

National Exams May 2019

16-Mec-B4, Integrated Manufacturing Systems

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. This is an OPEN BOOK exam. Any non-communicating calculator is permitted.
3. Any five (5) questions constitute a complete paper. Only the first five (5) questions as they appear in your answer book will be marked.
4. All questions are of equal value.
5. Some questions require an answer in essay format. Clarity and organization of the answer are important.

Question 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?

Question 2:

Control charts are maintained on the weight of an item. After a base period of 30 samples of size 3, $\sum \bar{X} = 12930$ g and $\sum R = 123$ g.

- a)
- I. Compute the control limits and estimate the standard deviation of the item weights. (Assume that base period observations indicate the process to be in control.)
 - II. If the process average of the weights shifts to 433 g, how long will it take to detect the shift using the control limits in part (a)?
- b) Production is started to produce a newly designed component. To monitor the length \bar{X} and R charts are started based on 25 subgroups of four items each. For these 25 subgroups $\sum \bar{X} = 500$ cm and $\sum R = 153.2$ cm. Determine the 3σ control limits. What is the probability that a shift of 2 cm in the process average would be detected on the first subgroup observed after the shift?

Question 3:

- What benefits may result from planning a system for materials handling?
- Should materials handling labour cost be a direct cost or an indirect cost? Give reasons .
- List the reasons for considering plant layout at the same time materials handling requirements are determined.

Question 4:

- A lightweight component in an electrical assembly has a reliability of 0.70. Provision of two redundant units can be tolerated with no appreciable effect on weight specifications. If two redundant units of the same component are installed, what will be the compound reliability of the three?
- An assembly, through simplification, can be reduced from six components to three components. The reliability of each of the six components is 0.98. Presuming no change in component reliabilities, what would be the change in the assembly reliability with reduction of components?

Question 5:

The monthly usage rate for a certain type of cemented carbide insert used in the machine shop is averaging 1100 units. The inserts cost \$4.36 each when ordered in quantities over 500. It is estimated that it costs an average of \$60 each time a batch of inserts is ordered. The holding cost for this shop is based on using 25% per year of the cost of the item in inventory. What is the economic order quantity for this insert?

Question 6:

A digital-to-analog converter (DAC) uses a reference voltage source of 10V and uses a binary register with six-digit precision. In two successive sampling instants 0.5 s apart, the data contained in the binary register are as follows:

Sampling Instant	Binary Data					
	B ₁	B ₂	B ₃	B ₄	B ₅	B ₆
t - 1	1	0	1	0	1	0
t	1	0	1	1	0	1

The DAC uses a zero-order hold to maintain the voltage output between sampling instants. Determine the voltage output during the sampling interval following instant t.

Question 7:

- a) The cost of producing between 1,500 units and 2,500 units of a product consists of \$25,000 fixed cost and \$10-per-unit variable cost. With the selling price at \$20.00 per unit, what is the break-even point? Suppose the price per unit was increased to \$25. How does this affect the break-even point?
- b) A new machine has a cost of \$24,000, an estimated economic life of eight years, and a salvage value of \$4000 at the end of the eight-year period. Assume that the annual operating costs will be \$3000 per year and that the going rate of interest is 10%. What is the present value of new expenditures for the machine?