Instruction: Answer any four (4) questions

TIME: 2½ HOURS

1. (a) A food products company is contemplating the production of a revolutionary new product with packaging or replacing the existing product at much higher price ($S_1$). It may even make a moderate change in the composition of existing product, with a new packaging at a small increase in price ($S_2$) or small change in the composition of the existing product backing it with the word 'New' and a negligible increase in price ($S_3$). The three possible states of nature or events are, (i) high increase in sales ($N_1$), (ii) no change in sales ($N_2$) and (iii) decrease in sales ($N_3$). The marketing department of the company work out the payoff in terms of yearly net profits for each of the strategies of three events (expected sales). This is represented in the following table: state of nature

| | $N_1$ | $N_2$ | $N_3$ |
|---|---|---|---|
| $S_1$ | 7,000,000 | 3,000,000 | 1,500,000 |
| $S_2$ | 5,000,000 | 4,500,000 | 0 |
| $S_3$ | 3,000,000 | 3,000,000 | 3,000,000 |

Which strategy should the concerned executive choose on the bases of (i) Maximin criterion (ii) Minimax regret (salvage) criterion (iii) Laplace Bayes criterion (iv) Hurwitz criterion given degree of pessimism as 60%? (12½ marks)

(b) Explain with the aid of diagram the structure of any queuing system. (5 marks)

2. The management of Smart Limited is considering the acquisition of some machines to enhance its production capacity and has a choice of Type A or Type B machines. The company has budgeted ₦160, 000 for the purchase of the machines. Type A machine cost ₦5, 000 each; require 25 hours of maintenance a week and produce 1,500 units a week. Type B machines cost ₦10, 000 each; require 10 hours of maintenance a week and produce 2,000 units a week.

Each machine type needs 50 square metres of floor area. The available square metre of floor area is 1000 while 400 hours of maintenance time is available in a week. Since all products produced can be sold, the management of the company wishes to maximise output.

Required:
(a) State the objective function for the above problem.
(b) State the constraints for the above problem.
(c) Determine the optimum mix of the machines to acquire.
(d) What is the number of hours of maintenance that are unused?

3   a. Outline the basic assumptions in transportation model (4marks)          (17½ marks) ✔

b. The cost of transportation per unit from three sources and four destination are given in the table below

| SOURCE | DESTINATION | | | | SUPPLY |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1 | 4 | 2 | 7 | 3 | 500 |
| 2 | 3 | 7 | 5 | 8 | 900 |
| 3 | 9 | 4 | 3 | 1 | 1000 |
| Demand | 400 | 800 | 600 | 600 | 2400 |

✔ done

Obtain the initial basic feasible solution using the following methods

i. North-West Corner Method                                         (4 marks)

ii. Least Cost Method                                             (4 marks)

iii. Vogel's Approximation Method                             (5½ marks)

4   a) Define the following terms (i) Optimal strategy (ii) Value of the game (iii) Saddle point                   (5 marks)

b) OOU management is currently involved in negotiations with its academic staff union on the upcoming wages contract. Positive signs in the table represent wages increase while negative sign represents wages reduction. What are the optimal strategies for the management as well as the union? What is the game value?

Conditional costs to the management are as presented below.

Union strategies

| Management strategies | $U_1$ | $U_2$ | $U_3$ | $U_4$ |
|---|---|---|---|---|
| $C_1$ | 0.25 | 0.27 | 0.35 | -0.02 |
| $C_2$ | 0.20 | 0.06 | 0.08 | 0.08 |
| $C_3$ | 0.14 | 0.12 | 0.05 | 0.03 |
| $C_4$ | 0.30 | 0.14 | 0.19 | 0.00 |

(12½ marks)

5   Given the following information about the frequency and arrival times of luxury buses at a park in Ikeja, Lagos State; ✔

| Time (minutes) | 5 | 15 | 25 | 35 | 45 | 55 |
|---|---|---|---|---|---|---|
| Frequency | 3 | 18 | 15 | 50 | 12 | 2 |

You are required to:

(a) Simulate via Monte Carlo method the arrival time of 8 buses using the following random numbers – 30, 44, 70, 81, 17, 10, 78 and 25.

(b) Calculate the estimated mean time between arrivals.

(c) Determine the standard deviation.

(17 ½ marks)

6. a. The application of scientific measures in solving problem is the focus of operation research. However, solving operational problems requires the use of Models.

i. Define a model and discuss the purpose of modelling (7½ marks)

ii. Outline the major limitations of operation research (5 marks)

iii. List and explain the stages involved in operational research study (7 marks) done