UNIVERSITY OF JOHANNESBURG

PROGRAM	: B-TECH ENGINEERIG: INDUSTRIAL
SUBJECT	: **QUALITY ASSURANCE**
CODE	: **BQA 411**
DATE	: EXAMINATION 2014 09 JUNE 2014
DURATION	: SESSION 1
WEIGHT	: 40 : 60
TOTAL MARKS	: 100

ASSESSOR	: Dr K. BATTLE
MODERATOR	: MR. S. CHIKUMBA
NUMBER OF PAGES	: 4 PAGES

INSTRUCTIONS	: ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED.
REQUIREMENTS	: NONE

INSTRUCTIONS TO STUDENTS

Question 1

The Doornfontein Campus has been monitoring water usage on campus as it is initiating an improvement process for efficient usage. The following data was collected over 25 days on water usage which is measured in units (each unit is equal to 840 000 litres). It was noted that on Day 5 there was a leak in a water main outside of the John Orr Building.

Day	Water Usage
1	2.50
2	2.67
3	2.73
4	2.64
5	4.45
6	2.74
7	3.31
8	2.49
9	2.76
10	2.63
11	2.47
12	2.59
13	3.20
14	3.02
15	2.31
16	2.30
17	2.50
18	3.31
19	2.48
20	2.22
21	2.61
22	2.64
23	2.92
24	2.10
25	3.18

a) A Colleague has computed the control chart parameters for you – Construct the control chart(s) including the Zones.

Individual Chart			Moving Range Chart	
UCL	4.09		UCL MR	1.65
LCL	1.41		LCL MR	0

	Individual			MR	
Upper	A-B Boundary	3.65		A-B Boundary	1.06
	B-C Boundary	3.20		B-C Boundary	0.78
Lower	A-B Boundary	1.86		A-B Boundary	-
	B-C Boundary	2.30		B-C Boundary	0.23

(15 Marks)

b) Comment on the Water Usage in terms of stability/control – include use of the 7 Rules (see Appendix)

(15 Marks)

Question 2

a) Using examples – illustrate the difference between an Affinity Diagram and a Cause and Effect Diagram

(5 Marks)

b) How do you combine the two in analysing a process?

(5 Marks)

c) Given an example of when you would use check sheet?

(5 Marks)

Question 3

A machine shop manager wishes to study the time it takes an assembler to complete a given small subassembly. Measurements, in minutes, are made at 15 consecutive half-hour intervals. The times to complete the task are: 12, 10, 18, 16, 4, 16, 11, 15, 15, 13, 19, 10, 15, 17, and 11.

a) Construct a frequency distribution and cumulative frequency distribution for these data. **(3)**

b) Is a run chart an appropriate display for these data? Explain why or why not, and if so, construct a run chart. **(3)**

c) Calculate the **mean time** to complete the task on the basis of this sample of 15 observations. **(3)**

d) Calculate the **median time** to complete the task on the basis of this sample of 15 observations. **(3)**

e) Calculate the **modal time** to complete the task on the basis of this sample of 15 observations. **(3)**

Question 4

Traditional thinking sometimes leads one to believe that Increased Quality leads to increased costs and decreased productivity. Explain why this is incorrect thinking – making specific reference to Deming's 14 Points and the management changes required to shift this paradigm.

(20 Marks)

Question 5

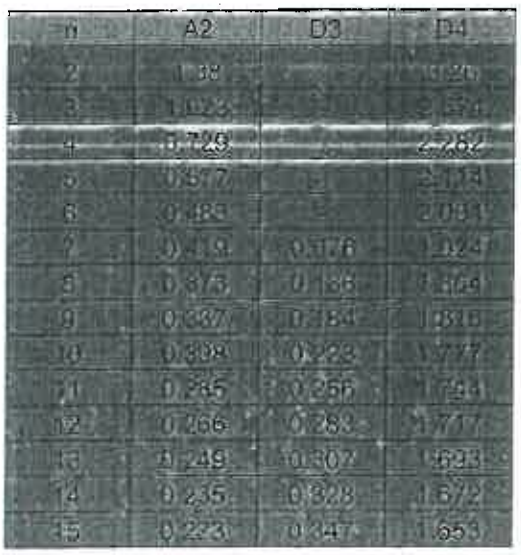
Discuss the role and use of Control Charts in improving Quality including specific reference to variation in process outputs.

(20 Marks)

Formulas for Control Charts

Individual and Moving Range Charts		
Name	Symbol	Formula
Number of samples	j	
MR =Moving Range of sample i	MR_i	$ABS(X_j - X_{j-1})$
Average Range	$\overline{MR}$	$\frac{MR_2 + MR_3 + \cdots + MR_j}{j-1}$
Average of the samples	$\overline{\overline{X}}$	$\frac{X_1 + X_2 + \cdots + X_j}{j}$
Upper Control Limit for the Individual Chart	UCL_X	$\overline{\overline{X}} + 2.660 \times \overline{MR}$
Lower Control Limit for the Individual Chart	LCL_X	$\overline{\overline{X}} - 2.660 \times \overline{MR}$
Upper Control Limit for the MR chart	UCL_{MR}	$3.268 \times \overline{MR}$
Upper Control Limit for the MR chart	LCL_{MR}	NA

$\bar{X}$ and Range Charts		
Name	Symbol	Formula
Number of subgroups	k	
Number of samples in a subgroup	n	
R =Range of subgroup j	R_j	$X_{\max} - X_{\min}$
Average Range	$\bar{R}$	$\frac{R_1 + R_2 + \cdots + R_k}{k}$
Average of the Subgroup Averages	$\bar{\bar{X}}$	$\frac{\bar{X}_1 + \bar{X}_2 + \cdots + \bar{X}_k}{k}$
Upper Control Limit for the $\bar{X}$ Chart	$UCL_{\bar{X}}$	$\bar{\bar{X}} + A_2 \times \bar{R}$
Lower Control Limit for the $\bar{X}$ Chart	$LCL_{\bar{X}}$	$\bar{\bar{X}} - A_2 \times \bar{R}$
Upper Control Limit for the R chart	UCL_R	$D_4 \times \bar{R}$
Lower Control Limit for the R chart	LCL_R	$D_3 \times \bar{R}$



n	A2	D3	D4
2	1.88		3.267
3	1.023		2.574
4	0.729		2.282
5	0.577	0	2.114
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
11	0.285	0.256	1.744
12	0.266	0.283	1.717
13	0.249	0.307	1.693
14	0.235	0.328	1.672
15	0.223	0.347	1.653

Rules for Identifying Out of Control Patterns

- Rule 1. A process exhibits a lack of control if any subgroup statistic falls outside of the control limits

- Rule 2. A process exhibits a lack of control if any two out of three consecutive subgroup statistics fall in one of the A zones or beyond on the same side of the centerline.

- Rule 3. A process exhibits a lack of control if four out of five consecutive subgroup statistics fall in one of the B zones or beyond on the same side of the centerline.

- Rule 4. A process exhibits a lack of control if eight or more consecutive subgroup statistics lie on the same side of the centerline.

- Rule 5. A process exhibits a lack of control if eight or more consecutive subgroup statistics move upward in value or if eight or more consecutive subgroup statistics move downward in value.

- Rule 6. A process exhibits a lack of control if an unusually small number of runs above and below the centerline are present (a saw-tooth pattern).

- Rule 7. A process exhibits a lack of control if 13 consecutive points fall within zone C on either side of the centerline