RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

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

MAT3301 – ADVANCED LINEAR PROGRAMMING

Time: Three (03) hours **Calculators will be provided**

Answer ALL Questions

1. a) Describe the assignment problem with its general mathematical formulation.

[15 marks]

b) What is meant by the unbalanced assignment problem? Explain the method for solving such a problem.

[15 marks]

c) Write down the Hungarian algorithm which is used to solve the assignment problem.

[20 marks]

d) Solve the following assignment problem using Hungarian method, the matrix entries represent the processing times of jobs by operators in hours:

[50 marks]

		Operator				
		1	**2**	**3**	**4**	**5**
Job	**A**	09	11	14	11	07
	B	06	15	13	13	10
	C	12	13	06	08	08
	D	11	09	10	12	09
	E	07	12	14	10	14

[Turn over]

2. a) State three widely known methods of finding initial basic feasible solution for a transportation problem.

[10 marks]

b) A dairy firm has three plants located in a district. The daily milk production at each plant is as follows:

Plant	:	**A**	**B**	**C**
Milk supply (in 100's)	:	7	9	18

Each day, the firm must fulfil the needs of its four distribution centers. Minimum requirement at each center is as follows:

Centre	:	**1**	**2**	**3**	**4**
Milk demand (in 100's)	:	5	8	7	14

The transportation costs (in rupees) per unit between plants to distribution centers are given in the table below:

	1	2	3	4
A	19	30	50	10
B	70	30	40	60
C	40	8	70	20

If the objective is to minimize the total transportation cost, find an initial basic feasible solution for the problem given above using each method stated in part (a).

[60 marks]

c) Find the optimal solution to the transportation problem given in part (b) using VAM and MODI methods.

[30 marks]

3. a) Briefly explain how you would deal with the assignment problems, where

(i) the objective function is to be maximized? **[15 marks]**

(ii) some assignments are prohibited? **[15 marks]**

b) In the modification of a plant layout of a factory, three new machines P, Q and R are to be installed in a machine shop. Four operators A, B, C and D are available. The performance of operating a machine by an operator (performance matrix) is as follows:

	P	Q	R
A	90	76	67
B	68	70	69
C	75	72	71
D	69	65	65

Determine the assignments of machines to operators to maximize the total performance of the machines and write down the all possible optimal assignments.

[70 marks]

4. a) What is goal programming? Explain the objective function of a goal programming problem.

[20 marks]

b) You work for an Advertising agency. A customer has identified three primary target audiences he is trying to reach and has an advertising budget of $600,000. The customer has expressed his targets in the form of three goals:

Goal 1- Ads should be seen by at least 40 million high-income men (HIM).

Goal 2- Ads should be seen by at least 60 million low-income people (LIP).

Goal 3- Ads should be seen by at least 35 million high-income women (HIW).

You recognize that advertising during football games and soap operas will cover the target audience. The table below indicates the number of viewers from the different categories that will be viewing these types of programes:

	HIM	**LIP**	**HIW**	**Cost**
Football Ads (per minute)	7 million	10 million	05 million	$100,000
Soap Opera Ads (per minute)	3 million	05 million	05 million	$60,000

[*Turn over*]

Suppose each shortfall of 1,000,000 viewers from the goal translates to a cost of $200 000 for HIM, $100 000 for LIP and $50 000 for HIW.

(i) Define the decision variables to reach the above objectives. **[10 marks]**

(ii) Mathematically formulate each goal using decision variables. **[30 marks]**

(iii) Formulate the given problem as a goal programming problem. (***Do not solve it***)

[40 marks]

5. a) Briefly explain preemptive and non-preemptive goal programming problems.

[20 marks]

b) Explain the modified simplex algorithm in solving goal programming problems.

[20 marks]

c) Manufacturing firm produces two types of products A and B. The unit profit from A is $200 and that of product B is $100. The goal of the firm is to earn total profit of exactly $1,400 in the next week. In addition of the profit goal, the manager wants to achieve sales volume for products A and B close to 6 units and 5 units respectively.

Formulate this problem as a goal programming model and solve it using Modified Simplex method.

[60 marks]

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