

THE OPEN UNIVERSITY OF SRI LANKA
 FACULTY OF ENGINEERING TECHNOLOGY
 DIPLOMA IN TECHNOLOGY (MECHANICAL) – LEVEL 04
 FINAL EXAMINATION – 2005/2006
 MEX4235/MED2206 – PRODUCTION MANAGEMENT – PART B



DATE : 07 APRIL 2006 (Friday)
 TIME : 1015-1230
 DURATION : 2 HOURS AND 15 MINUTES

*Answer any five (05) questions. All questions carry equal marks.
 Graph sheets will be provided at request.*

1. A construction company is to build a new plant. The construction project will require nine distinct activities. Table 1 gives the nine project activities required to complete together with their duration, possible crashing and associated costs.

| Activity | Preceding Activities | Required Time (weeks) | | Cost (Rs.) | |
|----------|----------------------|-----------------------|-------|------------|--------|
| | | Normal | Crash | Normal | Crash |
| A | - | 4 | 2 | 10,000 | 11,000 |
| B | A | 3 | 2 | 6,000 | 9,000 |
| C | A | 2 | 1 | 4,000 | 6,000 |
| D | B | 5 | 3 | 14,000 | 18,000 |
| E | B, C | 1 | 1 | 9,000 | 9,000 |
| F | C | 3 | 2 | 7,000 | 8,000 |
| G | E, F | 4 | 2 | 13,000 | 25,000 |
| H | D, E | 4 | 1 | 11,000 | 18,000 |
| I | H, G | 6 | 5 | 20,000 | 29,000 |

Table 1.

- (i) Construct a network diagram for the total project showing precedence relationships.
 (06 marks)
- (ii) Determine the critical path and estimated project completion time.
 (04 marks)
- (iii) If you want to shorten the project by three weeks, which tasks would be shortened and what would the final project cost be?
 (10 marks)

2. (a) What is a typical transportation problem? In general, how do you decide which cost elements to include in a transportation problem?

(05 marks)

(b) A departmental store wishes to purchase the following quantities of ladies dresses.

| | | | | |
|------------|-----|-----|-----|-----|
| Dress size | I | II | III | IV |
| Quantity | 100 | 200 | 450 | 150 |

Three manufactures are willing to supply dresses. The quantities given below are the maximum they are able to supply of any given combination of orders for dresses.

| | | | |
|----------------|-----|-----|-----|
| Manufacturer | A | B | C |
| Total Quantity | 150 | 450 | 250 |

The departmental store expects profits per dress (in rupees) to vary with the manufacturer as given in table 2.

| Manufacturer | Sizes | | | |
|--------------|-------|------|------|------|
| | I | II | III | IV |
| A | 2.50 | 4.00 | 5.00 | 2.00 |
| B | 3.00 | 3.50 | 5.50 | 1.50 |
| C | 2.00 | 4.50 | 4.50 | 2.50 |

Table 2

Using the transportation method, find how the orders should be placed with the manufacturers in order to maximise profits.

(15 marks)

3. (a) Describe the difference between dependent and independent demand and give an example of each for an automobile manufacturing company.

(05marks)

(b) A dealer makes the following information available to you with regard to a product he deals with.

- Annual demand : 10,000 units
- Ordering cost : Rs.10.00 per order
- Unit Price : Rs. 20.00 per unit
- Inventory carrying cost: 20% of unit price per unit per annum

The dealer is considering the possibility of allowing some backorder (stock-out) to occur. He has estimated that the annual cost of back ordering will be 25% of the value of inventory.

- (i) What should be the optimum number of units of the product to be bought in one lot?
- (ii) What quantity of the product should be allowed to be back-ordered?
- (iii) What would be the maximum quantity of inventory at any time of the year?

(15marks)

4. (a) How does modern quality management differ from the "inspection" approach?

(05marks)

(b) A manufacturing company is engaged in producing different types of valves for automobiles manufactures. The company produces a quantity of 10,000 special valves during a 10-day period. Each day, the company quality control manager takes a sample of 50 valves, tests them, and determines the number of defective valves. Since this is the first order for the special valves, the manufacturer wishes to determine whether the process is under control and establish control limits for future use.

Table 4 lists the number of defective items in the 20 sample lots of 50 valves in each.

| Lot Number | Number of defectives | Proportion defectives (P) | Lot Number | Number of defectives | Proportion defectives (P) |
|------------|----------------------|---------------------------|------------|----------------------|---------------------------|
| 1 | 4 | 0.08 | 11 | 5 | 0.10 |
| 2 | 3 | 0.06 | 12 | 14 | 0.28 |
| 3 | 8 | 0.16 | 13 | 9 | 0.18 |
| 4 | 12 | 0.24 | 14 | 11 | 0.22 |
| 5 | 7 | 0.14 | 15 | 2 | 0.04 |
| 6 | 15 | 0.30 | 16 | 9 | 0.18 |
| 7 | 20 | 0.40 | 17 | 3 | 0.06 |
| 8 | 13 | 0.26 | 18 | 13 | 0.26 |
| 9 | 9 | 0.11 | 19 | 6 | 0.12 |
| 10 | 8 | 0.16 | 20 | 9 | 0.18 |

(Total number of defectives = 180)

Table 4

- i) Draw the p-chart and plot all points on it.
- ii) Suppose that an investigation was initiated and review of the shop records indicated that the particular shift during which lot 7 was manufactured, was started by a new operator, and that he misunderstood the adjustment of specific machining process. After a brief introduction of the correct method, the cause for defects in the process was eliminated. Considering this fact, recommend the revised control limits for future production. (15 marks)

5. (a) What are Gantt charts and why are they used in sequencing? (04 marks)

- (b) A refrigeration company has six plants located in different areas of a city. Every year, it is necessary for each plant to be completely overhauled. The overhauling is carried out in two stages, I and II, and each stage requires two groups of workmen with completely different skills namely crew C_1 and C_2 . Crew C_1 is responsible for overhaul operations in stage I and Crew C_2 is responsible for overhaul operations in stage II. The work on stage II can start only when stage I has been completed. The time (in days) required by crew C_1 and C_2 on different plants are as given in the table 5.

| | Plant 1 | Plant 2 | Plant 3 | Plant 4 | Plant 5 | Plant 6 |
|------------|---------|---------|---------|---------|---------|---------|
| Crew C_1 | 6 | 6 | 4 | 6 | 5 | 8 |
| Crew C_2 | 4 | 2 | 10 | 5 | 3 | 6 |

Table 5

At present the company undertakes the overhauling in a sequential manner, i.e. plant 2 is overhauled after overhauling of plant 1 is completed and plant 3 after plant 2 and so on. However, it is established that this is not the optimum sequence for scheduling of overhauls.

- (i) Determine the optimal sequence.
- (ii) If down time of any of the six plants costs Rs. 8,000.00 per day, idle time for crew C_1 cost Rs. 2,500.00 per day, and idle time for crew C_2 costs Rs. 4300.00 per day, determine the loss due to non implementation of the optimal sequence.

Note: Assume that a plant has to be shut down for the entire the period for its overhauling.

(16 marks)

6. (a) How is break-even analysis used for process/equipment selection?
- (b) A manufacturer has identified the following alternative processes for obtaining a machined part.

Process 1 : It can buy the part at Rs. 2000.00 per unit including materials.

Process 2 : It can make the part on a numerically controlled semiautomatic Lathe at Rs. 750.00 per unit including materials.

Process 3 : It can make the part on a CNC machining centre at Rs.150.00 per unit including materials.

Assume that the cost of a semiautomatic lathe is Rs. 800,000.00 cost of a CNC machining centre is Rs. 2,000,000.00 and there is a negligible fixed cost if the item is purchased. Selling price of a part is Rs. 3000.00.

- (i) Determine the break-even point for each process.
- (ii) If process selection is based solely on cost minimization or profit maximization, for what range of production would each process be chosen?
7. (a) Define "work-study" and explain the need for work-study in an organization. (04 marks)
- (b) A time study was conducted on a job that contains four elements. The observed times and performance rating for six cycles are shown in table 7.

| Element | Performance Rating (%) | Observations (minutes per cycle) | | | | | |
|---------|------------------------|----------------------------------|------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 90 | 0.44 | 0.50 | 0.43 | 0.45 | 0.48 | 0.46 |
| 2 | 85 | 1.50 | 1.54 | 1.47 | 1.51 | 1.49 | 1.52 |
| 3 | 110 | 0.84 | 0.89 | 0.77 | 0.83 | 0.85 | 0.80 |
| 4 | 100 | 1.10 | 1.14 | 1.08 | 1.20 | 1.16 | 1.26 |

Table 7

- (i) Determine the average cycle time for each element.
- (ii) Find the normal time for each element.
- (iii) Assuming an allowance factor of 15 percent of job time, compute the standard time for this job. (12 marks)
- (c) Why should the allowances are considered when calculating the standard time of a job? (04 marks)

8. Write short notes on any four (04) of the following.

- (i) Importance of demand forecasting for a manufacturing organization
- (ii) Objectives of facility layout
- (iii) Group Technology and its benefits
- (iv) Maximum and minimum price fixing in economics
- (v) Management accounting Vs Cost accounting
- (vi) Replacement policies in plant maintenance

(4 X 5 marks)

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