MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

FOURTH YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF ECONOMICS AND STATISTICS

BACHELOR OF ECONOMICS

EES 402: OPERATIONS RESEARCH II

DATE: 22/1/2021 **TIME: 2.00-4.00 PM**

INSTRUCTIONS:

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

QUESTION ONE (30 MARKS)

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

i) Degeneracy (2 marks)

ii) Transhipment (2 marks)

iii) Dual price (2 marks)

iv) Simulation (2 marks)

v) Independent float (2 marks)

b) State four disadvantages of simulation (4 marks)

c) At a certain ATM shop, six customers arrived every one hour to withdraw money. Each customer took five minutes on average to withdraw money. Assuming that the arrivals follow a Poisson distribution and the serving time follows an exponential distribution, determine;

i. The percentage of time that there was no customer at the ATM shop (2 marks)

ii. The average number of customers at the ATM shop (2 marks)

iii. The average number of customers waiting for their turn (2 marks)

iv. The average time a customer spent at the ATM shop (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 6400 units. The unit cost is ₤ 12 and the inventory carrying charges 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 has three plants X, Y and Z, which supply to the distribution located at A, B, C, D and E. Monthly plant capacities are 80, 50 and 90 units respectively. Monthly requirements of distributors are 40, 40, 50, 40 and 80 units respectively. Unit transport costs are given in the table below

From/To	A	B	C	D	E	Capacity(supply)
X	5	8	6	6	3	80
Y	4	7	7	6	6	50
Z	8	4	6	6	3	90
Requirement (demand)	40	40	50	40	80	

a) Find the initial feasible transport schedule and the associated transport cost using Vogel's Approximation Method (10 marks)

b) Determine an optimal transport schedule and the associated transport cost (10 marks)

QUESTION THREE (20 MARKS)

A construction project is composed of sixteen activities whose description, relationships and Durations in days indicated in brackets are described as follows:

Activities A (40), B (24) and C (16) can start concurrently. Activities D (24) and E (32) follow C and B respectively. C and E precede F (64). Both G (40) and H (16) require C, E and F. I (16) depends on A and F. Both J (24) and K (40) succeed D, G and H. The prerequisites for L (16) are D and H. Both M (20) and N (16) follow I and J. Activities K, L and M precede O (20). P (10) requires C.

a) Generate precedence table showing the prerequisites and duration for each activity.

(5 marks)

b) Draw the network diagram for this project. (8 marks)

c) Determine the earliest start times and latest start times and finish times and hence the critical path and project duration (7 marks)

QUESTION FOUR (20 MARKS)

A company produces two products A and B on two machines. A unit of product A requires 2 hours on machine 1 and 1 hour on machine 2. Product B requires 1 hour on machine 1 and 3 hours on machine 2. The revenues per unit of products A & B are $30 & $20 respectively. The total daily processing time available for each machine is 8 hours.

a) Formulate a linear program (3 marks)

b) Find the optimal product mix (7 marks)

c) Determine the dual/shadow price for machine 1 (4 marks)

d) Determine the feasibility range for machine 1 (3 marks)

e) Find the optimality range (3 marks)

QUESTION FIVE (20 MARKS)

A linear program is defined as follows

$$
\begin{aligned}
&Max\ \ Z = 30X + 20Y + 10Z \\
&s.t \\
&2X + Y + Z \leq 15 \\
&2X + 2Y + 8Z \leq 20 \\
&2X + 3Y + Z \leq 32 \\
&X; Y; Z \geq 0
\end{aligned}
$$

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)