

### Section A : Basic Concepts (30 Marks)

- This section consists of questions with serial number 1 - 30.
- Answer all questions.
- Each question carries one mark.
- Maximum time for answering Section A is 30 Minutes.

1. While the old concept of quality element emphasized on detection of errors, the new quality element emphasizes on
- (a) Reduction of errors  
 (b) Operational errors  
 (c) Quality Control  
 (d) Short-term decisions  
 (e) Prevention of errors.
2. Some people's behavior is based on their feelings. The circumstances, conditions and environment drive them and tell them how to respond. This type of behavior is referred to as
- (a) Put first things first  
 (b) Proactive  
 (c) Synergy  
 (d) Renewal  
 (e) Reactive.
3. Several common problems do arise during decision making process by a team. Which of the following problems occur when the team has trouble starting or ending a project or different stages of a project?
- (a) Floundering  
 (b) Wanderlust  
 (c) Attribution  
 (d) Feuding  
 (e) Overbearing.
4. Benchmarking is a popular tool which is used to improve the quality of the product or service. Which of the following is **not** a pitfall or criticism of benchmarking?
- (a) It is not very helpful if it is used for processes that do not offer much opportunity for improvement  
 (b) It breaks down if process owners and managers feel threatened or do not accept and act on the findings  
 (c) It is not a substitute for innovation  
 (d) It forces an organization to set goals and objectives based on external reality  
 (e) It is an improvement tool.

5. Which of the following dimensions of quality specifies consistency of performance over a period of time and the average time for the unit to fail?
- (a) Performance  
 (b) Conformance  
 (c) Aesthetics  
 (d) Reputation  
 (e) Reliability.
6. Unethical behavior is associated with various types of costs. Which of the following costs can be addressed by developing policies that encourage and protect whistleblowers and require the existence of ombudsmen who can work confidentially with people to solve ethical problems internally?
- (a) Costs from pressure  
 (b) Costs from opportunity  
 (c) Costs from attitudes  
 (d) Costs from simplicity  
 (e) Costs from risk.
7. The scope of benchmarking should not be too small or too large. If the scope is too small, the benchmarking process completes quickly without giving expected results and if it is too large, it may not be completed at all even after extending to several years. Hence, both scope and time should be limited. Which of the following is the best scope of study that helps the teams to complete the benchmarking process successfully in the stipulated time?
- I. Broad and deep.  
 II. Broad and shallow.  
 III. Narrow and shallow.
- (a) Only (I) above  
 (b) Only (II) above  
 (c) Only (III) above  
 (d) Both (I) and (II) above  
 (e) Both (II) and (III) above.
8. Which of the following statements is/are true regarding compliance, one of the performance problems?
- I. These problems are identified by the feedback received from external customers.  
 II. The diagnosis of these problems is difficult, because of the complexity of products and processes.  
 III. These problems can be addressed by the performance standards.
- (a) Only (II) above  
 (b) Both (I) and (II) above  
 (c) Both (I) and (III) above  
 (d) Both (II) and (III) above  
 (e) All (I), (II) and (III) above.

9. Organizations have realized that to increase or maintain the market share, they must be in conformance with an ISO standard. Which of the following ISO standard demonstrates conformity of the quality management systems to customers, regulatory and the organization's own requirements?
- (a) ISO 9000:2000 ✓
  - (b) ISO 9004:2000
  - (c) ISO 9001:2000 ✓
  - (d) ISO/TS 16949 ✓
  - (e) ISO 9100.
10. A customer questionnaire is a popular tool for obtaining opinions and perceptions of customers about an organization and its products and services. Which of the following statements is **not true** regarding customer questionnaire that is used for collecting feedback regarding customer satisfaction?
- (a) Both clients and customers are treated as the same
  - (b) Data analysis and interpretation requires less time if more time is spent in survey development ✓
  - (c) Before the collection of data, the analysis and uses of data should be known ✓
  - (d) Generally the questions asked are to be graded on a one to ten scale ✓
  - (e) In a mail survey, usually the results are not representative of a normal population. ✓
11. Which of the following does not constitute the salient features of Deming Philosophy?
- (a) Institute training
  - (b) Teach and institute leadership
  - (c) Eliminate exhortations for the work force
  - (d) Establish numerical quotas for the work force ✓
  - (e) Encourage education and self-improvement for everyone.
12. In a house of quality, which of the following is **true** regarding target value?
- (a) It is intersection point of HOW's and WHATs
  - (b) It provides quality comparison between the products of two competitors ✓
  - (c) It is the intersection point of technical competitive assessment and customer competitive assessment
  - (d) It is added while developing prioritized customer requirements
  - (e) It provides relationship between customer requirements and the technical competitive assessment.
13. In an organization, the time consumed during the start-ups of machinery can be considered as
- (a) Unplanned downtime losses
  - (b) Reduced speed losses
  - (c) Planned downtime losses ✓
  - (d) Poor quality losses
  - (e) Idle and minor stoppage losses.

14. In a matrix diagram, which of the following format is used to establish relationship between three variables?

- (a) L – shape
- (b) Z – shape
- (c) C – shape
- (d) U – shape
- (e) X – shape.

15. Organizations are emphasizing on service quality to win and retain customer satisfaction. Which of the following elements of service quality focuses on providing a clean and comfortable customer reception area?

- (a) Organization
- (b) Customer care
- (c) Communication
- (d) Front-line people
- (e) Leadership.

*clw*

16. Which of the following is required for data analysis tools such as average, sample standard deviation and histogram to give error free conclusions?

- (a) Control charts
- (b) Normal curve
- (c) Run chart
- (d) Variation chart
- (e) X chart.

17. If a customer complains about the malfunction of a product, temporary measures will be taken by the management to provide an initial solution. Subsequently, finding a permanent solution, the problem solving team identifies and eliminates the root cause or causes of the problem. But, this does not make the product better than the original design. Which of the following improvement strategies does this refers to?

- (a) Renovation
- (b) Refinement
- (c) Remanufacture
- (d) Repair
- (e) Cannibalization.

18. If in a manufacturing concern, 35 units out of the total 1235 units produced are nonconforming, then what is the rate of quality products produced in that manufacturing concern?

- (a) 93.12%
- (b) 94.63%
- (c) 96.35%
- (d) 97.16%
- (e) 99.23%.

19. The companies should give high priority to the quality characteristics that are creating difficulty in terms of production problem or cost. Quality characteristics can be expressed in terms of basic units and derived units. Which of the following is **not** a basic unit of quality characteristics?
- (a) Length
  - (b) Temperature
  - (c) Mass
  - (d) Substance
  - (e) Energy.
20. The Kano model conceptualizes customer requirements and they are differentiated in a variety of ways. Which of the following includes both written and verbal requirements that are easily identified, expected to be met and typically performance related?
- (a) Implicit requirements
  - (b) Innovations
  - (c) Hygiene requirements
  - (d) Explicit requirements
  - (e) Novelties.
21. Which of the following statements is/are **true** regarding autonomous work groups?
- I. Autonomous work groups are established based on the natural flow of activity.
  - II. These groups are formed merely including machine operators working at bottom level of an organization to solve the various quality problems.
  - III. These groups must have the authority to make decisions about keeping the equipment in first-class running order.
- (a) Only (I) above
  - (b) Only (II) above
  - (c) Both (I) and (II) above
  - (d) Both (I) and (III) above
  - (e) Both (II) and (III) above.
22. The application of forced field analysis has been proven useful in process improvement. Which of the following statements is/are **not true** regarding forced field analysis?
- I. It clarifies the interrelationship of many factors of a complex situation.
  - II. It helps an organization to better understand promoting and restraining forces that influence the goal.
  - III. It encourages team creativity, breaks down barriers and stimulates ownership of the process.
- (a) Only (I) above
  - (b) Only (II) above
  - (c) Only (III) above
  - (d) Both (I) and (III) above
  - (e) All (I), (II) and (III) above.

23. If the process capability index ( $C_p$ ) for a process is observed as 0.33 then which of the following specification limits is followed by the process?  
(Assume that the process was normally distributed and centered)
- (a)  $\pm 1\sigma$   
 (b)  $\pm 2\sigma$   
 (c)  $\pm 3\sigma$   
 (d)  $\pm 4\sigma$   
 (e)  $\pm 5\sigma$
24. The Interrelationship Diagram (ID) clarifies the interrelationship of many factors of a complex situation. Which of the following is/are **not true** in the context of ID?
- I. It ensures that the team should agree on the issue or problem statement.  
 II. It provides rankings with a numerical value starting from one, for least important and continuing to the most important.  
 III. It ensures that all of the ideas or issues from other techniques or from brainstorming should be laid out.
- (a) Only (I) above  
 (b) Only (II) above  
 (c) Only (III) above  
 (d) Both (I) and (III) above  
 (e) Both (II) and (III) above.
25. Managers should develop interesting activities for employees by altering their assignments. Which of the following combines the tasks vertically by adding managerial elements such as planning, scheduling and inspection?
- (a) Job rotation  
 (b) Job enrichment  
 (c) Job enlargement  
 (d) Job specification  
 (e) Job analysis.
26. An organization's sales revenue is ₹ 10,50,000. The labor cost as percent of sales is 25% and the actual teams cost is ₹ 2,50,000. The gain as per gainsharing is
- (a) ₹ 10,500  
 (b) ₹ 11,800  
 (c) ₹ 12,500  
 (d) ₹ 13,000  
 (e) ₹ 13,250.
- lab cost =*

27. A cause- and-effect diagram is designed to represent a meaningful relationship between an effect and its causes. Which of the following is **not correct** regarding cause-and-effect diagram?
- (a) Cause-and-effect diagrams are used to investigate either a good effect or a bad effect
  - (b) Cause-and-effect diagrams have unlimited applications in research and other operations
  - (c) Cause and effect diagrams customizes existing and proposed operations as per the customer demand
  - (d) Cause-and-effect diagrams eliminate conditions causing nonconformities and customer complaints
  - (e) Cause-and-effect diagrams helps to find the alternatives for more efficient use of resources.
28. Which of the following categories of costs is **associated** with the costs incurred to translate customer and user needs into reliable quality standards and requirements and to manage the quality of new product or service developments prior to the release of authorized documentation for initial production?
- (a) External appraisal costs of new product/service design
  - (b) Preventive costs of design and development
  - (c) Manufacturing appraisal costs
  - (d) Retrofit and recall costs
  - (e) Internal failure costs of design and development.
29. In 'Quality Function Deployment' (QFD), which of the following is a **most** suitable method for collecting and organizing the information?
- (a) Interrelationship diagram
  - (b) Cause-and-effect diagram
  - (c) Affinity diagram
  - (d) Tree diagram
  - (e) Matrix diagram.
30. Organizations can improve team performance by understanding and recognizing the **stages** in the life cycle of teams. In which of the following **stages** of team development process, members become aware of the boundaries of acceptable behavior?
- (a) Adjourning
  - (b) Performing
  - (c) Norming
  - (d) Storming
  - (e) Forming.

**END OF SECTION A**

Section B : Problem/Caselets (30 Marks)

- The section consists of questions with total marks of 30.
- Answer all questions.
- Marks are indicated against each question.
- Students with registration number from 1001 to 1005 are exempted from this section.
- The total time for this section is 120 minutes or 2 hours.

Question 1: Read the following information from the caselet and answer the questions that follow. The marks are indicated against each question.

Year	Net Profit (₹)
2007	100
2008	120
2009	150
2010	180
2011	200
2012	220
2013	250
2014	280
2015	300

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## Sections B&C

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Read the following information based on the given caselet.

Caselet: The business of a company is growing rapidly. The company has been successful in the market for the last few years. The company has a strong reputation and a loyal customer base. The company has a wide range of products and services. The company has a strong financial position and a high level of profitability. The company has a strong management team and a clear vision for the future. The company has a strong commitment to quality and customer service. The company has a strong focus on innovation and research and development. The company has a strong presence in the market and a high level of brand awareness. The company has a strong track record of success and a high level of customer satisfaction. The company has a strong reputation for reliability and integrity. The company has a strong commitment to social responsibility and environmental sustainability. The company has a strong focus on employee development and training. The company has a strong culture of innovation and creativity. The company has a strong focus on customer feedback and continuous improvement. The company has a strong presence in the market and a high level of brand awareness. The company has a strong track record of success and a high level of customer satisfaction. The company has a strong reputation for reliability and integrity. The company has a strong commitment to social responsibility and environmental sustainability. The company has a strong focus on employee development and training. The company has a strong culture of innovation and creativity. The company has a strong focus on customer feedback and continuous improvement.



## Section B : Problem/Caselets (50 Marks)

- This section consists of questions with serial number 1 – 5.
- Answer all questions.
- Marks are indicated against each question.
- Detailed workings/explanations should form part of your answer.
- Do not spend more than 110 - 120 minutes on Section B.

1. Konark & Sons Ltd., received consignment from China, which was inspected by the quality control department of the company. The inspection results are given below:

Sample No.	No. of defectives
1	225
2	230
3	216
4	241
5	235
6	222
7	280
8	206
9	237
10	205

You are **required** to determine central line and trial control limits for p-chart and np-chart. (**Note:** Each sample consists of 500 items) ( 10 marks)

### Caselet 1

Answer the following questions based on the given Caselet:

2. Compare the traditional quality assurance method followed by western countries and the quality approaches followed by Nissan. (10 marks)
3. Discuss the initiatives taken by Nissan for maintaining quality assurance at supplier's end. (10 marks)

Nissan Motor Manufacturing (NMUK) Limited commenced vehicle manufacturing in 1986, and progressively increased the level of local component content with a policy of developing a long-term relationship with its chosen suppliers. In order to progress towards the goal of 'Total Quality Management', a good starting point would be to adopt a role-reversal attitude. This is where the customer adopts the role of supplier. This can be difficult for the customer, as he is used to and familiar with the supplier pandering to his every whim and desire. Remember the old saying 'The customer is always right'. When the customer adopts the role of supplier, he required to consider the information of product delivery, quality and cost. This information is the foundation upon which the successful supplier will build to try and achieve the customer's targets and satisfy their needs.

'Pre-Production Quality Assurance' (PPQA) is a well-defined method utilized by both supplier and customer within Nissan, Japan. The 'Pre-Production Quality Assurance' process commences at the very earliest stage of a project and continues through into a monitoring situation at Start of Production. The ultimate

target of PPQA is to achieve a fully developed vehicle by start of production. The individual elements of the PPQA method are not new or unknown in the West. As a part of PPQA, the company focuses on total company involvement and it pays attention to detail the procedure requirements. Within NMUK, quality assurance is only one of the members of the PPQA team. Design, Purchase and Process Engineering are all key members. Likewise the supplier to NMUK is also expected to develop the team approach to component development. PPQA team uses tools such as Preparatory Analysis, which is a refined version of the familiar Failure Mode and Effect Analysis, Specification Requirement Tables, Development History Logs, Capability Summaries etc. As an example, the NMUK preparatory analysis system considers two aspects. The company first look into the previous history of similar products and processes, as it is very inefficient to have to keep re-inventing the wheel for each new component. It is necessary to carry over the 'know how' from product to product. In the next step of the preparatory analysis, the executives analyze the new product and address the potential failures. And new processes or new manufacturing technology will be carefully considered by the team. New materials will be given special consideration and treated with caution. The Company requires all NMUK suppliers to address these elements. Nissan uses PPQA with their suppliers throughout the development period of both product and process. The company pre-plans key events into the development period, bench marks that the supplier is totally aware of and monitor both the suppliers progress and their own towards the joint targets.

At Nissan the design changes that take place during the product development period occur earlier than when directly compared with the typical western development program—with a target of no further changes after start of production. Every western company whether related to the motor industry or not has experienced late product launches or late design/process changes because of unplanned or unforeseen occurrences. It is a fact that several customers still refuses to purchase a newly released vehicle. Their feeling is that the vehicle is still being developed after launch, and he has no desire to be an unpaid test driver, and the motor manufacturer can 'sort the bugs out at their own expense'. This is a terrible indictment of the industry, but a very real one. To move forward the Company must have a clear understanding of the present situation and where it wants to be in the future. If it considers reasons for the vast number of late changes during the development stage, one is the traditional concept of customer based product development, where the principal designer is the customer and the product development is carried out for satisfying the customer requirements. Nissan recognized the whole chain of customers from the design department; the production engineering department who must develop the facilities and methods to ensure efficient use of the product, the quality assurance departments who must confirm the support facilities and perhaps the most important, the production department who must prepare and train for the new product. For example, the traditional quality control approach is that parts are evaluated as 'initial samples' and this generally within a couple of weeks of volume supply and the initial samples were rejected for one reason or another. With this situation the production department is not given any opportunity to contribute on the suitability of the product until production commences, by then of course it is too late. The people in the West and especially within the 'UK' think of themselves as a nation of 'doers', minimizing the planning stage, believing it to be an unnecessary burden on the

resources. It can be said that the 'doing' element takes approximately the same amount of time whether planning was conducted or not. As the process progresses through the 'checking stage' more unforeseen circumstances are revealed, rather like the initial samples. Finally the 'action stage' instead of being fine-tuning, becomes an area of fire-fighting and crisis management. The question is how to avoid the pitfalls that lead to the fire-fighting mode. To answer the question, Pre Production Quality Assurance (PPQA) is the method adopted by NMUK and is the basis for many of the company's development procedures. Nissan's PPQA activities are also extended to its suppliers. Nissan Motor's supplier quality assurance activity is divided into three major categories, i.e., planning for what is to come, the dynamic, in-production period, continuous improvement. Nissan attempts to take the mystique out of the concept of quality. Experience has shown that the more down-to-earth and tangible the requirements are the more easily understood they become and the more successful their implementation. Nissan maintained strict agreement policies with its suppliers. Nissan's policy is 'agreeing a standard—and sticking to it'. The planning stage of activities preparation is steered through a project management system with Pre-Production Quality Assurance activity (PPQA). In this stage PPQA team develops the benchmarks and convinces its suppliers to follow them. At the start of a project, new suppliers to NMUK are given an explanation of PPQA activity. The content of this explanation is generally found to be straightforward, logical and not at all revolutionary. The suppliers are explained the elements associated to the success of the project. The company clearly defines the content of the items involved in the project. It lists out the members from both customer and the supplier that play specific roles in the overall project. Test methods are clarified to the suppliers. Preparatory Analysis of the supplier's firm combines the experience gained from previous similar projects with the predictions of potential areas of suppliers, considering such items as function, material content, and manufacturing technology and their fitness for quality assurance activities. The capability study helps Nissan to understand the level of process variation. The company uses process sequence charts to understand the detailed step-by-step manufacturing process and control points. Quality assurance standards set by the company helps to resolve any areas of ambiguity which may occur within the technical specification. During the course of the PPQA activity, it helps suppliers to conduct trial runs and assesses the development of the process. During these trials the Deming cycle principle is followed by the company. It is planned to prepare for the trial and ensures the involvement of appropriate customers, i.e. all personnel involved in the final use of the product are in attendance. Then the trials are conducted as planned. The PPQA group analyses the results and takes necessary action by implementing the changes. Problems must be seen as an opportunity to improve and not a cause for recrimination. 'Zero defects' as a concept can only approach reality in an environment of competence and trust. At Nissan much emphasis is placed on the effectiveness of supplier training programs for both on-the-job and off-the-job training. On-the-job training teaches the essential skills for satisfying the main task; off-the-job training broadens horizons and addresses such items as team work, inter-personal relationships, leadership, as well as statistical and technical issues.

END OF CASELET 1

## Caselet 2

Answer the following questions based on the given Caselet:

4. A prime reason for the success of United Technologies' waste reduction project was employee involvement in planning and implementing the waste reduction projects. In this context, discuss how employee involvement helped the company to achieve success in waste reduction project. (10 marks)
5. United Technologies' waste reduction success was based on quality council's suggestions. With respect to the caselet, discuss quality council and explain its duties. (10 marks)

At a time when waste disposal costs skyrocketed for most manufacturers, a western Michigan automotive supplier decreased annual plant disposal costs by almost 50 percent. Aggressive waste reduction projects at the Holland Plant of United Technologies Automotive Engineered Systems Division (formerly Sheller-Globe Corporation) reduced the costs of disposing of production and office wastes from \$25,900 in 1986 to \$1,36,700 in 1987. A prime reason for the success was employee involvement in planning and implementing the waste reduction projects. According to Mel Schaub, recycling coordinator for the United Technologies' Holland Plant and three nearby plants, "With the direct assistance of our employees, waste disposal loads have been reduced 90 percent over the past two years. Now we are trying to reduce the remaining 10 percent to less than 1 percent."

The first waste reduction project was the recycling of approximately 5,000 pounds per month of office paper. The employees discovered a ready market for 'mixed' office paper, which included most types and grades of paper and which accounted for 15 percent by volume of solid wastes being land filled. Arrangements were made for pickup of collected paper twice each week by Lubbers Resource Systems, Inc., Grand Rapids, which assisted in setting up the collection system, including supplying a dumpster. Although no money has been received for the paper, approximately \$150 a month has been saved in disposal charges.

A unique feature of this project was the construction of a round chute from the office collection center to the dumpster positioned directly beneath in the shipping area one floor below. Office paper is conveniently and efficiently accumulated in the dumpster with little handling. In fact, a paper shredder was mounted over the chute to ensure confidentiality. Following the successful office paper recycling effort, new projects were implemented to end the disposal of cardboard, damaged wooden pallets, scrap metals from maintenance operations and plastic shrink wrap. Recycling of cardboard reduced waste disposal volume by 10 percent, while collectively, the recycling of pallets, scrap metals and plastic accounted for another 10 percent reduction. In addition to reduced disposal costs, payment has been received from the sale of cardboard and scrap metal. Revenues have been used for employee education and recreation programs.

The most challenging waste reduction project soon followed. A primary product line of the Holland Plant has been compression- formed heat barriers and noise reduction pads for automobile bodies and engines. The elimination or reduction of this waste, however, became a major priority because it accounted for 55 percent of the original waste. Some success had been achieved in reusing mastic with

small quantities of foam contamination. The need to economically separate the materials into separate foam and mastic fractions was clear. Soon, a process for granulating the scrap and separating the materials with a cyclone was developed. A market for the finely-cut foam particles was established. The investment of approximately \$40,000 in the new process was paid back in less than four months of operation.

In addition to these major waste reduction projects, the company has implemented several small profit-building practices suggested by employees. Returnable containers are used to ship product, saving packaging costs. Recycled paper is used for most office correspondence. Currently, a project is underway to redesign the faucets on solvent drums for more efficient shutoff, eliminating overflowing and dripping when liquids are withdrawn.

United Technologies' waste reduction successes began as quality council suggestions. Quality council, consisting of six to eight employees, meets for one hour each week to review plant operating concerns. The council may consider any aspect of operations, except for confidential areas such as payroll. 'Brainstorming' sessions serve to identify or itemize problem areas. No suggestion is dismissed as being insignificant. Next, the problems are ranked based upon concerns for worker safety, product quality and cost and overall operating efficiencies, for example. The third step in the planning process is 'data gathering' for the top-rated problems. A 'fishbone' type of chart has served as a useful tool for displaying the elements of a problem, including interrelationships of operations. The final step of the quality council procedure is to develop and present a proposal to company management for support of the plan and authorization of needed resources. "Management has rejected very few of our suggestions," says Schaub, "even though some of the ideas have required relatively large appropriations. The enthusiastic support of management has certainly helped our projects to be successful." Interestingly, the presentations to management are videotaped so as to help develop the proposal-making skills of the presenters.

Plant personnel suggest that companies wishing to reduce disposal costs through waste reduction should encourage participation by their employees in planning and implementation. In general, employees want to make their companies financially strong for job security. Furthermore, they have concerns on pollution of air, water and land. Joe Schrader, Manger, Human Resources said, "The thinking and resourcefulness of our employees have resulted in substantial cost savings to the company. And, they have a feeling of satisfaction that they have made a contribution to a cleaner environment."

END OF CASELET 2

END OF SECTION B

### Section C : Applied Theory (20 Marks)

- This section consists of questions with serial number 6 - 7.
- Answer all questions.
- Marks are indicated against each question.
- Do not spend more than 25 - 30 minutes on Section C.

6. Organizations focusing on customer service to win and retain customer satisfaction. In this regard, discuss the elements of customer service. (10 marks)
7. House of quality is a primary tool used in quality function deployment that helps managers in meeting the customer requirements. Describe a house of quality and discuss the steps involved in building a house of quality. (10 marks)

**END OF SECTION C**

**END OF QUESTION PAPER**