

QUALITY TECHNIQUES**Course Code : 316011****Programme Name/s : Production Engineering****Programme Code : PG****Semester : Sixth****Course Title : QUALITY TECHNIQUES****Course Code : 316011****I. RATIONALE**

The "Quality Techniques" course is designed to equip polytechnic students with essential skills for modern industry. The course focuses on practical applications of quality control, assurance, and improvement methodologies and provide experience and exposure to students in statistical analysis, lean manufacturing, and adherence to industry standards and ISO standards with advanced IoT tools.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Utilize quality techniques to improve process efficiency

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify the dimensions of quality for a given product or process.
- CO2 - Use statistical tools to ensure quality.
- CO3 - Suggest strategies for minimizing waste using 5S and six sigma methodologies.
- CO4 - Suggest actions for process improvement based on quality audit report.
- CO5 - Utilize digital twin technology for quality improvement.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL						
				CL	TL	LL			FA-TH			SA-TH	Total	Practical		SLA						
														FA-PR	SA-PR	Max	Min	Max	Min			
316011	QUALITY TECHNIQUES	QTN	DSC	2	-	2	-	4	2	-	-	-	-	-	25	10	50@	20	-	-	75	

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the definition and importance of quality TLO 1.2 Explain different dimensions of quality TLO 1.3 Compare the quality philosophies	Unit - I Introduction to Quality Techniques 1.1 Definition and Importance of Quality, Quality in Manufacturing and Service Sectors 1.2 Dimensions of Quality (Garvin's Dimensions), Cost of Quality (CoQ) 1.3 TQM Philosophies: Deming, Juran and Crosby	Flipped Classroom
2	TLO 2.1 Monitor product quality using control charts and process capability analysis TLO 2.2 Make decisions about acceptance or rejection of sample	Unit - II Statistical Quality Control (SQC) 2.1 Introduction to statistical methods used in quality control, Key concepts: Control charts, process capability analysis, and acceptance sampling, Tools: X-bar and R charts, P-charts, and S-charts. 2.2 Application of SQC in monitoring and controlling product quality, understanding process variation and establishing control limits to maintain consistent quality.	Site/Industry Visit Case Study Hands-on
3	TLO 3.1 Explain the principles of Lean Manufacturing TLO 3.2 Identify type of inefficiencies and areas for improvement for a given workspace using 5s TLO 3.3 Identify the underlying causes of errors or defects in products or services using 6 sigma.	Unit - III Lean Manufacturing 3.1 Principles of Lean Manufacturing 3.2 7 Wastes (Muda) and Their Reduction, 5S Methodology for Workplace Organization 3.3 Six Sigma Methodology (DMAIC & DMADV), Tools in Six Sigma (Pareto Analysis, Cause & Effect Diagram, FMEA)	Collaborative learning Demonstration
4	TLO 4.1 Describe the quality audit process and reporting methods. TLO 4.2 Explain the key components of supplier quality management TLO 4.3 Explain risk management principles in quality assurance as per ISO 31000. TLO 4.4 Illustrate continuous improvement and benchmarking strategies.	Unit - IV Quality Assurance 4.1 Quality Audits: Types of Quality Audits (Internal, External, Supplier), Audit Process and Reporting 4.2 Supplier Quality Management 4.3 Risk Management in Quality (ISO 31000) 4.4 Continuous Improvement and Benchmarking	Case Study Model Demonstration
5	TLO 5.1 Explain the concepts of Reliability, Maintainability, and Availability (RMA). TLO 5.2 Compare and contrast international quality standards and industry-specific standards. TLO 5.3 Explain the role of Industry 4.0 technologies (IoT, AI, Big Data) in modern quality control systems. TLO 5.4 Discuss the application of Smart Manufacturing and Digital Twin Technology.	Unit - V Modern Quality Tools 5.1 Reliability, Maintainability, and Availability (RMA) Concepts, Statistical Methods for Reliability Testing (Weibull Analysis). 5.2 Quality Standards (ISO 9001, ISO 14001, ISO 45001), Industry-Specific Standards (IATF 16949 for Automotive, AS9100 for Aerospace) 5.3 Industry 4.0 in Quality Control (IoT, AI, Big Data Analytics) 5.4 Smart Manufacturing & Digital Twin Technology in Quality	Presentations Model Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning	Sr	Laboratory Experiment / Practical	Number	Relevant
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MSBTE Approval Dt. 04/09/2025

Semester - 6, K Scheme

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Outcome (LLO)	No	Titles / Tutorial Titles	of hrs.	COs
LLO 1.1 Identify quality attributes in a manufacturing product and a service process. LLO 1.2 Compare how quality is measured and ensured in both sectors.	1	Inspection of quality attributes of a product using measurement tools	2	CO1
LLO 2.1 Conduct quality parameter testing for Performance, Reliability, and Durability. LLO 2.2 Interpret and compare test results using real-world quality benchmarks. LLO 2.3 Explain the impact of these dimensions on customer satisfaction.	2	Measurement of Quality Dimensions Using Real Products	2	CO1
LLO 3.1 Identify defects in a process of any lab using the Zero Defects approach. LLO 3.2 Apply corrective actions to eliminate identified defects. LLO 3.3 Develop a preventive strategy to minimize future defects.	3	* Implementation of Zero Defects approach	2	CO1
LLO 4.1 Collect and analyze sample data from a manufacturing or service process. LLO 4.2 Construct X-R, P, and S charts to visualize process stability. LLO 4.3 Interpret control charts to identify common and special cause variations.	4	*Construction of X-R, P, and S charts to monitor process variation	2	CO2
LLO 5.1 Calculate Process Capability Indices (Cp, Cpk). LLO 5.2 Analyze if a process meets specifications and customer requirements.	5	*Determination of capability using Cp and Cpk indices	2	CO2
LLO 6.1 Design a sampling plan using AQL (Acceptable Quality Level). LLO 6.2 Perform random sampling and inspect products for defects LLO 6.3 Apply decision rules to accept or reject a batch based on findings.	6	* Implementation of an AQL-based sampling plan for batch inspection and decision-making.	2	CO2
LLO 7.1 Identify examples of the 7 Wastes (Overproduction, Waiting, Transport, etc.). LLO 7.2 Analyze the impact of waste on efficiency and suggest improvements. LLO 7.3 Apply Lean techniques (Kaizen, Kanban) to minimize waste	7	*Reducing process waste by applying Lean techniques in a practical setting	2	CO3
LLO 8.1 Conduct a 5S audit in a workshop or simulated workplace.	8	*Implementation of 5S audit in institute workshop	2	CO3
LLO 9.1 Collect and classify defect data from a sample batch LLO 9.2 Create a Pareto Chart to prioritize major defect types LLO 9.3 Develop a Cause-and-Effect Diagram to analyze root causes.	9	*Identifying major defects and their causes using Pareto and Cause-and-Effect diagrams.	2	CO3
LLO 10.1 Understand and apply the audit process (planning, execution, reporting, follow-up). LLO 10.2 Prepare a checklist based on ISO 9001 or other relevant standards.	10	* Execution of an audit using a checklist based on ISO 9001 standards	2	CO4
LLO 11.1 Assess supplier quality based on delivery, defect rates, compliance, and responsiveness. LLO 11.2 Prepare a Supplier Quality Report with recommendations	11	Evaluation of supplier quality through data collection and reporting.	2	CO4

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LLO 12.1 Identify potential quality risks in a manufacturing or service process. LLO 12.2 Develop mitigation strategies using quality management tools (FMEA, Control Plans).	12	*Identification of risks using ISO 31000 risk management principles	2	CO4
LLO 13.1 Use Weibull Distribution to analyze failure patterns (early failure, random failure, wear-out). LLO 13.2 Calculate key reliability parameters (shape factor, scale factor, mean time to failure - MTTF).	13	*Execution of a reliability test using Weibull analysis.	2	CO5
LLO 14.1 Understand key ISO & industry-specific quality standards and their applications. LLO 14.2 Perform a mock compliance audit using ISO checklists. LLO 14.3 Identify non-conformities and suggest corrective actions for compliance.	14	* Implementation of a mock ISO compliance audit and identification of non-conformities.	2	CO5
LLO 15.1 Analyze real-time production data for defect detection and process optimization. LLO 15.2 Use Big Data tools to identify quality trends and anomalies. LLO 15.3 Discuss Digital Twin technology and its role in predictive quality control.	15	* Evaluation of quality data using advanced tools.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- Mock ISO 9001 Audit for Quality Compliance – Conduct a simulated ISO audit for a manufacturing or service process and identify gaps in quality compliance.
- Six Sigma DMAIC Project on Quality Improvement – Identify a quality issue, apply the Define, Measure, Analyze, Improve, and Control (DMAIC) approach, and suggest improvements.
- Identification & Reduction of 7 Wastes (Muda) in a Small-Scale Setup – Observe a manufacturing or service process and suggest lean improvements to eliminate waste.
- Digital Twin Simulation for Predictive Quality Control – Develop a simple digital twin model of a production process and analyze its impact on defect prediction.
- Control Chart Analysis for Process Monitoring – Collect real or simulated data and create X-bar, R, P, and S charts to analyze process stability.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials

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and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Vernier Caliper & Micrometer	1,2,3
2	Dial Gauge with Magnetic Stand	1,2,4
3	Checklist & Auditing Toolkit	10,14
4	3D Scanner for Quality Inspection	12
5	Vision Inspection System (Camera-Based)	12
6	Weibull Analysis Software, Accelerated Life Testing Setup	13
7	ISO 9001 Documentation Software	14
8	IoT Sensors (Temperature, Pressure, Vibration)	15
9	Digital Twin Simulation Software (Mathematical software)	15
10	Weighing Balance (Digital)	5
11	SPC Software (Spreadsheet and control chart software)	6
12	Stopwatch, Software for analysis (Spreadsheet and control chart software)	7
13	Hardness Tester (Rockwell, Brinell, Vickers), Surface Roughness Tester	8

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Quality Techniques	CO1	4	0	0	0	0
2	II	Statistical Quality Control (SQC)	CO2	8	0	0	0	0
3	III	Lean Manufacturing	CO3	6	0	0	0	0
4	IV	Quality Assurance	CO4	6	0	0	0	0
5	V	Modern Quality Tools	CO5	6	0	0	0	0
Grand Total				30	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- For laboratory learning 25 Marks

Summative Assessment (Assessment of Learning)

- End semester assessment of 50 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	-	-	3	1			

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CO2	3	2	-	2	-	3	1			
CO3	3	2	3	2	-	3	1			
CO4	3	2	3	2	-	3	1			
CO5	3	-	-	2	1	3	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield	Total Quality Management	Prentice Hall, ISBN: 978-0136394037
2	Arasu Senthil B, Paul Praveen J	TQM - Total Quality Management	Scitech Publications (India) Pvt. Ltd., Chennai,2015, ISBN: 978-81-8371-578-2
3	Jain K. C, Chitale A. K	Quality Assurance and Total Quality Management (ISO-9000, QS-9000, ISO-14000)	Khanna Publishers, New Delhi,2005, ISBN: 9788174091741
4	Arora K. C.	TQM and ISO 14000	S.K. Kataria & Sons, New Delhi,2014, ISBN: 9788185749990
5	Nagararazan R. S, Arivalagar A. A	Total Quality Management	New Age International (P) Ltd., New Delhi,2016, 978-81-224-3968-7
6	Michael L. George	Lean Six Sigma: Combining Six Sigma Quality with Lean Speed	McGraw Hill, ISBN: 978-0071385213
7	Douglas C. Montgomery	Introduction to Statistical Quality Control	Wiley, ISBN: 978-1118146811
8	E. Balagurusamy	Reliability Engineering	McGraw Hill, ISBN: 978-0070702752

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.coursera.org/learn/six-sigma-improve-control-advanced?	Coursera – Online courses on Six Sigma, SPC, and quality control.
2	https://www.flinkiso.com/pricing/free-qms-download.html	FlinkISO – Open-source Indian Quality Management System (QMS) software for automating quality compliance.
3	https://www.youtube.com/watch?v=SMOQV2CyVQo	YouTube NPTEL – Concepts in Quality Management - I, a video lecture for understanding quality fundamentals.
4	https://archive.nptel.ac.in/courses/110/101/110101010/	NPTEL IIT Kharagpur – Quality Management course focusing on quality evolution, service/product quality, and pioneers like Deming and Crosby.
5	https://archive.nptel.ac.in/courses/110/104/110104080/	NPTEL IIT Kanpur – Total Quality Management course covering fundamental quality principles and philosophies.

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students