KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN ECONOMICS AND MATHEMATICS

COURSE CODE: **MATH 329**

COURSE TITLE: **QUALITY CONTROL AND ACCEPTANCE**

STREAM: **Y3S2**

DAY: **TUESDAY**

TIME: **9.00 – 11.00 A.M.**

DATE: **24/03/2009**

INSTRUCTIONS:

1. Question ONE is compulsory.
2. Attempt question ONE and any other TWO

PLEASE TURN OVER

QUESTION ONE-COMPULSORY (30 marks)

a) Explain the two causes of variations in every manufacturing process. (4 marks)

b) Set up the 3σ control chart for $\bar{x}$ when μ and σ^2 are specified. (3 marks)

c) A table of 10 samples of sizes 200 are recorded in the table below for the number of defective items in each sample

Sample no.	1	2	3	4	5	6	7	8	9	10
Defectives (d)	4	7	6	12	7	4	3	6	5	9

i) Using initial value of $p = 5\%$ if the process is under control, set up the p chart at $\alpha = 0.2\%$ level of significance. (8 marks)

ii) Set up the 3σ control limits if p is unknown. (3 marks)

d) Control charts for $\bar{x}$ and R are maintained on a certain dimension of a manufactured part, measured in meters. The subgroup size is five. The value of $\bar{x}$ and R are computed for each subgroup and recorded in a table as shown below.

Sample	1	2	3	4	5	6	7	8	9	10
Average ($\bar{x}_i$)	143.0	139.8	139.2	140.0	139.2	141.4	140.6	140.4	141.8	138.0
Range $\mathbf{R_i}$	8	6	8	8	13	9	8	13	8	6

Estimate the mean (μ) and variance (σ^2) of the process assuming that it is under statistical control. Calculate the 3σ control limits for the $\bar{x}$ and R-charts. Is the process under statistical control? [$d_2 = 2.326$ $D_3 = 0$ $D_4 = 2.11$]

(8 marks)

e) Define the following terms as used in acceptance sampling (2 marks)

a. Acceptance Quality Level [AQL]
b. Acceptance Outgoing Quality [AOQ]

f) The statistical quality control (SQC) department is a necessary component of any production process. State two major roles of this department in a production process.

(2 marks)

QUESTION TWO (20 Marks)

a) State the advantages of a process under statistical control (4 marks)

b) Construct a control chart for mean ($\overline{X}$) and the range (R) for the following data on the basis of the fuses. Samples of five being taken every hour. Comment on whether the production is under control assuming that these are the first sets of data ($A_2 = 0.58$, $D_3 = 0$, $D_4 = 2.11$) (15 marks)

Sample Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Samples	71	71	49	66	71	80	91	48	44	99	95	90
	96	76	54	83	82	104	91	50	61	139	119	109
	106	98	110	100	87	105	102	57	69	142	123	124
	107	108	111	108	96	108	124	71	91	149	140	140
	118	121	112	113	107	161	167	91	115	183	141	165

QUESTION THREE (20 Marks)

a) Define the action and warning limits for the c-chart. (8 marks)

b) In welding of beams, defects included pinholes and cracks etc. A record was made of the number of defects formed in one beam each hour for a total of 12 hours.

4, 7, 3, 9, 5, 3, 4, 9, 9, 9, 7, 4

i) Set up the 3σ control limits for the number of defects and comment on your limits. (6 marks)

ii) Obtain the action and warning limits for the c-charts. (6 marks)

QUESTION FOUR (20 Marks)

a) A random sample of size n is selected from a normal population of mean (μ) and variance (σ^2). Suppose the process mean (μ) has change by θ but variance unchanged. Derive the expression of the probability that the process is under control denoted by $p(\theta)$ for the $\overline{x}$ chart, $\alpha = 0.2\%$ (12 marks)

b) Sketch a graph of $p(\theta)$ against θ for part (c) above. (4 marks)

c) A process is normally distributed with mean 100 and standard deviation of 5. Find probability of detecting a change of process mean to 108, using the x-chart. (n = 5 , $\alpha = 0.2\%$ (4 marks)

QUESTION FIVE (20 Marks)

a) The following is a record of number of defects per unit in textile product **17,8,18,13,10,15,15,14,13,9,12,7,11,8,14,8,12,11,12,13** Construct a 3σ c-chart and comment on the state of the process. (7 marks)

b) Determine a sequential sampling plan with the following parameters draw the lines of rejection and acceptance. Label the regions on the graph $\theta_0 = 0.04, \alpha = 0.02, \theta_1 = 0.2, \beta = 0.02$ (13 marks)