



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

End-Semester 7 Examination in Engineering: May 2023

**Module Number: ME 7303    Module Name: Production and Operations Management**

**[Three Hours]**

**[Answer all Five Questions, each question carries 20 marks]**

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### Instructions:

1. Start your answers to each question on a fresh page.
2. Graph papers will be provided for answering Question 3 (Q3).

**Q1 (a)** Explain the term "Productivity".

[4 Marks]

- (b) A musical equipment manufacturer produces guitars for beginners. Out of hundred (100) guitars that begin production in a month, only 80% are of acceptable quality to be sold. The remaining 20% are scrapped due to quality problems that are identified only after production has been completed.

The selling price of each guitar is USD 250. The production process is partially automated and each guitar requires only 10 labor hours. Each employee works an average of 160 hours per month. Labor is paid at USD 10 per hour, material cost is USD 40 per guitar and the overhead is USD 4000 per month.

- i. Calculate the labor and multifactor productivity ratios

[6 Marks]

- ii. The process was analyzed by the process improvement team and the following two productivity improvement options were suggested,
  - a. Increase the sales price by 10 percent
  - b. Reduce the number of defectives per month by 10 percent

Which of the two options above has the greatest impact on the multifactor productivity measure?

[10 Marks]

**Q2 (a)** Explain the different functional areas of a business (Provide diagrams where

necessary).

[5 Marks]

- (b) Discuss the “Core Processes” and “Support Processes” of a firm (Provide examples where necessary).

[5 Marks]

- (c) State four important considerations in developing Corporate strategy. Discuss in brief.

[5 Marks]

- (d) Discuss the differences between Corporate, Tactical and Control strategies.

[5 Marks]

- Q3 (a) State the two broad classes of quality characteristics. Discuss them giving at least two examples.

[4 Marks]

- (b) Discuss the different categories of cost of quality.

[4 Marks]

- (c) A company produces bolts with the length specified at 20mm. Semi-automated equipment is used to produce these bolts. Samples of five (05) bolts are taken from each hour's production for quality management purposes. Table Q3 - 1 below gives the details of the hourly samples taken in an eight (08) hour shift.

Table Q3 - 1

Hour	Sample Bolt Length (mm)				
	1	2	3	4	5
1	19.5	19.8	19.6	20.4	20.1
2	20.1	19.8	20.3	19.7	19.6
3	20.0	20.4	20.5	19.9	20.0
4	19.9	20.4	20.3	20.1	19.7
5	19.8	19.2	19.7	20.4	20.3
6	20.3	20.0	19.4	20.2	19.6
7	19.6	20.7	20.3	19.8	19.7
8	20.4	19.4	19.8	20.4	19.9

Find out whether the manufacturing process is in statistical control by using your understanding of Xbar - R charts.

For the Xbar Chart, Upper Control Limit (UCL) and Lower Control Limit (LCL) are given as following,

$$\begin{aligned} \text{Upper control limit (UCL)} &= \bar{\bar{X}} + A_2\bar{R} \\ \text{Lower control limit (LCL)} &= \bar{\bar{X}} - A_2\bar{R} \end{aligned}$$

For the R Chart, Upper Control Limit (UCL) and Lower Control Limit (LCL) are given as following,

$$\begin{aligned} \text{Upper control limit (UCL)} &= D_4\bar{R} \\ \text{Lower control limit (LCL)} &= D_3\bar{R} \end{aligned}$$

(Refer Table Q3 - 2 on page 5 for the relevant factors  $A_2$ ,  $D_3$  and  $D_4$  for calculating the control limits)

[12 Marks]

- Q4 (a) The activity details of a project and their predecessors are given along with their activity times in Table Q4 below.

Table Q4

Activity	Predecessor	Activity Time (Weeks)
A	-	2
B	A	3
C	A	2
D	B	5
E	B	3
F	C,D	4
G	E,F	1

- i. Construct the network diagram using the Critical Path Method (CPM). Use the Activity on Arrow (AOA) notation.

[6 Marks]

- ii. Calculate the total project duration.

[3 Marks]

iii. Name the critical path.

[3 Marks]

(b) Discuss the Planning Evaluation and Review Technique (PERT) and compare with the Critical Path Method (CPM).

[4 Marks]

(c) Explain the cost - time tradeoff of expediting a project (Provide diagrams where necessary).

[4 Marks]

Q5 (a) Explain the term "Concurrent Engineering".

[4 Marks]

(b) With a concurrent engineering approach in mind, explain the role of Computer Aided Design (CAD) in Design & Manufacture of a sewing machine

[6 Marks]

(c) Explain the following with an example for each of them,

(i) Design for environmental manufacturing

(ii) Design for environmental packaging

(iii) Design for disposal and recyclability.

[6 Marks]

(d) What is meant by an "Accelerated Test" and why is it important for certain products?

[4 Marks]

Table Q3 - 2: Factors for the Calculation of Control Limits

Sample size $n$	$A_2$	$D_3$	$D_4$
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777
12	0.266	0.284	1.716
14	0.235	0.329	1.671
16	0.212	0.364	1.636
18	0.194	0.392	1.608
20	0.180	0.414	1.586
22	0.167	0.434	1.566
24	0.157	0.452	1.548