# The Open University of Sri Lanka
# Faculty of Engineering Technology
# Department of Mechanical Engineering

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|---|---|---|
| Study Programme | : | Bachelor of Technology Honours in Engineering |
| Name of the Examination | : | Final Examination |
| **Course Code and Title** | : | **DMX6540 /MEX6240 Industrial Engineering** |
| Academic Year | : | 2017/18 |
| Date | : | 18.02.2019 |
| Time | : | 1330-1630 hrs |
| Duration | : | 3 hours |

**General instructions**

1. Read all instructions carefully before answering the questions.
2. This question paper consists **of 08 questions and 06 pages.**
3. **Answer any 05 questions only**. All questions carry equal marks.
4. Answer for each question should commence from a new page
5. Relevant charts/ equations are provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.
9. Last page (**page 6**) should be attached to the answer scripts.

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Q1.  a)  Name two common scheduling techniques known to you.    [01 mark]

   b)  What are the main differences between PERT and CPM?    [01 mark]

   c)  A project has activities from A to J are shown in the table given below. The Preceding activities, Normal duration of each activities and Normal cost of each activity is also given.

| Activity | Preceding Activity | Normal duration(days) | Normal cost (Rs) |
|----------|--------------------|-----------------------|------------------|
| A | - | 2 | 200 |
| B | - | 3 | 500 |
| C | - | 4 | 500 |
| D | A,B | 6 | 600 |
| E | B,C | 5 | 400 |
| F | D,E | 4 | 600 |
| G | B,C | 6 | 700 |
| H | D,E | 4 | 400 |
| I | F,G | 10 | 300 |
| J | H,I | 8 | 500 |

(i) Draw the Activity On Arrow (AOA) diagram using the data given in the table above. [05 marks]

(ii) Find the Critical Path of the Project. [01 mark]

(iii) Find the project duration. [01 mark]

(iv) Find Latest Starting time (LST) and Latest Finishing time(LFT) of each activity. [05 marks]

(v) What are the activities which can be delayed without affecting project duration? [02marks]

(vi) Which activity can be delayed most? [01 mark]

(vii) If indirect cost of the project is Rs.100 per day, what is the total cost of the project? [03 marks]

Q2. a) Compare and contrast production plan with business plan [05 marks]

c) What is meant by Capacity Requirement Planning? [05 marks]

b) "Rough cut capacity planning is the process of determining the long range capacity, a resource must provide" Elaborate the above statement.[05 marks]

d) Why scheduling techniques are important in production planning?[05 marks]

Q3. (a) What is the purpose of workstudy? [04 marks]

(b) What is the objective of the method study? How it is achieved? [02 marks]

(c) When selecting a work for method study what are the main factors to be taken into consideration? [03 marks]

(d) What are the human attitudes expected from a person responsible for method study? [03 marks]

(e)

| Observation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time (min) | 5 | 6 | 4 | 5 | 4 | 6 | 7 | 5 | 6 | 4 | 3 | 5 | 4 | 7 | 6 |

In a time study a job undertaken in a machining process has been observed and the time taken to finish the job is measured and tabled as shown above. What is the minimum number of observations required to achieve 95% confidence limit with 5% accuracy?

Required number of observations for a 95% confidence limit with 5% accuracy is given by

$$N_1 = \left[ \frac{40\sqrt{N \, \Sigma x^2 - (\Sigma x)^2}}{\Sigma x} \right]^2$$

where N is the total number of observations and x is the frequency.

[08 marks]

Q4. (a) Describe the terms PS, MPS, MRP and ERP. [02 marks]

(b) What are the benefits of MRP? [03 marks]

(c) What are the basic elements of the MPR system? [02 marks]

(d) Product X is made of two units of Y and three units of Z. Y is made of two units of A and two units of B. Z is made of two units of A and three units of C.

Lead times of each products are as given below:

| Product | X | Y | Z | A | B | C |
|---|---|---|---|---|---|---|
| Lead Time(Weeks) | 1 | 2 | 2 | 1 | 1 | 3 |

i) Draw the Product structure tree (BOM) [05 marks]

ii) If 50 units of X are needed in week ten (10), develop a Material Requirement Plan when there are 20X, 20Y, 30Z, 30A,60B and 100C are in stock. . [08marks]

**(Use the MRP sheet attached at the end of the question paper to answer Q4)**

Q5. a) Name three methods that can be used in solving a transportation problem.

[02 marks]

b) Paddy is harvested in Polonnaruwa and stored in paddy stores in three different cities Anuradhapura, Kurunegala, and Polonnaruwa. These paddy stores supply paddy to the rice mills, located in Colombo, Galle and Matara. Paddy is shipped to the mills by Lorries, each capable of holding one ton of paddy. Each lorry is able to supply the following number of tons of paddy to the rice mills on a monthly basis.

| Paddy Stores | Supply |
|---|---|
| 1. Anuradhapura | 150 |
| 2. Polonnaruwa | 175 |
| 3. Kurunegala | 275 |
| Total | 600 tons |

Each rice mill demands the following number of tons of rice per month.

| Rice Mill | Demand |
|---|---|
| A. Matara | 200 |
| B. Galle | 100 |
| C. Colombo | 300 |
| Total | 600 tons |

The cost of transporting one ton of paddy from each paddy stores to each rice mill differs according to the distance. These cost of transporting 1 kg of paddy from paddy stores to the rice mills are shown in the table below.

| | Rice Mill | | |
|---|---|---|---|
| Paddy Stores | A. | B. | C. |
| 1. | Rs6 | Rs 8 | Rs10 |
| 2. | 7 | 11 | 11 |
| 3. | 4 | 5 | 12 |

(i) Find the transportation cost using the least cost method. [06marks]
(ii) Use MODI method to find the optimum transportation cost. [10marks]

Page 4 of 6

(iii)   What is the minimum transportation cost.                        [02marks]

Q6.

a)  What is the key principle of lean operations?                        [04marks]

b)  Give reasons why you propose to introduce lean manufacturing for an organization.
                                                                         [04marks]

c)  What are the eight wastes in a lean manufacturing system?.           [04marks]

d)  Define the term Just in Time (JIT)?                                  [02marks]

e)  What are the main differences between Traditional approach and JIT approach.  [04marks]

f)  What is Kanban? If you introduce Kanban to your organization what are the benefits you
    can expect?                                                          [02marks]

Q7. Write short notes on following

a)  Role of the Industrial Engineer                                      [04 marks]
b)  Production Systems                                                    [04 marks]
c)  ERP and its applications                                             [04 marks]
d)  5 S                                                                   [04 marks]
e)  TPS                                                                   [04 marks]

Q8. (a) What are the basic elements of a linear programming model?       [02marks]

(b) What is the importance of linear programming?                        [01mark]

(c) What are the limitations of graphical method of linear programming?  [01mark]

(d) A company has budgeted a maximum of Rs. 600,0000 for advertising a certain product
    nationally. Each minute of television time costs Rs.600,000 and each one page of newspaper
    advertisement costs Rs15,0000. Each television advertisement is expected to be viewed by
    15 million viewers, and each newspaper advertisement is expected to be seen by 3 million
    readers. The company's market research department advises the company to use at most
    90% of the advertising budget on television advertisements.

(i)     Determine and define the decision variables                      [02 marks]

(ii)    Formulate the objective function                                 [02 marks]

(iii)   Formulate each constrains                                        [02 marks]

(iv)    Use the Simplex method to allocate the advertising budget to maximize the total
        audience.
                                                                         [10 marks]

| Item | | Week | | | | | | | | | |
|------|--|------|--|--|--|--|--|--|--|--|--|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| X (LT=1) | Gross Requirement | | | | | | | | | | |
| | On Hand (20 ) | | | | | | | | | | |
| | Net Requirement | | | | | | | | | | |
| | Planned Order receipts | | | | | | | | | | |
| | Planned Order release | | | | | | | | | | |
| Y (LT=2) | Gross Requirement | | | | | | | | | | |
| | On Hand (20 ) | | | | | | | | | | |
| | Net Requirement | | | | | | | | | | |
| | Planned Order receipts | | | | | | | | | | |
| | Planned Order release | | | | | | | | | | |
| Z (LT=2) | Gross Requirement | | | | | | | | | | |
| | On Hand (30 ) | | | | | | | | | | |
| | Net Requirement | | | | | | | | | | |
| | Planned Order receipts | | | | | | | | | | |
| | Planned Order release | | | | | | | | | | |
| A (LT=1) | Gross Requirement | | | | | | | | | | |
| | On Hand (30 ) | | | | | | | | | | |
| | Net Requirement | | | | | | | | | | |
| | Planned Order receipts | | | | | | | | | | |
| | Planned Order release | | | | | | | | | | |
| B (LT=1) | Gross Requirement | | | | | | | | | | |
| | On Hand ( 60 ) | | | | | | | | | | |
| | Net Requirement | | | | | | | | | | |
| | Planned Order receipts | | | | | | | | | | |
| | Planned Order release | | | | | | | | | | |
| C (LT=3) | Gross Requirement | | | | | | | | | | |
| | On Hand ( 100 ) | | | | | | | | | | |
| | Net Requirement | | | | | | | | | | |
| | Planned Order receipts | | | | | | | | | | |
| | Planned Order release | | | | | | | | | | |