(Knowledge for Development)

KIBABII UNIVERSITY

(KIBU)

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

SPECIAL/SUPPLEMENTARY EXAMINATIONS
YEAR FOUR SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF COMMERCE
(OPERATIONS AND INFORMATION SYSTEMS)

COURSE CODE : BCO 443E

COURSE TITLE : APPLIED ACTUARIAL SCIENCE

DATE: 11/10/2018 TIME: 11:30 A.M - 1:30 P.M

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

$$4x_1 + 7x_2 \leq 20$$
$$5x_1 + 2x_2 \leq 10$$
$$6x_1 + 8x_2 \leq 25$$

x_1 *and* x_2 are unrestricted in sign. (3 Marks)

d) Solve the following LP problem using Simplex Method.
Maximize $z = 6x_1 + 8x_2$

Subject to

$$5x_1 + 10x_2 \leq 60$$
$$4x_1 + 4x_2 \leq 40$$
$$x_1 \quad and \quad x_2 \geq 0$$

d) Consider the details of a distance network as shown below:

Arc	Distance	Arc	Distance
1 – 2	6	5 – 6	13
1 – 3	7	5 – 8	9
1 – 4	10	6 – 7	5
2 – 3	8	6 – 8	4
2 – 5	4	6 – 9	8
3 – 4	6	6 – 10	3
3 – 5	11	7 – 9	10
3 – 6	3	8 – 10	10
3 – 7	5	9 – 10	9
4 – 7	7		

(i) Construct the distance network
(ii) Find the minimum spanning tree using PRIM algorithm

(5 Marks)

e) (i) State four assumption of Linear programming (4 Marks)

(ii) Write a linear programming model of the General transportation problem. (3 Marks)

QUESTION TWO (20 MARKS)

a) Solve the following Linear programming problem using the result of its dual.

Minimize $z = 24x_1 + 30x_2$

Subject to: $2x_1 + 3x_2 \geq 10$

$4x_1 + 9x_2 \geq 15$

$6x_1 + 6x_2 \geq 20$ (6 Marks)

$x_1 \quad and \quad x_2 \geq 0$

b) In a multi-speciality hospital, nurses report to duty at the end of every four hours as shown in a table below. Each nurse, after reporting, will work for 8 hours continuously. The minimum number of nurses required during various periods are summarized in the table below. Develop a Mathematical Model to determine the number of nurses to report at the beginning of each period such that the total number of nurses who have to report to duty in a day is minimized. (3 Marks)

Internal number	Time Period		Minimum number of nurses required
	From	To	
1	12 midnight	4.00a.m	20
2	4.00a.m.	8.00a.m	25
3	8.00a.m	12Noon	35
4	12 Noon	4.00p.m	32
5	4.00p.m	8.00p.m	22
6	8.00p.m.	12midnight	15

c) Consider the following Linear Programming Model and solve it using the dual simplex Method

Minimize $z = 12x_1 + 18x_2 + 15x_3$

Subject to: $4x_1 + 8x_2 + 6x_3 \geq 64$

$3x_1 + 9x_2 \geq 15$

$6x_1 + 6x_2 + 12x_3 \geq 96$

$x_1 \quad x_2 \quad and \quad x_3 \geq 0$

(7 Marks)

(d) Show that assignment model is a special case of the transportation model.

(4 Marks)

QUESTION THREE

(a) What are types of transportation problem? Explain them with suitable examples.

(4 Marks)

(b) A dairy farm has three plants located throughout a city. Daily mild production at each plant is as follows.

Plant 1 - 6 million litres

Plant 2 - 1 million litres

Plat 3 - 10 million litres

Each day the farm must fulfil the needs of four distribution centrs. Minimum requirement at each center is as follows.

Distribution centre 1 - 7 million litres.

Distribution centre 2 - 5 million litres.

Distribution centre 3 - 3 million litres.

Distribution centre 4 - 2 million litres.

The cost of shipping one million litres of milk form each plant to each distribution center is given in the following table in hundreds of shillings.

Distribution centres

Plants	1	2	3	4
1	2	3	11	7
2	1	0	6	1
3	5	8	15	9

The dairy farm wishes to decide as to how much should be the shipment from which plant to which plant to which distribution center so that the cost of shipment may be minimum.

(i) Formulate the transportation matrix

(ii) Obtain the initial feasible solution using the following methods. Northwest corner cell method, Least cost cell method and Vogel's Approximation Method.

(9 Marks)

b) A college is having a degree programme for which the effective semester time available is very less and the programme requires fieldwork. Hence a few hours can be saved from total number of class hours and can be utilized for the fieldwork. Based on past experience, the college has estimated the number of hours required to teach each subject by each faculty. The course in its present semester has 5-subjects and the college has considered 6 existing faculty members to teach these courses.

The objective is to assign the best 5 teachers out of these 6 faculty members to teach 5 teach 5 different subjects so that the total number of class hours required is minimized. The data is given in the table below.

Solve this assignment problem optimally using the Hungerian Method.

Subject

	1	2	3	4	5
1	30	39	31	38	40

2	43	37	32	35	38
3	34	41	33	41	34
4	39	36	43	32	36
5	32	49	35	40	37
6	36	42	35	44	42

(7 Marks)

QUESTION FOUR

(a) An organization is planning to diversify its business with a maximum outlay of R_s.5 crores. It has identified three different locations to install plants. The organization can invest in one or more of these plants subject to the availability of the fund. The different possible alternatives and their investment (in crores of rupees) and present worth of returns during the useful life (in crores of rupees) of each of these plants are summarized in Table 8.1. The first row of Table 8.1 has zero cost and zero return for all the plants. Hence, it is known as do-nothing alternative. Find the optimal allocation of the capital to different plants which will maximize the corresponding sum of the present worth of returns.

Table 8.1 Example 8.1

	Plant 1		Plant 2		Plant 3	
Alternative	Cost	Return	cost	Return	Cost	Return
1	0	0	0	0	0	0
2	1	15	2	14	1	3
3	2	18	3	18	2	7
4	4	28	4	21	-	-

(b) Solve the following model of the optimal subdividing of a cable of length 10 units into three parts such that the product of their lengths is maximized, using dynamic programming technique.

Maximize $z = p_1 x p_2 x p_3$

Subject to $p_1 + p_2 + p_3 = 10$

$p_1, p_2 and p_3 > 0$

QUESTION FIVE

Consider Table below summarizing the details of a project involving 11 activities.

		Duration (Weeks)		
Activity	Predecessor (s)	a	m	b
A	-	6	7	8
B	-	1	2	9
C	-	1	4	7
D	A	1	2	3
R	A, B	1	2	9
F	C	1	5	9
G	C	2	2	8
H	E, F	4	4	4
I	D,	4	4	10
J	H	2	5	14
K	I, G	2	2	8

(a) Construct the project network.

(b) Find the expected duration and variance of each activity.

(c) Find the critical path and the expected project completion time.

(d) What is the probability of completing the project on or before 25 weeks?

(e) If the probability of completing the project is 0.84, find the expected project completion time.