

**PAN AFRICA CHRISTIAN UNIVERSITY
BACHELORS OF INFORMATION COMMUNICATION TECHNOLOGY
END OF TERM EXAMINATION**

DEPARTMENT: COMPUTING & INFORMATION TECHNOLOGY
COURSE CODE: BSIT202
COURSE TITLE: OPERATION RESEARCH
CAMPUS: ROYSAMBU
EXAM DATE: FRIDAYXXXX/AUGUST
TIME: START HOUR – 11.00AM-2.00PM

INSTRUCTIONS

- This exam carry a total of SIX Questions of [10 Marks Each]
- Section One (I) is compulsory.
- Answer any 3(Three) Questions from Section Two (II)
- Read all questions carefully before attempting.

SECTION A
(Answer ALL questions in this section)

QUESTION ONE (10 Marks)

- a) Distinguish between feasible and optimal solution in linear programming. (2 Marks)
- b) Discuss any two characteristics of a project. (2 marks)
- c) Explain two applications of Linear Programming. (2 marks)
- d) Minimize $Z=3x_1+2x_2$ solve by graphically. (4 marks)

Subject to

$$5x_1+x_2\geq 10$$

$$x_1+x_2\geq 6$$

$$x_1+4x_2\geq 12$$

$$x_1, x_2 \geq 0$$

SECTION B
((Answer any THREE (3) questions in this section))

QUESTION TWO (10 Marks)

- a) A bank has one teller. Customers arrive at a rate of 10 per hour (Poisson distribution), and the teller can serve 12 customers per hour (exponential distribution).
 - i) Calculate the utilization rate of the teller. (2 marks)
 - ii) Calculate the average number of customers in the queuing system (waiting and being served)? (2 marks)
 - iii) What is the average waiting time for a customer in the queue? (2 marks)
- b) Solve the following assignment problem using the Hungarian method: (4 marks)

$$\begin{bmatrix} 12 & 7 & 9 & 7 \\ 8 & 9 & 6 & 6 \\ 7 & 17 & 12 & 14 \\ 15 & 14 & 6 & 6 \end{bmatrix}$$

QUESTION THREE (10 marks)

- a) A project consists of the following activities with their precedence relationships and optimistic, most likely, and pessimistic time estimates (in days):

Activity	Predecessor	Optimistic (a)	Most Likely (m)	Pessimistic (b)
A	-	2	4	6
B	A	3	5	7
C	A	4	6	8
D	B, C	5	8	11
E	D	1	2	3

- Draw the AOA (Activity-On-Arrow) network diagram for this project. (2 marks)
- Calculate the expected duration and variance for each activity. (2 marks)
- Determine the critical path and the expected project completion time. (2 marks)

- b) Use the **Simplex Method** to solve the following LPP: (6 marks)

$$\text{Maximize } Z = 3x_1 + 5x_2$$

Subject to:

$$x_1 + 2x_2 \leq 6$$

$$3x_1 + 2x_2 \leq 12$$

$$x_1, x_2 \geq 0$$

QUESTION FOUR (10 marks)

- a) An airline uses an OR model to optimize its flight crew scheduling, leading to significant cost savings. However, this optimization sometimes results in very short layovers for crews in distant cities and complex, rapidly changing schedules.

- Beyond cost savings, what other factors should the airline critically consider when implementing such an OR solution? (2 marks)
- Discuss the ethical considerations involved when an OR model's "optimal" solution potentially negatively impacts human factors (e.g., employee well-being, stress). (4 marks)

- iii) How might an OR analyst use their critical thinking skills to propose alternative model formulations or constraints that balance efficiency with other important, less quantifiable objectives in this scenario? (4 marks)

QUESTION FIVE (10 Marks)

a) State the areas of application of integer programming (3 marks)

b) The following are activities of a project XYZ.

Activity	Preceding activity	Duration
A	-	2
B	A	3
C	A	5
D	A	8

Activity	Predecessor	O	M	P
Activity	Predecessor	O	M	P
A	-	1	2	3
B	A	2	4	6
C	A	3	5	7
D	B	2	2	2
E	B, C	4	5	6

Activity	Predecessor	O	M	P
A	-	1	2	3
B	A	2	4	6
C	A	3	5	7
D	B	2	2	2
E	B, C	4	5	6
F	D, E	3	6	9

- i) Calculate the expected time and variance for all activities. (2 marks)
- ii) Construct the PERT network. (2 Marks)
- iii) Identify the critical path. (2 marks)
- iv) Estimate the project completion time and standard deviation. (2 marks)
- v) Calculate the probability that the project will be completed in 20 days. (2 marks)