NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SMA 5172

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED MATHEMATICS

OPERATIONS MANAGEMENT

DEC 2002

Time : 3 hours

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

SECTION A

A1. Define the term *production and operations management*, hence explain what is meant by an operating system. [3]

A2. State and briefly describe all the operating subsystems. [9]

A3. State any four design criteria for a (i) product, and (ii) process. [2,2]

A4. Define *quality* of a product and state why and how the quality of a product is maintained. [4]

A5. (a) Define Manufacturing Resource Planning, MRPII, and explain how it differs from Materials Requirement Planning, MRP. [4]

(b) Discuss the value of MRP in areas of a firm other than production. [4]

SECTION B

B6. (a) Define *corporate mission, business strategy, and operations strategy.*

(b) How is operations strategy related to business strategy?

(c) How does operations strategy impact business strategy?

(d) Name and describe any three competitive priorities. Discuss how these priorities are created?

[3,3,3, 9]

B7. (a) Compare and contrast (i) *process design*, and (ii) *product design* in the product manufacturing and service operations. [9]

(b) Define *facility layout*, hence state and describe the three possible types of layouts. [1,4]

(c) Compare and contrast the layout of a hospital and a bank. How are they alike and how are they different? [4]

B8. (a) What is resource requirements planning? [3]

(b) Identify the major elements of resource requirements planning. [4]

(c) If the beginning inventory for a product is 500 units, safety stock is 200 units, and estimated weekly demand is 300, 400, 300, 800, 1 000 and 500 units over a 6-week planning horizon, develop a net requirements schedule for the product. [11]

B9. The net requirements for a material from an MRP schedule are:

Week	1	2	3	4	5	6	7	8
Net requirements	300	500	1 000	600	300	300	300	1 500

The annual demand for this end item is estimated at 30 000 units over a 50 - week - per - year schedule, or an average of 600 units per week. It costs \$500 to change over the machines in the final assembly department to this end item when a production lot is begun. It costs \$0.50 per unit when one unit of this product must be carried in inventory from one week to another; therefore, when one unit of this product is in ending inventory, it must be carried as beginning inventory in the next week and incurs the \$0.50 per unit carrying cost.

Determine which of lot - sizing methods results in the least carrying and change-over (ordering) costs for the 8-week schedule:

(a) lot for lot, [6]

(b) economic order quantity, EOQ, and [6]

(c) period order quantity, POQ [6]

B10. A new machine has just been installed to cut and rough-shape large slugs. The slugs are transferred to a precision grinder. One critical measurement is the outside diameter. The quality control inspector was instructed to select five slugs at random every half hour from the output of the new machine, measure the outside diameters, and record the results. The measurements (in millimeters) for the period from 8:00 am to 10:30 am follow.

Outside diameter (mm)

Time	1	2	3	4	5
8:00 AM	87.1	87.3	87.9	87.0	87.0
8:30 AM	86.9	88.5	87.6	87.5	87.4
9:00 AM	87.5	88.4	86.9	87.6	88.2
9:30 AM	86.0	88.0	87.2	87.6	87.1
10:00 AM	87.1	87.1	87.1	87.1	87.1
10:30 AM	88.0	86.2	87.4	87.3	87.8

(a) Design a mean chart. Insert the control limits and other essential figures on the chart. [5]

(b) Plot the means on the chart. [3]

(c) Immediately below the mean chart, draw the range chart. Plot the ranges on the chart. [6]

(d) Interpret the two charts. [2,2]

B11. (a) The Ball joint bearing company in Bulawayo produces ball and roller bearings of various sizes for automobile manufacturers. One such ball bearing, the *1/2"* Chrome polished bearing - No. 3580 - has been the subject of customer complaints in recent months because of surface defects. Mr Ncube, the director of the Ball Joint's quality control department, has decided that an acceptance plan based on random samples should be established for this product. Mr Ncube carefully researches records of the past periods when the surface-polishing operation was known to be operating properly and finds that 2 percent of the No. 3580 ball bearings were defective. If a sample size of 200 bearings and a one-tailed significance level of 0.025 is to be used:

(i) Set the acceptance criterion for the defectives in a sample, [6]

(ii) If a sample is drawn that has 7 defective ball bearings should it be accepted? [3]

(b) The Department of Transport, DOT, in the Ministry of Transport and Communications, must accept sections of paving constructed by private contractors in the inter-province highway system system. these sections are usually 10 km long, and they are acceptable based on cores drilled from the concrete pavement at random intervals. DOT specifications require a compression strength in the roadway of 12 500 kilogrammes per square metre.

Dr Moyo, the head testing engineer for the Bulawayo district, wishes to establish a statistical acceptance plan wherein sections of pavement would be accepted based on the mean compression strength of a sample of 50 cores removed from each section. Dr. Moyo knows from experience that the standard deviation of compression strength for thousands of cores from hundreds of kilometres of pavement is 1,625 kilograms per square metre.

(i) Set the acceptance criteria of DOT's acceptance plan if a one-tailed $\alpha = 0.005$ test is used. [5]

(ii) Fifty cores are pulled from a 10 km section. The mean compression strength of the sample is 11 500 pounds per square metre. Should the section of pavement be accepted? [4]

END OF QUESTION PAPER