KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF COMMERCE

BMS 301: OPERATIONS RESEARCH I

DATE: TUESDAY, 23RD NOVEMBER 2010 TIME: 8.00 A.M. - 10.00 A.M.

INSTRUCTIONS: Attempt question ONE and any OTHER TWO QUESTIONS.

QUESTION ONE (30 Marks)

(a) Define the term operations research (OR) and give four examples, and state their advantages, limitations and importance in problem solving. (6 marks)

(b) Explain the meaning of:

(i) Stochastic models (2 marks)

(ii) Dynamic models (2 marks)

(iii) Unbalanced transportation problem (2 marks)

(iv) Critical path (2 marks)

(c) Obtain the dual for the following LP:

Maximize $Z = 3x_1 + 5x_2 + 7x_3$

Subject to:

$x_1 + x_2 + 3x_3 \leq 10$

$4x_1 - x_2 + 2x_3 \geq 15$

$x_1, x_2 \leq 0, >10$ (4 marks)

(d) MultiPro Limited produces three types of parts for automatic washing machines. It purchases castings of the parts from a local supplier and then finishes the parts on drilling, shaping and polishing machines. The selling prices of parts A, B, and C are respectively sh8, 10 and 14. All parts made can be sold. Castings for parts A, B, and C respectively cost Sh5, 6 and 10.

MultiPro possesses only one of each type of the machines. Costs per hour to run each type of the three machines are sh20 for drilling, sh30 for shaping, and sh30 for polishing. The capacities (parts per hour) for each part on each machine are as shown in Table 1.

Table 1.

	Capacity per Hour		
Machine	**Part A**	**Part B**	**Part C**
Drilling	**25**	**40**	**25**
Shaping	**25**	**20**	**20**
Polishing	**40**	**30**	**40**

The manager of the company wants to know how many parts of each type to produce per hour in order to maximize profits for the hours run.

Formulate the manager's problem as a linear programming problem. (6 marks)

e) Given the following transportation problem presented in Table 2, use the North-West corner rule to obtain the initial feasible solution, and then solve the problem.

Table 2

		WAREHOUSE		
		D	**E**	**F**
PLANT	**A**	**6**	**4**	**1**
	B	**4**	**8**	**7**
	C	**3**	**4**	**2**

f) Given the following information on a small project:

A is the first activity of the project and precedes activities B and C.

Activity D succeeds both activities B and C, whereas only C is required to start activity E. D precedes "F while G succeeds E. H is the final activity of the project and succeeds F and G.

Draw a project network based on this information. (6 marks)

QUESTION TWO (20 marks)

(a) List four assumptions of linear programming. (2 marks)

(b) Bryson Company uses three machines in the manufacture of three products. Each unit of product A requires 3 hours on machine I, 2 hours on machine II and one hour on machine III, each unit of product B requires 4 hours on machine I, one hour on machine II and 3 hours on machine III, while each unit of product C" requires 2 hours on each of the three machines. The contribution margin of the three products is sh30, sh40, and sh35 per unit respectively. The machine hours available on the three machines are 90, 54 and 93 respectively.

(i) Formulate the above problem as a linear programming problem. (2 marks)

(ii) Obtain the optimal solution to the problem. Which of the three products shall not be produced by the company? Why? (10 marks)

(iii) Determine the percentage of capacity utilization in the optimal solution. (2 marks)

(iv) What are the shadow prices of the machine hours? (2 marks)

(v) Is the optimal solution degenerate? Explain your answer. (2 marks)

QUESTION THREE (20 marks)

A pharmaceutical company has the choice of producing four similar products W, X, Y and Z in any combination. These products have profit rates of Sh70, 65, 80 and 75, respectively. They all require two types of raw materials R and T and two types of labour: skilled and semi-skilled. The per unit requirements and availability of the resources every week is as shown in Table 3.

Table 3

Resource	**Per Unit Requirement**				**Availability**
	W	X	Y	Z	
R	4	4	3	7	90 Kg
T	6	3	5	4	120 Kg
Skilled labor	5	2	3	3	60 hrs
Semi-skilled	6	5	1	2	100 hrs

(a) Determine the optimal product mix for the firm. (12 marks)

(b) Carry out a sensitivity analysis for changes in the objective function coefficients and the right-hand-side values of the constraints. (8 marks)

QUESTION FOUR (20 marks)

(a) Identify five rules of network construction and explain the role of a dummy in the network. (5 marks)

(b) Information available on the activities required for a project is as follows in Table 4:

Table 4.

Name	Activities Nodes	Duration (days)
A	1 - 2	2
B	1 - 3	7
C	1 - 4	8
D	2 - 5	3
E	3 - 5	6
F	3 - 6	10
G	3 - 7	4
H	4 - 6	6
I	5 - 7	2
J	6 - 7	5
K	7 - 8	6

(i) Draw a network for the project. (5 marks)

(ii) Calculate the ES, EF, LS and LF times for each activity. (10 marks)

****