UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2018

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

[Three Hours]

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

Q1. a) State **two** characteristics of a hyper efficient and flexible factory in the fourth industrial revolution.

[2.0 Marks]

b) Briefly describe the impact of brand switching customers in the process of marketing strategy formulation.

[3.0 Marks]

c) Briefly describe the importance of external context in the manufacturing strategy of an organization in order to retain in competition.

[3.5 Marks]

d) Briefly describe with aid of suitable diagrams the need of product and process optimization at different stages of a Product Life Cycle (PLC).

[3.5 Marks]

Q2. a) Clearly state the difference between Quality Control and Quality Assurance in the context of manufacturing process.

[2.0 Marks]

b) With suitable examples, briefly describe two potential benefits of implementing ISO 9001-2015 Quality Management Systems in a manufacturing organization.

[3.0 Marks]

c) Describe the key roles and responsibilities of the operation manager towards ensuring the socio-economic development of the nation.

[3.5 Marks]

d) Describe two work-related physical factors that lead towards the musculoskeletal disorders among the working population.

[3.5 Marks]

Q3. a) An electronic module of a satellite monitoring system has 500 components in series. The stated reliability of each component is 0.999.

(i) Find the overall reliability of the module.

(ii) Discuss the status of the reliability of the module, if the arrangement of the components changed to parallel with removal of 200 components.

[3.0 Marks]

b) Briefly discuss **three** techniques in lean concept to eliminate wastes.

[3.0 Marks]

c) The interest of better serving the public in St. Adolf's Hospital has decided to relocate from Christopher to Northville, a large suburb that at present has no primary medical facility. The move to Northville will involve constructing a new hospital. **Table Q3(c)** presents the tasks and corresponding time estimates (in weeks) for the proposed project.

(i) Find the estimated completion time of the project.
(ii) Identify the critical path(s).
(iii) Calculate the probability of completing the project in 72 weeks.
(iv) Discuss the impact on the critical time if task H is delayed by 1 week and 3 weeks.

[6.0 Marks]

Q4. a) "Method Study should preferably be carried out by professionally qualified external expert with the help of workers, supervisors and managers." Discuss the above statement with suitable examples.

[3.5 Marks]

b) The total observed time for assembling an electric switch is 1.00 min. If the rating is 120%, find the normal time. If an allowance of 10% is given for the operation, determine the standard time.

[3.5 Marks]

c) A company produces 160 kg of plastic moulded parts of acceptable quality by consuming 200 kg of raw materials for a particular period. For the next period, the output is doubled by consuming 420 kg of raw materials and for a third period, the output is increased to 400 kg by consuming 400 kg of raw materials.

(i) Calculate the productivity for each time period and productivity gain/loss. Clearly state the assumptions where necessary.
(ii) "Effective production or increase of production simply does not mean productive" Justify the statement in brief.

[5.0 Marks]

Q5. a) Describe the difference between capability indices that express the process potential and process performance.

[3.0 Marks]

b) In an electrical circuit, the capacitance of a component should be between 25 and 40 picofarads(pF). A sample of 25 components yields a mean of 30 pF and a standard deviation of 3 pF. Calculate the process capability index and comment on the process performance.

[4.0 Marks]

c) A quality control inspector of the Cocoa Fizz soft drink company has taken 5 samples with four observations each of the sample, where the volume of the filled soft drinks had been measured. The collected data is given in **Table Q5(c)**. If the standard deviation of the bottling operation is 0.14 ounces, develop control limits of three standard deviations for the bottling operation and determine whether the process is in control or not.

[5.0 Marks]

Table Q3(c)

Activity	Description	Optimistic time	Most likely time	Pessimistic time	Immediate predecessor/s
A	Select administrative and medical staff	11	12	13	-
B	Select the site and do site survey	7	8	15	-
C	Select equipment	5	10	15	A
D	Prepare final construction plans and layout	8	9	16	B
E	Bring utilities to the site	14	25	30	B
F	Interview applicants	6	9	18	A
G	Purchase and delivery of equipment	25	36	41	C
H	Construct the hospital	35	40	45	D
I	Develop the information system	10	13	28	A
J	Install the equipment	1	2	15	E,G,H
K	Train nurses and supportive staff	5	6	7	F,I,J

Table Q5(c)

Sample	Observations/ (volume of the bottle in ounces)			
	1	2	3	4
1	15.85	16.02	15.83	15.93
2	16.12	16.00	15.85	16.01
3	16.00	15.91	15.94	15.83
4	16.20	15.85	15.74	15.93
5	15.74	15.86	16.21	16.10

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

Variables Data ($\bar{x}$ and $\bar{R}$ 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

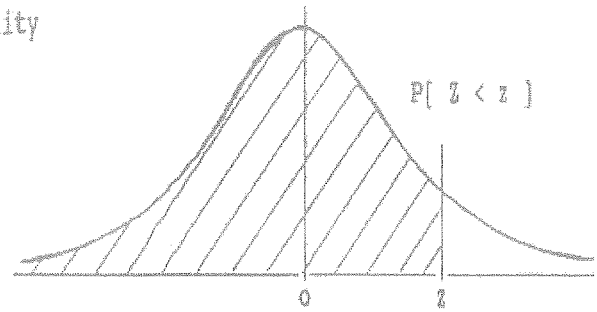
STANDARD STATISTICAL TABLES

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