MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF ECONOMICS AND STATISTICS

BACHELOR OF ECONOMICS

EES 402: OPERATIONS RESEARCH II

DATE: 21/10/2020 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

Answer Question **ONE** and any other **TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Explain briefly the following terms as used in operations research

i) Unbalanced transport problem (2 marks)

ii) Inventory management (2 marks)

iii) Dual price (2 marks)

iv) Simulation (2 marks)

v) Independent float (2 marks)

b) Briefly explain two factors that may give rise to transhipment problem (4 marks)

c) During health awareness week at the University, six students arrived every one hour at the clinic for screening. The medical staff took five minutes on average to attend to each one of them. Assuming that the arrivals follow a Poisson distribution and the serving time follows an exponential distribution, determine the following:

i) The percentage of time that there was no student being served at the clinic (2 marks)

ii) The average number of students who would be in the waiting room (2 marks)

iii) The average number of students who were waiting for their turn (2 marks)

iv) The average time a student spent in the in the waiting room (2 marks)

$$\rho = \frac{\lambda}{\mu} \quad N_q = \frac{\lambda^2}{\mu(\mu-\lambda)} \quad N_s = \frac{\lambda}{\mu-\lambda} \quad T_q = \frac{\lambda}{\mu(\mu-\lambda)} \quad T_s = \frac{1}{\mu-\lambda}$$

d) The annual demand per item is 12,800 units. The unit cost is £ 24 and the inventory carrying charges are 25% per annum. If the cost of procurement is £ 300 determine the following:

i) Economic order quantity (2 marks)

ii) Number of orders per year (2 marks)

iii) Optimum period of supply per optimum order (2 marks)

iv) Optimum cost (2 marks)

QUESTION TWO (20 MARKS)

A manufacturing company produces two steel products, P and Q, which requires labour and capital. A unit of product P requires 10 man-hours of labour and thirty units of capital daily. A unit of product Q requires 10 man-hours of labour and ten units of capital daily. The company allocates thirty man-hours of labour and fifty units of capital per day for the production of the two products. The selling prices per unit of products P and Q are $ 80 and $ 60

a) Formulate a linear program using the above information (3 marks)

b) Find the optimal product mix using graphical method (5 marks)

c) Determine the dual price for labour using graphical method (4 marks)

d) Determine the feasibility range for labour (4 marks)

e) Compute the optimality range (4 marks)

QUESTION THREE (20 MARKS)

A manufacturing company has three plants X, Y and Z, which supply to five warehouses located at A, B, C, D and E. Monthly plants capacities are 160, 100 and 180 units respectively. Monthly requirements of warehouses are 80, 80, 100, 80 and 160 units respectively. Unit transport costs are given as follows;

From/To	A	B	C	D	E	Capacity (supply)
X	5	8	6	6	3	160
Y	4	7	7	6	6	100
Z	8	4	6	6	3	180
Requirement(demand)	80	80	100	80	160	

a) Find the initial feasible solution for the transportation problem using Vogel's Approximation Method and the associated transport cost.

(10 marks)

b) Find the optimum transportation schedule and the minimum total cost of transportation.

(10 marks)

QUESTION FOUR (20 MARKS)

A construction project is composed of eleven activities. The description, prerequisites, normal and crash times and costs of these activities are as given below:

a) Draw the network diagram (8 marks)

b) Find the critical path, the normal project duration and the associated cost (8 marks)

c) Crash the relevant activities systematically and determine the optimal Project time and cost. (4 marks)

Activity	Pre-requisite	Time (days)	Time	Cost (US$)	Cost
		Normal	Crash	Normal	Crash
A	-	10	8	800	1000
B	-	18	10	1000	1200
C	A & B	7	5	1300	1500
D	A	9	6	1800	2400
E	A & B	12	9	1500	1800
F	C & D	9	7	1600	2000
G	E & F	14	11	1700	2000
H	A	8	7	1400	1500
I	C & D	3	2	1200	1600
J	I, G & H	15	14	1000	1700
K	E & F	5	2	800	1200

QUESTION FIVE (20 MARKS)

A linear program is defined as follows

$$Max \;\; Z = 30X + 20Y + 10Z$$

s.t

$$2X + Y + Z \leq 15$$

$$2X + 2Y + 8Z \leq 20$$

$$2X + 3Y + Z \leq 32$$

$$X; Y; Z \geq 0$$

a) Solve the linear program above to find the optimal solution (14 marks)

b) Find the dual price for each constraint and interpret it (6 marks)