**NATIONAL OPEN UNIVERSITY OF NIGERIA**
**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI-ABUJA**
**FACULTY OF COMPUTING**
**DEPARTMENT OF COMPUTER SCIENCE**
**2025_2 EXAMINATIONS**

---

**COURSE CODE:** CIT 756
**COURSE TITLE:** Operations Research
**CREDIT:** 2 Units
**TIME ALLOWED:** 2 Hours
**INSTRUCTION: Answer Question One (1) and any other Two (2)**

**Question 1**

a. Analyse the concept of problem definition in operation research **[5 marks]**
b. Give the Differences between Critical Path Analysis (CPA) and Programme Evaluation and Review Technique (PERT) - **[4 marks]**
c. Assume a single channel service system of a library in a school. From past experiences it is known that on an average, every hour 8 students come for issue of the books at an average rate of 10 per hour. Determine the following **[6 marks]**
(i). Probability of the assistant librarian being idle
(ii). Probability that there are at least 3 students in the system
*(iii).* Expected time that a student is in queue
d. State the steps involved in calculation of replacement policy when money value changes **[5 marks]**
e. Analyse the behavior of customers while waiting in a queue **[6 marks]**
f. A service system has a number of facilities positioned in a suitable manner, highlight these facilities **[4 marks]**

**Question 2**

a. Analyse the concept of solution development in operation research **[5 marks]**
b. A special diet for a patient in the hospital must have at least 8000 units of vitamins, 100 units of minerals and 2800 units of calories. Two types of foods X and Y are available in the market at the cost of #8 and #6 respectively. One unit of X contains 40 units of vitamins two units of minerals and 80 units of calories. One unit of food B contains 200 units of vitamins, four units of minerals and 80 units of calories.
Form a mathematical model and state the constraints to find the combination of foods X and Y that can be used so that the minimum requirement of vitamins, minerals and calories is maintained and the cost incurred by the hospital is minimised? **[7 marks]**
c. Briefly explain four (4) important terms used in Queuing Theory **[8 marks]**

**Question 3**

a. Arrival rate of customers at a photocopying centre is according to Poisson distribution, with an average time of 12 minutes between two consecutive customers' arrival. The length of photocopying for each customer is assumed to be exponentially distributed with a mean of 4 minutes **[8 marks]**
(i). Determine the probability that a customer arriving at the centre will have to wait **[2 marks]**
(ii). The photocopying company will install second centre when convinced that an arrival would expect to have to wait at least 5 minutes for the photocopying. Find the increase in flows of arrivals which will justify a second centre **[3 marks]**
(iii). What is the probability that a customer will have to wait for more than15 minutes before the photocopying? **[2 marks]**
(iv). Find the fraction of a day that the photocopier will be in use **[1 mark]**

b. Analyse the reasons for replacing equipment **[6 marks]**
c. (i) Mention the type of sequencing problems we have **[2 marks]**

(ii) State any four factors that determines the solution to the problems in (i) – **[4 marks]**

**Question 4**

a. Demonstrate a flow that shows the steps involved in operation research **[5 marks]**
b. A metal alloy used in the manufacture of rifles uses two ingredients A and B. A total of 120 units of alloy are used for production. Not more than 60 units of A can be used and at least 40 units of ingredient B must be used in the alloy. Ingredient A costs Rs. 4 per unit and ingredient B costs Rs. 6 per unit. The company manufacturing rifles is keen to minimise its costs. Formulate a mathematical model for the problem and state the constraints to the solution **[9 marks]**.

c. Itemize some of the details required to schedule the resource requirements for a project **[6 marks]**

**Question 5**

a. Analyse the weakness of operation research **[5 marks]**
b. Assuming a company found out that it is not importing its raw materials in the most economic way. A financial analysis shows that:
It cost #900.00 to make an order. Each item costs #50.50. The annual holding costs are 10 per cent of the price paid. The current annual consumption is 500,000.00. Determine the following **[11 marks].**
i. The optimal order size.
ii. The number of days this supply would last.
iii. The number of orders per year? (Assume year = 250 working days)
c. From the activity table and network given, identify all possible paths through the network **[4 marks]**

| Activity label | Description | Preceding Activity |
|---|---|---|
| *A* | Decide test market area | - |
| *B* | Agree marketing strategy | - |
| *C* | Agree production specification | - |
| *D* | Decide brand name | *B* |
| *E* | Prepare advertising plan | *A* |
| *F* | Agree advertising package | *E* |
| *G* | Design packaging | *D* |
| *H* | Production of test batch | *C* |
| *I* | Package and distribute | *G , H* |
| *J* | Monitor media support | *F , D* |