

2002 National Exams

Mec-B5

PRODUCTION PLANNING AND MANUFACTURING

3 Hours Duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. Any non-communicating calculator is permitted. This is an Open Book exam. Note to candidates you must indicate the type of calculator being used, i.e., write the name and model designation of the calculator, on the first inside left hand sheet, of the exam work book.
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are of equal value.

1. a) The annual amount ordered from one raw material supplier is \$260,000. Order costs are 1% of the value of each order, and carrying costs are 18% of the average inventory level. How many weeks of supply should be ordered at one time?
- b) Parts used in assembly work are purchased from a supplier who has a remarkable record for prompt delivery. The inventory history closely follows an instantaneous replenishment pattern. However, to be on the safe side, a policy is followed of never planning an inventory level below 500 parts. The following costs are applicable:

procurement cost	=	\$60 per order
carrying cost	=	\$0.20 per unit per year based on average inventory

If the demand is 40,000 parts per year used at a steady rate, what is the total annual inventory cost?

2. Job orders are received at a work center with the characteristics indicated by the data in Table 2. In what sequence should the orders be processed at the work center if the priority dispatch decision rule is:

- a. FCFS (first come-first served)?
- b. SOT (shortest operation time)?
- c. SS (static slack, i.e., due date less time of arrival at work center)?
- d. FISFS (due date system, first in system-first served)?
- e. SS/RO (static slack/remaining number of operations)?

Compute priorities for each rule and list the sequence in which orders would be processed.

Which decision rule do you prefer? Why?

Table 2 Order and Processing Data for Six Jobs

Order Number	Due Date	Date and Time Received at Center	Operation Time, Hours	Remaining Operations
1	May 1	Apr. 18, 9 a.m.	6	3
2	Apr. 20	Apr. 21, 10 a.m.	3	1
3	June 1	Apr. 19, 5 p.m.	7	2
4	June 15	Apr. 21, 3 p.m.	9	4
5	May 15	Apr. 20, 5 p.m.	4	5
6	May 20	Apr. 21, 5 p.m.	8	7

3. a) A large manufacturer of watches makes some of his own parts and buys some other parts from a vendor. The vendor submits lots of parts that meet the specifications of the horologist. The vendor thus wishes to keep a continuous check on his production of watch parts. One gear has been a special problem. A check of 25 samples of 5 pieces gave the following data on a key dimension:

$$\bar{\bar{X}} = 0.125 \text{ inch} \quad \bar{R} = 0.002 \text{ inch}$$

What criterion should be set up to determine when the process is out of control? How should this criterion compare with the specifications? What are his alternatives if the criterion is not compatible with the specification?

4. a) Discuss a manufacturing situation in which centralized inspection would be particularly desirable.
- b) In what ways may the use of data processing equipment and computers be of value in the quality control program?
- c) In what way can statistical quality control aid in promoting the understanding and appreciation of quality control?

5. The Stamped Metal Products Co. (StaMCo) is considering the manufacture of a special item for the Air Force. After considerable analysis, the company has identified the following costs:

Material	\$0.5 per unit
Tooling	20 hours
Unit direct labour	0.4 hour
Labour rate	\$2 per hour
Factory burden	115% of labour
General and administrative burden	20% of factory cost
Target profit	10% of total cost

Construct a break-even chart on a 10,000 basis with a unit sales price of \$3.

6. a) Suppose that an electronic process control system consists of five components, all of which must function in order for the system to operate. If the components are designated A, B, C, D, and E, and if their respective failure rates per 1000 hours of operation are

$$\lambda_A = 1.2, \quad \lambda_B = 0.75, \quad \lambda_C = 0.65, \quad \lambda_D = 0.95, \quad \lambda_E = 1.15$$

- a) What is the reliability of the system for 500 hours of operation?
 b) What is the MTTF of each component?
 c) What is the MTTF of the system?
- b) If only two of the components of the system in case a) above can be made redundant, how much can the reliability of the system be improved? Draw a block diagram of the system showing the redundancies.

7. a) An instrument has been used to measure the length of a part. The result was 2.638 inches. An error of measurement study was made on the instrument with the following results:

Accuracy: +0.001 inch (on the average, the instrument reads 0.001 inch high)

Precision: 0.0004 inch (1 standard deviation)

Make a statement concerning the true value of the part just measured. State all assumptions needed.

- b) The precision of a certain mechanical gage is indicated by a standard deviation (of individual repeat measurements) of 0.001 inch. Investigate the effect on precision of making multiple measurements. Consider 2, 3, 4, 5, 10, 20, and 30 as multiples. Graph the results.