2022-23

MECHANICAL ENGINEERING

QM

PREPARED BY
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Techno India NJR Institute of Technology

Session 2022-23

Course File

Quality Management (6ME4- 05)

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Mechanical Engineering

6ME4-05: QUALITY MANAGEMENT

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	The meaning of Quality and quality improvement dimensions of quality, history of quality methodology, quality control, Quality of design and quality of conformance, Quality policy and objectives, Economics of quality.	5
	Modeling process quality: Describing variation, frequency distribution, continuous and discrete, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance.	4
3	Statistical Quality Control: Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, analysis of patterns on control charts. The magnificent seven.	4
	Control chart for variables,: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts.	4
4	Control chart for attributes: control chart for fraction non conforming P- chart, np-chart, c-chart and u-chart. Demerit systems, choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma.	7
5	Quality Assurance: Concept, advantages, field complaints, quality rating, quality audit.	2
	Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ.	4
	Introduction to Quality systems like ISO 9000 and ISO 14000.	2
6	Reliability and Life Testing- Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability	4
	Introduction to Taguchi Method of Design of Experiments, Quality loss function.	4
	TOTAL	41

Course Overview:

Student will learn basics of quality management from this 41 hours course. Quality management ensures that an organization, product or service is consistent. It has four main components: quality planning, quality assurance, quality control, and quality improvement. Quality management is focused not only on product and service quality, but also on the means to achieve it. Quality management, therefore, uses quality assurance and control of processes as well as products to achieve more consistent quality. What a customer wants and is willing to pay for it determines quality. It is a written or unwritten commitment to a known or unknown consumer in the market. Thus, quality can be defined as fitness for intended use or, in other words, how well the product performs its intended function.

Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Synthesis	Student will be able to understand the role of statistical tools in quality improvement.
2	Synthesis	Student will be able to understand the different types of variability, rational subgroups, and how a control chart is used to detect assignable causes.
3	Design	Students will be able to Construct and interpret control charts for variables such as x-bar, r, s charts.
4	Design	Students will be able to Construct the sampling plan and OC curve etc.

Course Outcome Mapping with Program Outcome:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	0	0	0	0	1	0	1
CO2	3	2	3	2	2	0	0	0	0	1	0	1
CO3	2	2	3	1	2	0	0	0	0	1	0	1
C04	2	2	2	2	2	0	0	0	0	1	0	1
Average	2.50	2.00	2.75	1.75	2.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	**1**	**INTRODUCTION:** Objective, scope and outcome of the course
2	**2**	**QUALITY:** student should be able to understand the meaning of Quality, Quality improvement, Dimensions of quality
3	2	Student should be able to understand history of quality methodology
4	2	Student should be able to understand Quality control, Quality of design and quality of conformance
5	2	Student should be able to understand Quality policy and objectives , Economics of quality
6	**2**	**MODELING PROCESS QUALITY:** Describing variation, frequency distribution
7	2	Student should be able to understand continuous and discrete, Probability distributions
8	2	Student should be able to understand probability distributions, Pattern of variation
9	2	Student should be able to understand inferences about process quality: Sampling distributions and estimation of process parameters
10	2	Student should be able to understand Analysis of variance
11	**3**	**STATISTICAL QUALITY CONTROL**: Student should be able to understand concept of SQC, Chance and assignable causes of variation
12	3	Student should be able to understand statistical basis of control chart and basic principles
13	3	Student should be able to understand choice of control limits, Sample size
14	3	Student should be able to understand sampling frequency and Analysis of patterns on control charts
15	3	Student should be able to understand the magnificent seven
16	**3**	**CONTROL CHART FOR VARIABLES:** X-bar and R charts
17	3	Student should be able to understand X-bar and R charts
18	3	Student should be able to understand X-bar and S charts

19	3	Student should be able to understand Control chart for individual measurement
20	3	Student should be able to understand Application of variable control charts
21	**4**	**CONTROL CHART FOR ATTRIBUTES:** Control chart for fraction non-conforming P- chart
22	4	Student should be able to understand P- chart, np-chart
23	4	Student should be able to understand C-chart and u-chart
24	4	Student should be able to understand demerit systems, choice between attribute and variable control chart
25	4	Student should be able to understand SPC for short production runs
26	4	Student should be able to understand process capability analysis using histogram and probability plot
27	4	Student should be able to understand capability ratios and concept of six sigma
28	**5**	**QUALITY ASSURANCE:** Student should be able to understand Concept, advantages, Field complaints, quality rating, Quality audit
29	**5**	**ACCEPTANCE SAMPLING:** Student should be able to understand Fundamental concepts in acceptance sampling, Operating characteristics curve
30	5	Student should be able to understand Operating characteristics curve
31	5	Student should be able to understand acceptance sampling plans, single, double and multiple sampling plans
32	**5**	Student should be able to understand **LTPD, AOQL, AOQ**
33	**5**	**INTRODUCTION TO QUALITY SYSTEMS** like ISO 9000 7 ISO 14000
34	**6**	**RELIABILITY AND LIFE TESTING**- Student should be able to understand Failure models of components, Definition of reliability
35	6	Student should be able to understand MTBF, Failure rate, Common failure rate curve
36	6	Student should be able to understand types of failure, Reliability evaluation in simple cases of exponential failures in series
37	6	Student should be able to understand Paralleled and series-parallel device configurations
38	6	Student should be able to understand Redundancy and improvement factors evaluations
39	6	Student should be able to understand Introduction to Availability and Maintainability
40	**6**	**INTRODUCTION TO TAGUCHI METHOD OF DESIGN OF EXPERIMENTS**
41	6	Student should be able to understand Quality loss function

TEXT/REFERENCE BOOKS

- STATISTICAL QUALITY CONTROL BY DOUGLAS C. MONTGOMERY
- STATISTICAL QUALITY CONTROL BY M. MAHAJAN , DHANPAT RAI & CO.

Course Level Problems (Test Items):

CO.NO.	Problem description
1	A. What is Quality. Explain the dimension of quality. B. Explain the "Quality of Conformance" and "Quality of Design". C. Discuss the importance of Quality Control in the success of any organization. D. Discuss the major aspects of effective management of Quality.
2	A. Explain the concept of statistical quality control (SQC). B. What are the objectives of control chart. C. What do you understand by Control Charta for variables. D. Difference between variable chart and attribute chart.
3	A. Describe the types of attribute control chart in detail. B. How can we improve the process using control chart. C. Explain the concept of process capability. D. Discuss relative advantages and disadvantages of single, double and multiple sampling plans.
4	A. Explain Operating Characteristic (OC) curve. B. Explain bath tub curve with neat diagram. C. What are difference between MTTF and MTBF. D. Define reliability also explain failure data analysis.

Assessment Methodology:

1. Practical exam in lab where they have to write readings of statistical tools.
2. Assignments one from each unit.
3. Midterm subjective paper where they have to write numericals.
4. Final paper at the end of the semester subjective.

Teaching and Learning resources unit-wise:

Unit-1

A. Introduction, objective, scope of the quality management.

Video Tutorials: https://www.youtube.com/watch?v=s4zr313edEI

Theory concepts: https://cyzotech.com/quality-management/

Sample Quiz:
https://www.wisdomjobs.com/e-university/quality-management-interview-questions.html

Unit-2

A. Meaning of quality improvement and quality policy and objectives

Video Tutorials: https://youtu.be/K5vbIhUyqXU

Theory concepts:
https://www.slideshare.net/AFAQAHMEDJAMADAR/introduction-to-quality-engineering-quality-control

Sample Quiz:http://www.yancypm.com/project_management/quality_sample_questions.html

B. Modeling process quality

Video Tutorials: https://youtu.be/eTG5NuTXBQg

Theory concepts: https://nptel.ac.in/courses/112/107/112107214/

Sample Quiz: http://www.yancypm.com/project_management/quality_sample_questions.html

Unit-3

A. Statistical Quality Control

Video Tutorials: https://youtu.be/L1ZuNUqyeMk

Theory concepts: https://www.sciencedirect.com/topics/engineering/statistical-quality-control

Sample Quiz:http://www.yancypm.com/project_management/quality_sample_questions.html

B. Control chart for variables

Video Tutorials: https://youtu.be/dkSROYov-ow

Theory concepts: https://www.yourarticlelibrary.com/industrial-engineering-2/types-of-control-charts-with-diagram-industries/90321

Sample Quiz:http://www.yancypm.com/project_management/quality_sample_questions.html

Unit-4

A. Control chart for attributes

Video Tutorials: https://youtu.be/ZDEteNQyTsE

Theory concepts:
https://www.yourarticlelibrary.com/industrial-engineering-2/types-of-control-charts-with-diagram-industries/90321

Sample Quiz: http://www.yancypm.com/project_management/quality_sample_questions.html

B. Concept of six sigma

Video Tutorials: https://youtu.be/qH-btrXLai8

Theory concepts:
https://www.henryharvin.com/blog/5-benefits-of-six-sigma-for-mechanical-engineers/

Sample Quiz: http://www.yancypm.com/project_management/quality_sample_questions.html

C. Quality Assurance

Video Tutorials: https://youtu.be/jTHZdfqRFUY

Theory concepts: https://en.wikipedia.org/wiki/Quality_assurance

Sample Quiz: http://www.yancypm.com/project_management/quality_sample_questions.html

D. Acceptance sampling

Video Tutorials: https://youtu.be/TdAimBiLOgA

Theory concepts: https://www.researchgate.net/publication/286900881_Acceptance_Sampling

Sample Quiz: http://www.yancypm.com/project_management/quality_sample_questions.html

Unit-5

A. Reliability and life testing

Video Tutorials: https://youtu.be/8-a3Cf0eZ90

Theory concepts: https://accendoreliability.com/mechanical-systems-reliability-testing/

Sample Quiz:http://www.yancypm.com/project_management/quality_sample_questions.html

B. Taguchi method

Video Tutorials: https://youtu.be/pEmiYcAlKHQ

Theory concepts: https://www.sciencedirect.com/topics/materials-science/taguchi-method

Sample Quiz: http://www.yancypm.com/project_management/quality_sample_questions.html

Previous Year Question Papers:

RTU paper

5E6204

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B.Tech. V Semester (Main/Back) Examination, Nov./Dec. - 2017
Mechanical Engineering
5ME4A Quality Assurance and Reliability

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 26

Instructions to Candidates:

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly). Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) Explain what do you mean by quality. Describe the dimensions of quality. **(2+8)**

   b) Define what do you mean by quality of design. Enumerate the factors influencing quality of design. **(2+4)**

OR

1. a) A lot contains 100 items, 5 of which do not conform to requirements. If 10 items are selected at random without replacement, find the probability of finding one or less non-conforming item in the sample. **(4)**

   b) An experiment was conducted in which 10 observations on road octane number were obtained for each of two product formulations. These data are indicated in Table - 1 below for gasoline formulation 1 and formulation 2.

Table - 1 Road octane numbers for two Gasoline formulations :

Observation No.	1	2	3	4	5	6	7	8	9	10
Formulation 1 (contains lead)	89.5	90.0	91.0	91.5	92.5	91.0	89.0	89.5	91.0	92.0
Formulation 2. (Contains no lead)	89.5	91.5	91.0	89.0	91.5	92.0	92.0	90.5	90.0	91.0

Construct a 99% confidence interval on the true mean difference in road octane numbers (Given $t_{0.005, 18} = 2.878$). **(12)**

Unit - II

2. a) Explain chance and assignable causes of variability in quality and compare these two. **(2+3)**

b) There are seven major tools for statistical process control problem solving. What are these called? Explain each one of these. **(1+10)**

OR

2. A tyre company sells its ATC-50 Tyres with a 50,000 miles-treaded life warranty. Simulated road tests were conducted to monitor life of the output from the ATC-50 production process. For each of the last 12 batches of 1000 tyres, 5 tyres were tested and the results were recorded as following in Table 2 with ($\bar{x}$ and R)

Table 2 $\bar{x}$ & R values :

Batch No.	1	2	3	4	5	6	7	8	9	10	11	12
$\bar{x}$	50.5	49.7	50.0	50.7	50.7	50.6	49.8	51.1	50.2	50.4	50.6	50.7
R	1.1	1.6	1.8	0.1	0.9	2.1	0.3	0.8	2.3	1.3	2.0	2.1

a) Construct a $\bar{x}$ chart **(12)**

b) Is the production process under control? Explain. **(4)**

Unit - III

3. a) Frozen orange juice concentrate is packed in a 6-OZ cardboard cans. These cans are/formed on a machine by spinning them from cardboard stock and attaching a metal bottom penal. A can could possibly leak either on the side seam or around bottom penal. 30 samples of n = 50 cans each were selected at half-an-hour interval over a three shift period in which the machine was in continuous operation. The data are shown in Table 3 below :

Table 3 Data for Trial control limits - n = 50 **(8+2)**

Sample number	Number of non-conforming cans	Sample number	Number of non-conforming cans	Sample number	Number of non-conforming cans
1	12	11	5	21	20
2	15	12	6	22	18
3	8	13	17	23	24
4	10	14	12	24	15
5	4	15	22	25	9
6	7	16	8	26	12
7	16	17	10	27	7
8	9	18	5	28	13
9	14	19	13	29	9
10	10	20	11	30	6

Establish a control chart and conclude whether the production process is in control

b) Consider the data in the Question No. 3 (a) above in Table - 3 for the fraction non conforming orange juice concentrate cans and determine the parameters of np control chart and construct a np control chart. **(4+2)**

OR

3. a) Table - 3.1 indicates the number of non-conformities observed in 26 samples of 100 printed circuit boards (pcb). The inspection unit is defined as 100 PCBs.

Table - 3.1 Data on the number of non conformities in samples of 100 PCBs

Sample number	Number of non-conformities	Sample number	Number of non-conformities	Sample number	Number of non-conformities
1	21	10	25	19	28
2	24	11	20	20	39
3	16	12	24	21	30
4	12	13	16	22	24
5	15	14	19	23	16
6	5	15	10	24	19
7	28	16	17	25	17
8	20	17	13	26	15
9	31	18	22		

Construct a C chart and indicate whether process is in control. **(6+2)**

b) A personal computer manufacturer wishes to establish a control chart for non-conformities per unit on the final assembly line. The sample size selected as 5 computers. Data on the numbers of nonconformities in 20 samples of 5 computers each are shown in Table - 3.2.

Table - 3.2 Data on number of non-conformities in personal computers, sample size = 5

Sample number	Total number of non conformities	Sample number	Total number of non-conformities
1	10	11	9
2	12	12	5
3	8	13	7
4	14	14	11
5	10	15	12
6	16	16	6
7	11	17	8
8	17	18	10
9	10	19	7
10	15	20	5

Construct a control chart for average number of non conformities. **(8)**

Unit - IV

4. a) Explain what do you mean by quality assurance. Enumerate advantage of quality assurance. **(1+3)**

   b) Enumerate reasons for customer (field) complaints and design a procedure for handling and disposal of customer complaints. **(2+3)**

   c) A double sampling plan is as follows :

      i) Select a sample of 2 from 20 articles. If both the articles inspected are good, accept the lot. If both are defective, reject the lot. If 1 is good and 1 is defective, take a second sample of 1 article.

      ii) If the articles in the second sample is good, accept the lot. If it is defective, reject the lot. If a lot 25% defective is submitted what is the probability of acceptance. **(7)**

OR

4. a) A single sampling plan uses a sample of size 15 and an acceptance numbers 1 using Hypergeometric probabilities, compute the probability of acceptance of lots of 50 articles 2% defective. **(6)**

   b) Compute the consumer's risk for the single sampling scheme from a batch of 2000 items with LTPD = 0.01, sample size 15 and acceptance number 1. **(6)**

   c) Enumerate the major clauses of international standard ISO 9001 : 2008. **(4)**

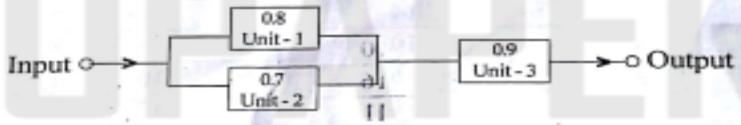
Unit - V

5. a) An electronic circuit consists of 5 Silicon Transistors, 3 Silicon Diodes 10 composition Resistors and 2 ceremic capacitors. The hourly failure rate of each component is given as follows
   Silicon Transistor = 4×10^{-5} Silicon Diode = 3×10^{-5}, composition Resistor = 2×10^{-4}, ceramic capacitor = 2×10^{-4}. Calculate the reliability of the circuit for 10 hours when the components follow exponential distribution. **(6)**

   b) Explain what do you mean by reliability. Describe Bath Tub curve for pattern failures. **(2+8)**

OR

5. a) Estimate the system reliability of the units arranged in the assembly of a product shown in the product below. Individual reliability is indicated in the block (Assume the elements to be independent). **(8)**



   b) Describe Taguchis methodology of design of experiments. **(8)**

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B. Tech V Sem. (Main/Back) Exam. Nov-Dec. 2015
Mechanical Engineering
5ME4A Quality Assurance and Reliability

Time: 3 Hours

Maximum Marks: 80
Min. Passing Marks Main: 26
Min. Passing Marks Back: 24

Instructions to Candidates:

*Attempt any **five questions,** selecting **one question** from **each unit.** All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

1. Data Tables 2. NIL

UNIT-I

Q.1 Discuss the following in detail: [4×4=16]

(a) Dimensions of quality

(b) History of quality

(c) Quality improvements

(d) Quality control

OR

Q.1 (a) What do you understand by probability distribution? [8]

(b) Construct an OC curve for the sampling plan where the lot size is 2000, the sample size is 50, and the acceptance number is 2. [8]

UNIT-II

Q.2 (a) Explain X-bar and R charts with suitable examples. [8]

(b) How patterns on control chart are analysed? [8]

OR

Q.2 (a) Discuss the seven major statistical quality control problem solving tools. [8]

(b) The thickness of the magnetic coating on audio tapes is an important characteristic. Random samples of size 4 are selected, and the thickness is measured using an optical instrument. Table-1 shows the standard deviation for 20 samples. The specifications are 38±14.5 microns. If a coating thickness is less than the specifications called for, the tape can be used for a different purpose by running it through another coating operation. Draw an S-chart with control limits. [8]

Table -1

Sample	1	2	3	4	5	6	7	8	9	10
Standard Deviation	4.6	3.7	5.2	4.3	4.4	3.9	5.0	6.1	4.1	5.8
Sample	11	12	13	14	15	16	17	18	19	20
Standard Deviation	5.3	3.5	4.7	5.6	5.0	4.1	5.6	4.8	4.7	5.4

UNIT-III

Q.3 (a) Discuss the process capability analysis using Histogram. [8]

(b) The number of non-conformities in carpets is determined for 20 samples, but the amount of carpet inspected for each sample various. Results of the inspection are shown in table-2. Construct a control chart for the number of nonconformities per $100m^2$. [8]

Table -1

Sample	1	2	3	4	5	6	7	8	9	10
Amount Inspected (m^2)	200	300	250	150	250	100	200	150	150	250
Number of Nonconformities	5	14	8	8	12	6	20	10	6	10
Sample	11	12	13	14	15	16	17	18	19	20
Amount Inspected (m^2)	300	250	200	250	100	200	200	100	300	200
Number of Nonconformities	9	16	12	10	6	8	5	5	14	8

OR

Q.3 Classify the control charts for fraction nonconforming. Explain them. [16]

UNIT-IV

Q.4 (a) Discuss quality rating and quality audit in detail. [8]

(b) What are the sampling methods? Explain in detail. [8]

OR

Q.4 (a) Discuss the sampling plans in detail. [8]

(b) Construct on AOQ curve for the sampling plan where the lot size is 2000, the sample size is 100, and the acceptance number is 3. [8]

UNIT-V

Q.5 (a) Explain maintainability and availability. Also explain Taguchi method. [8]

(b) Explain failure, its types and causes of failure. [8]

OR

Q.5 Discuss the following in detail: [4×4=16]

(a) Hazard rate

(b) Bath-tub curve

(c) MTTF

(d) Redundancy
