RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Third Year - Semester I Examination – September/October 2019

MAT 3301 – ADVANCED LINEAR PROGRAMMING

Time: Three (03) hours

Answer All Questions.

01. Steel mills in three cities produce the following amounts of steel.

Location	Weekly Production (tons)
A. Bethlehem	150
B. Birmingham	210
C. Gary	320
	680

These mills supply steel to four cities where manufacturing plants have the following demand.

Location	Weekly Production (tons)
1. Detroit	130
2. St. Louis	70
3. Chicago	180
4. Norfolk	240
	620

Shipping costs (in dollars) per tons of steel are as follows.

	To			
From	1	2	3	4
A	14	9	16	18
B	11	8	7	16
C	16	12	10	22

Because of a truckers' strike, shipments are at present prohibited from Birmingham to Chicago.

a) Set up a transportation table for this problem. **(10 marks)**

b) Use VAM finds the initial solution. **(30 marks)**

c) Solve this problem using MODI. **(30 marks)**

d) Are there multiple optimal solutions? Explain your answer. If so, identify them. **(10 marks)**

e) Formulate this problem as a general linear programming model. **(20 marks)**

02.

a) Define each of the following

i. A balance assignment problem

ii. Unbalanced assignment program **(10 marks)**

b) Briefly explain how you deal with the assignment problems in following conditions,

i. The objective function is to be maximized?

ii. Some assignments are prohibited? **(20 marks)**

c) A university department head has five instructors to be assigned to four different courses. All of the instructors have taught the courses in the past and have been evaluated by the students. The rating for each instructor for each course is given in the following table (a perfect score is 100). The department head wants to know the optimal assignment of instructors to courses that will maximize the overall average evaluation. The instructor who is not assigned to teach a course will be assigned to grade exams.

	Course			
Instructor	A	B	C	D
1	80	75	90	85
2	95	90	90	97
3	85	95	88	91
4	93	91	80	84
5	91	92	93	88

i. Formulate this problem as a general linear programming model. **(10 marks)**

ii. Solve this problem using the assignment method.

(60 marks)

03.

a) Briefly explain the ***Dantzig- Wolfe Decomposition*** Algorithm. **(10 marks)**

b) Write down the solution steps of the above algorithm. **(20 marks)**

c) Hence solve the following problem.

Minimize $z = -x_1 - x_2 - 2x_3 - x_4$

Subject to

$$x_1 + 2x_2 + 2x_3 + x_4 \leq 40$$

$$x_1 + 3x_2 \leq 30$$

$$2x_1 + x_2 \leq 20$$

$$x_3 \leq 10$$

$$x_4 \leq 10$$

$$x_3 + x_4 \leq 15$$

$$x_i \geq 0,\ i = 1, 2, 3, 4$$

(70 marks)

04.

a) State the steps of the ***Bounded variable simplex*** algorithm. **(20 marks)**

b) Hence solve the following linear programing program.

$$Max\ Z = 3x_1 + 5x_2 + 3x_3$$

Subject to

$$x_1 + 2x_2 + 2x_3 \leq 14$$

$$2x_1 + 4x_2 + 3x_3 \leq 23$$

$$0 \leq x_1 \leq 4$$

$$0 \leq x_2 \leq 5$$

$$0 \leq x_3 \leq 3$$

(80 marks)

05.

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

(20 marks)

b) The company in planning next month production of its two bicycle A & B. Both models are using same seats and tyres. Currently 2000 seats and 2400 tyres are available. Gears are assembling only for type B and availability is 1000. Production time per unit of A is two hours and 3 hours for type B. Profits are 40$ and 10$ respectively.

Consider the given priority levels and formulate the goal programming problem

i. Fulfill a contract for 400 bicycle of type A to be delivered in next month.

ii. Produce at least 1000 total bicycle during the month

iii. Achieve at least $10000 for the month in the same priority use no more than 1600 labour hours during the month

iv. At least 200 tyres left over at the end of the month and at least 100 gears assemble left over at the end of the month

(40 marks)

c) Use simplex algorithm solves the following goal programming problem.

$$\text{Min } z = P_1 d_1^- + P_2(2d_2^- + d_3^-) + P_3 d_1^+$$

Subject to

$$x_1 + x_2 + d_1^- - d_1^+ = 400$$

$$x_1 + d_2^- = 240$$

$$x_2 + d_3^- = 300$$

$$x_1, x_2, d_i^-, d_i^+ \geq 0 \; ; i = 0, 1, 2$$

(40 marks)

END