

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH

SORS5101: OPERATIONS MANAGEMENT

MSc IN OPERATIONS RESEARCH AND STATISTICS

NOVEMBER 2024 EXAMINATION

Time : 3 hours

Candidates should attempt **ALL** questions from Section A and **ANY THREE** questions from Section B.

**SECTION A: Answer ALL questions in this section (25 marks).**

- A1.** Use a snack vending machine in a walkway at an airport to define an operation. [4]
- A2.** Suppose that Delta Beverages discovered that most of their retail customers in an upcoming town could not go to their depot, purchase the soft drinks in bulk and carry them back to their different types of shops. Illustrate how Delta Beverages can apply the Basic OM model in their planning to solve the problem. [6]
- A3.** Explain how Kango Products Limited can create competitive priorities when managing its operations as a manufacturing firm. [5]
- A4.** Discuss the direct OM responsibilities of a branch manager at Jet Stores. [10]

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**SECTION B: Answer ANY THREE questions in this section (75 marks).**

- B5.** (a) A tooling clamp of a milling machine is assembled from two parts of component A and three parts of component B. Component A in turn, is made of component W and two parts of component X. Component B is made of two parts of component W and two parts of component Y. There is an order of a hundred of these tooling clamps to be supplied by the end of the tenth week.
- (i) Construct a product tree structure of the tooling clamp. [3]
- (ii) How many units of each component must be produced to satisfy the demand? [6]
- (iii) It takes one week to assemble each tooling clamp, two weeks to make components A and B, three weeks to order components W and one week each to make components X and Y. Construct a materials requirement plan for supplying the hundred tooling clamps. [6]
- (b) Demand forecasts for each quarter of the year for quantities of a certain product are 120, 140, 110 and 90 with this pattern repeating in the future as far as can be told. The current manpower is 11 workers and each can produce ten units per quarter. Each unit of the product can be held in the company's stocks for \$10 per quarter with back-ordering costs set at \$13 per unit in each quarter until the shortage is filled. It costs the company \$100 to hire or lay off a worker in each quarter but each idle worker requires \$150 in that particular quarter. However, if they decide to hire the current workers on overtime then they have to pay each worker an extra wage of \$15 per quarter. Calculate the total annual cost when the company opts for a mixed strategy with one change by mid-year. [10]
- B6.** (a) A retiree used his experience in the custom refinishing auto-servicing industry to open a workshop offering such services. Custom refinishing techniques have improved introducing faster processing times. As a result, customers no longer want to be delayed by more than one and a half hours waiting for their car to be custom refinished. On a certain day, the retiree received cars in the order stated in Table 1 with known customising hours.

Table 1:

Car Number	1	2	3	4	5	6
Customising time (hrs)	3.0	2.0	2.5	0.7	1.6	2.1
Required time (hrs)	10.0	9.5	8.0	10.5	11.0	7.5

Find a sequence on which the retiree can custom refinish the cars without frustrating any customer. [13]

Table 2:

Job Number	1	2	3	4	5
Machine A	5	7	6	9	5
Machine B	2	1	4	5	3
Machine C	3	7	5	6	7

- (b) Find the total number of hours lapsed and idle hours on each machine in a series production line with the job information in Table 2.

[12]

- B7. Mrs Masache is opening a grocery supermarket in the central business centre of the Bulawayo Metropolitan Province. She identified several tasks which must be done before opening the supermarket as shown in Table 3.

Table 3:

Activity	Duration (days)
Sandblast exterior	10
Decorate interior	6
Buy stock	15
Decorate exterior	10
Prepare advertisements	3
Advertisement campaign	10
Arrange window displays	2
Plan store layout	5
Stock shelves	10

The first three stated activities can all be started immediately and can take place at the same time. Once the sandblasting has been completed, the exterior of the supermarket can be decorated. Mrs Masache is hoping to get a discount on some items when she visits a local warehouse to purchase them. If she gets a discount, then she intends to have some special offers which she will include in her advertisements. Therefore, the preparation of the advertisements cannot commence until the stock has been purchased. Once the advertisements have been prepared then the advertising campaign can begin. This includes advertising in a local newspaper and posting flyers. Mrs Masache does not wish to arrange the window displays until the exterior has been sandblasted, the interior has been decorated and the stock has been purchased. The plan for the supermarket layout can begin as soon as the stock arrives. Stocking of shelves can take place once the layout has been done and window displays have been finished.

- (a) Apply the critical path method to find out how long it would take Mrs Masache before she opens the supermarket.

[20]

- (b) Identify activities Mrs Masache should not delay. [3]
- (c) Regarding Mrs Masache's supermarket opening, distinguish a free float from a total float. [2]

- B8.** (a) A national stock feed giant has warehouses in Masvingo, Mutare and Gweru. Their only plant is in Harare and they distribute the produced stock feed to the warehouses according to the demand and transportation costs associated with each warehouse. Table 4 shows the costs associated with each warehouse.

Table 4:

City	Weekly cost (\$'000)	Cost/ton (\$)
Gweru	2.45	230
Masvingo	2.68	220
Mutare	2.36	250

Find the range of demand quantities the stock feed producer distributes to each warehouse. [20]

- (b) A mobile banking service is at the maturity stage in its life cycle as a product in Zimbabwe. Comment on the statement. [5]

END OF QUESTION PAPER