

QUALITY CONTROL AND MANAGEMENT

ENIE 413

Lecture : 3
Tutorial : 1
Practical : 0

Year : IV
Part : I

Course Objectives:

The objective of this course is to develop understanding of quality management principles, statistical and analytical tools and modern industrial practices such as TQM, lean and six sigma for improving product and process quality in manufacturing and service systems.

- 1 Quality Management and Philosophy (5 hours)**
 - 1.1 Concepts and definitions of quality: Quality of design versus quality of performance
 - 1.2 Quality philosophies and evolution: From inspection to TQM
 - 1.3 Philosophies of: Deming (14 Points), Juran (Trilogy), Crosby (Zero Defects), Ishikawa
 - 1.4 Quality characteristics and dimensions of quality in manufacturing and services
 - 1.5 Impact of quality on cost, productivity and market share
- 2 Statistical Quality Control (8 hours)**
 - 2.1 Introduction to statistical methods and variation: Common versus assignable causes
 - 2.2 Control charts for variables
 - 2.3 Control charts for attributes
 - 2.4 Process variation and control chart patterns
 - 2.5 Process capability analysis
- 3 Acceptance Sampling (5 hours)**
 - 3.1 Fundamentals of sampling: Producer's risk and consumer's risk, AQL and LTPD
 - 3.2 Operating characteristic (OC) curve: Construction and properties
 - 3.3 Sampling plans: Single, double and multiple sampling plans
 - 3.4 Acceptance sampling by attributes versus variables
- 4 Quality Engineering Tools and Failure Analysis (7 hours)**
 - 4.1 Seven basic quality (7 QC) tools: Check sheets, pareto charts, fishbone diagrams, histograms, scatter plots, stratification and control charts

- 4.2 Root cause analysis: Brainstorming and the 5-why method
- 4.3 Failure mode and effects analysis (FMEA): Concept, RPN calculation and mitigation
- 4.4 Suppliers quality management and incoming inspection

5 Total Quality Management (TQM) and ISO Standards (6 hours)

- 5.1 TQM principles: Customer focus, continuous improvement (PDCA) and employee involvement
- 5.2 Cost of quality: Prevention, appraisal, internal failure and external failure costs
- 5.3 ISO 9000 family: Requirements, documentation, registration and auditing
- 5.4 Benchmarking: Types, process and competitive analysis

6 Six Sigma and Lean Systems (6 hours)

- 6.1 Six sigma concept and methodology: DMAIC (Define, measure, analyze, improve, control)
- 6.2 Sigma levels, DPMO and process performance metrics
- 6.3 Lean concepts: Kaizen, 5S, Poka-Yoke (Mistake proofing) and value stream mapping
- 6.4 Quality circles and team-based improvement

7 Quality Function Deployment and Taguchi Method (4 hours)

- 7.1 Quality function deployment (QFD): Translating customer needs into technical specifications
- 7.2 House of quality: Structure and construction
- 7.3 Taguchi method: Quality loss function and robust design concepts

8 Quality, Productivity and Digital Systems (4 hours)

- 8.1 Quality circles and quality organization
- 8.2 Productivity and efficiency relationship with quality
- 8.3 Introduction to Industry 4.0 in quality

Tutorial (15 hours)

- 1. Variable control charts: Construct and analyze $\bar{X}$ and R charts using industrial data sets
- 2. Attribute control charts: Practice numerical problems on p, c and u charts for non-conforming units
- 3. Process capability analysis: Calculate and interpret Cp and Cpk indices to evaluate process performance
- 4. Acceptance sampling: Design single sampling plans and construct operating characteristic (OC) curves
- 5. Quality engineering tools: Construct a house of quality (QFD) and perform FMEA with RPN calculations

6. Six sigma and Taguchi Methods: Solve problems on DPMO, Sigma levels and the Taguchi quality loss function

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	5	6
2	8	10
3	5	6
4	7	8
5	6	8
6	6	10
7, 8	8	12
Total	45	60

* There may be minor deviation in marks distribution.

References

1. Besterfield, D. H. (2018). Total quality management. Pearson.
2. Evans, J. R., Lindsay, W. M. (2020). The management and control of quality. Cengage Learning.
3. Feigenbaum, A. V. (2004). Total quality control. McGraw-Hill.
4. George, M. L. (2002). Lean Six Sigma: Combining Six Sigma quality with lean production speed. McGraw-Hill.
5. Goetsch, D. L., Davis, S. B. (2021). Quality management for organizational excellence: Introduction to total quality. Pearson.
6. Juran, J. M. (1992). Juran on quality by design: The new steps for planning quality into goods and services (Latest Edition). Free Press.
7. Montgomery, D. C. (2020). Introduction to statistical quality control. Wiley.
8. Pyzdek, T., Keller, P. A. (2021). The Six Sigma handbook. McGraw-Hill Education.
9. Taguchi, G. (1987). Quality engineering (Latest Edition). Asian Productivity Organization.