RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Third Year– Semester II Examination –October/November 2017

MAT 3310 – INTEGER PROGRAMMING

Time:Three (3) hours

Answer **all** questions

1. The Electro-Poly Corporation is the world's leading manufacturer of slip rings. A slip ring is an electrical coupling device that allows current to pass through a spinning or rotating connection such as a gun turret on a ship, aircraft, or tank. The company recently received a $750,000 order for various quantities of three types of slip rings. Each slip ring requires a certain amount of time to wire and harness. The following table summarizes the requirements for the three models of slip rings.

	Model 1	Model 2	Model 3
Number Ordered	3,000	2,000	900
Hours of Wiring Required per Unit	2	1.5	3
Hours of Harnessing Required per Unit	1	2	1

Unfortunately, Electro-Poly does not have enough wiring and harnessing capacity to fill the order by its due date. The company has only 10,000 hours of wiring capacityand 5,000 hours of harnessing capacity available to devote to this order. However, the company can subcontract any portion of this order to one of its competitors. Theunit costs of producing each model in-house and buying the finished products froma competitor are summarized below.

	Model 1	Model 2	Model 3
Cost to Make	$50	$83	$130
Cost to Buy	$61	$97	$145

Electro-Poly wants to determine the number of slip rings to make and the number to buy, to fill the customer order at the least possible cost.Formulate an Integer Programming model for this problem.

(100 marks)

2. Consider the following Integer Programming Problem,

$Maximize\ Z = 3x_1 + 4x_2$

$subject\ to$

$2x_1 + x_2 \leq 6$

$2x_1 + 3x_2 \leq 9$

$x_1, x_2 \geq 0\ and\ all\ are\ integers$

a) Solve the above problem using the dual fractional integer programming algorithm. **(30 marks)**

b) Express each additional constraint in terms of the original variables. **(30 marks)**

c) Solve the above problem graphically by relaxing the integer requirement and hence discuss the optimal solution to the integer problem by rounding the solutions for $x_1\ and\ x_2$. **(40 marks)**

3.

a) Briefly explain the steps of Dual All Integer-Integer Algorithm. **(20 marks)**

b) Consider the following Integer Programming Problem.

$Maximize\ Z = 3x_1 + x_2 + 2x_3$

subject to the constraints

$-x_1 + 2x_2 + x_3 \leq 4$

$4x_2 - 3x_3 \leq 2$

$x_1 - 3x_2 + 2x_3 \leq 3$

$x_1, x_2, x_3 \geq 0$ and integer

Solve the above problem using **Dual all integer-integer algorithm**. **(80 marks)**

4. Harrison Electric Company produces two products popular with home renovators, old-fashioned chandeliers and ceiling fans. Both chandeliers and fans require a two-step production process involving wiring and assembly. It takes 2 hours to wire each chandelier and 3 hours to wire a ceiling fan. Final assembly of the chandeliers and fans requires 6 and 5 hours respectively. The production capability is such that only 12 hours of wiring time and 30 hours of assembly time are available. Each chandelier produced nets the firm a profit of \$7 and each fan \$6.

a) Formulate an Integer Programming model for the above problem. **(50 marks)**

b) Use Dakin Variation Algorithm of the Branch and Bound Method to solve this problem. **(50 marks)**

5.

a) Suppose that you have 7 full of wine bottles, 7 half-full, 7 empty. You would like to divide the 21 bottles among three individuals so that each will receive exactly 7. Additionally, each individual must receive the same quantity of wine. Express the problem as Integer Linear Programming problem.

(40 marks)

b) Show graphically that the following Integer Linear Programming problem has no feasible solution, and then verify the result using **Branch-and-Bound Algorithm**.

Maximize $z = 5x_1 + 4x_2$

subject to :

$x_1 + x_2 \leq 5$

$10x_1 + 6x_2 \leq 45$

$x_1, x_2 \geq 0$ and integer.

(60 marks)

END