Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2724603 **Date: 24/05/2016**

Subject Name: Quality Engineering and Six Sigma Fundamentals

Time:10:30 am to 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is quality? Is it costing to the organization or adding profit to it? – Support your answer with suitable examples. **07**

(b) Explain the quality loss function concept as given by Dr. Taguchi. **07**

Q.2 **(a)** Six Sigma is not just for manufacturing, it can be applied to any industry/business. – Justify the statement giving suitable examples. **07**

(b) List 7 QC tools. Select appropriate tool out of 7 QC tools for following cases. (Only one per case). **07**

i) To categorize probable causes of gear failure generated as a result of brainstorming process.

ii) To ascertain the numbers of different defects found in the castings produces during last one week.

iii) To keep a track on shaft diameter produced in large quantity on CNC lathe and to observe the variation pattern.

iv) To know the impact of cutting speed on the quality of surface finish produced during machining a job.

v) To find out few critical defects on which to concentrate for effective quality improvements from many defects observed for a product.

OR

(b) 5S technique can help improve quality, productivity and safety. - Justify the statement giving suitable examples. **07**

Q.3 **(a)** Following table illustrates diameter of a shaft turned on a lathe machine. A sample of six shafts was taken per shift for eight consecutive shifts. The shaft diameter is 50.65 +/- 0.1 mm. Construct X-bar and Range charts from the data available. Calculate process capability of the machine and comment suitably based on your calculations. (Draw charts on your answer sheet only taking suitable scale). **07**

1st Shift	2nd Shift	3rd Shift	4th Shift	5th Shift	6th Shift	7th Shift	8th Shift
50.67	50.70	50.67	50.69	50.64	50.67	50.67	50.68
50.70	50.68	50.68	50.66	50.72	50.70	50.70	50.67
50.68	50.66	50.67	50.69	50.67	50.64	50.68	50.67
50.63	50.60	50.67	50.64	50.68	50.64	50.66	50.68
50.66	50.71	50.70	50.72	50.63	50.72	50.70	50.63
50.65	50.67	50.64	50.67	50.66	50.67	50.64	50.66

(Take $A_2 = 0.48$, $D_4 = 2$, $D_3 = 0$, $d_2 = 2.534$)

(b) What is Affinity diagram? A company is facing problem of not maintaining delivery commitments to their customers. For that the key personnel have conducted brain storming session and came out with following probable causes. Draw Affinity diagram based on the same and suggest where the company has to focus more to improve up on the problem. **07**

1) Developmental items (Making for the first time/Non regular item)
2) Commitments given without any scientific basis (Given based on past experience and intuitions)
3) Commitment given without having time-study data of the products (No record of standard time of different products)
4) Frequent alterations in planning
5) Haphazard pattern of ordering from customers (forecasting not possible)
6) Delay due to bought out items and raw materials
7) Haphazard changes in priority by customers
8) CNC machine is the bottleneck machine causing delay in all the items
9) Monthly/ yearly production capacity unknown for different product mix
10) Balance load projection not readily available
11) No systems for evaluation of past commitments

OR

Q.3 (a) M/s. ABC is a small size machining unit engaged in jobbing work of few OEMs. Their last year sales was Rs. 2,17,33,333/- and for that the company had incurred following major expenditure. **07**

Spent Rs. 3,50,000/- for getting ISO certification, trained their six engineers as Six Sigma Green Belt at the cost of Rs. 30,000 per engineer, purchased specific inspection standards for critical products and hired experts to understand the same at the cost of Rs. 1,00,000/-. Apart from these, they have also purchased ultrasonic testing unit for conducting non destructive tests costing Rs. 3,00,000/- and hired a specialist engineer to carry out SQC analysis, the expenses of the same was Rs. 1,80,000/-.

In spite of such quality control and assurance measures, the company had to face expenditures on rejections, rework, and warranty claims etc., which are as below.

Rs. 5,00,000/- as cost of repair and rework of damaged parts to make them salable and Rs. 5,50,000/- as scrap generated of the rejected parts which are beyond repair. Further, the company had to make some free replacement of the faulty parts during warranty period worth Rs. 6,00,000/-. Transportation expenses to bring back the rejected parts from the customers' site was Rs. 3,00,000/- and the expenses occurred for sending the engineers at customers' site to fix the problems occurred in the field was Rs. 2,00,000/-.

Your Task:

a) Find out how much expenditure the company has made under the four categories of cost of quality, that is, Prevention Cost, Appraisal Cost, Internal Failure Cost and External Failure Cost and find out total cost of quality.
b) Find out the % contribution of each of the four cost categories in to making total COQ.
c) What is the COQ as % of sales for this company?

(b) As part of quality control measure, a firm producing washer has drawn 25 samples of size 50 from a lot. The number of washer not confirming to quality standard from each sample is shown in the table below. Calculate the limits for proportion defective chart and draw the same. If found out of control revise the limit till it becomes stable (Do not draw chart for revised limits). **07**

Sample	No. of inspected washers	No. of non confirming washers	Sample	No. of inspected washers	No. of non confirming washers
1	50	4	13	50	5
2	50	2	14	50	2
3	50	5	15	50	3
4	50	3	16	50	2
5	50	2	17	50	4
6	50	1	18	50	10
7	50	3	19	50	4
8	50	2	20	50	3
9	50	5	21	50	2
10	50	4	22	50	5
11	50	3	23	50	4
12	50	5	24	50	3
			25	50	4

Q.4 (a) What is QFD? Draw typical QFD structure and explain importance of its each section. **07**

(b) What is FMEA? What is the importance of Risk Priority Number (RPN) in FMEA? How RPN is calculated? State importance of each element which are used in the calculation of RPN. **07**

OR

Q.4 (a) Following are the characteristics to ascertain service quality. **07**

a) Service non conformity
b) Timeliness
c) Facility related
d) Human factors and behavioral

You have to ascertain the quality of a multi specialty hospital. List all possible sub factors you would consider to examine under each of above characteristic.

(b) Compare the Malcolm Baldrige National Quality Award and the Deming Prize. **07**

Q.5 (a) List the importance of each phase of DMAIC process improvement methodology of Six Sigma. Also list two typical tools and techniques generally used at each phase. **07**

(b) Explain the important factors to be considered for successful execution of Six Sigma project. **07**

OR

Q.5 (a) What is Cp index? Why only Cp index is not sufficient to know about the process during any Six Sigma project? Which another index is to be used along with Cp and why? **07**

(b) Draw a typical Six Sigma project organization structure. List the general roles and responsibilities of each belt level member in the structure. **07**

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