Chapter 2: Quality Management Concepts and Tools

Repeated Questions:

1. Quality Circle, 5S and Kaizen:

- **Q.** Define and explain Quality Circle. / Explain the process of operation of quality circle. / Explain Quality Circle with its advantages. **(WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks; SUMMER 2026, 3 Marks)**

Answer:

- **Definition:** A Quality Circle is a small group of employees (6–12) from the same work area who voluntarily meet regularly to identify, analyze, and solve work-related quality problems.
- **Operation:** Members are trained in problem-solving tools; they select a problem, analyze causes, recommend solutions to management, and implement approved solutions.
- **Advantages:** Improves quality and productivity, enhances employee morale and teamwork, reduces defects and waste, and develops problem-solving skills at the grassroot level.

- **Q.** Explain the concept of 5S. **(SUMMER 2022, 7 Marks – part c; WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 4 Marks – "Explain 5's Principle in context to your institute workshop.")**

Answer:

- **Seiri (Sort):** Remove unnecessary items from the workplace; keep only what is needed.
- **Seiton (Set in Order):** Arrange necessary items in proper places for easy access and use.
- **Seiso (Shine):** Clean the workplace and equipment regularly to maintain standards.
- **Seiketsu (Standardize):** Establish standards and procedures to maintain the first three S's consistently.
- **Shitsuke (Sustain):** Develop self-discipline and habit to follow rules and continuously improve.

  (For 7 marks: elaborate each S with examples from an institute workshop — e.g., sorting tools in carpentry, marking tool boards, cleaning machines, standard checklists, daily audits.)

- **Q.** Describe the concept of Kaizen. **(WINTER 2022, 3 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 3 Marks)**

Answer:

- **Definition:** Kaizen means continuous improvement — small, incremental changes made by everyone in the organization to improve processes, quality, and productivity.
- **Key Features:** Involves all employees, focuses on process improvement rather than results, uses small low-cost changes, and requires top-management commitment.
- **Benefits:** Reduces waste, improves quality, lowers costs, and increases employee involvement and morale.

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2. Poka-Yoke and PDCA:

- **Q.** Explain Poka-Yoke with two examples. **(SUMMER 2022, 3 Marks; SUMMER 2023, 3 Marks)**

Answer:

- **Definition:** Poka-yoke (mistake-proofing) is a technique that prevents human errors from occurring or detects them immediately so that defects cannot pass to the next stage.
- **Example 1:** A USB connector that can be inserted only in the correct orientation — prevents wrong insertion.

- **Example 2:** A microwave oven that does not start when the door is open — prevents operation with door open.
- **Purpose:** Achieves zero defects by designing processes that make errors impossible or immediately visible.

- **Q.** Explain the PDCA cycle. **(WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks; WINTER 2024, 7 Marks OR; WINTER 2025, 4 Marks)**

Answer:

- **Plan:** Identify the problem, analyze causes, and plan improvement actions.
- **Do:** Implement the planned actions on a small scale or pilot basis.
- **Check:** Measure and verify results against expected outcomes; identify deviations.
- **Act:** Standardize successful improvements or revise the plan based on findings; repeat the cycle for continuous improvement.
- **Benefits:** Provides a systematic, data-driven framework for continuous improvement and problem-solving.

  (For 7 marks: explain each phase with a practical example — e.g., reducing rejection in a machining process.)

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3. QFD, FMEA and Fault Tree Analysis:

- **Q.** Define QFD and Discuss the House of Quality (Product Planning Matrix). [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 4 Marks – "Describe Quality function Deployment with a neat sketch.")**

Answer:

- **Definition:** Quality Function Deployment (QFD) is a systematic method to translate customer requirements (Whats) into technical design requirements (Hows) at every stage of product development.
- **House of Quality (HOQ):** The central matrix of QFD that links customer needs to engineering characteristics.

Components of HOQ:

Customer Requirements (Whats) — voice of the customer.

Technical Requirements (Hows) — engineering characteristics.

Relationship Matrix — strength of link between Whats and Hows (strong, medium, weak).

Competitive Assessment — comparison with competitors.

Importance Ratings — priority of customer needs.

Roof Matrix — correlation between technical requirements (positive/negative).

- **Steps:** Identify customer needs → determine technical requirements → build relationship matrix → assign importance weights → analyze correlations → prioritize design actions.
- **Benefits:** Focuses design on customer needs, reduces design changes, improves cross-functional communication, and increases customer satisfaction.

  Diagram Description: A matrix with customer requirements listed vertically on the left, technical requirements horizontally on top, a relationship matrix in the center, a triangular "roof" showing correlations between technical requirements, and competitive assessment and importance ratings on the right and bottom.

- **Q.** What is FMEA? Explain how it helps in ensuring quality. / Draw its format. **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks; SUMMER 2026, 7 Marks – "Elaborate FMEA with suitable examples.")**

Answer:

- **Definition:** Failure Mode and Effects Analysis (FMEA) is a systematic, proactive technique to identify potential failure modes, assess their effects, and prioritize actions to prevent failures.
- **Types:** Design FMEA (DFMEA) and Process FMEA (PFMEA).

Key Terms:

- **Severity (S):** Seriousness of effect (1–10).
- **Occurrence (O):** Likelihood of cause occurring (1–10).
- **Detection (D):** Likelihood of detecting failure before customer (1–10).

  Risk Priority Number (RPN) = S × O × D — higher RPN means higher priority.
- **Steps:** List failure modes → determine effects and severity → identify causes and occurrence → list current controls and detection → calculate RPN → recommend corrective actions → re-evaluate RPN.
- **How it ensures quality:** Identifies problems before they occur, prioritizes high-risk areas, reduces warranty and field failures, and drives continuous improvement in design and processes.
- **Format:** A table with columns: Process/Part Function, Potential Failure Mode, Potential Effects, Severity, Potential Causes, Occurrence, Current Controls, Detection, RPN, Recommended Actions, Responsibility, Target Date, Action Results (S, O, D, RPN).

  Diagram Description: A tabular FMEA worksheet with rows for each failure mode and columns for severity, occurrence, detection, RPN, and recommended actions.

- **Q.** Explain Fault tree analysis [FTA]. **(WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks – "Elaborate Fault tree analysis- FTA")**

Answer:

- **Definition:** Fault Tree Analysis (FTA) is a deductive, top-down technique that identifies all possible causes of a specified undesired event (top event) using Boolean logic.
- **Symbols:** AND gate (all inputs must occur), OR gate (any input can cause event), basic event (circle), intermediate event (rectangle).
- **Steps:** Define top event → identify immediate causes → develop tree using gates → determine minimal cut sets → evaluate probability → recommend improvements.
- **Uses:** Identifies critical failure paths, quantifies system reliability, and helps in design and safety improvements.

  Diagram Description: A tree diagram with the top undesired event at the top, connected through AND/OR gates to intermediate events and basic causes at the bottom.

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4. Quality Control Tools:

- **Q.** Discuss the basic 7 Quality Control Tools. **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; SUMMER 2026, 7 Marks – "Explain 7 Quality control tools with its advantages.")**

Answer:

- **Check Sheet:** A structured form for collecting and recording data in real time; helps identify patterns and frequencies.
- **Histogram:** A bar chart of frequency distribution; shows the shape, spread, and centering of process data.

- **Pareto Chart:** A bar chart arranged in descending order of frequency with a cumulative line; highlights the "vital few" causes (80/20 rule).
- **Cause-and-Effect (Fishbone) Diagram:** Identifies potential causes of a problem across categories like Man, Machine, Material, Method, Measurement, and Environment.
- **Scatter Diagram:** Plots two variables to show correlation; helps identify relationships between process factors and quality characteristics.
- **Control Chart:** A time-series plot with control limits; distinguishes common-cause variation from special-cause variation.
- **Flow Chart:** A diagram of process steps; helps understand the process, identify non-value-added steps, and locate problem areas.

- **Q.** List out and explain the 7 new management/quality improvement tools. **(SUMMER 2023, 7 Marks OR; WINTER 2024, 7 Marks; WINTER 2025, 3 Marks; WINTER 2025, 7 Marks – "List out 7 new management tools and explain any five in detail.")**

Answer:

- **Affinity Diagram:** Organizes large amounts of qualitative data into natural groupings based on relationships.
- **Interrelationship Digraph:** Identifies cause-and-effect relationships among interrelated factors and highlights key drivers.
- **Tree Diagram:** Breaks down a goal or problem into progressively smaller, actionable components.
- **Matrix Diagram:** Shows relationships between two or more sets of factors using symbols or numbers.
- **Matrix Data Analysis:** A quantitative matrix technique (e.g., principal component analysis) to prioritize options.
- **Process Decision Program Chart (PDPC):** Maps possible contingencies and countermeasures for a plan to reduce risk.
- **Arrow Diagram:** A network diagram that sequences tasks and identifies the critical path for project planning.

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5. TQM Implementation:

- **Q.** Discuss TQM and its barriers/obstacles in implementation. **(SUMMER 2025, 7 Marks OR; SUMMER 2025, 3 Marks OR; WINTER 2025, 4 Marks – "What is the obstacles to implementing a TQM.")**

Answer:

- **TQM (Total Quality Management):** A management philosophy for continuous improvement involving all employees and processes to meet customer requirements.

Barriers/Obstacles to TQM Implementation:

- **Lack of Top Management Commitment:** Without leadership support and vision, TQM initiatives fail.
- **Resistance to Change:** Employees and managers resist new practices, fear job loss, or prefer status quo.
- **Poor Communication:** Unclear goals and lack of feedback across levels hinder implementation.
- **Inadequate Training:** Insufficient training in quality tools and principles reduces effectiveness.
- **Lack of Employee Involvement:** Failure to empower and involve employees in decision-making.
- **Short-Term Focus:** Expecting quick results instead of long-term continuous improvement.

- **Organizational Culture:** Bureaucratic, blame-oriented cultures discourage teamwork and improvement.
- **Insufficient Resources:** Lack of time, budget, and manpower for quality initiatives.
- **Measurement Issues:** Absence of clear metrics and data-based decision-making.

  (For 3/4 marks: list any 4–5 barriers.)

Other Important Questions:

1. TQM Elements:

- **Q.** What is Total Employee Involvement? How can a leader improve it? **(WINTER 2023, 7 Marks OR)**

Answer:

- **Definition:** Total Employee Involvement (TEI) means engaging every employee at all levels in quality improvement, decision-making, and problem-solving to achieve organizational goals.

How a Leader Can Improve TEI:

- **Empowerment:** Give employees authority to make decisions and take ownership of their work.
- **Training and Development:** Provide continuous training in quality tools, problem-solving, and teamwork.
- **Open Communication:** Share goals, performance data, and feedback openly; encourage suggestions.
- **Recognition and Rewards:** Recognize and reward contributions to quality improvement.
- **Teamwork:** Form quality circles, cross-functional teams, and encourage collaboration.
- **Remove Barriers:** Eliminate fear, blame culture, and obstacles to participation.
- **Lead by Example:** Demonstrate commitment to quality through personal actions and decisions.
- **Benefits:** Higher morale, lower defects, increased productivity, and a culture of continuous improvement.

- **Q.** What is the aim of Concurrent Engineering? **(WINTER 2024, 3 Marks)**

Answer:

- **Definition:** Concurrent Engineering is a systematic approach to product development where design, manufacturing, quality, and service functions work in parallel rather than sequentially.
- **Aim:** Reduce product development time, improve quality, lower costs, and increase customer satisfaction by integrating all functions from the early design stage.
- **Key Benefit:** Early identification of design problems and fewer redesigns and engineering changes.

- **Q.** Explain Kaizen and poka - yoke. **(SUMMER 2026, 4 Marks)**

Answer:

- **Kaizen:** Continuous improvement through small, incremental changes by all employees; focuses on process improvement and waste elimination.
- **Poka-yoke:** Mistake-proofing technique that prevents human errors or detects them immediately to achieve zero defects.
- **Difference:** Kaizen improves processes over time; poka-yoke designs processes so errors cannot occur or pass through.
- **Application:** Kaizen uses suggestions and teamwork; poka-yoke uses simple devices, sensors, or checklists at the workplace.

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2. TPM and 5S:

- **Q.** Explain Total Productive Maintenance (TPM). **(SUMMER 2025, 4 Marks OR)**

Answer:

- **Definition:** TPM is a maintenance strategy that aims to maximize equipment effectiveness through preventive and predictive maintenance involving all employees.
- **Key Pillars:** Autonomous maintenance, planned maintenance, quality maintenance, focused improvement, education and training, safety and environment, and office TPM.
- **Benefits:** Reduces breakdowns and downtime, improves equipment availability and OEE, lowers maintenance costs, and increases operator ownership.
- **Goal:** Zero breakdowns, zero defects, and zero accidents through total employee participation.

- **Q.** Discuss the role of 5S in quality improvements in manufacturing sectors. **(WINTER 2024, 7 Marks OR)**

Answer:

- **Sort (Seiri):** Removes unnecessary items, reducing clutter, accidents, and space wastage.
- **Set in Order (Seiton):** Creates a place for everything and everything in its place, reducing search time and errors.
- **Shine (Seiso):** Keeps machines and workplaces clean, enabling early detection of leaks, wear, and defects.
- **Standardize (Seiketsu):** Establishes visual standards and procedures, ensuring consistency and reducing variation.
- **Sustain (Shitsuke):** Builds discipline through audits and training, ensuring long-term adherence.
- **Impact on Quality:** Reduces defects caused by dirty or disorganized workplaces, improves safety, increases productivity, and supports a culture of continuous improvement.
- **Foundation for Other Tools:** 5S is the foundation for TPM, TQM, and lean manufacturing; a clean and organized workplace enables effective implementation of quality systems.
- **Employee Engagement:** Involves all employees in daily improvement activities, raising awareness and ownership of quality.
