(6)

(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER

SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR SCIENCE

COURSE CODE: MAT 429

COURSE TITLE: OPERATION RESEARCH II

DATE: 04/10/18 **TIME:** 11.30 AM -1.30 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 7 Printed Pages. Please Turn Over.

QUESTION 1: [30 Marks] (COMPULSORY)

a) Explain the following terms as used in critical path analysis

i. Float of an activity and event **[1mk]**

ii. Critical path **[1mk]**

iii. Free float **[1mk]**

iv. Length of critical path **[1mk]**

v. Independent float **[1mk]**

b) Determine an initial feasible solution to the following transportation problem by using the North-west method.

		Destination				
		D_1	D_2	D_3	D_4	SUPPLY
SOURCE	S_1	1	2	1	4	30
	S_2	3	3	2	1	50
	S_3	4	2	5	9	20
	Demand	20	40	30	10	

[5mks]

c) A corporation is entertaining proposals from its three plants for possible expansion of facilities and is budgeting Shs 5 million for allocation to all three plants as shown in table below

Proposal	Plant 1		Plant 2		Plant 3	
	C_1	R_1	C_2	R_2	C_3	R_3
1	0	0	0	0	0	0
2	1	2	1	5	2	8
3	-	-	2	6	3	9
4	-	-	-	-	4	12

Find the optimal solution using the backward recursive dynamic programming model **[8mks]**

d) Consider the reliability problem of an electronic device consisting of four main components. The four components are arranged in series so that the failure of one component will cause the failure of the entire device. The total capital is C=10 and the reliabilities $R_j(k_j)$ and cost

$C_j(k_j)$ for the j^{th} components $(j = 1,2,3,4)$ giving k_j parallel units are as summarized in the table below;

k_j	COMPONENTS							
	1		2		3		4	
	R_1	C_1	R_2	C_2	R_3	C_3	R_4	C_4
1	0.4	1	0.6	1	0.7	3	0.5	2
2	0.8	3	0.8	2	0.8	5	0.7	4
3	0.95	7	0.9	3	0.9	6	0.9	5

Determine the number of parallel units k_j^* in component j that will maximize the reliability of the device without exceeding the total capital C **[10mks]**

QUESTION 2: [20marks]

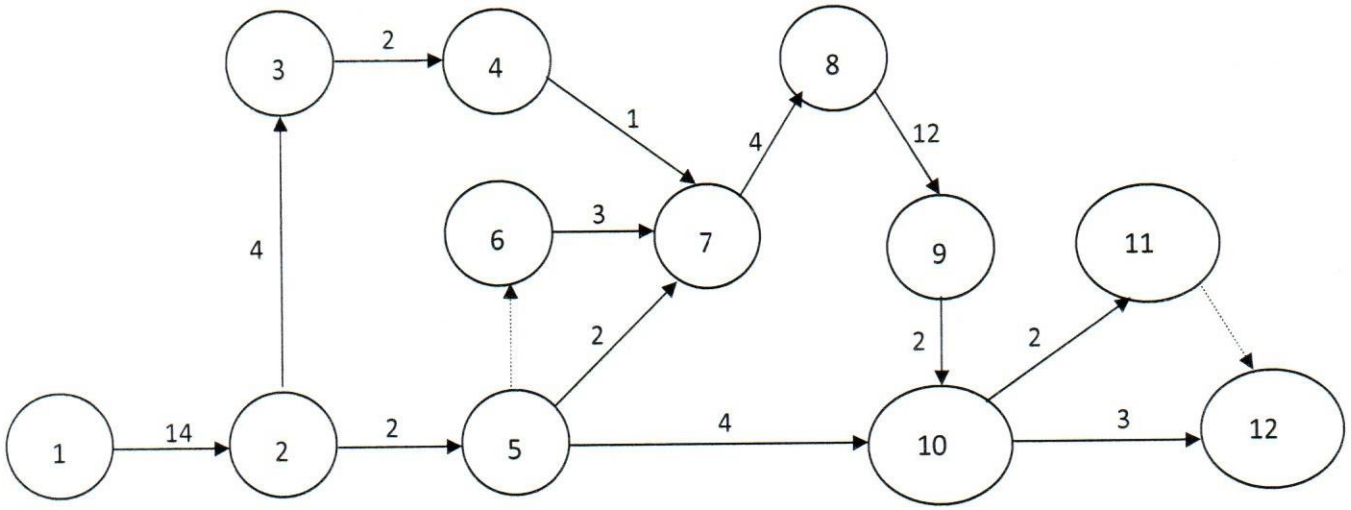
a) Explain briefly the following as used in the transportation problem

i. Least cost method **[1mk]**

ii. Vogel's approximation method **[1mk]**

iii. North –west corner method **[1mk]**

b) Determine the critical path in the following network that starts at node 1 and terminates at node 12. What is its length?



[8mks]

c) A firm has five workers who have to be allocated to three departments. The return (or profit) from each department depends upon the number of workers working in that

department. The expected return for different number of workers in different zones, as estimated from the past records are given below;

Number of workers	Department		
	1	2	3
0	47	32	37
1	60	47	47
2	72	62	54
3	84	72	66
4	95	81	74
5	103	92	84

Determine the optimal allocation policy. **[9mks]**

QUESTION 3: [20marks]

a) Determine an initial basic feasible solution to the following transportation problem by using

		Distribution center				Supply
		D_1	D_2	D_3	D_4	
Plant	P_1	2	3	11	7	6
	P_2	1	0	6	1	1
	P_3	5	8	15	9	10
Demand		7	5	3	2	

i. North –west corner rule **[3mks]**

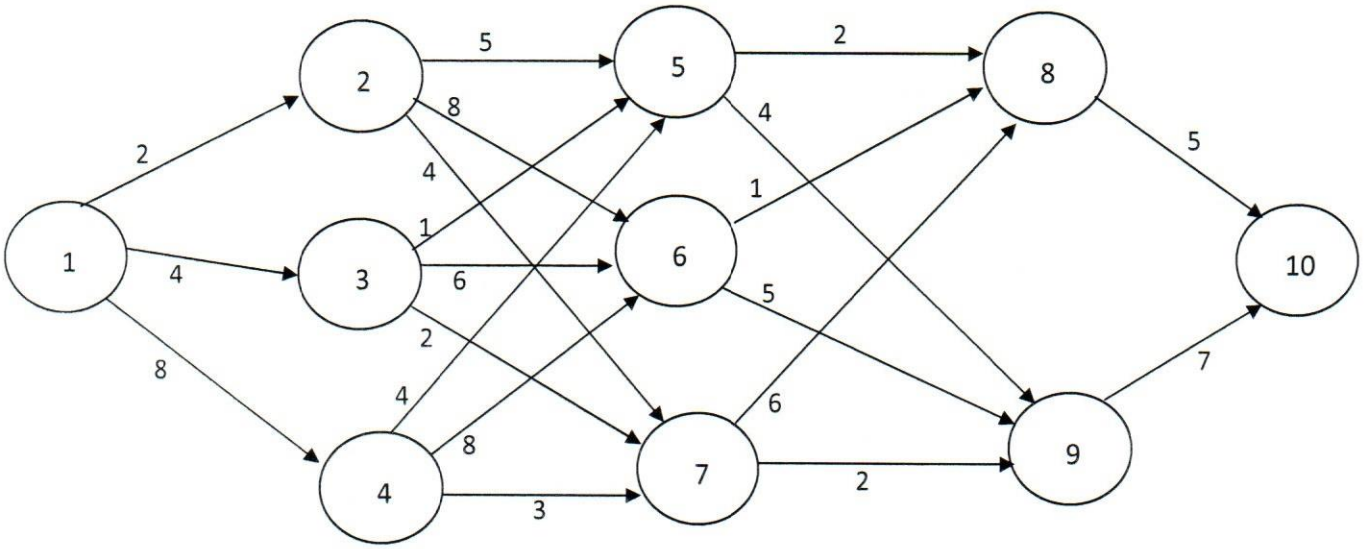
ii. least cost method **[3mks]**

iii. Vogel's approximation method **[4mks]**

If the objective is to minimize the total transportation

b) A lorry located in a town 1 decided to travel to town 10.The distances of alternative routes from town 1 to town 10 are given in a highway network map given in the figure below. The

arrow representing routes between towns and distances in kilometers are indicated on each route.



Find the shortest route that covers all the selected towns from 1to 10 **[10mks]**

QUESTION 4: [20marks]

a) Determine an initial basic feasible solution using Vogel's approximation method to the transportation problem shown in the table below

		DESTINATION				
		D_1	D_2	D_3	D_4	SUPPLY
SOURCE	S_1	19	30	50	10	**7**
	S_2	70	30	40	60	**9**
	S_3	40	8	70	20	**18**
DEMAND		**5**	**8**	**7**	**14**	**34**

[4mks]

b) An established company had decided to add a new product to its line. It will buy the product from a manufacturing concern, package it, and sell it to a number of distributors selected on a geographical basis. Market research has indicated the volume expected and the size of sales force required. The steps shown in the following table are to be planned

Activity	Description	Duration (days)	Predecessors
A	Organize sales office	6	-
B	Hire salesmen	4	A
C	Train salesmen	7	B
D	Select advertising agency	2	A
E	Plan advertising campaign	4	D
F	Conduct advertising campaign	10	E
G	Design package	2	-
H	Set-up packaging facilities	10	G
I	Package initial stocks	6	J,H
J	Order stock from manufacturer	13	-
K	Select distributors	9	A
L	Sell to distributors	3	C,K
M	Ship stock to distributors	5	I,L

i. Draw the network diagram showing the inter-relations between the various activities of the project. **[9mks]**

ii. Indicate the critical path. **[2mks]**

iii. For each non-critical activity find the total and free float. **[5mks]**

QUESTION 5: (20marks)

a) A company has five salesmen, who have to be allocated to three marketing zones. The return (or profit) from each zone depends upon the number of salesmen, working in that zone. The expected return for different number of salesmen in different zone, as estimated from the past records are given below

Number of salesmen	Marketing zone		
	1	2	3
0	45	30	35
1	58	45	45
2	70	60	52
3	82	70	64
4	93	79	72
5	101	90	82

Determine the optimal allocation policy **[8mks]**

b) Consider the problems of designing electronic device to carry five power cells, each o f which must be located within three electronic systems .If one systems power fails, then it will be powered on an auxiliary basis by the cells of the remaining systems .The probability that any particular system will experience a power failure depends on the number of cells originally assigned to it

Estimated power failure probabilities for a particular system are given below

Power Cells	Probability of system power failure		
	System 1	System 2	System 3
1	0.60	0.70	0.50
2	0.25	0.30	0.35
3	0.14	0.20	0.20
4	0.12	0.15	0.15
5	0.11	0.12	0.15

Determine how many power cells should be assigned to each system to maximize the overall system reliability **[12mks]**