I&ME-471 (Spring 2008)

Homework # 1 Solutions

Chapter 13:

1. What is a manufacturing system?

Answer: The definition given in the text is the following: A manufacturing system is a collection of integrated equipment and human resources, whose function is to perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts.

2. Name the four components of a manufacturing system.

Answer: As listed in the text, the four components are (1) production machines plus tools, fixtures, and other related hardware, (2) a material handling system, (3) a computer system to coordinate and/or control the preceding components, and (4) human workers to operate and manage the system.

3. What are the three classifications of production machines, in terms of worker participation?

Answer: In terms of worker participation, the machines can be classified as (1) manually operated, (2) semi-automated or (3) fully automated.

4. What are the five material handling functions that must be provided in a manufacturing system?

Answer: The five material handling functions that must be provided in a manufacturing system are (1) loading work units at each station, (2) positioning the work units at the station, (3) unloading the work units from the station, (4) transporting work units between stations in manufacturing systems comprised of multiple workstations, and (5) temporary storage of work units to prevent starving of workstations.

5. What is the difference between fixed routing and variable routing in manufacturing systems consisting of multiple workstations?

Answer: In fixed routing, the work units always flow through the same sequence of workstations. This means that the work units are identical or similar enough that the processing sequence is identical. In variable routing, work units are transported through a variety of different station sequences. This means that the manufacturing system processes or assembles different types of work units.

6. Name the three cases of part or product variety in manufacturing systems. Briefly define each of the three cases.

Answer: The three cases of part or product variety in manufacturing systems are (1) single model, (2) batch model, and (3) mixed model. In the single-model case, all parts or products made by the manufacturing system are identical. In the batch-model case, different parts or products are made by the system, but they are made in batches because the physical setup and/or equipment programming must be changed over between models. In the mixed-model case, different parts or products are made by the system, but the differences are not significant, so the system is able to handle them without the need for time-consuming changeovers in setup or program.

7. What is flexibility in a manufacturing system?

Answer: Flexibility is the attribute that allows a mixed-model manufacturing system to cope with a certain level of variation in part or product style without interruptions in production for changeovers between models.

8. What are the three capabilities that a manufacturing system must possess in order to be flexible?

Answer: As identified in the text, the three capabilities are (1) identification of the different work units, (2) quick changeover of operating instructions, and (3) quick changeover of the physical setup.

Chapter 23:

1. What are manufacturing support systems?

Answer: As defined in the text, manufacturing support systems are the procedures and systems used by the firm to manage production and solve the technical and logistics problems associated with designing the products, planning the processes, ordering materials, controlling work-in-process as it moves through the plant, and delivering products to customers.

2. What are the six phases of the general design process?

Answer: As listed in the text, the six phases of the general design process are (1) recognition of need, (2) problem definition, (3) synthesis, (4) analysis and optimization, (5) evaluation, and (6) presentation (e.g., documenting the design).

3. What is computer-aided design?

Answer: As defined in the text, computer-aided design (CAD) is any design activity that involves the effective use of the computer to create, modify, analyze, or document an engineering design.

4. Name four of the six reasons for using a CAD system to support the engineering design function?

Answer: The six reasons listed in the text are (1) to increase the productivity of the designer, (2) to expand the available geometric forms in the design, (3) to improve the quality of the design, (4) to improve design documentation, (5) to create a manufacturing database, and (6) to promote design standardization.

5. Give some examples of engineering analysis software in common use on CAD systems.

Answer: The text lists the following examples: (1) Mass properties analysis to calculate weight, center of gravity and similar part attributes, (2) interference checking to identify interferences between components in an assembly, (3) tolerance analysis, (4) finite element analysis, (5) kinematic and dynamic analysis, and (6) discrete-event simulation.

6. What is computer-aided manufacturing?

Answer: As defined in the text, computer-aided manufacturing (CAM) is the effective use of computer technology in manufacturing planning and control.

7. What is the difference between CAD/CAM and CIM?

Answer: CAD/CAM is concerned with the engineering functions in design and manufacturing. Computer integrated manufacturing (CIM) includes all of the engineering functions of CAD/CAM, but it also includes the firm's business functions that are related to manufacturing.

Chapter 2:

1. What are the three basic industry categories?

Answer: The three basic industry categories are the following: (1) Primary industries, which are those that cultivate and exploit natural resources, such as agriculture and mining; (2) secondary industries, which convert the outputs of the primary industries into products; they include manufacturing, construction, and power generation; and (3) tertiary industries, which constitute the service sector of the economy, which includes banking, retail, transportation, education, government, and so on.

2. What is the difference between a processing operation and an assembly operation?

Answer: A processing operation transforms a work material from one state of completion to a more advanced state that is closer to the final desired part or product. It adds value by changing the geometry, properties, or appearance of the starting material. An assembly operation joins two or more components to create a new entity, called an assembly, subassembly, or some other term that refers to the joining process.

3. Name the four categories of part-shaping operations, based on the state of the starting work material.

Answer: The four categories are (1) solidification processes, (2) particulate processing, (3) deformation processes, and (4) material removal processes.

4. Assembly operations can be classified as permanent joining methods and mechanical assembly. What are the four types of permanent joining methods?

Answer: The joining processes are (1) welding, (2) brazing, (3) soldering, and (4) adhesive bonding.

5. What is the difference between hard product variety and soft product variety?

Answer: Hard product variety is when the products differ substantially. In an assembled product, hard variety is characterized by a low proportion of common parts among the products; in many cases, there are no common parts. Soft product variety is when there are only small differences between products. There are a high proportion of common parts among assembled products whose variety is soft.

6. What type of production does a job shop perform?

Answer: Low production of specialized and customized products. The products are typically complex, such as space capsules, aircraft, and special machinery.

7. Flow line production is associated with which one of the following layout types: (a) cellular layout, (b) fixed-position layout, (c) process layout, or (d) product layout?

Answer: (d) Product layout.

8. What is the difference between a single-model production line and a mixed-model production line?

Answer: A single-model production line makes products that are all identical. A mixed-model production line makes products that have model variations characterized as soft product variety.

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