THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
POSTGRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING – LEVEL 7
FINAL EXAMINATION – 2005/2006
MEX 7214/MEP1204 – QUALITY AND RELIABILITY ENGINEERING
DATE : *09th April 2006*
TIME : *0930 hrs – 1230 hrs*
DURATION: *Three (03) hours*

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Answer any five (05) questions. All questions carry equal marks. Normal distribution table and coefficients of $\bar{x}$-R control charts are provided.

1. (a) In the production floor there are important quality practices that should be planned and implemented to maintain and control quality. Write an account of those practices.

   (b) Standardization is an activity which could be used to run the quality control process efficiently. Write an account on how this is done.

   (c) Explain the concepts and practices associated with "Control" and "Improvement". What are the differences between "Control" and "Improvement".

2. (a) In quality management, reliability is an important subject to be dealt with in a systematic way. It has to be given serious consideration at the product design stage. Explain a suitable methodology for incorporating reliability aspects right from the design stage.

   (b) 12 motors were tested for 500 hours, each under same operating conditions and 6 motors failed after following time periods.

   1st motor failed after 120 hours
   2nd motor failed after 150 hours
   3rd motor failed after 175 hours
   4th motor failed after 200 hours
   5th motor failed after 250 hours
   6th motor failed after 400 hours

   What is the failure rate of this type of motors ?

3. (a) "Process Approach" has become an important concept in quality management. Write an account of the important elements of this approach.

(b) "Process Approach" needs the application of quality tools and practices. Write an account of some important quality tools and practices used for the process approach.

4. (a) Quality is a term which has been defined in many ways. Discuss two definitions which received worldwide acceptance. Provide suitable examples to support your answer.

(b) Quality of a task or activity is defined in the same manner as quality of a product. A task or activity produces output which is received by an internal customer. Explain the concept of internal customer.

5. (a) Variation is fact in industrial life. Variation in product quality is a major issue taken up in quality improvement programmes. Explain how this variation occurs and the benefits of minimizing it.

(b) A certain process produces metal sheets having a length normally distributed with standard deviation 1.2 mm. Sheets less than 10 cm long are undesirable. However, a temporary concession has been given to accept 0.5% non-conforming products. Answer following questions.

(i) Under the above concession what should be the mean of the process.

(ii) Sheets having lengths greater than 10.5cm are unacceptable and no concession is allowed. Is this process capable of meeting the stipulated requirement.

(iii) If the process is to be improved so that no non-conforming products are produced, what should be the minimum standard deviation?

6. (a) A company manufacturing packets of spices for exports is considering variation in net weight as an important characteristic to be controlled. Explain in a step-wise manner how you would plan this assignment.

(b) A company manufacturing washing power needs to control the weight of washing powder in a packet.

The company has set up a specification of 202 ± 2 g for this purpose. 20 samples each having 5 packets were taken from the packing process at a constant interval of time. Mean and Range for each sample were also found. Mean-Range control charts for 20 points were plotted and the control limits were calculated using the relevant statistical formulae. After drawing the control limits on the charts it was found that all points were within control limits without any trends in both charts.

Sum of sample means was 4,020 and sum of sample ranges was 20. The control lines were extended for future production and seven more sets were taken. Sample mean values were 201.0, 201.2, 200.8, 200.5, 201.3, 200.7, 201.1and sample range values were 1.8, 1.3, 0.8, 1.1, 0.5, 0.9, 1.5. Based on these results what are your conclusions on the suitability of the control charts for future production. What further steps would you suggest to control the process?

7. (a) Problem solving teams are using basic quality tools to narrow down a problem and to find the root causes. Describe a quality tool for each of those purposes.

(b) A company producing coloured pencils for exports performs a final inspection before pencils are packed into packs. Data collected for 10 days are recorded in the following Table. Analyse the data and present your observations.

Data represents defectives numbers.

Day / Defect	1	2	3	4	5	6	7	8	9	10
Off – centre	36	-	68	145	180	170	28	30	38	28
Point broken	160	192	201	175	192	130	160	225	203	136
Short length	-	28	-	-	-	25	28	32	-	56
Roughness	62	26	48	48	58	36	57	83	69	46
Colour Variation	89	140	72	87	164	64	94	78	75	60
Wood Chipping	-	-	40	-	20	-	30	-	10	12
Stamp defect	20	10	32	32	-	-	-	12	12	21

8. (a) "In a process there are two aspects that are important. The process has to be statistically controlled and also it should conform to the specification."

Explain the two aspects.

(b) A fraction defective control chart has been set up at a particular stage of a process. In setting up the control charts 50 items were inspected each time. The statistical upper control limit is 0.062 and the central line is at 0.02. An inspector took 50 items and found 4 items defective. In terms of statistical control, what is your opinion about the process at this time.

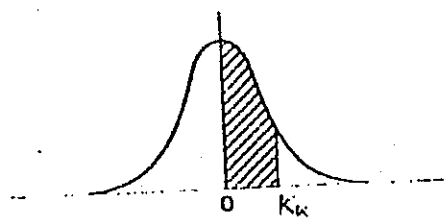
(c) In a textile factory, an inspection was carried out to find the number of defects per meter of cloth. Number of a particular defect was observed with time and recorded as follows : 1, 4, 4, 1, 5, 3, 2, 5, 4, 2, 2, 4, 6, 5, 6, 10, 7, 8, 9. What are your observations regarding statistical control ?

Coefficients for $\bar{x}$ - R charts

Sub group Size (n)	A_2	D_3	D_4	d_2
2	1.880	-	3.267	1.128
3	1.023	-	2.575	1.693
4	0.729	-	2.282	2.059
5	0.577	-	2.115	2.326
6	0.483	-	2.004	2.534
7	0.419	0.076	1.924	2.704
8	0.373	0.136	1.864	2.847
9	0.337	0.184	1.816	2.970
10	0.308	0.223	1.777	3.078

Table A Normal Distribution Areas*

Fractional parts of the total area (1.000) under the normal curve between the mean and a perpendicular erected at various numbers of standard deviations (K) from the mean. To illustrate the use of the table, 39.065 percent of the total area under the curve will lie between the mean and a perpendicular erected at a distance of 1.23σ from the mean.



Each figure in the body of the table is preceded by a decimal point.

K	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	00000	00399	00798	01197	01595	01994	02392	02790	03188	03586
0.1	03983	04380	04776	05172	05567	05962	06356	06749	07142	07535
0.2	07926	08317	08706	09095	09483	09871	10257	10642	11026	11409
0.3	11791	12172	12552	12930	13307	13683	14058	14431	14803	15173
0.4	15554	15910	16276	16640	17003	17364	17724	18082	14839	18793
0.5	19146	19497	19847	20194	20540	20884	21226	21566	21904	22240
0.6	22575	22907	23237	23565	23891	24215	24537	24857	25175	25490
0.7	25804	26115	26424	26730	27035	27337	27637	27935	28230	28524
0.8	28814	29103	29389	29673	29955	30234	30511	30785	31057	31327
0.9	31594	31859	32121	32381	32639	32894	33147	33398	33646	33891
1.0	34134	34375	34614	34850	35083	35313	35543	35769	35993	36214
1.1	36433	36650	36864	37076	37286	37493	37698	37900	38100	38298
1.2	38493	38686	38877	39065	39251	39435	39617	39796	39973	40147
1.3	40320	40490	40658	40824	40988	41149	41308	41466	41621	41774
1.4	41924	42073	42220	42364	42507	42647	42786	42922	43056	43189
1.5	43319	43448	43574	43699	43822	43943	44062	44179	44295	44408
1.6	44520	44630	44738	44845	44950	45053	45154	45254	45352	45449
1.7	45543	45637	45728	45818	45907	45994	46080	46164	46246	46327
1.8	46407	46485	46562	46638	46712	46784	46856	46926	46995	47062
1.9	47128	47193	47257	47320	47381	47441	47500	47558	47615	47670
2.0	47725	47778	47831	47882	47932	47982	48030	48077	48124	48169
2.1	48214	48257	48300	48341	48382	48422	48461	48500	48537	48574
2.2	48610	48645	48679	48713	48745	48778	48809	48840	48870	48899
2.3	48928	48956	48983	49010	49036	49061	49086	49111	49134	49158
2.4	49180	49202	49224	49245	49266	49286	49305	49324	49343	49361
2.5	49379	49396	49413	49430	49446	49461	49477	49492	49506	49520
2.6	49534	49547	49560	49573	49585	49598	49609	49621	49632	49643
2.7	49653	49664	49674	49683	49693	49702	49711	49720	49728	49736
2.8	49744	49752	49760	49767	49774	49781	49788	49795	49801	49807
2.9	49813	49819	49825	49831	49836	49841	49846	49851	49856	49861
3.0	49865	49869	49874	49878	49882	49886	49889	49893	49896	49900
3.1	49903	49906	49910	49913	49915	49918	49921	49924	49926	49929
3.2	49931	49934	49936	49938	49940	49942	49944	49946	49948	49950
3.3	49952	49953	49955	49957	49958	49960	49961	49962	49964	49965

*This table has been adapted, by permission, from F. C. Kent, *Elements of Statistics*, McGraw-Hill Book Company, New York, 1924.