UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	SFB47703 (V1)
COURSE TITLE	:	QUALITY ENGINEERING
PROGRAMME NAME	:	BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MANUFACTURING (AUTOMOTIVE)
DATE	:	26 JANUARY 2026
TIME	:	9:00AM - 11:00AM
DURATION	:	2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of ONE sections.
4. Section A consist of five questions. Answer FOUR (4) questions only.
5. Please write your answer on the answer booklet provided.
6. Please answer all questions in English only.
7. Refer to the attached Formula/ Appendies. ☑ *Tick if applicable*

THERE ARE 9 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 100 marks)

Answer FOUR (4) questions.

Please use the answer booklet provided.

Question 1

Six Sigma is a structured, data-driven method used to reduce process variation and improve product or service quality.

(a) Define Six Sigma and explain why it is considered both a strategy and a discipline.

(4 marks)

(b) Discuss how a SIPOC diagram helps project teams during the Define stage of DMAIC (Define-Measure-Analyze-Improve-Control). Provide an example of information captured.

(6 marks)

(c) Six Sigma promotes a culture of continuous improvement by encouraging decisions based on evidence and analytical thinking.

i. Evaluate one (1) specific way a strong continuous improvement culture strengthens Six Sigma practices. Include an example to support your answer.

(5 marks)

ii. Discuss how Six Sigma methodologies can be used to balance and resolve conflicting requirements across technical, engineering, ethical, sustainability, legal, managerial, and other organizational dimensions. Provide five (5) justifications.

(10 marks)

Question 2

The Measure stage focuses on collecting accurate data to understand the current performance of a process.

(a) Determine why a Pareto Diagram is an effective tool to start the Measure phase, and what decisions it can support.

(4 marks)

(b) A factory producing CNC-machined components recorded the following defects in a month as shown in the table below:
Refer Below - Table1 : Types of Defects .

Table 1: Types of Defects

Defect Type	Frequency
Surface scratch	478
Dimension error	323
Burrs	251
Improper assembly	199
Paint defect	175
Threading error	124
Missing component	80
Tool mark	53
Rust spots	46
Packaging damage	21

i. Construct a Pareto chart to identify the categories with significant complaints.

(16 marks)

ii. Based on the Pareto principle, conclude which defect types contribute to approximately 80% of the overall defects.

(5 marks)

Question 3

TechMotion Manufacturing Sdn. Bhd. produces precision-machined shafts for an automotive customer. Because the shafts operate inside an engine assembly, maintaining stability in the machining process is critical.

To monitor the process, the Quality Engineer, collects 25 consecutive daily samples, each consisting of four measurement *(n = 4)* of shaft diameter (mm). The goal is to determine whether the machining process is stable and under statistical control before releasing the batch for shipment.

Table below displays the 25 calculated mean (*X-bar*) and range (*R*) values of the shaft diameter (mm).

Refer Below - Table2 : Shaft Diameter Measurements (mm) .

Table 2: Shaft Diameter Measurements (mm)

Sample	X-bar (mm)	R
1	20.03	0.08
2	20.02	0.09
3	19.99	0.05
4	19.95	0.11
5	19.96	0.09
6	20.00	0.14
7	19.99	0.08
8	20.00	0.12
9	19.98	0.10
10	19.96	0.11
11	20.01	0.05
12	19.98	0.13
13	19.98	0.11
14	20.02	0.09
15	20.00	0.09
16	19.96	0.05
17	20.04	0.07
18	20.02	0.11
19	20.00	0.21
20	19.97	0.10
21	20.01	0.10
22	20.00	0.09
23	20.01	0.07
24	19.96	0.06
25	20.00	0.03

(a) Determine the overall mean (*X-double bar*) and range (*R-bar*) upper and lower control limits (*UCL* and *LCL)* for *X-bar* and *R* charts. Please refer to the control limit equations and control chart factors in the attachment below.
Refer Appendix Attachment - Control Limit Equations and Control Chart Factors .

(6 marks)

(b) Construct the X-bar and R charts and plot the values of the sample means and ranges.

(16 marks)

(c) Do the data indicate a process that is in control? Justify your answer.

(3 marks)

Question 4

Process capability is the method of evaluating how well a process can consistently produce outputs within specified limits by comparing natural process variation to customer or specification limits. It helps determine whether the process is capable, stable, and suitable for meeting quality requirements.

(a) A process produces plastic caps with LSL = 18.50 mm and USL = 19.50 mm. The measured process mean is 19.10 mm with σ = 0.12 mm. Calculate the C_{pk} for this process and interpret the process capability.

(7 marks)

(b) A manufacturing process produces metal rods with a specification of 50.00 ± 0.30 mm. Two operators supervise the same machine. Operator A's output shows a higher standard deviation but is well-centered at the target, while Operator B's output shows a lower standard deviation but is shifted toward the upper specification limit (USL).
Compare and evaluate which operator demonstrates a more capable process. Support your answer using C_p and C_{pk} concepts.

(8 marks)

(c) A company wants to achieve Six Sigma quality level (Cp ≈ 2.0) for a critical dimension. Currently the process has a standard deviation of 0.40 mm, and the specification width (USL-LSL) is 5.0 mm. Propose three (3) strategies to redesign the process (materials/machines/methods/environment) so that the process can meet the Six Sigma target.

(10 marks)

Question 5

Lean Manufacturing focuses on eliminating waste to improve efficiency and quality in production. It aims to deliver value to customers using fewer resources, time, and effort.

(a) Toyota emphasizes the elimination of *muda* (waste), *mura* (inconsistency), and *muri* (overburden) within Toyota Production System (TPS). Discuss how the interaction among these three elements affects overall system performance.

(7 marks)

(b) The timeline in a Value Stream Mapping (VSM) often shows lead time in days but processing time in minutes.
Interpret what this difference reveals about operational performance in a Lean perspective. State two (2) points.

(4 marks)

(c) Kanban is a visual tool used in manufacturing and service processes to manage workflow, control inventory, and signal when new materials or tasks are needed.

i. A manufacturing company is experiencing frequent shortages and overproduction of parts in its assembly line. The management is considering shifting to a Kanban pull system. Explain how implementing Kanban can reduce both inventory waste and production variability. Support your explanation with four (4) points.

(8 marks)

ii. A facility producing automotive brackets wants to implement a Kanban system to reduce inventory. The following data were collected for a specific bracket type used in the assembly line:
Daily demand: 1,200 units
Production lead time:
Waiting time: 0.5 day
Material handling time: 0.3 day
Processing time: 0.7 day
Safety stock: 0.4 day of demand
Container size: 150 units

Determine the number of Kanban cards needed.

(6 marks)

END OF EXAMINATION PAPER

APPENDIX

Appendix for Section A Question 3 (a) : Control Limit Equations and Control Chart Factors

Sample Size, n	Mean Factor, A_2	Upper Range, D_4	Lower Range, D_3
2	1.880	3.268	0
3	1.023	2.574	0
4	.729	2.282	0
5	.577	2.115	0
6	.483	2.004	0
7	.419	1.924	0.076
8	.373	1.864	0.136
9	.337	1.816	0.184
10	.308	1.777	0.223
12	.266	1.716	0.284
$UCL_{x\text{-}bar} = \overline{\overline{X}} + A_2\overline{R}$		$UCL_R = D_4\ \overline{R}$	
$LCL_{x\text{-}bar} = \overline{\overline{X}} - A_2\overline{R}$		$LCL_R = D_3\ \overline{R}$	