

# Standards & Quality Practices

*In Production, Construction;  
Maintenance & Services*

*New Pattern  
for UPSC IES/CSE*



**IES MASTER PUBLICATION**

Office : F-126, (Lower Basement) Katwaria Sarai, New Delhi - 110 016

Web : [www.iesmasterpublications.com](http://www.iesmasterpublications.com) | Phone : 011-26522064 | Mobile : 8130909220, 9711853908



## **IES MASTER Publication**

F-126, Katwaria Sarai, Lower Basement New Delhi-110016  
Phone : 011-41013406, Mobile : 8130909220, 9711853908  
Web : [www.iesmasterpublications.com](http://www.iesmasterpublications.com) E-mail : [info@iesmaster.org](mailto:info@iesmaster.org)

© No part of this booklet may be reproduced, or distributed in any form or by any means, electronic, mechanical, photocopying, or otherwise or stored in a database or retrieval system without the prior permission of **IES MASTER PUBLICATION**, New Delhi. Violaters are liable to be legally prosecuted.

**First Edition : 2016**

## Preface

### **Preface to first Edition**

Standards & Quality Practices has been written mainly to cater for students appearing for union public service commission, ESE (Engineering Services Examination), State public service commission and other competitive examinations. It covers in detail the syllabi for these examinations. Questions typical of those set in the examinations have been included to practice and to discover the extent of their knowledge. Keywords are printed in bold type to assist the student further in assimilating the information.

In writing this book we have had in mind the needs and interests of students appearing for these competitive examinations, since most of the text books already available are written too extensively making most of it irrelevant to the demands of the examination. The boxed information focus on points of topical interest or on particular concept.

IES Master wishes to take this opportunity of thanking Dr. Ramji Annepu for his extensive contribution in generating, shaping, editing and production of this book. We also thank the staff at IES Master and all those who have assisted with information and advice in the production of this book.

**IES Master Publication**

New Delhi, 2016



## CONTENTS

		<b>Pages</b>
<b>Chapter-1</b>	Introduction to Quality	<b>01 – 18</b>
<b>Chapter-2</b>	Approaches to Quality: Deming, Juran, Crosby	<b>19 – 38</b>
<b>Chapter-3</b>	Management Tools in Quality	<b>39 – 64</b>
<b>Chapter-4</b>	Statistical Tools in Quality	<b>65 – 82</b>
<b>Chapter-5</b>	Total Quality Management	<b>83 – 90</b>
<b>Chapter-6</b>	Quality Function Deployment & FMEA	<b>91 – 100</b>
<b>Chapter-7</b>	Quality Standards	<b>101 – 122</b>
<b>Chapter-8</b>	Quality in Manufacturing/Production	<b>123 – 138</b>
<b>Chapter-9</b>	Quality in Construction	<b>139 – 160</b>
<b>Chapter-10</b>	Quality in Maintenance	<b>161 – 184</b>
<b>Chapter-11</b>	Quality in Services	<b>185 – 199</b>
	<b>Practice Work Sheets</b>	<b>194 – 241</b>



## TABLE OF CONTENTS

Section	Description	Page No.
	<b>PREFACE</b> .....	<b>(iii)</b>
	<b>CONTENTS</b> .....	<b>(v)</b>
<b>CHAPTER-1</b>	<b>INTRODUCTION TO QUALITY</b>	<b>1 – 18</b>
1.1	Introduction	1
1.1.1	Definition	1
1.1.1.1	General Properties Quality Product/ Service	2
1.2	Quality Policy Implementation	3
1.2.1	Customer	3
1.2.1.1	Customer Needs	4
1.2.1.2	Customer Satisfaction	4
1.2.2	Cost of Quality	5
1.2.2.1	Cost of quality Mainly comprises four parts	6
1.2.2.2	Significant	7
1.2.3	Quality Measurement	8
1.2.3.1	Conformance to Specifications	8
1.2.3.2	Quality Assurance	8
1.2.3.3	Quality Audit	9
1.2.3.4	Types of Audits	11
1.2.3.5	Quality Survey	12
1.2.3.6	Product Audit	12
1.3	Quality Control	13
1.3.1	Standard Specifications	14
1.3.1.1	Objectives of Quality Control	14
1.3.1.2	Quality Control And Quality Assurance	15
1.3.1.3	Quality Introduction Levels	16
1.3.1.4	Quality Maintaining Functions	17
1.3.1.5	Quality Engineering recognizes four other characteristics	17

<b>CHAPTER-2</b>		<b>APPROACHES TO QUALITY: DEMING, JURAN, CROSBY</b>	<b>19 – 36</b>
2.1	Poka-yoke		19
	2.1.1	Benefits of Poka Yoke	20
2.2	kaizen concept		21
	2.2.1	Total Quality Control	22
	2.2.2	Kanban Just-in-time System	23
	2.2.3	Quality Circles	23
	2.2.4	Total Productive Maintenance (TPM)	24
	2.2.5	Kaizen Vs. Innovation	24
2.3	Deming's approach		25
	2.3.1	Points to Quality Management	26
	2.3.2	Seven Deadly Sins	
	2.3.3	The PDCA Cycle	28
	2.3.4	PDCA in TQM	29
2.4	Juran's approach		29
	2.4.1	Juran's Key ideas	29
		2.4.1.1 Pareto Principle	29
		2.4.1.2 Quality Campaigns	30
	2.4.2	Breakthrough	30
	2.4.3	Juran's Trilogy and Quality Planning Road Map	30
2.5	crosby's approach		31
	2.5.1	Four major principles	32
	2.5.2	14 Steps for effective quality program	32
2.6	Concurrent Engineering		35
<b>CHAPTER-3</b>		<b>MANAGEMENT TOOLS IN QUALITY</b>	<b>37 – 62</b>
3.1	Introduction		37
3.2	Seven Traditional Quality Tools		38
	3.2.1	Pareto Chart	38
		3.2.1.1 Histogram	39
	3.2.2	Process Flow Diagram	40
	3.2.3	Check sheet	40
	3.2.4	Scatter Diagram	41
	3.2.5	Control Chart	42
	3.2.6	Run Chart	42



3.2.7	Cause and Effect Diagram	43
3.3	Seven Recent QC Tools	43
3.3.1	Affinity Diagram	45
3.3.2	Interrelations Diagram	45
3.3.3	Tree Diagram	46
3.3.4	Matrix Diagram	47
3.3.5	Matrix Data Analysis Chart: (MDAC)	48
3.3.5.1	Prioritization Matrices	48
3.3.6	Process Decision Program Chart (PDPC)	49
3.3.7	Activity Network Diagram	50
3.4	Offline Quality Control	51
3.4.1	Taguchi Method	52
3.4.1.1	Customer Loss Functions	52
3.4.1.2	Parameter Design	53
3.4.1.3	Performance Measure	54
3.4.1.4	Taguchi's Tolerance Design/ Allowance	54
3.5	Experimental Designs, Six Sigma and Benchmarking	55
3.5.1	Experimental Design for Quality	56
3.5.1.1	One Factor at a Time Method	56
3.5.1.2	The Full Factorial Method	56
3.5.1.3	The Fractional Factorial Method	56
3.5.2	Six Sigma	57
3.5.2.1	Methodology	58
3.5.2.2	Six Sigma Organization Structure	59
3.5.3	Benchmarking	61
3.5.3.1	Approach	61

---

<b>CHAPTER-4</b>	<b>STATISTICAL TOOLS IN QUALITY</b>	<b>63 – 78</b>
------------------	-------------------------------------	----------------

---

4.1	Introduction	63
4.1.1	Significance of Statistics	63
4.1.1.1	Descriptive Statistics	64
4.1.1.2	Inferential Statistics	64
4.1.2	Population & Sample	65
4.1.2.1	Parameter Versus Statistic	65
4.1.3	Measures of Central Tendency and Dispersion	66
4.1.4	Confidence Interval	69

	(x)	
	4.1.5 Testing of Hypothesis	70
4.2	Probability Theory	70
	4.2.1 Additive Law of Probability	71
	4.2.2 Multiplicative Law of Probability	71
4.3	Statistical Process Control	73
	4.3.1 Random and Assignable Causes	74
	4.3.2 Control Charts for Variables	75
	4.3.2.1 Cusum Chart	77
	4.3.3 Control Charts for Attributes	78
	4.3.4 Pre-control Chart	78
4.4	Reliability	79
	4.4.1 Reliability and Quality	80
<hr/>		
<b>CHAPTER-5</b>	<b>TOTAL QUALITY MANAGEMENT</b>	<b>79 – 86</b>
<hr/>		
5.1	Total Quality Management	79
	5.1.1 Total Quality Management Principles	80
	5.1.2 Key Elements	81
	5.1.2.1 Foundation	82
	5.1.2.2 Building Bricks	82
	5.1.2.3 Binding Mortar	83
	5.1.2.4 Roof	83
	5.1.3 Axioms of TQM	84
	5.1.4 Implementation of TQM	84
	5.1.5 Approaches to Implement TQM	85
	5.1.5.1 Integrated Management Approach	85
	5.1.5.2 Traditional Management Approach	85
	5.1.5.3 Benefits & Disadvantages	86
	5.1.5.4 Disadvantages	86
<hr/>		
<b>CHAPTER-6</b>	<b>QUALITY FUNCTION DEPLOYMENT &amp; FMEA</b>	<b>87 – 96</b>
<hr/>		
6.1	Quality Function Deployment	89
	6.1.1 House of Quality	91
	6.1.1.1 Continual Improvement	92
	6.1.1.2 Benefits	93
6.2	Failure Mode and Effects Analysis (FMEA)	92
	6.2.1 Elements of FMEA	93
	6.2.2 Process FMEA	94

6.2.3	Application of FMEA	94
6.2.4	Benefits of FMEA	95
<b>CHAPTER-7</b>	<b>QUALITY STANDARDS</b>	<b>97 – 118</b>
7.1	Standards	97
7.1.1	Purpose of Standards	97
7.1.2	Levels of Standardization	98
7.2	Specifications	100
7.2.1	Types of Specification	100
7.2.1.1	1st set of Classification	100
7.2.1.2	2nd set of Classification	100
7.2.2	Benefits of Specifications	100
7.3	Iso International Organization for Standardization	100
7.3.1	ISO 9000 Components	103
7.3.2	Benefits of ISO 9000	105
7.4	Bureau of Indian Standards (BIS)	107
7.4.1	Formulation of Indian Standards	107
7.4.2	Certification schemes operated by BIS	108
7.4.2.1	Quality System Certification	108
7.4.2.2	Environmental Management Systems	108
7.4.2.3	HACCP Scheme	108
7.4.2.4	Rajiv Gandhi National Quality Award	109
7.5	Quality Council of India	109
7.5.1	The objectives of QCI	110
7.6	ISO 14000	110
7.7	Occupational Safety and Health Administration (OSHA)	111
7.7.1	Occupational Safety and Health Administration	111
7.7.1.1	OSHA Standards fall into the following four categories	112
7.7.1.2	OSHA Benefits	112
7.8	Quality System Standards & Business Excellence Models	113
7.8.1	Quality System Standards	114
7.8.1.1	Generic Standards	114
7.8.1.2	Industry-Related Standards	114
7.8.1.3	Quality Standards Serve the following Three Purposes	115

7.8.2	COPC-2000	115
7.8.2.1	Baldrige Criteria -Performance Excellence	116
7.8.2.2	CII-EXIM Bank Award(EFQM Model)	116
7.8.2.3	Tata Business Excellence Model (TBEM)	117

<b>CHAPTER-8</b>	<b>QUALITY IN MANUFACTURING/PRODUCTION</b>	<b>119 – 134</b>
8.1	Standards	119
8.2	Quality Management Strategies	119
8.3	Manufacturing Planning for Quality	122
8.3.1	Basic Approach to Quality Planning	123
8.3.1.1	Minor Changes in the Existing Product	123
8.3.1.2	Considerable Change in the Existing Product	123
8.3.1.3	Entirely New Products	123
8.4	Quality Conformance in Manufacturing	124
8.5	Quality Control	125
8.5.1	Benefits of Quality Control in Manufacturing	126
8.5.2	Quality Control in Manufacturing	129
8.5.3	Real-Time Defect Prevention	129
8.5.4	Quality Control and Lean Manufacturing	129
8.6	Lean Manufacturing	130
8.6.1	Five Lean Manufacturing Principles	131
8.6.1.1	Identify Value	131
8.6.1.2	Map the Value Stream	131
8.6.1.3	Create Flow	132
8.6.1.4	Establish Pull	132
8.6.1.5	Seek Perfection	133
8.6.2	Solutions for Lean Manufacturing Principles	133
<b>CHAPTER-9</b>	<b>QUALITY IN CONSTRUCTION</b>	<b>135 – 154</b>
9.1	Construction	135
9.1.1	Objectives	136
9.1.2	Scope	137
9.1.3	Holistic View of Quality Management	138
9.1.4	Organization Structure for Quality Management	139
9.1.4.1	Quality Management in Construction	139

9.2	Management of Quality in Different Stages of the Project	140
9.2.1	Pre-construction Phase	140
9.2.1.1	Project Appraisal	140
9.2.1.2	Project Development	141
9.2.1.3	Planning for Construction	142
9.2.1.4	Tender Action	142
9.2.2	Construction Phase	142
9.2.2.1	Quality in Construction Stages	142
9.2.2.2	Pre-construction Managerial Decisions	143
9.2.2.3	Design and Engineering	143
9.2.2.4	Quality Management System of Construction Agency	143
9.2.3	Commissioning and Handing Over Stage	143
9.3	Quality Management Requirements	144
9.3.1	Preparation of Quality Policy	144
9.3.2	QA & QC Manual and Quality Plan	145
9.3.2.1	Quality Plan (IS 10005: 2005)	145
9.3.2.2	Quality Procedures for Construction Equipment, Plant and Machineries	146
9.3.2.3	Quality Procedures for Works	146
9.3.2.4	Traceability	147
9.3.2.5	Dissemination of Quality Documents	147
9.3.3	Management of Stakeholder Interfaces	147
9.3.4	Developing Competence through Training	147
9.3.5	Management of Resources	147
9.3.5.1	Procurement of Supplies and Services	148
9.3.5.2	Resource Need Analysis & Deployment Planning	148
9.3.6	Project Peculiarities and Performance Risks	148
9.3.7	Integration, Clash Analysis & Validation	148
9.3.7.1	Integration of Technical Interfaces	149
9.3.7.2	Lean Construction Processes	149
9.3.7.3	Clash Analysis of Activities	149
9.3.7.4	Validation of Work Processes	149
9.3.8	Establishing Infrastructure for Construction Quality	149
9.3.8.1	Provision for Inspection & Test Equipment	149

	(xiv)	
	9.3.8.2 Control Laboratories and Testing Facilities	150
	9.3.8.3 Environmental Conditions and Enabling Infrastructure for Work Performance	150
	9.3.9 Training facilities	150
	9.3.10 Non-conforming Works, Emergencies & Disasters	150
	9.3.10.1 Identification, Segregation & Disposal	150
	9.3.10.2 Review and Management of Risks	151
	9.3.10.3 Management Response	151
	9.3.10.4 Prevention and Corrective Actions	151
	9.3.11 Monitoring and Continual Improvement	151
	9.3.11.1 Quality Performance Indicators	151
	9.3.11.2 Construction Process Outputs	152
	9.3.11.3 Quality Auditing	152
	9.3.11.4 Quality Cost Analysis (IS 10708)	152
	9.3.11.5 Quality Improvement Benchmarks	153
	9.3.11.6 Quality Improvement Interventions	153
	9.3.11.7 Organizational Process Assets Update	153
	9.4 Promoting a Quality Culture	153
	9.5 Performance Appraisal and Recognition,	153
	9.5.1 Integration with other Management System	154
	9.5.2 Post Construction Review & Documentation	154

---

<b>CHAPTER-10</b>	<b>QUALITY IN MAINTENANCE</b>	<b>155 – 178</b>
	10.1 Maintenance	155
	10.1.1 Importance of maintenance	156
	10.1.2 Objectives of Maintenance	157
	10.1.3 Types of Maintenance	158
	10.2 Maintenance Policies	161
	10.2.1 Major maintenance policies are	162
	10.2.1.1 Preventive maintenance	162
	10.2.1.2 Fixed-time replacement	162
	10.2.1.3 Condition-based Maintenance	162
	10.2.1.4 Opportunity Maintenance	162
	10.2.1.5 Failure & Corrective Maintenance	162
	10.2.1.6 Design-out Maintenance	163

(xv)

10.3	Maintenance Planning, Control and Scheduling	163
10.4	Maintenance Standards	164
10.5	Reliability in Maintenance	165
10.5.1	Objectives	166
10.5.2	Reliability and Quality	167
10.6	Maintainability	167
10.6.1	Availability, Reliability and Maintainability	169
10.7	Maintenance Evaluation	169
10.8	Maintenance Management and Control	171
10.8.1	Office Automation	171
10.8.2	Computer-aided Design	172
10.8.3	Accounting and Financial Management	172
10.8.4	Inventory Control	172
10.8.5	Personnel Record Keeping	172
10.8.6	Job Planning	172
10.8.7	Training	173
10.9	Economic Aspects of Maintenance	173
10.9.1	Life Cycle Costing	173
10.9.2	Maintenance Cost	174
10.9.2.1	Impact of Maintenance Cost	175
10.9.3	Production Cost VS Maintenance Cost	175
10.9.4	Maintenance Budget	175
10.9.5	Maintenance Cost Control	176
10.9.6	Optimization of Maintenance Cost	177
10.9.7	Absenteeism And Overtime	177
10.9.7.1	Cost of Accidents	178

---

<b>CHAPTER-11</b>	<b>QUALITY IN SERVICES</b>	<b>179 – 193</b>
-------------------	----------------------------	------------------

---

11.1	Services	179
11.1.1	Dimensions of Service Quality/	180
11.2	Service Quality Gaps	181
11.2.1	GAP 1:	182
11.2.2	GAP 2:	183
11.2.3	GAP 3:	183
11.2.4	GAP 4:	184
11.2.5	GAP 5:	184

(xvi)

11.3	Dimensions of service quality	185
11.4	Delivering Service Quality	187
11.4.1	Systems and Processes	187
11.4.2	People	189
11.5	Measuring Service Quality	190
11.5.1	Measuring Subjective Elements	191
11.5.2	Measuring Objective Elements	191
11.5.3	Soft Measures of Service Quality	191
11.5.4	Hard Measures of Service Quality	192
11.6	Service Quality Standards (SQSs) and Criteria	192
11.6.1	Principle 1: Provision of Information	192
11.6.2	Principle 2: Service Management	192
11.6.3	Principle 3: Service to Users	193
11.6.4	Principle 4: Respect for Service Users Right	193

**Practice Work Sheets**

**194 – 241**