



MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 407: OPERATION RESEARCH

DATE: 19/12/2017

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

Answer Question One and any other two questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- (a) (i) How does OR assist management in decision making? (3 marks)
- (ii) What is a basic feasible solution? (2 marks)
- (b) i) Use graphical method or otherwise to solve the following model:

$$\text{Maximize } Z = 3X_1 + 8X_2$$

$$\text{s.t } \begin{cases} X_1 + X_2 \geq 8 \\ 200X_1 - 300X_2 \leq 0 \\ X_1 + 2X_2 \leq 30 \\ 3X_1 - X_2 \geq 0 \\ X_1 \leq 10 \\ X_2 \geq 0 \\ X_1, X_2 \geq 0 \end{cases}$$

(5 marks)

ii) For the above model b (i), identify the redundant constraints if any. (2 marks)

- (c) i) Electra produces two types of electric motors, each on a separate assembly line. The respective daily capacities of the two lines are 600 and 750 motors. Type 1 motor uses 10 units of a certain electronic component, and type 2 motor uses only 8 units. The supplier of the component can provide 8000 pieces a day. The profits per motor for types 1 and 2 are \$60 and \$40, respectively.

a) Determine the optimum daily production mix. (5 marks)

b) Determine the optimality range of the ratio of unit profits that will keep the solution in (a) unchanged. (3 marks)

ii) For the following primal problem, write down the associated dual model:

$$\text{Minimize } Z = 5X_1 + 6X_2$$

$$\text{s.t } \begin{cases} X_1 + 2X_2 = 5 \\ X_1 - 5X_2 \leq -3 \\ 4X_1 + 7X_2 \leq 8 \end{cases}$$

X_1 unrestricted, $X_2 \geq 0$ (5 marks)

- (d) A firm has three shops with a total of 80 televisions. An order is received from local authority for 70 sets to be delivered to 4 schools. The transport costs from shops to schools are shown below together with the availabilities.

		Schools			
		A	B	C	D
Sets		20	30	15	5
Shop I	40	2	4	1	6
Shop II	20	4	3	3	3
Shop III	20	1	2	5	2

It is required to make the most economic deliveries.

- (i) Set up the initial tableau and make the initial feasible deliveries. (3 marks)

- (ii) Calculate the corresponding transportation cost. (2 marks)

QUESTION TWO (20 MARKS)

- a) Consider the following activities schedule.

Activity	Preceding	Time		Cost	
	Activity	Normal	Crash	Normal	Crash
1	-	5	3	500	620
2	-	4	2	300	390
3	1	7	6	650	680
4	1	3	2	400	450
5	2, 3	5	3	850	1,000

- i) Calculate the cost slopes and the critical path of the following network. (5 marks)
- ii) Construct a least cost schedule for the network in question a (i) showing all durations from normal time-normal cost to crash time-crash cost. (5 marks)

- b) Using the simplex method, solve the following model.

$$\text{Maximize } W = 45X_1 + 80X_2$$

$$\text{s.t } \begin{cases} 5X_1 + 20X_2 \leq 400 \\ 10X_1 + 15X_2 \leq 450 \\ X_1, X_2 \geq 0 \end{cases}$$

(10 marks)

QUESTION THREE (20 MARKS)

A small electronics dealer buys various components to assemble them into transistors, tape recorders and small stereo sets. He does the assembly work after business hours and on the weekends for sale during the next week. In a week, the dealer has time to assemble at the most 500 kits of any one or the combined items. Transistors being very popular, the number of these units assembled must exceed the number of tape recorders and stereos by 100 units. The costing department has worked out the profitability and every transistor contributes £75, a tape recorder £125 and a stereo set £150. How many units of each of these kits should be assembled during the week to maximize the total profit. (20 marks)

QUESTION FOUR (20 MARKS)

- a) Anand Metal Shop (AMS) handles custom metal jobs for local customers. AMS has currently five jobs to be done and have five machines to do them. The cost matrix gives the cost of processing each job on any machine. Because of specific job requirements and machine specifications, certain jobs cannot be done on certain machines. These have been shown by X in the cost matrix.
- The assignment of jobs to machines must be done on a one-to-one basis. The objective is to assign the jobs to the machines so as to minimize the total cost within the restrictions mentioned above.

		Jobs				
Machines		1	2	3	4	5
	1	80	40	X	70	40
	2	X	80	60	40	40
	3	70	X	60	80	70
	4	70	80	30	50	X
	5	40	40	50	X	80

Required

- i) Find the optimal assignment of jobs to the machine so as to minimize the total cost within the restrictions mentioned above. (6 marks)
- ii) Determine the corresponding optimal cost. (4 marks)
- b) Two leading manufacturers, firm A and B, of a detergent powder are planning to make fund allocation for advertising their product. The matrix given shows the percentage of market share of firm A for its various advertising policies.

	No advertising	Medium advertising	Large advertising
No advertising	60	50	40
Medium advertising	70	55	45
Large advertising	80	60	50

Determine the optimal strategies for firm A (10 marks)

QUESTION FIVE (20 MARKS)

A management student identifies a list of activities and sequencing requirements along with the time estimates for various activities related to the completion of his project work. With the help of a network diagram, determine the minimum time required to complete the project. From the net work, identify the activities which can be delayed without affecting the project duration and the extent of delay that is possible for such activities. (20 marks)

Activity List	Pre-requisite activity	Activity times (in days)		
		a	b	m
A- search of literature	None	3	9	6
B- deciding the project	None	2	12	4
C – preliminary work	B	1	5	1.5
D – formal proposal	C	1	3	2
E –project committee’s approval	A,D	1.5	4.5	2
F –progress report	E	0.5	1.5	1.0

G - formal research	A,D	4.5	11.5	5.0
H- data collection	E	2	8	5
I-analysis	G,H	4	10	5.5
J-conclusions	I	1.5	4.5	2.5
K-draft	I,F	2.0	8.0	3.5
L-final draft	J,K	2.5	4.0	3.0
M- presentation	L	0.5	1.5	1.0