and July 1 being number 183.

12. What is an OS&D report?
    a. An over, shortage, or damage report made out by the receiving clerk sent to purchasing for resolution.

13. What is a receiving report?
    a. A notice to the rest of the company that a product has been received.

14. How many dock doors should you have?
    a. Depends on arrival rate (trucks per hour) at peak and service rate (unloading time).
15. What does arrival rate mean?
   a. How many tucks must be serviced per hour?
16. What outside areas are needed for receiving and shipping departments?
   a. Parking space, maneuvering space, and roadway.
17. What is the visualization method for determining receiving department space requirements?
   a. Comparison of the pounds of finished produce produced in one day to the size of a semitrailer that holds 40,000 pounds. If you produced 100,000 pounds of produce per day, 2 ½ trailers could bring the raw material into the plant.
18. What are the functions of a shipping department?
   a. Pg. 229
19. Why do you weigh shipping containers?
   a. Trucking companies charge by the pound. Also helps determine the ratio of tare weight to the weight of goods shipped.
20. What is a bill of lading?
   a. The truckers’ authorization to remove the produce from the plant and a part of the trucking company’s billing process.
21. What is a store?
   a. A place to hold raw material and supplies.
22. What are the different types of stores?
   a. Raw material, finished parts, office supply, maintenance supply, janitorial supply, and so on.
23. What determines the store size?
   a. Size of parts, number to be stored.
24. What is ABC classifications?
   a. An inventory items are the 20% of the parts that account for 80% of the value of material. B items are 40% of the parts that account for 15% of the value, and C items are 40% of the parts that account for 5% of the value. If you can reduce the inventory level of A items, you can reduce the space requirements and inventory carrying costs.
25. What is an inventory carrying cost?
   a. About 25% of the value of the inventory each year and includes interest, taxes, insurance, space, utilities, damage, and obsolescence.
26. What is JIT?
   a. Just-in-time is an inventory policy that stresses having only enough inventory to run a few hours.
27. What are the goals of a stores department?
   a. Maximize the utilization of the cubic space, provide for immediate access to everything, and provide for the safekeeping of the inventory.
28. How can you get away with leaving room for only 50 percent of the inventory?
   a. The inventory curve shows that on the average only ½ the inventory is on hand (it is full on the first day of receipt and empty on the last day), so when material comes in, it is placed anywhere an empty spot exists.
29. How does random location work?
   a. Every location in the storeroom is identified with a location number. When something is placed in this location, the location number is recorded in the locator system.

30. What is an aisle foot?
   a. On foot of aisle access, on both sides of the aisle. You have two aisle fee of access with every foot of length of the aisle.

31. What is a warehouse?
   a. A location for storage of a finished product.

32. What are the two design criteria for a warehouse?
   a. Fixed locations and a small amount of everything.

33. What are the two functions for a warehouse?
   a. Safekeeping of finished goods and maintaining some stock of every product the company sells.

34. What is order picking?
   a. A function of the warehouse that collects a customer’s ordered goods.

35. How does ABC inventory analysis help you to lay out the warehouse?
   a. By identifying the most popular items sold by the company and locating those items more conveniently.

36. What is a pallet pattern?
   a. The layout of cartons on a pallet to ensure safe loads and maximum cube utilization.

37. What is a mezzanine?
   a. A form of balcony built over an area to use overhead space.

38. How many maintenance people should a plant have?
   a. From 2% to 4% of the plant’s personnel.

39. Explain how an automatic id and date capture (AIDC) system can aid with your receiving, storage and inventory tracking problems.
   a. Item tracking and inventory management and control.

40. Explain how the Pareto analysis works and how it can be applied to the organization of your warehouse.
   a. Aids with categorizing inventory items from the most frequently used or accessed to the least frequently needed items.

41. Explain the concept of random location for various items in the storeroom. How does it help with space utilization?
   a. Items are not assigned a specific location but are placed where space is available. It reduces wasted and idle space.

42. What is an item locator file and what purpose does it serve?
   a. In a random location storeroom, a locator file keeps track of quantity and location of various inventory items.

43. What necessitates the use of safety stock?
   a. Fluctuation in order lead time and usage rate.
Chapter 9

1. What are the employee services that require space?
   a. Pg. 264

2. How many parking spaces do you need?
   a. Depends on the number of employees and the employees to parking space ratio.

3. How many square feet per parking space (including aisles) are required?
   a. 250 square feet.

4. What is included in employee entrance space?
   a. Security, time cards, bulletin boards.

5. What should the employee entrance be close to?
   a. Parking, locker room, restroom, and cafeteria.

6. What is a locker room for?
   a. Give employees space for street clothes, work clothes, personal things such as lunches, coats, and so on.

7. How big is a locker room?
   a. Four square feet per employee.

8. How many restrooms do you need?
   a. No farther than 500 feet from any employee. No fewer than two (one men’s and one women’s).

9. How do you know how many toilets, urinals, and sinks are required?
   a. The building code will tell you.

10. How big is the restroom?
    a. Normally 15 square feet is required for toilets, washbasins, and doorways and 50% extra for the aisle. A good rule of thumb is 60 square feet per toilet, and this would include everything.

11. What are the five types of eating facilities?
    a. Cafeteria, vending machine, mobile vendors, dining rooms, off-site.

12. Where should the eating facility be located?
    a. Activity relationships diagram plus an outside wall close to restrooms and locker rooms.

13. How big should a lunchroom be?
    a. 10 square feet per employee.

14. How many drinking fountains should you have?
    a. Located within 200 feet of every person.

15. How big are the drinking fountain areas?
    a. 15 square feet each – including drinking space.

16. How much of the plant’s space should be taken up by aisles?
    a. As little as possible, but 25% would be outstanding.

17. How many employees justify a nurse?
    a. 500 employees equal one nurse.

18. How large should a medical facility be?
    a. From 36 square feet to 300 square feet per nurse per shift. Three nurses could occupy one 300 square feet area if one nurse were assigned to each shift.
19. What is ADA and what are its implications on the design of facilities?
   a. American with Disabilities Act (ADA) of 1989 requires that employers provide special and properly designed parking spaces and create a barrier-free environment in all aspects of the facility. The ADA requirements are a matter of the law.

20. In addition to the personnel requirements and the areas suggested in the text, what other areas can you suggest that may benefit your employees?
   a. Child care, outlet store, gym, and so on.

Chapter 10

1. What is material handling?
   a. Material handling is the function of moving the right material to the right place at the right time in the right amount in the sequence and in the right position to minimize costs.

2. What are some of the material control systems?
   a. Part numbering, location, inventory control, standardization lot size, order quantity, safety stock, labeling, and automatic identification techniques.

3. Which is the best piece of material handling equipment for a specific job?
   a. The one that produce the lowest unit cost.

4. What are the goals of material handling?

5. From where did the 10 principles of material handling come?
   a. The College Industry Committee on Material Handling Education, sponsored by the Material Handling Institute, Inc.

6. What are the 10 principles of material handling?
   a. A summary of generations of experience in material handling engineering. A guideline for the application of sound judgment. (234-245)

7. What is the material handling equation?
   a. See Figure 10-2

8. What is the material handling problem-solving procedure?
   a. See Page 245

9. How can material handling be combined with other production activities?
   a. Some of the activities that can possibly be incorporated with material handling may include sorting, counting, inspection, and inventory management to name a few.

10. How can automatic identification and data capture (AIDC) be incorporated into material handling systems?
    a. Via the use of automatic and built-in scanners and other automatic data collection devices.

11. State some industrial situations in which AIDC can improve efficiency when incorporated into a material handling system.
a. Automatic routing of parts and inventory management.

12. What factors, other than costs, could be considered important when selecting material handling equipment?
   a. Safety and ergonomic and human factor considerations.

13. What are the two categories of costs associated with the selection and acquisition of material handling equipment?
   a. The cost of ownership (purchase, maintenance, etc.) and the cost of operation (training, energy usage, etc.)

14. What would be an example of ergonomic consideration when selecting material handling equipment?
   a. Avoidance of work-related injury and cumulative trauma disorders.

15. How can a material handling system increase plant space use? How can it reduce work-in-process (WIP) inventory?
   a. By providing efficient and timely material flow and eliminating the need for storage between operations.

16. What are the five dimensions of a material handling system?
   a. Movement, quantity, time, space, and control.

17. What does cumulative trauma disorder (CTD) mean?
   a. The adverse long-term effect of an activity (lifting, bending of the wrist, etc.) on the operator is referred to as CTD.

18. How can CTD risks be reduced through the use of material handling systems?
   a. Through proper design so that stress and strain on the body are reduced.

Chapter 11

1. What are the four basic classifications of material handling equipment?
   a. Point-to-point or fixed path
   b. Fixed-area, variable path
   c. Variable-area, variable path
   d. Auxiliary equipment

2. What is a pneumatic conveyor and why would it be classified as fixed-path equipment?
   a. Such as canisters used at the bank drive-in windows. It can only serve the path where it is installed.

3. A problem dealing with unloading heavy bags of material was discussed in the previous chapter. Did you discover any equipment in this chapter that may resolve this problem? Discuss your solution.
   a. See figures 11-10a and 11-10b.

4. What is a magnetic conveyor? What are the advantages and disadvantages?
   a. The bed is magnetized and can be used for ferrous materials.

5. What is a manipulator?
   a. Material handling device that helps with lifting, turning, rotating, and positioning items.

6. Explain cross-docking. Are there any advantages to cross-docking?
a. It attempts to eliminate storage steps between receiving and shipping items by moving the product form receiving through the facility to its ultimate destination uninterrupted.

7. Do you agree with the statement? “Automated material handling systems are the solution to all material handling problems?” Explain your answer.
   a. No. Automation is not necessarily the solution to every material handling problem. The primary goal should always be to eliminate the move! Simple mechanical devise may just do the trick without resorting to automation.

Chapter 12

1. What are the goals of office layout?
   a. Goals
      1. Minimize project cost
      2. Promote productive use of employees
      3. Office layouts must be flexible
      4. Be mindful of cleaning and maintenance costs
      5. Keep Noise to a minimum
      6. Material flow must be held to a minimum
      7. Create a pleasing atmosphere
      8. Minimize visual distractions
      9. Create a pleasing reception area
      10. Be mindful of energy costs
      11. Allotment appropriate work space and equipment
      12. Provide convenience for employees
      13. Provide safety for employees.

2. What are the four types of office space?
   a. Types
      1. Supervisor’s
      2. Open space
      3. Conventional
      4. Modern

3. What are the advantages of the open office layout concept?
   a. Easy communication, common equipment, less space needed easier to heat and cool, easier to supervise, easier to change, common files and literature, easier to clean and maintain.

4. What are the disadvantages of the open office layout concept?
   a. Lack of privacy, noise, status, confidentiality.

5. List 19 specific office requirements and considerations.
   a. Privacy, point of use storage, second floor, centralized or decentralized, flexibility, conference room, library, reception, area, telephone system, copy machine, mail, file, storage, word processing, aisles, computers, lighting, vaults, expansion.

6. What are the techniques of office layout?
a. Organizational chart, procedures diagram, communications force diagram, activity relationship chart worksheet, dimensionless block diagram, office space determination, and master layout.

7. How does the organizational chart help in office layout?
   a. It would tell you the number of people and their level in the organization.

8. How much space is required in the office (rough estimate)?
   a. 200 square feet per employee.

9. What are the standard symbols of the procedures diagram?
   a. Pg. 339

10. What is a communications force diagram?
    a. It tells who talks and works with whom.

11. What symbols are used in the communications force diagram?
    i. Circles and lines. 4 lines = absolutely necessary that these two departments (or people) be close together, 3 lines = especially important, 2 lines = important, 1 line = ordinary importance.

12. What is the basic source of information to create an activity relationship chart?
    a. The communicants force diagram.

Chapter 13

1. What is area allocation?
   a. Dividing the building’s space among the departments.

2. What is the total space requirements worksheet?
   a. A collection of space requirements for every department and service area to develop the total plant space needs.

3. What are the different levels within the plant?
   a. Under floor, overhead, floor, in the trusses, and on the roof.

4. How do you convert square footage to building size?
   a. By using the golden rule of architecture. A building is most efficient if it is twice as long as wide. This is a 2:1 ratio, rounded off to the nearest column space. This dimension will be the width, and twice the dimension will be length.

5. What is the area allocation procedure?
   a. Pg. 355

6. What is the end result of the area allocation procedure?
   a. An area allocation diagram.

7. How can you better use of the clear space?
   a. Mezzanines, racks, shelves, overhead conveyors, and so on.

8. Which of these two areas would you place upstairs and why?
   a. Restrooms or locker rooms
      i. Locker rooms because they are used less often
   b. Accounting or purchasing
      i. Accounting because it has fewer guests
   c. Old files or current files
      i. Old files because they are used less often.
9. What is a column? Why is it important?  
   a. Columns are posts that hold up the roof.
10. What is common spacing?  
   a. The distance between columns
11. Using the golden rule of architecture, what would be the length and width of the buildings with the following space requirements?  
   a. 825,000 square feet  
      i. Length: 550,000  
      ii. Width: 275,000  
   b. 250,000 square feet  
      i. Length: 166,667  
      ii. Width: 83,333  
   c. 87,500 square feet  
      i. Length: 59,333  
      ii. Width: 29,167
12. Once the length and width of the building have been determined, how do you know where to place the departments?  
   a. The dimensionless block diagram
13. Discuss the advantages or disadvantages of placing offices on the second floor?  
   a. Advantages are it frees up prime space that can be used for manufacturing and other heavy activities; it separates office areas from noise, dirt, and manufacturing-related hazards. Possible disadvantages may be increased difficulty in communication and supervision.
14. What are the most expensive systems in building office spaces?  
   a. Foundation and roof.

Chapter 14

1. The layout is only as good as what?  
   a. As the data backing it up.
2. What are the two types of layouts?  
   a. Plot plan and master plan
3. What flow analysis technique depends on the plant layout?  
   a. The flow diagram is drawn on a plant layout.
4. What is a plot plan?  
   a. Show how the building, parking, and driveways fit on the property.
5. Which is more costly, a front foot or an additional foot of depth?  
   a. A front foot.
6. To where will you expand the factory? The office?  
   a. To the back of the plan and up in the office.
7. How much property should you buy?  
   a. Ten times the building space needed.
8. What is the master plan?
a. The finished product of a plant layout project. Shows where every machine, workstation, department, desk, and so on are located.

9. What are the four methods of constructing a master plan?
   a. Architectural drawing, templet and tape, three-dimensional, and CAD.

10. Which is the most expensive? Why?
    a. Architectural because of redraw time.

11. What are the most common scales? List two.
    a. ¼ inch = 1 foot; 2\textsuperscript{nd}  1/8 inch = 1 foot.

12. Is there a time when the architectural technique would be best?
    a. Yes, when it is a one-time project.

13. What are 10 measurements of performance used in evaluating layout alternatives?
    a. Distance traveled, automatic travel ratio, gravity feet ratio, stores and warehouse cube utilization, aisle space ratio, machine space ratio utilization, automatic machine loading ratio, machine utilization, material handling costs ratio, in-process time.

14. What should the trends be for the following?
    a. Distance traveled
       i. down
    b. Automatic feet ratio and gravity feet ratio
       i. up
    c. Aisle Space
       i. down
    d. Cube utilization
       i. up
    e. Machine space utilization
       i. up
    f. Percent automatic loading
       i. up
    g. Machine utilization
       i. up
    h. Percent material handlers
       i. down
    i. Material handling ratio
       i. down
    j. In-process time
       i. down

15. What are the advantages (or disadvantages) of computer-aided facilities planning?
    a. Advantages are speed, accuracy, and efficiency. Data can be entered once and shared with different people and for different purposes. Disadvantages may include reliance on inaccurate input or oversimplification of the input variables.

16. How does standardization in electronic data interchange technology affect facilities planning?
a. Standardizations would enable sharing of various electronic files, drawings, and so on.

17. What role does virtual reality play in facilities planning?
   a. Enables the planner and the users of the facilities to “walk through” the plant and to evaluate its layout during the planning and design stages.

**Chapter 15**

1. Define simulation
   a. Simulation is an experimental technique that attempts to mimic a real-life situation in order to evaluate various scenarios and to answer what-if questions.

2. How does a mathematical model differ from a computer simulation model?
   a. Mathematical models are more precise and more clearly defined and formulated. When such exact definitions are not possible or feasible, computer modeling is more helpful.

3. What is meant by a “stochastic” model and how does it differ from a “deterministic” model?
   a. Stochastic events are random in nature, whereas the outcome of a deterministic model is not left to chance.

4. What is the difference between a dynamic and a static model?
   a. Dynamic models are tracked over a period of time and their behavior is influenced by the passage of time. Static models are unaffected by time.

5. Discuss some advantages and some disadvantages of computer simulation.
   a. Fast and efficient and allows for examining various scenarios. Complex models may not easily lend themselves to simulation and may result in simplistic solutions.

6. How do you envision using computer simulation in planning a manufacturing facility?
   a. Capacity planning, inventory policies, line balancing, warehousing and logistics, office layout, and so on.

7. Explain how, and why, what-if scenarios are played when designing a facility.
   a. Examine various alternatives, that is, adding (or deleting) additional stations, equipment, and so on.

8. What are the two distinct categories of computer-aided facility layout software packages?
   a. Aid in planning and design
   b. Perform simulation and analysis

9. When using simulation, why are problem and system definitions important?
a. Problem definition defines the goals and the purpose, system definition defines the boundaries and limitations of the system.

10. Why is the integrity of input data significant?
   a. As the old cliché states, “garbage-in, garbage-out!”