**RAJARATA UNIVERSITY OF SRI LANKA**
**FACULTY OF APPLIED SCIENCES**

**B.Sc. (General) Degree in Applied Sciences**
**Second Year - Semester I Examination – June/July 2018**

**MAA 2204 – LINEAR PROGRAMMING**

**Time: Two (2) hours**

**Answer FOUR Questions only**
**Calculators will be provided**

1. a) Explain the following terminologies used in Linear Programming:
   i. Basic feasible solution
   ii. Degenerate solution
   iii. Unbounded Solution **(15 marks)**

   b) Aqua Packaging Pvt. Ltd is a leading company in manufacturing high quality custom made packaging materials for export to clients in USA and Europe. The company manufactures two packaging materials: low-density polyethylene (LDPE) and high-density polyethylene (HDPE) by using three machines M1, M2 and M3. The available capacities of machines M1, M2 and M3 during the coming week are 4 hours, 24 hours and 35 hours respectively. One unit of LDPE requires one hour in Machine M1, 3 hours in machine M2 and 10 hours in machine M3. Similarly one unit of HDPE requires 1 hour, 8 hours and 7 hours in machines M1, M2 and M3 respectively. When one unit of LDPE is sold, it yields a profit of Rs. 5 and that HDPE is Rs. 7. The company wants to determine the number of units of LDPE and HDPE to be manufactured in a week so that profit is maximized. Company assumes that all the units produced will be sold.
   i. Formulate a linear programming model to solve the above problem.
   ii. Solve the model formulated in part (i) using a suitable method and interpret the solution. **(85 marks)**

2. a) Define slack and surplus variables in linear programming and explain their usage in a linear programming problem. **(15 marks)**

b) A furniture manufacturer produces and sells desks, chairs and bookshelves. Manufacturer has no difficulty in selling the produced items. However, the limited availability of machine hours, labour hours and floor space restrict the production. The following table exhibits machine hours, labour hours, floor space in square feet needed per unit of each item, marginal profit of each item and total supply of each item. The manufacturer wants to determine number of units to be produced so that total profit will be maximized:

| | Desk | Chair | Bookshelf | Supply in units |
|---|---|---|---|---|
| Machine hours per unit | 8 | 4 | 5 | 1000 |
| Labour hours per unit | 5 | 3 | 3 | 650 |
| Floor space (sq ft) per unit | 9 | 6 | 9 | 1260 |
| Profit (Rs.) per unit | 270 | 144 | 225 | |

i. Formulate this problem as a linear programming model.

ii. Solve the above linear programming model by using Simplex method.

iii. The manager of this company claims that by recruiting additional labour force, the profits can be increased. By assuming no other changes, is this claim valid? Justify your answer.

**(85 marks)**

3. a) Explain the purpose of using Revised Simplex method over to Regular Simplex method. **(15 marks)**

b) A restaurant makes pizza in two flavours: regular and white. Each pizza needs one portion of dough. Each regular pizza needs one portion of sauce and one portion of cheese. Each white pizza does not need sauce but needs two portions of cheese. A regular pizza contributes $ 2 to profit while a white pizza contributes $ 3 to profit. The restaurant has 4 portions of dough, 3 portions of sauce and 6 portions of cheese.

i. Formulate a linear programming model to determine number of each flavour of pizza to be made so as to maximize the total profit.

ii. Use Revised simplex method to determine how many pizza of each flavour should be made to get the maximum profit.

**(85 marks)**

4. a) Explain the term 'Artificial variable' and its use in linear programming.

**(15 marks)**

b) Use the Big-M Method to solve the following linear programming problem:

$Minimize\ Z = 5x_1 + 3x_2$

Subject to the constraints

$2x_1 + 4x_2 \leq 12$

$2x_1 + 2x_2 = 10$

$5x_1 + 2x_2 \geq 10$

$x_1, x_2 \geq 0$

**(85 marks)**

5. a) Represent a linear programming problem with $n$ decision variables and $m$ constraints in matrix form. **(10 marks)**

b) Briefly explain the relationship between Primal and its Dual linear programming problem. **(10 marks)**

c) Consider the following primal linear programming problem:

$Maximize\ Z = 3x_1 + 4x_2$

*Subject to*

$x_1 + 2x_2 \leq 2$

$2x_1 - x_2 \leq 3$

$x_1, x_2 \geq 0$

i. Formulate the corresponding dual linear programming problem.

ii. Solve the dual linear programming problem graphically.

iii. Obtain the optimal solution of the primal linear programming problem by using the optimal solution of the dual linear programming problem found in part (ii).

**(80 marks)**

END