FACULTY OF ENGINEERING TECHNOLOGY
POSTGRADUATE DIPLOMA IN TECHNOLOGY
IN INDUSTRIAL ENGINEERING LEVEL 7
FINAL EXAMINATION – 2009/2010

MEX7214 – QUALITY AND RELIABILITY ENGINEERING
DATE : 21 March 2010
TIME : 0930 -1230 Hrs
DURATION: THREE (03) HOURS

Answer any five (05) questions. All questions carry equal marks. Normal Distribution Table and Exponential Distribution Table are provided.

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1. (a) Quality is a term that has been defined in many ways. Discuss one such definition with special reference to products and services. Support your answer with appropriate examples from selected few products and services.

   (b) One method to achieve quality is by paying attention to "Quality Parameters". What are these "Quality Parameters"? Explain how quality is achieved through quality parameters.

2. Comment on the following statements with suitable examples as appropriate.

   (a) Product specification should be a clear and unambiguous statement in order to implement a successful quality programme.

   (b) Practice of Standardization at enterprise or company level will greatly help to maintain quality.

3. (a) Explain the following terms with suitable examples.
   (i) Reliability (ii) Availability

   (b) Failure Mode and Effect Analysis (FMEA) is a method to examine a product design for possible ways of failure. Explain how this analysis is done.

   (c) A washing machine requires 45 minutes to process a load of clothes. What is the reliability of the machine completing a washing cycle without failure, if a constant failure rate is to be assumed?

   The mean time between failure of this type of machines is 45 hours.

4. (a) Explain the philosophy behind internal customer concept. Explain how internal customer concept if practiced effectively will improve processes and strengthen relationships between employees at different levels of an organization.

   (b) Explain how Total Quality Management (TQM) concepts lead to the improvement of performance of the entire organization.

5. A company packing rice in bags has marked 5kg as the net weight for each bag. The company wishes to keep 5kg as the minimum net weight during the packing process. A study of the packing process was performed and the results showed that the mean net weight was 5.05 kg with a standard deviation of 35g. If the weight is normally distributed, find the answers to the following questions.

   (i) Does the process produce bags less than 5kg? If so what percentage?

   (ii) The company has set up an upper specification limit of 5.1 kg. Is the process capable of meeting this upper specification?

   (iii) If the company wishes to produce at least 97% of bags below the upper specification limit, what should be the mean of the packing process?

6. Write an account on each of the following statements.

   (a) Variation in product quality leads to customer dissatisfaction and also affects profitability of the enterprise.

   (b) "Control" and "Improvement" are linked together but they need two different approaches.

   (c) "Process Approach" is a concept widely used in modern quality management systems.

7. (a) Fraction defective control chart has to be installed at an important step of a process. Explain in a step-wise manner how you would proceed to install the control chart. If the company has decided on a minimum acceptable faction defective level, how would you validate the control chart for future use?

   (b) A fraction defective control chart has been set up at a particular stage of a process. In setting up the control chart, 100 items were inspected at each time. The average fraction defective line of this control chart is 0.032. The company has specified 6 percent as the maximum acceptable defective level. An inspector subsequently taking readings has recorded 4,5,2,3,7,2,8 defectives on consecutive samples of 100 items each. What is your opinion about the state of the process and the suitability of the control chart?

8. (a) In problem solving it is important to narrow down a problem and then find root causes. Describe a quality tool for each of the two purposes.

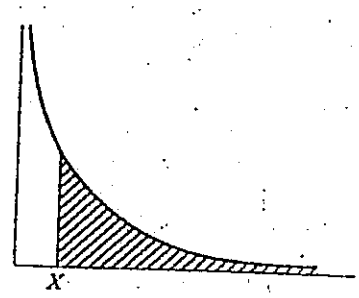
   (b) A manufacturer of liquid car wash is operating a manual bottling process. On an average 1,000 bottles are processed per day. Data was collected for 5 days on types of defects in the bottling process. Six types of defects were observed in this process. The data collect are given in the Table below.

   Analyze the data using a quality tool and present your results with your conclusions.

Type of defect	Day 1	Day 2	Day 3	Day 4	Day 5
Cap not fitting	4	2	2	1	3
Label damage	6	3	4	4	4
Label wrongly pasted	14	16	18	12	14
Short fill	4	3	4	5	2
Leaking	3	2	2	2	2
Dirty bottle	7	3	8	6	10

Table B Exponential distribution values of $e^{-X/\mu}$ for various values*

Fractional parts of the total area (1.000) under the exponential curve greater than X. To illustrate: if X/μ is 0.45, the probability of occurrence for a value greater than X is 0.6376.

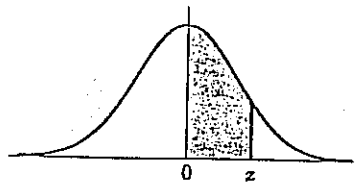


$\frac{X}{\mu}$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	1.000	0.9900	0.9802	0.9704	0.9608	0.9512	0.9418	0.9324	0.9231	0.9139
0.1	0.9048	0.8958	0.8860	0.8781	0.8694	0.8607	0.8521	0.8437	0.8353	0.8270
0.2	0.8187	0.8106	0.8025	0.7945	0.7866	0.7788	0.7711	0.7634	0.7558	0.7483
0.3	0.7408	0.7334	0.7261	0.7189	0.7118	0.7047	0.6977	0.6907	0.6839	0.6771
0.4	0.6703	0.6637	0.6570	0.6505	0.6440	0.6376	0.6313	0.6250	0.6188	0.6126
0.5	0.6065	0.6005	0.5945	0.5886	0.5827	0.5769	0.5712	0.5655	0.5599	0.5543
0.6	0.5488	0.5434	0.5379	0.5326	0.5273	0.5220	0.5169	0.5117	0.5066	0.5016
0.7	0.4966	0.4916	0.4868	0.4819	0.4771	0.4724	0.4677	0.4630	0.4584	0.4538
0.8	0.4493	0.4449	0.4404	0.4360	0.4317	0.4274	0.4232	0.4190	0.4148	0.4107
0.9	0.4066	0.4025	0.3985	0.3946	0.3906	0.3867	0.3829	0.3791	0.3753	0.3716

$\frac{X}{\mu}$	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1.0	0.3679	0.3329	0.3012	0.2725	0.2466	0.2231	0.2019	0.1827	0.1653	0.1496
2.0	0.1353	0.1225	0.1108	0.1003	0.0907	0.0821	0.0743	0.0672	0.0608	0.0550
3.0	0.0498	0.0450	0.0408	0.0369	0.0334	0.0302	0.0273	0.0247	0.0224	0.0202
4.0	0.0183	0.0166	0.0150	0.0136	0.0123	0.0111	0.0101	0.0091	0.0082	0.0074
5.0	0.0067	0.0061	0.0055	0.0050	0.0045	0.0041	0.0037	0.0033	0.0030	0.0027
6.0	0.0025	0.0022	0.0020	0.0018	0.0017	0.0015	0.0014	0.0012	0.0011	0.0010

*Adapted from S. M. Selby (ed.). *CRC Standard Mathematical Tables*, 17th ed., CRC Press, Cleveland, Ohio, 1969, pp. 201–207.

AREAS under the STANDARD NORMAL CURVE from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000