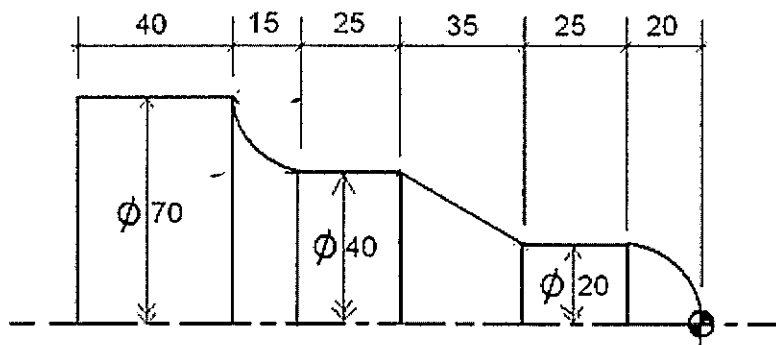


請回答下列問題，請依據你自己整理過後來回答問題，請不要直接照抄課本上的段落，直接照抄將不給分，。

1. What is the flexible automation? Describe the expected benefits of using the flexible automation solution in a factory. (5 points)
2. What is the lean production? Describe the expected benefits of using the lean automation solution in a factory. (5 points)
3. What is the availability of a production system and how is it defined? (5 points)
4. What is the CNC machining? Please describe the expected benefits of using the CNC machining to replace manual operation. (5 points)
5. For the part shown in the Figure, please write a NC program for turning this part. You must start from the raw material, roughing and finishing. If the material is carbon steel, determine the proper cutting by yourself conditions such as spindle speed and feed. (5points)



RAW MATERIAL: MS BAR OF DIAMETER 70 MM  
AND LENGTH 160 MM  
DIAGRAM NOT TO SCALE  
ALL DIMENSIONS ARE IN MM

6. A continuous voltage signal is to be converted into its digital counterpart using an analog-to-digital converter. The maximum voltage range is  $\pm 5$  V. If the required resolution is less than 0.05V, answer the following questions: (a) the minimum number of bits of an ADC and b) the quantization levels. (5 points)
7. A dc servomotor is used to drive one of the table axes of an NC milling machine. The motor is coupled directly to the ballscrew for the axis. If the maximum rotation speed of the motor is 3000rpm. The optical encoder attached to the lead screw emits 1000000 pulses per revolution of the lead screw. Determine (a) the pitch of the ballscrew, if the maximum feed velocity must be larger than 60m/min, (b) control resolution of the system, expressed in linear travel distance of the table axis, (c) frequency of the pulse train emitted by the optical encoder when the servomotor operates at full speed. (6 points)

8. A DC servomotor is used to actuate a machine axis. The motor has a torque constant of 20 Nm/A and a voltage constant of 10 V/(1000 rev/min). The armature resistance is 1.5 ohms. At a given moment, the positioner table is not moving and a voltage of 20 V is applied to the motor terminals. Determine the torque (a) immediately after the voltage is applied and (b) at a rotational speed of 800 rev/min. (c) What is the maximum theoretical speed of the motor? (7 points)
9. The A Company is planning to introduce a new product line and will build a new factory to produce the parts and assemble the final products for the product line. The new product line will include 60 different models. Annual production of each model is expected to be 2000 units. Each product will be assembled of 400 components. All processing of parts and assembly of products will be accomplished in one factory. There are an average of 8 processing steps required to produce each component, and each processing step takes 20 sec. (includes an allowance for setup time and part handling). Each final unit of product takes 2.0 hours to assemble. All processing operations are performed at work cells that each includes a production machine and a human worker. Products are assembled on single workstations consisting of two workers each. If each work cell and each workstation require 300 ft<sup>2</sup>, and the factory operates one shift (5500 hr/yr), determine: (a) how many production operations, (b) how much floorspace, and (c) how many workers will be required in the plant. (7 points)
10. An inspector must 100% inspect a production batch of 500 parts using a gaging method. If the actual fraction defect rate in the batch is  $q = 0.02$ , and the inspector's accuracy is given by  $p_1 = 0.96$  and  $p_2 = 0.84$ , determine (a) the number of defects the inspector can be expected to report and (b) the expected number of Type I and Type II errors the inspector will make. (10%)
11. What is the difference between accuracy and precision in measurement? Define these two terms. (6%)
12. What are some of the advantages of noncontact inspection? (5%)
13. The operation of a machine vision system can be divided into three functions. Name and briefly describe them. (6%)
14. It is currently day 10 in the production calendar of the XYZ Machine Shop. Three orders (A, B, and C) are to be processed at a particular machine tool. The orders arrived in the sequence A-B-C. The table below indicates the process time remaining and production calendar due date for each order. Determine the sequence of the orders that would be scheduled using the following priority control rules: (a) first-come-first-serve, (b) earliest due date, (c) shortest processing time, (d) least slack time, and (e) critical ratio. For each solution, (a) through (e), determine which jobs are delivered on time and which jobs are tardy. (15%)

Order	Remaining process time	Due date
A	4 days	Day 20
B	16 days	Day 30
C	6 days	Day 18

15. A stamping plant supplies sheet metal parts to a final assembly plant in the automotive industry. The following data are values representative of the parts made at the plant. Annual demand is 150,000 pc (for each part produced). Average cost per piece is \$18 and holding cost is 20% of piece cost. Changeover (setup) time for the presses is 5 hours and the cost of downtime on any given press is \$200/hr. Determine (a) the economic batch size and (b) the total annual inventory cost for the data. If the changeover time for the presses could be reduced to 10 minutes, determine (c) the economic batch size and (d) the total annual inventory cost. (8%)