MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

FOURTH YEAR **FIRST** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE

SMA 2433 – QUALITY CONTROL METHODS

DURATION: 2 HOURS

DATE: 13TH DECEMBER 2017

TIME: 9.00AM – 11.00AM

Instructions to Candidates:

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A (Compulsory)

QUESTION ONE (30 Marks)

a) Define the term 'Quality control' as used in statistics. (2 Marks)

b) Differentiate between chances and assignable causes as used in quality control methods. (2 Marks)

c) In the production of certain pipes, a process is said to be in control if the outside diameter have a mean of 2.25cm and a standard deviation of 0.003 cm. Construct the warning and action limits for the means of random sample of size 4. (4 Marks)

d) A machine is set to deliver products of a given weight. Ten products of size 5 each were recorded as follows;

Sample No.	1	2	3	4	5	6	7	8	9	10
Mean ($\overline{x}_i$)	13	17	15	18	17	14	18	15	17	16
Range R_i	7	7	4	9	8	7	12	4	11	5

Construct the control limits and comment on the state of control (Take $a_n = 0.4299$). (6 Marks)

e) A process is normally distributed with a mean of 1000 and standard deviation of 50. What is the probability of detecting a change of process mean to 1080 using the control chart for means of 4 values using the warning limits. (5 Marks)

f) Define the following terms as used in sampling inspection procedure;

i. Lot tolerance percentage defective (1 Mark)

ii. Acceptance quality level. (1 Mark)

g) Twenty pieces of cloth from different roll contains the following imperfections 1,4,3,2,5,6,7,2,3,4,2,5,7,6,4,2,1,3,8,5. Ascertain whether the process is in state of statistical control. (5 Marks)

h) Based on 15 subgroups, each of size 200 taken at intervals of 45 minutes from a manufacturing process, the average fraction defective was found to be 0.068. Calculate the control limits. (4 Marks)

SECTION B (Answer any two questions)

QUESTION TWO (20 Marks)

a) State four (4) factors that causes assignable causes in statistical control. (4 Marks)

b) Let $x_1, x_2, \cdots, x_n$ be a random sample from normal distribution with mean μ and varianceσ^2. Let $S^2 = \frac{1}{n-1}\sum_{t=1}^{n}(x_i - \overline{x})^2$ be the sample variance. Show that;

i. $E(S^2) = \sigma^2$ (4 Marks)

ii. The 3 – sigma control limits are given by $E(S^2) \pm k$ where $k = 3\sigma^2\sqrt{\frac{2}{n-1}}$ (8 Marks)

c) Differentiate between spot check inspection and 100% inspection procedure as used in acceptance injection procedure. (4 Marks)

QUESTION THREE (20 Marks)

a) A company manufactures a product which is packed in bottles. It utilizes automatic filling equipment. It takes a sample of seven bottles every two hours and measures the filling of each bottle. The following table shows the measurements of filling (in grams) in the last 7 samples.

Sample No.	Individual measurements (g)							Sample range
1	1	2	3	4	5	6	7	
2	501	502	500	498	499	485	490	
3	499	498	498	498	499	495	499	
4	500	501	499	498	502	498	497	
5	494	496	496	500	499	485	487	
6	499	487	492	491	500	501	500	
7	493	499	491	498	501	502	500	

Set up the 3-σ control chart for the ranges and state whether the process is under control or not. (take $D_3 = 0, D_4 = 2.15$) (8 Marks)

b) A cost accountant manager is asked to set up a system for controlling waste in a certain department coverting rolls of iron into iron sheets. The kilograms of waste are recorded by shifts for a period of 10 days as shown below;

	Day									
Shift	1	2	3	4	5	6	7	8	9	10
1	99	111	122	90	78	87	122	99	97	115
2	89	109	107	118	80	106	107	101	84	123
3	114	133	104	99	80	92	106	115	89	99

Construct the 3-σ control limit chart for the sample variance. (12 Marks)

QUESTION FOUR (20 Marks)

a) A manufacturer of bulbs found that in 15 subgroups of 30 bulbs the number of defectiveness were as follows;

3,5,4,2,3,2,7,0,2,4,2,1,8,6,4

Construct the control chart for fraction defective and comment on the state of control.

(9 Marks)

b) The answering of calls at a switchboard may be thought of as a process. Each call is a unit of product and the time the caller waits to be answered is a measure of the quality of the service rendered. Five calls chosen at random are timed during each hour the switch board is open. Results for the last 10 hours shows the following

Sample No.	1	2	3	4	5	6	7	8	9	10
Mean $(\overline{x}_i)$	25	39	49	44	30	33	17	38	41	27
Range R_i	27	43	19	9	24	21	25	15	44	14

Construct an $\overline{X}$ and R charts and determine whether this process is in a state of control.

(Take $a_n = 0.4299, D_3 = 0, D_4 = 2.115$) (11 Marks)

QUESTION FIVE (20 Marks)

a) The following data refers to visual degree found during inspections of the first 10 samples each of size 100

Sample No.	1	2	3	4	5	6	7	8	9	10
No. of Defectives	4	8	11	3	11	7	7	16	12	6

Set up a control chart for fraction defective taking level of significance as 5% at both ends.

(10 Marks)

b) Construct the control chart for C, the number of defects from the following data pertaining to the number of imperfection in 20 pieces of cloth of equal length in a certain make of polyester and infer whether the process is in a state of control. (5 Marks)

2	3	5	8	12	2	3	4	6	5
6	10	4	6	5	7	4	9	7	3

c) A sample of four items is drawn at random from a lot of 50 items out of which 10 are defective. What is the probability of getting at least one defective item. (5 Marks)