UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2017

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

[Three Hours]

[Answer **all questions**, each question carries **12** marks]

Q1. a) Clearly state the difference between a manufacturing system and a production system.

[2.0 Marks]

b) Briefly explain two broader responsibilities of an operational manager in a service organization.

[2.0 Marks]

c) Explain the term "Sustainable Manufacturing" in operational management point of view.

[3.0 Marks]

d) Explain the Production Engineer's role and responsibilities in providing safety, health and welfare of the public, and proper utilization of funds by considering a production system.

[5.0 Marks]

Q2. a) State the impact of productivity for the Product Life Cycle.

[2.0 Marks]

b) Discuss the relationship of key elements such as innovations and inventions with the productivity levels in a manufacturing organization.

[3.0 Marks]

c) A team of workers manufacture 400 units of a product, which is valued by its standard cost of Rs 100 each (before mark ups for other expenses and profit). The accounting department reports that for this job the actual cost is Rs 400 for labour, Rs 1000 for materials and Rs 300 for overhead. Calculate the multifactor productivity.

[3.0 Marks]

d) A company has introduced a process improvement which reduces processing time for each unit, so that output is increased by 25% with less material, but one additional worker required. Under the old process, five workers could produce 60 units per hour. Labour cost is Rs 12 per hour, and previous material requirement was Rs 16 per unit but for the new process, material requirement is Rs 10 per unit. Overhead is charged at 1.6 times direct labour cost. Each finished units is sold for Rs 31. What increase in productivity is associated with the process improvement?

[4.0 Marks]

Q3. a) Briefly describe the applications of two motion economy devices with aid of neat sketches.

[3.0 Marks]

b) Explain the term "Work Measurement" and discuss three factors that affect to the moment and pace in production line.

[4.0 Marks]

c) An operator manufactures 50 items in 6 hours and 30 minutes. This time includes the time for setting up the machine. For the above mentioned manufacturing process, standard setting time is 35 minutes and production time per item is 8 minutes. Calculate the operator's efficiency.

[5.0 Marks]

Q4. a) Explain Quality Function Deployment (QFD) with aid of schematic diagrams.

[3.0 Marks]

b) Discuss the philosophy of "Managing superior quality" in Total Quality Management (TQM) with aid of rule based methods including appropriate examples.

[4.0 Marks]

c) Consider a manufacturing process and suggest how design and manufacturing might be integrated for it.

[5.0 Marks]

Q5.

a) Explain the concept of 'process capability' as applied to the product development process and its role in the statistical process control (SPC) of production.

[3.0 Marks]

b) In a fruit juice manufacturing plant, produced juice is packed in cardboard cans which are formed on a machine by spinning them from the card board stock and attaching a metal bottom panel. By inspection a can, it can be determined whether it is leaking or not, leaking cans are rejected. It is planned to establish a control chart to improve the fraction of non-confirming cans produced by the machine. 15 samples of 50 cans were selected within 30 minutes in level over 3 shift period. (Shown in Table Q5.1).Determine whether the process is in statistically control or not. (Use appropriate formulas for the calculations given in Table Q5.3)

[3.0 Marks]

c) A production manager at Ultra Clean Dishwashing company is monitoring the quality of the company's production process. There has been concern relative to the quality of the operation to accurately fill the 16 ounces of dishwashing liquid. The product is designed for a fill level of 16.00 ± 0.30 ounces. The company collected the sample data (shown in Table Q5.2) on the production process. (Use the appropriate formulas for the calculations given in the Table Q5.3). Using this information.

(i) State whether the process appear to be in statistical control or not.

[3.0 Marks]

(ii) Calculate C_p and C_{pk}.

[2.0 Marks]

(iii) Do you think this process is capable of meeting the design standard?

[1.0 Marks]

Table Q 5.1

Sample No	Non Conformities
01	12
02	15
03	08
04	10
05	04
06	07
07	16
08	09
09	14
10	10
11	05
12	06
13	17
14	12
15	22

Table Q 5.2

Sample	Observations/ (ounces)			
	1	2	3	4
1	16.40	16.11	15.90	15.78
2	15.97	16.10	16.20	15.81
3	15.91	16.00	16.04	15.92
4	16.20	16.21	15.93	15.95
5	15.87	16.21	16.34	16.43
6	15.43	15.49	15.55	15.92
7	16.43	16.21	15.99	16.00
8	15.50	15.92	16.12	16.02
9	16.13	16.21	16.05	16.01
10	15.68	16.43	16.20	15.97

Table Q 5.3: 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