UNIVERSITY OF KELANIYA – SRI LANKA

Centre for Distance and Continuing Education

FACULTY OF COMMERCE & MANAGEMENT STUDIES

Bachelor of Commerce (Special) Degree Third Year Examination (External) – 2023

November 2025

BCOM E3055 – Operations Research

No. of questions: five (05) **Time: 03 hours**

Answer all the questions

Question Number 01

a) Describe Operations Research and discuss its applications across various disciplines.

(06 Marks)

b) Bright Furniture Ltd. manufactures two types of tables: Dining Tables (X_1) and Study Tables (X_2). Each unit of Dining Table yields a profit of Rs. 60, and each unit of Study Table yields a profit of Rs. 45. Determine the optimal production plan to maximize profit using the graphical method.

The production process is subject to the following constraints:

Maximize:
$Z = 60x_1 + 45x_2$
Subject to:
$5x_1 + 3x_2 \leq 3000$ *(Machine hour constraint)*
$4x_1 + 6x_2 \leq 3600$ *(Labor hour constraint)*
$x_1 \geq 200$ *(Minimum Production requirement for* dining tables*)*
$x_2 \geq 100$ *(Minimum Production requirement for* study tables*)*
$2x_1 + 3x_2 \geq 1800$ *(*Material usage constraint*)*

Where:
x_1 = number of dining tables produced
x_2 = number of study tables produced
Also, $x_1, x_2 \geq 0$.

(07 Marks)

c) Bright Wood Chairs manufactures two types of chairs — Manager Chairs and Economy Chairs. A Manager Chair sells for Rs. 650 and incur Rs. 250 in raw material costs, while adding Rs. 180 in labor and overhead expenses. An Economy Chair sells for Rs. 380 and incurs Rs. 140 in raw material costs, with an additional Rs. 110 in labor and overhead costs. Each Manager Chair requires 4 hours of carpentry work and 3 hours of polishing, whereas each Economy Chair requires 2 hours of carpentry and 1 hour of polishing. The company

has a total of 160 hours of carpentry labor and 110 hours of polishing labor available per week. Due to market limitations, 25 Manager Chairs can be sold at most each week, while the demand for Economy Chairs is unlimited. In addition, the company faces a raw material availability constraint: each Manager Chair requires 5 units of raw material, and each Economy Chair requires 2 units, with a maximum of 150 units of raw material available weekly. Formulate a linear programming model to determine how many Manager Chairs and Economy Chairs Bright Wood should produce weekly in order to maximize its profit. Use graphical methods to identify the feasible region and determine the combination of chairs that yields the maximum weekly profit.

(07 Marks)
(Total 20 marks)

Question number 02

a) Explain the role of Linear Programming in optimizing resource allocation in a manufacturing business with examples.

(04 Marks)

b) The table below shows the details of the production of three products using three types of resources. Calculate the number of units to be produced to maximize profit using the Simplex Method.

Resources	Product 1	Product 2	Product 3	Resources (Quantity)
Labor (hrs)	10	10	12	3850
Material (Kg)	8	8	9	8280
Machine time (hrs)	10	9	11	7920
Profit (Rs:)	40	48	52	

(16 Marks)
(Total 20 Marks)

Question Number 03

a) Discuss the problems and applications that can be analyzed by network line connectivity.

(06 Marks)

b) You are a project manager of the following scheduled construction project of LMN Construction Company. The management of the company is seeking your suggestions for

the following situations as the client is not happy with the critical timing of this project. The time estimates obtained for each activity of the project are given in the table below.

Activities	Immediate Predecessor	Optimistic (Weeks)	Most Probably (Weeks)	Pessimistic (Weeks)
A	-	2	6	8
B	-	3	8	9
C	A	4	5	6
D	A	2	8	10
E	B	8	10	24
F	B	3	7	10
G	C, D	1	3	11
H	D	3	10	15
I	E, F	8	12	16
J	G, H	2	4	12
K	I, J	1	8	9

i. Draw a network diagram with arrows representing activities and connections.

(08 arks)

ii. Identify all paths highlighting Critical Path(s).

(03 Marks)

iii. Find the timings of all routes

(03 Marks)

(Total 20 Marks)

Question Number 04

a) Explain the use cases of Transportation Problem giving examples.

(05 Marks)

b) Sunrise Distributors (Pvt) Ltd operates four factories that supply goods to four regional warehouses. Each factory has a specific production capacity, and each warehouse has a specific demand requirement. The transportation cost per unit from each factory to each warehouse also varies depending on distance and logistics conditions:

Factories	Stores				Supply (Units)
	L	M	N	P	
G	10	3	8	7	1200
H	6	7	6	11	1500
L	3	3	8	9	2000
M	4	2	5	10	1000
Demand (Units)	1700	500	2300	1200	5700

Determine a basic solution to the above transportation problem using the following methods.

i. North west coner rule
ii. Minimum cost method
iii. Vogel's Approximation method

(15 Marks)
(Total 20 Marks)

Question Number 05

a) A farmer association has to decide whether or not to drill a well on their farm lands. In their village, only 40% of wells drilled were successful at 200 feet of depth. If no water found at 200 feet, there is a 20% chance of finding water, if they drill further 50 feet. Cost of drilling is Rs. 50 per foot. The farmer association estimated that they would pay Rs. 18,000 during a 5-year period in the present value terms, if they continue to buy water from the neighbor rather than having own well which would have a life of 5 years. The farmer association has 3 decisions to make: (1) should they drill up to 200 feet and (2) if no water is found at 200 feet, should they drill up to 250 feet? (3) Should they continue to buy water from their neighbor?

i. Sketch the decision tree for the farmer association.
ii. What is the estimated farmer association best strategy under expected value approach.?

(10 Marks)

b) A manager must decide how many machines of a certain type to buy. The machines will be used to manufacture a new gear for which there is increased demand. The manager has narrowed the decision to two alternatives: buy one machine or buy two. If only one machine is purchased and demand is more than it can handle, a second machine can be purchased later. However, the cost per machine would be lower if the two machines were purchased at the same time. The estimated probability of low demand is .30, and the estimated probability of high demand is .70.

The net present value associated with the purchase of two machines initially is Rs: 75,000 if demand is low and Rs: 130,000 if demand is high.

The net present value for one machine and low demand is Rs: 90,000. If demand is high, there are three options. One option is to do nothing, which would have a net present value of Rs: 90,000. A second option is to subcontract; that would have a net present value of Rs: 110,000. The third option is to purchase a second machine. This option would have a net present value of Rs: 100,000. How many machines should the manager purchase initially? Use a decision tree to analyze this problem.

(10 Marks)

(Total 20 Marks)