BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

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GRADUATE SCHOOL OF BUSINESS

EXECUTIVE MASTER'S IN BUSINESS LEADERSHIP (EMBL)

OPERATIONS MANAGEMENT (EMB504)

EXAMINATION QUESTION PAPER

DURATION: 3 HOURS 30 MINUTES

Instructions and Information to Candidates

1. **Section A is compulsory and carries 40 marks.**
2. **Answer 'Question 1' from Section A and any three (3) questions from Section B.**
3. **The paper carries six questions.**
4. **All Questions in Section B carry equal marks of 20 each.**
5. **The use of cell phones is not allowed in the examination.**

SECTION A [COMPULSORY]

QUESTION 1

A keen sportsman has decided to open up a new shop in Harare. There are several tasks, which must be achieved before the ground opening day. The Activity Dependency Table is presented in Table 1.0. The first three activities can all be started immediately and can take place at the same time. Once the sandblasting has been completed, the exterior of the shop can be decorated.

The owner is expecting to get a discount on some items when he visits the local warehouse to purchase them. If he does, then he intends to have some special offers which he would like to include in his advertisements. Therefore, the preparation of the advertisements cannot commence until the stock has been purchased. Once the advertisements have been prepared, the advertising campaign can begin. This will include advertisements in the local paper and posting leaflets on doors in a few local housing estates.

The owner does not wish to arrange the window display until the exterior has been sandblasted, the interior has been decorated and the stock has been purchased. The plan of the store layout can begin as soon as the stock arrives. The stocking of the shelves can take place once the layout has been planned and the window display has been finished. Hence the activity depend will be as shown Table 1.0.

Table 1.0: Activity Dependency Table For The Sports-Shop Problem

Activity	Description	Immediate Predecessor	Expected Duration (Days)
A	Sandblast Exterior	-	10
B	Decorate Interior	-	6
C	Buy Stock	-	15
D	Decorate Exterior	A	10
E	Prepare Advertisements	C	3
F	Advertisement Campaign	E	10
G	Arrange Window Display	A, B, C	2
H	Plan Store Layout	C	5
I	Stock Shelves	G, H	10

Required:

(a) Draw a network diagram to represent the Sports-shop problem. **(10 marks)**

(b) Using the Critical Path Method (CPM) determine the critical path of the Sports-shop problem. **(10 marks)**

(c) Give a detailed interpretation of the results obtained in (b). **(10 marks)**

(d) Calculate the ***free float*** for all the activities and give an explanation of your results. **(5 marks)**

(e) Calculate the ***independent float*** for all the activities and give an explanation of your results. **(5 marks)**

[Total: 40 marks]

SECTION B : ***Answer any <u>three</u> (3) questions from this Section.***

QUESTION 2

The AutoGlass Company produces high quality glass products including windows and glass doors. Due to declining earnings, top management has decided to revamp the company's product line. Unprofitable products are being discontinued, releasing production capacity to launch two new products having large sales potential.

Product 1: An 8-foot glass with aluminum framing.

Product 2: A 4 X 6 foot double-hung wood framed window.

Product 1 requires some of the production capacity in Plant 1 and 3, but none in Plant 2. Product 2 needs only Plant 2 and 3. However, because both products will be competing for the same production capacity in Plant 3, it is not clear which mix of two products would be most profitable. Production rate is here defined as the number of batches produced per week where each product is produced in batches of 20. All the necessary information is summarised in Table 2.0.

Table 2.0: Plant Capacity, Product Time Requirements and Profit For AutoGlass Company

Plant	Product 1 time/batch	Product 2 time/batch	Time available (hours)
1	1	0	4
2	0	2	12
3	3	2	18
Profit/batch ($)	3000	5000	

Required:

(a) Develop a linear programming model that maximizes the firms profit **(10 marks)**

(b) Use the graphical method to determine the number of product 1 and 2 batches to be manufactured per week to maximize the profit. **(10 marks)**

[Total: 20 marks]

QUESTION 3

Two reservoirs are available to supply the water needs of three cities. Each reservoir can supply up to 50 million gallons of water per day. Each city would like to receive 40 million gallons per day. For each million gallons per day for unmet demand, there is a penalty. At city 1, the penalty is $20; at city 2, the penalty is $22; and at city 3, the penalty is $23. The cost of transporting 1 million gallons of water from each reservoir to each city is shown in Table 3.0.

Table 3.0: Demand, Supply and Transportation Costs for the Transportation Problem

From	To			Supply (million gallons)
	City 1	City 2	City 3	
Reservoir 1	$7	$8	$10	50
Reservoir 2	$9	$7	$8	50
Demand (million gallons)	40	40	40	

(a) Formulate a balanced transportation problem that can be used to minimise the sum of shortage and transport costs. **(5 marks)**

(b) Use the following methods to determine the basic feasible solution.

i. Northwest Corner Method **(2 marks)**

ii. The Minimum Cost Method **(3 marks)**

iii. The Vogel's Method **(3 marks)**

(c) Using the basic feasible solution obtained by the Northwest corner method, determine the optimal solution using the transportation simplex method. **(7 marks)**

[Total: 20 marks]

QUESTION 4

Five employees are available to perform four jobs. The time it takes each person to perform each job is given in Table 4.0.

Table 4.0: Time Taken By Each Employee to Perform Each Job

Person	Time (hours)			
	Job 1	Job 2	Job 3	Job 4
1	22	18	30	18
2	18	*	27	22
3	26	20	28	28
4	16	22	*	14
5	21	*	25	28

Note: * indicates that the person cannot do that particular job.

Required:

(a) Develop a linear programming model to minimise the time it takes to perform the four jobs. **(7 marks)**

(b) Determine the assignment of employees to jobs that minimizes the total time required to perform the four jobs. **(10 marks)**

(c) What is the associated optimal time to perform the four jobs? **(3 marks)**

[Total: 20 marks]

QUESTION 5

Tagarika Investors of Harare recently purchased land and wants to determine the size of a holiday resort it should build. The sizes of holiday resorts being considered are: small, medium and large. At the same time, an uncertain economy makes it difficult to ascertain the demand for the new resort area. Tagarika's management realises that a large development followed by a low demand could be very costly to the company. However, if Tagarika makes a conservative small development decision and then finds a high demand, the firm's profits will be lower than they might have been. With the three levels of demand (low, medium, and high), Tagarika's management has prepared the profit ($1000s) payoff matrix in Table 5.0.

Table 5.0: Tagarika Investors Payoff Table

Decision Alternatives	Demand		
	Low (s1)	Medium (s2)	High (s3)
Small (d1)	400	400	400
Medium (d2)	100	600	600
Large (d3)	-300	300	900
Probability	0.2	0.35	0.45

Required:

(a) Calculate the Expected Monetary Value (EMV) and devise an appropriate decision strategy. **(4 marks)**

(b) Calculate the Expected Opportunity Loss (EOL) and devise an appropriate decision strategy. **(4 marks)**

(c) Represent the decision strategy under the EMV on a tree diagram for Tagarika Investments. **(6 marks)**

(d) What is the expected value of perfect information (EVPI)? Give an interpretation of this calculated EVPI. **(6 marks)**

[Total: 20 marks]

QUESTION 6

Suppose that the demand D for a spare aeroplane part has an exponential distribution with mean 50 given by:

$$\varphi_D(\xi) = \begin{cases} \frac{1}{50} e^{-\xi/50} & , if\ \xi \geq 0 \\ 0 & , \quad otherwise. \end{cases}$$

This aeroplane will be obsolete in 1 year, so all production of the spare part is to take place at present. The production cost now are \$1,000 per item that is, $c = 1000$ but they become \$10,000 per item if supplied at later dates that is, $p = 10{,}000$. the holding costs charged on the excess after the end of the period are \$300 per item.

Required:

(a)

(i) Determine the optimal number of spare parts to be produced. **(9 marks)**

(ii) If there are 25 parts already in the inventory, determine the optimal number of spares to be produced. **(3 marks)**

(b) A newspaper stand purchases newspapers for 20 cents and sells them for 25 cents per newspaper (because the dealer buys papers at retail price to satisfy shortages). The holding cost is 0.1 cent. The demand distribution is a uniform distribution between 200 and 300.

Find the optimal number of papers to buy. **(8 marks)**

[Total: 20 marks]

END OF EXAMINATION PAPER