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**University Examinations 2014/2015**

FIRST YEAR, SPECIAL / SUPPLEMENTARY EXAMINATION FOR THE DEGREE OF BACHELOR OF BUSINESS INFORMATION TECHNOLOGY

AND

SECOND YEAR, SPECIAL / SUPPLEMENTARY EXAMINATION FOR THE DEGREE OF BACHELOR OF COMMERCE

**SMB 3425: OPERATIONS RESEARCH**

**DATE: OCTOBER, 2015 TIME:** $2$**HOURS**

**INSTRUCTIONS:** *Answer questions* ***one*** *and any other* ***two*** *questions*

**QUESTION ONE - (30 MARKS)**

1. (i) Define the term Operation Research. (2 Marks)

(ii) Briefly discuss the history of operations research. (3 Marks)

1. (i) Describe the characteristics of a linear programming problem. (3 Marks)

(ii) A baby food manufacturer wishes to mix two brands of food so that the vitamin content per kilogram of the mixture is at least 18 units of vitamin A, 14 units of vitamin B, 20 units of vitamin C and 24 units of vitamin D. The vitamin content per kg of each brand is shown in the table below.

|  |  |
| --- | --- |
|  | Vitamin Content |
| Vitamin  | A | B | C | D |
| Brand 1 | 4 | 2 | 2 | 2 |
| Brand 2 | 2 | 2 | 4 | 6 |

If Brand 1 cost sh.10 per kilogram and Brand 2 cost sh.14 per kilogram,formulate a linear programming problem. (5 Marks)

(iii) Consider the above linear programming problem in part(b) (ii) of question one. State two methods that can be successfully used in solving the problem. (2 Marks)

1. Given the linear programming problem:

maximize $z=x+4y$

Subject to

$$-x+2y \leq 6$$

$$5x+4y \leq 40$$

$$x \geq 0$$

$$y\geq 0$$

1. Express this linear programming problem in standard form. (2 Marks)
2. Use simplex method to solve the linear programming problem. (7 Marks)
3. Find the initial solution of the following transportation problem using North-West corner rule. (6 Marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Plant | W1 | W2 | W3 | Capacity |
| P1 | 8 | 6 | 10 | 29 |
| P2 | 13 | 17 | 11 | 45 |
| P3 | 9 | 8 | 7 | 44 |
| Demand | 35 | 46 | 37 | 118 |

**QUESTION TWO – (20 MARKS)**

1. Job A,B and C are to be allocated to machines R, S and T and the returns in terms of profit in thousands of shilling are shown on the table below. Each machine is to be allocated to one job for maximum profit.

|  |  |  |  |
| --- | --- | --- | --- |
|  MachineJob | R | S | T |
| A | 8 | 6 | 10 |
| B | 11 | 9 | 6 |
| C | 4 | 7 | 5 |

1. Transform this problem into a minimization problem and use Hungarian method to determine the optimal allocation. (6 Marks)
2. What is the maximum profit? (2 Marks)
3. Ozark farm uses at least 800kg of special feeds daily. The special feed is a mixture of corn and soya beans meal with the following compositions;

|  |  |  |  |
| --- | --- | --- | --- |
| **Feed Stuff** | **Protein** | **Fiber**  | **Cost (Ksh /kg)** |
| Corn | 0.09 | 0.02 | 30 |
| Soybean | 0.60 | 0.06 | 90 |

The dietary requirements of the special feed stipulate at least 30% protein and at most 5% fiber. Ozark farm wishes to determine the daily minimum cost feed mix.

1. Formulate a linear programming problem for Ozark farm and simplify the constraints.

(4 Marks)

1. Use a suitable method to determine the daily minimum cost feed mix for Ozark farm.

 (6 Marks)

1. Given the primal problem

Maximize $z=3x+4y$

Subject to

$$2x+y \leq 16$$

$$5x+2y \geq 20$$

$$x ,y\geq 0$$

Write down its dual problem. (2 Marks)

**QUESTION THREE – (20 MARKS)**

1. Incident occurs on freeway that has capacity of 4000 veh/hr and constant flow of 2900 vehicles per hour during commute. Traffic accidents occur at 8:00 a.m closing the freeway. At 8:12 a.m freeway partially opened with flow capacity of 2000 vehicles per hour. Freeway restored to full capacity of 4000 vehicles per hour at 8:31 a.m. Determine queue dissipation, longest queue length, total delay, average delay per vehicle and longest wait of any vehicle. (10 Marks)
2. A manufacturer produces two types of drinks, castle and lager. Castle is sold at a profit of three shillings per unit and lager four shillings per unit. The manufacturer wishes to establish the weekly production plan which maximizes profit. Production data are as follows;

|  |  |  |  |
| --- | --- | --- | --- |
|  | Machine hrs/Unit | Labour hrs/Unit | Materials kg |
| Castle | 4 | 4 | 1 |
| Lager | 2 | 6 | 1 |
| Total available per week | 100 | 180 | 40 |

Because of a trade agreement sales of castle are limited to a weekly maximum of twenty units and to honour an agreement with an old established customer at least ten units of lager must be sold per week. Formulate a linear programming model governing this data and apply simplex method or otherwise to determine the maximum profit. (10 Marks)

**QUESTION FOUR – (20 MARKS)**

1. Construct an arrow diagram for the following project.

|  |  |
| --- | --- |
| Activity | Predecessor |
| A | B, C | 5 |
| B |  | 7 |
| C | G | 6 |
| D | B,C | 8 |
| E | B | 10 |
| F | D,G | 10 |
| G |  | 7 |
| H | E | 5 |
| J | F,G,H | 9 |

Identify the critical path. (10 Marks)

1. Define the following terms as used in network analysis.
2. Total float (2 Marks)
3. Critical path (2 Marks)
4. State three differences between PERT and CPM techniques in a project management.

(6 Marks)

**QUESTION FIVE – (20 MARKS)**

1. Distinguish between transportation and assignment problems. (2 Marks)
2. Consider a distribution system having the following constraints.

|  |  |
| --- | --- |
| Factory | Capacity(Units) |
| A | 45 |
| B | 15 |
| C | 40 |

|  |  |
| --- | --- |
| Warehouse | DemandUnits |
| X | 25 |
| Y | 55 |
| Z | 20 |

The transportation cost per unit (in Ksh) allocated with each route are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  ToFrom | X | Y | Z |
| A | 10 | 7 | 8 |
| B | 15 | 12 | 9 |
| C | 7 | 8 | 12 |

Determine the minimum initial total cost of transportation using Vogel’s approximation method. (8 Marks)

1. A firm has four plants, P1, P2, P3 and P4 each of which can manufacture any of the four products A, B, C and D. Production cost difer from one plant to another as do the cost of raw materials. Given the profit data below, assign the products to plants so as to realize maximum profit, and state the maximum profit. (10 Marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  ProductsPlants | A | B | C | D |
| P1 | 1 | 8 | 4 | 1 |
| P2 | 5 | 7 | 6 | 5 |
| P3 | 3 | 5 | 4 | 2 |
| P4 | 3 | 1 | 6 | 3 |