National Exams December 2010

07-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 questions constitute a complete paper. Only the first five (5) questions as they appear in your answer book will be marked.
4. Each question is of equal value.
5. Some questions require an answer in essay format. Clarity and organization of the answer are important.

Question 1:

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 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 $4,000 at the end of the eight-year period. Assume that the annual operating costs will be $3,000 per year and the going rate of interest is 10 percent. What is the present value of new expenditures for the machine?

Question 2:

The following tasks must be performed on an assembly line in the sequence and times specified below.

Task	Task Time (seconds)	Task which must precede
A	50	-
B.....	40	-
C.....	20	A
D.....	45	A, C
E.....	20	A, C
F.....	25	A, C, D
G.....	10	A, C, E
H.....	35	A, B, C, D, E, F

a) Draw the schematic diagram.

b) What is the theoretical minimum number of stations required to meet a forecasted demand of 400 units per eight-hour day?

c) Select a balancing rule and balance the line in the minimum number of stations to produce 400 units per day.

Question 3:

a) What are the three basic controllable variables of a production planning problem? What are the four major costs?

b) Distinguish between pure and mixed strategies in production planning.

c) How does Search Decision Rule method work?

d) What are the general conditions for which preventive maintenance is appropriate?

Question 4:

A company is considering whether to overhaul or replace a machine. The machine was purchased four years ago and was overhauled two years ago.

A new machine costs $2000, and an overhaul costs $500 and lasts two years. Experience indicates that annual operating costs increase with time owing to increased maintenance charges. Table 2 shows operating costs for new and overhauled machines.

Analyze the situation and indicate what decision should be made. Assume that machines have no salvage value at any time and that the cost of capital is 15 percent per year.

Table 2
Operating Costs

Year	New Machine	First Overhaul	Second Overhaul	Third Overhaul	Fourth Overhaul
1	$1000	$1100	$1300	$1700	$2300
2	$1100	$1300	$1700	$2300	$3200

Question 5:

a) 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?

b) An assembly, through specification, 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 6:

a) A large manufacturer of watches makes some parts and buys some other parts from a vendor. Periodically, the vendor submits a batch of parts that meet the specifications of the horologist. The vendor thus wishes to keep a continuous check on 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:

$\bar{\bar{X}} = 0.125$ inch $\qquad \bar{R} = 0.002$ 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 the alternatives if the criterion is not compatible with the specification?

Question 7:

For the next week, the work center capacities are as follows:

Work center	A	B	C	D
Capacity (hours available)	70	45	60	55

The following jobs have been loaded on the work centres:

	Hours required per work centre			
Job Number	A	B	C	D
10	5	6	4	2
12	6	2	-	4
14	2	6	2	2
15	7	8	4	-
16	4	-	6	2
17	8	5	2	3
18	14	11	9	5
19	3	9	4	-
20	6	-	5	7

Is sufficient capacity available to perform all the jobs? Are any work centers overloaded?