



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

**B.Sc. (General) Degree in Information and Communication Technology
Third Year - Semester II Examination – February/March 2019**

ICT 3202 – OPERATIONAL RESEARCH

Answer all questions

Time: Two (2) hours

ADDITIONAL MATERIAL

2 Graph papers

INSTRUCTIONS TO CANDIDATES

1. This paper contains 5 questions on 4 pages (including the cover page).
2. The total marks obtainable for this examination is 100. The marks assigned for each question & sections thereof are included in brackets.
3. This examination accounts for 60% of the module assessment.
4. This is a closed-book examination.
5. Answer **ALL** questions.
6. Start to answer a new question on a new page.
7. **All the necessary steps** for the answers should be **clearly indicated**.
8. Rough work sheets may be attached separately.
9. Calculators are **ALLOWED**.
10. Graph papers are provided. If used, they must be fastened securely inside the answer book.
11. If a page is not printed, please inform the supervisor immediately.

1

Question 01

(10 marks)

A retired couple supplements their income by making fruit pies, which they sell to a local grocery store. During the month of September, they produce apple (A) and cherry (C) pies. The pies are sold to the grocer for the following prices: apple - \$ 1.50 and cherry - \$ 1.20.

Because of high quality and fresh ingredients in the pies, the couple is able to sell all they can produce. In addition to the apples and cherries used in each pie, the pies use other ingredients which are the same: sugar and flour. For the month of September, they have 1,200 cups of sugar (S) and 2,100 cups of flour (F). The couple working together can produce an apple pie in 6 minutes and a cherry pie in 3 minutes. Each apple pie contains 1.5 cups of sugar and 3 cups of flour. Each cherry pie requires 2 cups of sugar and 3 cups of flour. The couple plans to work no more than 60 hours.

Answer the following questions:

- (a) Formulate the objective function for *Revenue*.

(03 marks)

- (b) What are the constraint equations?

(07 marks)

2

Question 02

(20 marks)

Solve the following linear programming problem using graphical method and answer the following questions:

Maximize: $Z = 6A + 3B$ (revenue)

\downarrow

Subject to:

Material $20A + 6B \leq 600 \text{ kg}$

Machinery $25A + 20B \leq 1000 \text{ hr}$

Labour $20A + 30B \leq 1200 \text{ hr}$

$A, B \geq 0$

- (a) What are the optimal values of the decision variables and Z ?

(14 marks)

- (b) Do any constraints have (nonzero) slack?
If yes, which one(s) and how much slack does each have? (02 marks)
- (c) Do any constraints have (nonzero) surplus?
If yes, which one(s) and how much surplus does each have? (02 marks)
- (d) Are any constraints redundant? If yes, which one(s)? Explain briefly. (02 marks)

3 Question 03

(30 marks)

Consider the following linear programming problem:

Minimize: $Z = 16S + 45T$

Subject to:

$$2S + 5T \geq 50$$

$$S + 3T \geq 27$$

$$S, T \geq 0$$

- (a) Write down the dual of the above linear programming problem. (05 marks)
- (b) Solve the dual problem by using the Simplex Method. (25 marks)

4 Question 04

(25 marks)

Consider the following linear programming model:

Maximize: $Z = 100x_1 + 150x_2$

Subject to:

$$8000x_1 + 4000x_2 \leq 40000$$

$$15x_1 + 30x_2 \leq 200$$

$$x_1, x_2 \geq 0 \text{ and integer}$$

- (a) Solve this problem using the implicit enumeration method. (08 marks)

- (b) Solve this model using the branch and bound method. (15 marks)
- (c) State whether the solution in (a) is compatible with your solution to (b), Justify your answer. (02 marks)

5 Question 05

(15 marks)

Consider the following Linear Programming Model:

$$\text{Maximize: } Z = 20x_1 + 30x_2 + 10x_3 + 40x_4$$

Subject to:

$$2x_1 + 4x_2 + 3x_3 + 7x_4 \leq 10$$

$$10x_1 + 7x_2 + 20x_3 + 15x_4 \leq 40$$

$$x_1 + 10x_2 + x_3 \leq 10$$

$$x_1 = 0 \text{ or } 1$$

$$x_2 = 0 \text{ or } 1$$

$$x_3 = 0 \text{ or } 1$$

$$x_4 = 0 \text{ or } 1$$

- (a) Solve the above problem using the implicit enumeration method. (13 marks)
- (b) What difficulties would be encountered with the implicit enumeration method if this problem were expanded to contain five or more variables and more constraints? (02 marks)

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