



(*Knowledge for Development*)  
**KIBABII UNIVERSITY**

**UNIVERSITY EXAMINATIONS  
2022/2023 ACADEMIC YEAR**

**END OF SEMESTER EXAMINATIONS  
YEAR FOUR SEMESTER ONE EXAMINATIONS**

**FOR THE DEGREE OF  
BACHELOR OF SCIENCE COMPUTER SCIENCE**

**COURSE CODE : CSC 412  
COURSE TITLE : OPERATIONS RESEARCH**

**DATE: 26/04/2023 TIME: 2:00 P.M – 4:00 P.M**

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**INSTRUCTIONS TO CANDIDATES**

**ANSWER QUESTIONS ONE AND ANY OTHER TWO.**



**QUESTION ONE (30 MARKS)**

- a) Explain the following terms as used in operation research
- i) Slack variable (1 mark)
  - ii) Post optimality (1 mark)
  - iii) Feasible solution (1 mark)
  - iv) Transportation problem (1 mark)
  - v) Basic variable (1 mark)
- b) Write a zero-one programming model for assignment problem. (3 marks)
- c) A manager has three jobs to be assigned to three of his clerical staff. Clerical staff differs in efficiency. The efficiency is a measure of time taken by them to do various jobs. The matrix given below shows the time taken by each person to do a particular job.

		Men (Time taken to do job in hours)		
		X	Y	Z
Jobs	A	10	27	16
	B	14	28	16
	C	36	21	10

- i) Assign the duty to the staff using hungarian method (6 marks)
  - ii) Find the minimum total time taken by the staff. (2 marks)
- d) Obtain an initial basic feasible solution to the following transportation problem using North West corner method. (10 marks)
- |                      | D   | E   | F   | G   | Available (Supply) |
|----------------------|-----|-----|-----|-----|--------------------|
| A                    | 11  | 13  | 17  | 14  | 250                |
| B                    | 16  | 18  | 14  | 10  | 300                |
| C                    | 21  | 24  | 13  | 10  | 400                |
| Requirement (Demand) | 200 | 225 | 275 | 250 | 950                |
- e) Explain two assumptions of linear programming. (4 marks)



## QUESTION TWO

a) Explain three properties of linear programming (6 marks)

b) Solve the following problem using Big M method. (14 marks)

$$\text{Min } Z = 10x_1 + 15x_2 + 20x_3$$

Subject to

$$2x_1 + 4x_2 + 6x_3 \geq 24$$

$$3x_1 + 9x_2 + 6x_3 \geq 30$$

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

## QUESTION THREE

a) Form the dual of the following LP problem

$$\text{Min } z = 24x_1 + 30x_2$$

Subject to

$$2x_1 + 3x_2 \geq 10$$

$$4x_1 + 9x_2 \leq 15$$

$$6x_1 + 6x_2 \geq 20$$

$$x_1, x_2 \geq 0$$

(4 marks)

b) Write a linear programming model for the General transportation problem (3 marks)

c) Consider the following LP problem

$$\text{Max } z = 6x_1 + 8x_2$$

Subject to

$$5x_1 + 10x_2 \leq 60$$

$$4x_1 + 4x_2 \leq 40$$

$$x_1, x_2 \geq 0$$

i) Solve the LP (8 marks)

ii) Hence find the new solution if

I) The right hand side constraints of the constraint 1 and constraint 2 are changed from 60 to 40 and 40 to 20. (3 marks)

II) If a new constraint  $7x_1 + 2x_2 \leq 65$  is added (2 marks)

## QUESTION FOUR

a) Explain the following terms

i) Assignment problem (2 marks)

ii) Transshipment problem (2 marks)



b) Use simplex method to

$$\text{Max } z = 2x_1 + 5x_2$$

Subject to

$$x_1 + x_2 \leq 10$$

$$2x_1 + x_2 \leq 8$$

$$x_1, x_2 \geq 0$$

(10 marks)

c) Use graphical method to obtain the optimum solution to the linear programming problem.

$$\text{Max } z = 30x_1 + 40x_2$$

Subject to

$$x_1 + x_2 \leq 50$$

$$2x_1 + x_2 \leq 90$$

$$x_1 + 2x_2 \leq 80$$

$$x_1, x_2 \geq 0$$

(6 marks)

### QUESTION FIVE

a) Differentiate between balanced and unbalanced transportation problem. (4 marks)

b) Obtain the initial basic solution using the following methods in the problem below.

i) North west corner cell method (5 marks)

ii) Least cost cell method (5 marks)

iii) Vogel's approximation method (6 marks)

Factories	A	B	C	D	Capacities
X	6	6	6	4	1000
Y	4	2	4	5	700
Z	5	6	7	8	900
Requirement	900	800	500	400	2600