Chapter 1 Introduction to Computer-Aided Manufacturing

Review Questions

1.1. What is computer-aided manufacturing?

Computer Aided Manufacturing (CAM) maybe defined as the effective utilization of computers in manufacturing. There are direct applications such as NC, robotics, PLC, machine monitoring and control, etc. and indirect applications such as MRP, CIM, process planning, scheduling, inventory, shop floor control, manufacturing execution system (MES), etc.

1.2. What are the major developments of CAM technology?

Major developments of CAM technology include but not limited to: NC, Industrial robot, Interactive computer graphics, CNC computer, DNC/FMS, CAD/CAM, PLC, device & cell control, Computer vision, 3-D CAD, solid modeling, factory networking, MAP/TOP, CIM, Concurrent engineering, Intelligent Manufacturing System.

1.3. What is the trend of manufacturing? Describe it in terms of market changes, technological development (both on products, and processes), managerial organization and philosophy shift, and social changes (use brain generation, green movement, and so on).

Trend of manufacturing:

- Rapid changing market place
- Fast development of new technologies
  Vacuum Tubes ->: Transistor -> IC -> VLSI
  Wiring -> thru-hole PCB -> Surface Mount Component
  Quality product -> precision engineering -> nano-engineering
- Fierce competition
- Failing automotive industry, steel mills, …

A "use brain" generation, not willing to learn the trade which requires hand skill.

1.4. List five direct and five indirect applications of computers in manufacturing.

Direct applications: NC machine tool control, FMS control, Material handling system control, Automatic Guided Vehicle, Direct Numerical Control.

Indirect applications: computer aided process planning, computerized shop scheduling, shop floor control, Computer Integrated Manufacturing, manufacturing execution system.

1.5. Discuss how manufacturing impact our standard of living.

Whether we can maintain our standard of living depends on whether we can provide sufficient goods and services to the population. Manufacturing is the meaning to produce goods. Under the free trade movement goods and services are moved freely over the national borders. "Trading" means exchange of goods or services. One must have something others want in order to trade. While a city state may rely on tourism (service) dollars to trade food and goods. A big nation can not afford to specialize on one of the areas such as agriculture, manufacturing, services, etc. to generate enough GDP to trade for

other necessities. The nation must compete on all fronts. Without manufacturing, our standard of living will decline.

1.6. In the past four decades we saw manufacturing jobs moving from developed countries to developing countries. Do you believe that manufacturing jobs will always follow the lower cost labors? Why?

The labor intensive and less skilled manufacturing jobs will always follow the lower cost labors. Since the labor cost is a significant part of the total cost. However, knowledge intensive manufacturing jobs will go to where such labors are available.

1.7. CAM is embraced by not only developed countries but also developing countries. Why is CAM important for them?

Although developing countries provide well educated yet inexpensive labors, they still need CAM to improve the productivity and quality. Not all manufacturing tasks can be done by pure human labor. Due to the complexity of the product and quality requirements, most of the industrial products require sophisticated machines to build. It is just impossible to compete by manufacture products by hand.

Chapter 2. Engineering Product Specification

Review Questions:

2.1. What are the five major steps in a design process? Briefly explain each one.

The five major steps in the design process are:

- Conceptualization - This phase represents the emergence of an idea to solve an engineering problem. A need or a requirement triggers this process.
- Synthesis - Based on the concepts generated in the previous stage, the engineer 'synthesizes' a design from base principles.
- Analysis - The design that originated earlier is analyzed for its soundness in this stage. The types of analysis are Mathematical, analysis for strength, Material, etc.
- Evaluation - The design is evaluated in terms of feasibility, cost evaluation. Following evaluation steps (b) and (c) may be repeated again, for instance to insure manufacturability.

Representation - This is the culmination of the design process. A suitable method of representation (CAD models, 2-D drafting, etc.) is chosen to precisely represent the design idea.

2.2. Discuss how a design idea is represented in a designer's mind, that is, in the form of an equation, line drawing, etc.

The designer conceptualizes a part in order to satisfy a specific need. He first visualizes the general shape of the part and the specific features required fulfilling its function. Later he adds manufacturing attributes such as dimensions, tolerances, auxiliary features, etc. But the design in the designers' mind consists of a set of features to satisfy a particular requirement. He may sometimes think in terms of surface equations.

2.4. What are the methods used in diameter inspection?

The simplest method is the use of a micrometer screw gauge (for od), and Vernier's calipers (for id as well as for od). More precise measurements may be taken using sophisticated measurement techniques. In mass production, the fastest methods include the use of plug gauges.

2.5 Why is it that 100 percent inspection seldom ensures that a shipment of parts will be 100 percent to specifications?

If the inspection devices are 100 percent accurate and the person operating the devices never makes mistake, with 100 inspection the parts will be 100 percent to the specifications. However, the above assumption is not always false.

2.6 For what reasons is it advisable to control the surface roughness of a part?

It is for working surface. Working surfaces are those for items such as bearings, pistons, and gear teeth, for which optimum performance may require control of the surface characteristics. Non-working surfaces are sometimes controlled for aesthetical purposes.

2.7 What is meant by the root-mean-square deviation?

Root-mean-square is a calculated value representing the surface roughness. It is calculated by the square root of the mean value of squared surface deviation heights from the center line.