UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2016

Module Number: ME7302 **Module Name: Production and Operations Management**

[Three Hours]

[Answer **all questions**, each question carries **twelve** marks]

Q1. a) Clearly state the difference between Quality Control and Quality Assurance.

[2.0 Marks]

b) Briefly describe **three** methods that the customers can be included in the quality improvement process.

[3.0 Marks]

c) State **seven** philosophies of Total Quality Management.

[3.5 Marks]

d) (i) An office security system at Delco, Inc. has two component parts, both of which must work for the system to function. Part No 01 has a reliability of 80%, and part No 02 has a reliability of 98%. Compute the reliability of the system.

(ii) Delco, Inc. from Problem Q1, d (i), is not happy with the reliability of its security system and has decided to improve. The company will add a backup component to part No 01. The backup component will also has a reliability of 80%. What is the reliability of the improved system?

[3.5 Marks]

Q2. a) State **each five** controllable and uncontrollable factors affecting productivity.

[2.5 Marks]

b) Briefly describe **two** impact levels of Productivity in a **Service Organization**.

[2.5 Marks]

c) "Effective production or increase of production simply does not mean productive." Discuss the above statement with aid of suitable examples.

[3.0 Marks]

d) Mrs. Jesmin Aindra makes fashionable garments. During a particular week employees worked 360 hours to produce a batch of 132 garments, which 52 were "seconds" (meaning that they were flawed). Seconds are sold for 450 Rs/= each at J & A factory outlet store. The remaining garments are sold to retail distribution at 950 Rs/=. Calculate the **labor productivity**.

[4.0 Marks]

Q3. a) State and briefly discuss three elements for a successful of a project.

[3.0 Marks]

b) Compare and contrast the project evaluation and review technique (PERT) with the critical path method (CPM).

[3.0 Marks]

c) The new products manager at WEB Enterprise wants to evaluate the feasibility of a new computer based learning system. Table Q3(c) presents the tasks and corresponding time estimates (in weeks) for the proposed project.

i) What is the estimated completion time of the project?
ii) Identify the critical path(s).
iii) What is the probability of completing the project in 55 weeks? 60 weeks?
iv) What is the impact on the critical time if task F is delayed by 1 week? 3 weeks?

[6.0 Marks]

Q4. a) State **five** rules for deciding elements in the Work Measurement concept.

[2.0 Marks]

b) Explain **three** various allowances used to calculate the standard time.

[3.0 Marks]

c) "Method Study team should be careful to limit their role up to the development of new methods. The implementation and follow up of the new method should be left to the line executives and supervisors". Discuss the above statement with suitable examples.

[3.0 Marks]

d) (i) Find out the standard time using the following data:

- Average time for machine elements = 6 min
- Average time for manual elements = 4 min
- Performance rating = 110%
- Allowances = 10%

(ii) An operator manufactures 50 jobs in 6 hours and 30 minutes. This time includes the time for setting his machine. Calculate the **operator's efficiency**.
Standard time allowed for the job was:
Setting time = 35 min and production time per piece = 8 min

[4.0 Marks]

Q5.

a) Briefly describe the trade-offs which are involved in using attribute measurements instead of variable measurements of quality.

[2.0 Marks]

b) The management of West Allis Industries is concerned about the production of a special metal screw used by several of the company's largest customers. The diameter of the screw is critical. Data from five 5 samples are shown in Table Q5 (b). The sample size is 4.

State whether process is in control or not and if not construct a cause effect diagram to find out the reason for the uncontrollable output of the production.

[5.0 Marks]

c) The light-bulb production process yields bulbs with an average life of 900 hours and a standard deviation of 48 hours. The nominal value of the tolerance range is 1000 hours, with an upper specification of 1200 hours and a lower specification of 800 hours. The Operational Engineer wants to determine whether the process is capable of producing the bulbs to specification.

Use C_p and C_{pk} modules and interpret your results according to the operation.

[5.0 Marks]

Table Q3(c)

Activity	Description	Optimistic time	Most likely time	Pessimistic time	Immediate predecessor/s
A	Market research	5	7	10	-
B	R & D	12	18	25	-
C	Engineering	6	9	12	B
D	Prototype design	8	12	15	C
E	Costing	2	3	4	C
F	Testing	3	5	8	D
G	Market survey	2	4	7	A,D
H	Market analysis	2	3	4	G
I	Quality assurance	1	2	3	A,D
J	Financial analysis	3	3	4	E,F,H
K	Supplier analysis	2	2	2	E
L	Patent search	1	3	4	B
M	Internal	2	2	2	A
N	Reporting	3	3	3	I,J,K,L
O	Decision making	1	2	3	M,N

Table Q5(b)

Sample	Observations/ (inch)			
	1	2	3	4
1	0.5014	0.5022	0.5009	0.5027
2	0.5021	0.5041	0.5024	0.5020
3	0.5018	0.5026	0.5035	0.5023
4	0.5008	0.5034	0.5024	0.5015
5	0.5041	0.5056	0.5034	0.5047

Table Q5(b): Variables and Attribute Data for control charts

Variables Data ($\bar{X}$ and R Control Charts):

$\bar{x}$ Control Chart
- $UCL = \bar{\bar{x}} + A_2\bar{R}$
- $LCL = \bar{\bar{x}} - A_2\bar{R}$
- $CL = \bar{\bar{x}}$

R Control Chart
- $UCL = \bar{R}\,D_4$
- $LCL = \bar{R}\,D_3$
- $CL = \bar{R}$

Capability Study
- $PCR = (USL - LSL)/(6\hat{\sigma})$; where $\hat{\sigma} = \bar{R}/d_2$

n	A_2	D_3	D_4	d_2
2	1.880	0.000	3.267	1.128
3	1.023	0.000	2.574	1.693
4	0.729	0.000	2.282	2.059
5	0.577	0.000	2.115	2.326
6	0.483	0.000	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

Attribute Data (p, np, c, and u Control Charts):

Control Chart Formulas

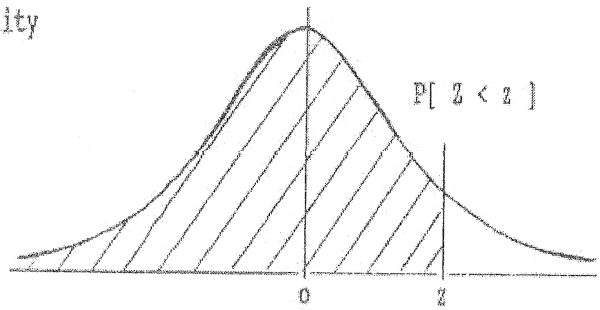
	p (fraction)	np (number of nonconforming)	c (count of nonconformances)	u (count of nonconformances/unit)
CL	$\bar{p}$	$n\bar{p}$	$\bar{c}$	$\bar{u}$
UCL	$\bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$	$n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$	$\bar{c} + 3\sqrt{\bar{c}}$	$\bar{u} + 3\sqrt{\frac{\bar{u}}{n}}$
LCL	$\bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$	$n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$	$\bar{c} - 3\sqrt{\bar{c}}$	$\bar{u} - 3\sqrt{\frac{\bar{u}}{n}}$
Notes	If n varies, use $\bar{n}$ or individual n_i	n must be a constant	n must be a constant	If n varies, use $\bar{n}$ or individual n_i

STANDARD STATISTICAL TABLES

1. Areas under the Normal Distribution

The table gives the cumulative probability up to the standardised normal value z

i.e. $$P[\,Z < z\,] = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp(-\tfrac{1}{2}Z^2)\, dZ$$



z	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	0.5159	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	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	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	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	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	0.8804	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	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	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	0.9865	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	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	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	0.9951	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	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000