

Unit 6 PRODUCT DESIGN AND DEVELOPMENT

Q.1) Write a short note on APQP

- Advanced Product Quality Planning (APQP) is a structured process aimed at ensuring customer satisfaction with new products or processes.
- APQP is used by progressive companies to assure quality and performance through planning.
- It used to help supply develop appropriate prevention and detection control for new product supporting the corporate quality effort.
- Supplier utilize APQP to bring new product and processes to successful validation and drive continuous improvement.
- There are numerous tools and techniques described within APQP.
- Each tool has potential value when applied in the correct timing.
- Tools that have the greatest impact on product and process success are called the Core Tools.
- The focus of APQP is utilization of tools and methods for mitigating the risks associated with change in the new product or process.
- This planning uses a five-phase process:
 - Product Planning and Quality Program Definition
 - Product Design and Development
 - Process Design and Development
 - Validation of Product and Process
 - Production Launch, Assessment, and Improvement.

Q.2) Write a short note on DFMEA

- Design failure mode and effect analysis (DFMEA) is a systematic group of activities used to recognize and evaluate potential systems, products, or process failures.
- DFMEA identifies the effects and outcomes of these failures or actions.
- It is a thorough analysis of the malfunctions that can be produced in the components of an engineering system.
- The probability of failure of each component, based on published data or company experience, is listed, and the probabilities of failure of the subassemblies, assemblies, and the complete system are calculated from reliability theory.
- The DFMEA is applied when:
 - There is a new design with new content
 - There is a current design with modifications, which also may include changes due to past failure
 - There is a current design being used in a new environment or change in duty cycle (no physical change made to design).

Q.3) Discuss the elements of PLM in detail

The essential elements of PLM are:

- Management of design and process documents
- Product structure (bill of material) management
- Central data vault (electronic file repository)
- Part and document classification and metadata ("attribute") management
- Materials content identification for environmental compliance
- Product-focused project task assignment
- Workflow and process management for approving changes
- Multi-user secured access, including "electronic signature"
- Data export for loading downstream ERP systems

Q.4) List down types of FMEA and explain steps of DFMEA.

Type of FMEA:

- Design FMEA (DFMEA): enables you to identify and address failure modes during the design stage or at the end.
- Process FMEA (PFMEA): It is used in analyzing and maintaining process control objectives.
- Functional FMEA (FFMEA) / System FMEA (SFMEA)
- Software FMEA: study the programming logic that goes into generating reports or controls associated processes.

Steps of DFMEA:

- List each system with its function and other design requirement.
- Identify the failure mode of each system.
- Describe the potential effect of each failure mode and assign rating.
- Determine the potential causeway of each failure mode.
- Specify prevention control and assign occurrence rating.
- Indicate detection control and assign detection rating.
- Calculate risk priority number.
- Create high priority recommendation.
- Document action taken.
- Re-analyse the risk priority number to decide next step.

Q.5) What are guidelines for design for robustness? Discuss.

- They define a robust product or process as one that perform an indented even under non ideal condition such as manufacturing process variation or range of operating situation.
- Based on this definition, two criteria can be derived:
 - Decrease in performance variation
 - Handling of noise

- Some of the characteristics:

Transfer Function:

- Reducing or eliminating variation in positioning.
- Achieving independence of functions.
- Exploiting elasticity.
- Increasing product quality.
- Facilitating quality control.
- Reducing potential for occurrence of failure.

Noise behaviour model:

- Reducing or eliminating noise.
- Reducing or eliminating impact of noise.
- Reducing or eliminating influence of noise.

- General rules for robust design

- Always identify critical characteristics (CTQs) that quantify customer satisfaction.
- Always look for ways to reduce variation in CTQs.

Q.6) Differentiate Value analysis and value engineering

Parameter.	Value analysis.	Value engineering.
When applied.	After the product or service exist.	During the design and development phase.
Goal.	Improve value by reducing unnecessary cost.	Create value by designing efficiently.
Focus	Existing product or service.	New product or service.
Approach.	Fixing issues.	Preventing issues.
Cost management.	Reduces cost without changing functionality.	Avoid unnecessary cost during design.
Creativity	It used to focus on improvement	Encourage initiative and creative design.
Risk factor	Low.	high
Customer satisfaction.	Enhanced customer satisfaction by improving existing product.	Aim to meet customer need with optimized design.
Scope.	Limited to current design or process.	Influencing the oral design approach.
Time and effort.	Less effort and time required	Require more time and effort to develop design.
Sustainability.	It used to focus, making existing design more efficient, efficient.	Consider a Sustainability. from beginning.
Example	Modifying a product to lower production cost.	Designing a product with cost effective material.

Q.7) Write a short note on Product data Management (PDM)

- It is the use of software to manage product data and process related information in single central system.
- This information includes computer identities and data model parts, information manufacturing, instruction requirement and not send document.
- This system provides solution for secure data management process enablement, and configuration management.
- Benefits of product data management are:
 - Find the correct data quickly
 - Improve productivity and reduce cycle times
 - Reduce development errors and costs
 - Improve value chain orchestration
 - Meet business and regulatory requirements
 - Optimize operational resources
 - Facilitate collaboration between global teams
 - Provide visibility for better business decision-making.

Q.8) Write a short note on Product lifecycle management (PLM).

- It is referred to handling of a good and it move through typical stage of product life:
 - Development and introduction.
 - Growth.
 - Maturity or stability.
 - Decline.
- This handling involves both manufacturing of good and marketing of it.
- It helps in informing business, decision making from pricing and promotion to expansion or cost cutting.
- Benefit of product life cycle management:
 - Getting the product to market faster.
 - Improved product quality and reliability.
 - Saving through reuse of original data
 - Putting a higher quality product on the market.
 - Increasing sales opportunity.
 - Reducing error and waste
 - Improving product safety.
- Specialized computer software is available to assist with PLM through functions such as document management, design integration, and process management.

Q.9) Explain application of Teamcenter/Nx Manager in Product design and development.

- Teamcenter is a software that helps teams manage and collaborate on product design and development. It's like a digital hub where teams can store, share, and work on product data.
- NX is a computer-aided design (CAD) software that helps designers create and simulate product designs. It's like a digital toolbox that enables designers to create, analyze, and optimize product designs.
- Application in Product Design and Development:
 - Design Creation: Designers use NX to create 3D product designs.
 - Data Management: Teamcenter manages and stores the design data, making it accessible to the entire team.
 - Collaboration: Teamcenter enables teams to collaborate on designs, track changes, and manage different versions.
 - Simulation and Analysis: NX allows designers to simulate and analyze product performance, ensuring that designs meet requirements.
 - Manufacturing Planning: Teamcenter helps plan and manage manufacturing processes, ensuring that designs are produced efficiently.

Q.10) What is APQP, what role it plays in robust design and development?

- APQP stands for Advanced Product Quality Planning. It's a structured approach to designing and developing new products, focusing on quality and reliability.
- Role in Robust Design and Development
 - APQP plays a crucial role in robust design and development by:
 - Defining Customer Requirements: APQP helps identify and prioritize customer needs, ensuring that the product meets their expectations.
 - Designing for Reliability: APQP encourages designers to consider potential failures and develop mitigation strategies, resulting in more reliable products.
 - Reducing Variability: APQP helps minimize variability in the design and manufacturing process, ensuring that products perform consistently.
 - Ensuring Manufacturability: APQP considers manufacturing constraints and capabilities, ensuring that the design is producible and meets quality standards.
 - Validating Design: APQP involves testing and validation to ensure that the product meets requirements and performs as expected.