

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

THEORY: PRINCIPLES OF QUALITY ASSURANCE.SBB 2211

MAY 2005

3 HOURS (100 marks)

INSTRUCTIONS

Answer **Four (4)** Questions. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams.

1. Explain the concept of the Hazard Analysis Critical Control Point System (HACCP), and demonstrate its application in the production of a named food item.

2. State the objectives of the ISO 9001 Quality Management System, and outline in detail, the requirements for ISO 9001 certification of an organization.

3.(a) Define the terms 'variable' and 'attribute' with reference to quality standards. (4 marks)

(b) A patrol inspector tests 32 items of output every two hours with the following results.

Time	9	11	13	15	17	19	21	23
Defective	1	0	3	1	2	3	0	4

(i) Plot the results on a number defective chart. (10 marks)

(ii) Comment on the condition of the process as indicated by your chart. (2 marks)

(c) The target value of a process is 250.00, and the standard deviation of the normal distribution of this process is 0.8. Draw a control chart for samples of 5 using the target value as the grand mean. Comment on the values (250.7, 249.6, 251.0, 249.8, 250.5) in one subgroup of samples from the process. (9 marks)

4.(a) A random sample of 100 taken from a batch gave the following results for one variable.

Exceeding	Not exceeding	frequency in sample
203.4	203.8	2
203.8	204.2	7
204.2	204.6	13
204.6	205.0	18
205.0	205.4	22
205.4	205.8	17
205.8	206.2	14
206.2	206.6	6
206.6	207.0	1

- (i) Plot the frequency distribution curve for this sample. (6 marks)
 (ii) Deduce the distribution pattern of the variable from the shape of this curve. (2 marks)
- (b) Four readings of the thickness of packaging material are 0.076 mm, 0.082mm, 0.073 mm and 0.077mm. Determine the sample standard deviation. (6 marks)
- (c) The population mean of a company's product is 9.07 kg, with a population standard deviation of 0.40 kg. If the distribution is normal, determine,
 (i) the percentage less than 8.30 kg. (5 marks)
 (ii) the percentage greater than 10kgs. (6 marks)

$$\text{Note: } Z = \frac{X_i - \mu}{\sigma}$$

- 5.(a) A sampling plan is said to have an AQL of 0.6% at 5% producer risk, and an LTPD of 4% at 10% consumer risk. Explain the meaning of these terms. (8 marks)
- (b) Using this sampling plan, state the probability of accepting a batch containing
 (i) 0.6% defective (3 marks)
 (ii) 4% defective (3 marks)
- (c) What are the effects of increased sample size and increased acceptance number on an operating characteristic curve. (5 marks)
- (d) Outline the differences between single, double and multiple sampling plans. (6 marks)
- 6.(a) A project team is studying the downtime cost of a soft drink bottling line. Data analysis in thousands of dollars for a 3 month period are:
- | | |
|-------------------------|----|
| Back-pressure regulator | 30 |
| Adjust feed worm | 15 |
| Jam copper head | 6 |
| Lost cooling | 52 |
| Valve replacement | 8 |
| Other | 5 |
- Construct a Pareto diagram and comment on the action required to reduce downtime in this production line. (9 marks)
- (b) Outline briefly, the elements that contribute to quality costs in a production process. (10 marks)
- (c) Describe, with examples, three main categories of defects used within a quality system. (6 marks)

END OF EXAMINATION

TABLE A Areas Under the Normal Curve*

$\frac{X-\mu}{\sigma}$	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00
-3.5	0.00017	0.00017	0.00018	0.00019	0.00020	0.00020	0.00021	0.00022	0.00022	0.00023
-3.4	0.00024	0.00025	0.00026	0.00028	0.00029	0.00030	0.00031	0.00031	0.00032	0.00034
-3.3	0.00035	0.00036	0.00038	0.00040	0.00042	0.00044	0.00045	0.00046	0.00047	0.00048
-3.2	0.00050	0.00052	0.00054	0.00056	0.00058	0.00060	0.00062	0.00064	0.00066	0.00069
-3.1	0.00071	0.00074	0.00076	0.00079	0.00082	0.00085	0.00087	0.00090	0.00094	0.00097
-3.0	0.00109	0.00104	0.00107	0.00111	0.00114	0.00118	0.00122	0.00126	0.00131	0.00135
-2.9	0.00149	0.00144	0.00147	0.00151	0.00155	0.00159	0.00163	0.00167	0.00172	0.00176
-2.8	0.00219	0.00214	0.00217	0.00221	0.00225	0.00229	0.00233	0.00237	0.00242	0.00246
-2.7	0.00326	0.00321	0.00324	0.00328	0.00332	0.00336	0.00340	0.00344	0.00348	0.00352
-2.6	0.00486	0.00481	0.00484	0.00488	0.00492	0.00496	0.00500	0.00504	0.00508	0.00512
-2.5	0.00711	0.00706	0.00709	0.00713	0.00717	0.00721	0.00725	0.00729	0.00733	0.00737
-2.4	0.01044	0.01039	0.01042	0.01046	0.01050	0.01054	0.01058	0.01062	0.01066	0.01070
-2.3	0.01521	0.01516	0.01519	0.01523	0.01527	0.01531	0.01535	0.01539	0.01543	0.01547
-2.2	0.02167	0.02162	0.02165	0.02169	0.02173	0.02177	0.02181	0.02185	0.02189	0.02193
-2.1	0.03043	0.03038	0.03041	0.03045	0.03049	0.03053	0.03057	0.03061	0.03065	0.03069
-2.0	0.04241	0.04236	0.04239	0.04243	0.04247	0.04251	0.04255	0.04259	0.04263	0.04267
-1.9	0.05804	0.05799	0.05802	0.05806	0.05810	0.05814	0.05818	0.05822	0.05826	0.05830
-1.8	0.07826	0.07821	0.07824	0.07828	0.07832	0.07836	0.07840	0.07844	0.07848	0.07852
-1.7	0.10381	0.10376	0.10379	0.10383	0.10387	0.10391	0.10395	0.10399	0.10403	0.10407
-1.6	0.13559	0.13554	0.13557	0.13561	0.13565	0.13569	0.13573	0.13577	0.13581	0.13585
-1.5	0.17534	0.17529	0.17532	0.17536	0.17540	0.17544	0.17548	0.17552	0.17556	0.17560
-1.4	0.22364	0.22359	0.22362	0.22366	0.22370	0.22374	0.22378	0.22382	0.22386	0.22390
-1.3	0.28076	0.28071	0.28074	0.28078	0.28082	0.28086	0.28090	0.28094	0.28098	0.28102
-1.2	0.34693	0.34688	0.34691	0.34695	0.34699	0.34703	0.34707	0.34711	0.34715	0.34719
-1.1	0.42220	0.42215	0.42218	0.42222	0.42226	0.42230	0.42234	0.42238	0.42242	0.42246
-1.0	0.50000	0.49995	0.49998	0.50002	0.50006	0.50010	0.50014	0.50018	0.50022	0.50026
-0.9	0.58244	0.58239	0.58242	0.58246	0.58250	0.58254	0.58258	0.58262	0.58266	0.58270
-0.8	0.66915	0.66910	0.66913	0.66917	0.66921	0.66925	0.66929	0.66933	0.66937	0.66941
-0.7	0.75995	0.75990	0.75993	0.75997	0.76001	0.76005	0.76009	0.76013	0.76017	0.76021
-0.6	0.85496	0.85491	0.85494	0.85498	0.85502	0.85506	0.85510	0.85514	0.85518	0.85522
-0.5	0.95398	0.95393	0.95396	0.95400	0.95404	0.95408	0.95412	0.95416	0.95420	0.95424
-0.4	1.05601	1.05596	1.05599	1.05603	1.05607	1.05611	1.05615	1.05619	1.05623	1.05627
-0.3	1.17125	1.17120	1.17123	1.17127	1.17131	1.17135	1.17139	1.17143	1.17147	1.17151
-0.2	1.29958	1.29953	1.29956	1.29960	1.29964	1.29968	1.29972	1.29976	1.29980	1.29984
-0.1	1.44015	1.44010	1.44013	1.44017	1.44021	1.44025	1.44029	1.44033	1.44037	1.44041
-0.0	1.59244	1.59239	1.59242	1.59246	1.59250	1.59254	1.59258	1.59262	1.59266	1.59270

*Proportions of total area under the curve that is under the portion of the curve from $-\infty$ to $(X - \mu)/\sigma$; represents any desired value of the variable X .

TABLE A (Continued)

$\frac{X-\mu}{\sigma}$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
+0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
+0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
+0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
+0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6369	0.6406	0.6443	0.6480	0.6517
+0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6771	0.6806	0.6841	0.6877
+0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7122	0.7155	0.7190	0.7224
+0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
+0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7824	0.7852
+0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8079	0.8106	0.8133
+0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
+1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
+1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
+1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
+1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
+1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
+1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
+1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
+1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
+1.8	0.9644	0.9652	0.9659	0.9666	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
+1.9	0.9713	0.9719	0.9725	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
+2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
+2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
+2.2	0.9861	0.9864	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
+2.3	0.9893	0.9896	0.9898	0.9901	0.9903	0.9905	0.9907	0.9909	0.9911	0.9913
+2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
+2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9950	0.9952
+2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
+2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
+2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
+2.9	0.9981	0.9982	0.9983	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
+3.0	0.9986	0.9986	0.9987	0.9987	0.9988	0.9988	0.9988	0.9989	0.9989	0.9990
+3.1	0.9990	0.9990	0.9991	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992
+3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995
+3.3	0.9995	0.9995	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996
+3.4	0.9996	0.9996	0.9996	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997
+3.5	0.9997	0.9997	0.9997	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998