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1 OPERATIONS MANAGEMENT - INTRODUCTION

Q1. 'Operations management is responsible for producing goods & services.' In this context, define 'Operating System' & state the principal functions of an operating system. **[June 2016 & Dec 2015 - 5 Marks]**

Answer:

An Operating System is defined as a configuration of resources, combined for the provision of goods or services.

The function of an operating system reflects the purpose it serves for its customers. The following four principal functions identified below also relate to the basic four operations done in any organization:

1	**Manufacture**	Manufacturing function is the one which involves some physical transformation, or a change in the form utility of the resources. Something is physically created & the output consists of goods which differ physically (e.g. in terms of form, content etc.) from those materials input to the system.
2	**Transport**	This function of operating system provides a change in the place utility of something or someone in order to satisfy customer. The customer, or something belonging to the customer, is moved from place to place & thus results in the change in location. There is no major change in the form of resources.
3	**Supply**	This function provides a change in the possession utility of a resource, i.e., the ownership or possession of goods in changed. Unlike manufacture, outputs of the system are physically same as the inputs.
4	**Service**	This function primarily results in a change in the state utility of a resource. The principal common characteristic is the treatment or accommodation of something or someone. The state or condition of the physical outputs will differ from the inputs as they have undergone same kind of treatment.

Q2. List categories of processes in a production system. **[Dec 2016 - 2 Marks]**

Answer: Basically, processes can be categorised as:

(a) Conversion processes: i.e., converting the raw materials into finished products (for example, converting iron ore into iron & then to steel). The conversion processes could be metallurgical or chemical or manufacturing or construction processes.

(b) Manufacturing processes: Can be categorised into (a) Forming processes, (b) Machining processes & (c) Assembly processes.

(c) Testing processes: Which involve inspection & testing of products (sometimes considered as part of the manufacturing processes.)

Q3. 'An important objective of Operations Management is Resource Utilization'. Enumerate also list the scope of Operations Management. **[June 2017 - 6 Marks]**

Answer:

- Another major objective is to utilize resources for the satisfaction of customer wants effectively, i.e., customer service must be provided with the achievement of effective operations through efficient use of resources. Inefficient use of resources or inadequate customer service leads to commercial failure of an operating system.
- Operations management is concerned essentially with the utilization of resources, i.e., obtaining maximum effect from resources or minimizing their loss, underutilization or waste. The extent of the utilization of the resources' potential might be expressed in terms of the proportion of available time used or occupied, space utilization, levels of activity, etc. Each measure indicates the extent to which the potential or capacity of such resources is utilized. This is referred as the objective of resource utilization.
- Operations management is also concerned with the achievement of both satisfactory customer service & resource utilization. An improvement in one will often give rise to deterioration in the other. Often both cannot be maximized, & hence a satisfactory performance must be achieved on both objectives.
- All the activities of operations management must be tackled with these two objectives in mind, & many of the problems will be faced by operations managers because of this conflict. Hence, operations managers must attempt to balance these basic objectives.

Scope of Operation Management

Operations Management concern with the conversion of inputs into outputs, using physical resources, so as to provide the desired utilities to the customer while meeting the other organizational objectives of effectiveness, efficiency & adoptability. It distinguishes itself from other functions such as personnel, marketing, finance, etc. by its primary concern for 'conversion by using physical resources'.

Following are the activities, which are listed under Production & Operations Management functions:

(a) Location of facilities

(b) Plant layouts & Material Handling

(c) Product Design

(d) Process Design

(e) Production & Planning Control

(f) Quality Control

(g) Materials Management

(h) Maintenance Management

Q4. Briefly explain the characteristics of the modern production system. **[Dec 2017 & Dec 2019 - 7 Marks]**

Answer: The production management of today presents certain characteristics which make it look totally different from what it was during the past as follows:

(a) Manufacturing as Competitive Advantage: In the past production was considered to be like any other function in the organisation. When the demand was high & production capacities were inadequate, the concern was to somehow muster all inputs & use them to produce goods which would be grabbed by market. But today's scenario is contrasting. Plants have excess capacities, competition is mounting & firms look & gain competitive advantage to survive & succeed. Production system offers vast scope to gain competitive edge & firms intend to exploit the potential. Total Quality Management (TQM), Time-Based Competition, Business Process Re-engineering (BPRE), Just-in-Time (JIT), Focused Factory, Flexible Manufacturing Systems (FMS), Computer Integrated Manufacturing (CIM), & The Virtual Corporation are some techniques which the companies are employing to gain competitive advantage.

(b) Services Orientation: Service sector is gaining greater relevance these days. The production system, therefore, needs to be organised keeping in mind the peculiar requirements of the service component. The entire manufacturing needs to be geared to serve (i) intangible & perishable nature of the services, (ii) constant interaction with clients or customers, (iii) small volumes of production to serve local markets, & (iv) need to locate facilities to serve local markets. There is increased presence of professionals on the production, instead of technicians & engineers.

(c) Disappearance of Smokestacks: Protective labour legislation, environmental movement & gradual emergence of knowledge-based organisations have brought total transformation in the production system. Today's factories are aesthetically designed & built, environment friendly - in fact, they are homes away from homes. Going to factory every day is no more excruciating experience, it is like holidaying at a scenic spot.

(d) Small has Become Beautiful: It was E.F. Schumacher who, in his , famous book Small is Beautiful, opposed giant organisations & increased specialisation. He advocated instead, intermediate technology based on smaller working units, community ownership, & regional workplaces utilising local labour & resources. For him, small was beautiful. Businessmen, all over the world, did not believe in Schumacher's philosophy. Inspired by economies of scale, industrialists went in for huge organisations & mass production systems.

Q5. Categorise the objectives of operations management & discuss about each category. **[June 2018 - 6 Marks]**

Answer: Operations management is also concerned with the achievement of both satisfactory customer service & resource utilization. An improvement in one will often give rise to deterioration in the other. Often both cannot be maximized, & hence a satisfactory performance must be achieved on both objectives. All the activities of operations management must be tackled with these two objectives in mind, & many of the problems will be faced by operations managers because of this conflict. Hence, operations managers must attempt to balance these basic objectives.

- **Resource Utilization** Another major objective is to utilize resources for the satisfaction of customer wants effectively, i.e., customer service must be provided with the achievement of effective operations through efficient use of resources. Inefficient use of resources or inadequate customer service leads to commercial failure of an operating system. Operations management is concerned essentially with the utilization of resources, i.e., obtaining maximum effect from resources or minimizing their loss, underutilization or waste. The extent of the utilization of the resources' potential might be expressed in terms of the proportion of available time used or occupied, space utilization, levels of activity, etc. Each measure indicates the extent to which the potential or capacity of such resources is utilized. This is referred as the objective of resource utilization.

- **Customer Service** an operations objective reflects how fast the firm can respond to customer requests. The more enhanced operations cycles, the faster the firm can respond, the higher customer satisfaction then the more likely they will buy again. The aim is to speed up response, ensure dependability of delivery, & reduce costs through minimizing total inventory across the whole system. Fast operations cycles reduce the time between customer request & product delivery & hence increase the overall revenue of the firm.

Q6. Explain concept of operating system in order to have a clear idea of operations management. **[Dec 2018 - 6 Marks]**

Answer:

- In order to have a clear idea of Operations Management, one must have an idea of 'Operating Systems'.
- An Operating System is defined as a configuration of resources combined for the provision of goods or services.
- Retail organizations, hospitals, bus & taxi services, tailors, hotels & dentists are all examples of operating systems. Any operating system converts inputs, using physical resources, to create outputs, the function of which is to satisfy customers wants. The creation of goods or services involves transforming or converting inputs into outputs.
- Various inputs such as capital, labour, & information are used to create goods or services using one or more transformation processes (e.g., storing, transporting, & cutting). To ensure that the desired output is obtained, an organization takes measurements at various points in the transformation process (feedback) & then compares with them with previously established standards to determine whether corrective action is needed (control).
- It is important to note that goods & services often occur jointly. For example, having the oil changed in your car is a service, but the oil that is delivered is a good. Similarly, house painting is a service, but the paint is a good.
- The goods-service combination is a continuum. It can range from primarily goods, with little service, to primarily service, with few goods. Because there are relatively few pure goods or pure services, companies usually sell product packages, which are a combination of goods & services. There are elements of both goods production & service delivery in these product packages. This makes managing operations more interesting, & also more challenging.

Q7. List down various activities lying under Production & Operations Management function. **[June 2019 - 6 Marks]**

Answer: Various Activities lying under Production & Operations Management functions:

(a) Location of Facilities.
(b) Plant layouts & Material Handling.
(c) Product Design.
(d) Process Design.
(e) Production Planning & Control.
(f) Quality Control.
(g) Materials Management.
(h) Maintenance Management.

Q8. Enumerate what are the Activities which are listed under the production & Operations Management functions. **[Dec 2022 - 4 Marks]**

Answer: Following are the activities, which are listed under Production & Operations Management functions:

1. Location of Facilities:

- Plant location may be understood as the function of determining where the plant should be located for maximum operating economy & effectiveness.
- The selection of a place for locating a plant is one of the problems, perhaps the most important, which is faced by an entrepreneur while launching a new enterprise.
- A selection on pure economic considerations will ensure an easy & regular supply of raw materials, labour force, efficient plant layout, proper utilization of production capacity & reduced cost of production. An ideal location may not, by itself, guarantee success; but it certainly contributes to the smooth & efficient working of an organisation.
- A bad location, on the other hand, is a severe handicap for any enterprise & it finally bankrupts it. It is, therefore, very essential that utmost care should be exercised in the initial stages to select a proper place. Once a mistake is made in locating a plant it becomes extremely difficult & costly to correct it.

2. Plant layouts & Material Handling:

- Plant Layout, also known as layout of facility refers to the configuration of departments, work-centres & equipment & machinery with focus on the flow of materials or work through the production system.

- Plant layout or facility layout means planning for location of all machines, equipment's, utilities, work stations, customer service areas, material storage areas, tool servicing areas, tool cribs, aisles, rest rooms, lunch rooms, coffee/tea bays, offices, & computer rooms & also planning for the patterns of flow of materials & people around, into & within the buildings.
- Layout planning involves decisions about the physical arrangement of economic activity centres within a facility. An economic activity centre can be anything that consumes space, a person or group of people, a machine, a work station, a department, a store room & so on. The goal of layout planning is to allow workers & equipment's to operate more effectively.

3. **Product Design:** Production or operations strategy is directly influenced by product design for the following reasons:
   (a) As products are designed, all the detailed characteristics of each product are established.
   (b) Each product characteristic directly affects how the product can be made or produced (i.e., process technology & process design)
   (c) How the product is made determines the design of the production system (production design) which is the heart of production & operations strategy.

   Further, product design directly affects product quality, production costs & customer satisfaction. Hence, the design of product is crucial to success in today's global competition. A good product design can improve the marketability of a product by making it easier to operate or use, upgrading its quality, improving its appearance, &/or reducing manufacturing costs. A distinctive design may be the only feature that ' significantly differentiates a product. An excellent design includes usability, aesthetics, reliability, functionality, innovation & appropriateness. An excellent design provides competitive advantage to the manufacturer, by ensuring appropriate quality, reasonable cost & the expected product features. Firms of tomorrow will definitely compete not on price & quality, but on product design.
4. **Process Design:** Process Design is concerned with the overall sequences of operations required to achieve the product specifications. It specifies the type of work stations to be used, the machines & equipment's necessary to carry out the operations. The sequence of operations is determined by:
   (a) The nature of the product.
   (b) The materials used.
   (c) The quantities to be produced.
   (d) The existing physical layout of the plant.
5. **Production Planning & Control:**
   - The ultimate objective of production planning & control is to contribute to the profits of the enterprise. This is accomplished by keeping the customers satisfied through the meeting of delivery schedules.
   - Further, the specific objectives of production planning & control are to establish the routes & schedules for work that will ensure the optimum utilization of raw materials, labourers, & machines to provide the means for ensuring the operation of the plant in accordance with these plans. Production planning & control is essentially concerned with the control of work-in-process. To control work-in-process effectively it becomes necessary to control not only the flow of material but also the utilization of people & machines.
6. **Quality Control:** Timely execution of orders will be meaningful when the quality of the output is not below expectations. To ensure quality, inspection should be conducted at different stages of manufacture. An ideal layout provides ample space to carryout inspection to ensure better quality control.
7. **Materials Management:** Materials management is a core function of supply chain management, involving the planning & execution of supply chains to meet the material requirements of a company or organisation. The primary purpose of materials management is to ensure that manufacturers have all the raw materials they need to make goods. Materials management also focuses on ensuring that no components are wasted & optimizing inventory maintenance & management.
8. **Maintenance Management:** Maintenance management can be defined as the process of maintaining a company's assets & resources & its main objectives are controlling costs, controlling time, managing resources & ensuring regulatory compliance. It helps companies maintain their resources while controlling time & costs to ensure maximum efficiency of the manufacturing process, the utilities & related facilities.

Q9. Recent trends in production/operations management relate to Global Competition & the impact it has on manufacturing firms. In this context list down what are the recent trends in production/operations management.

[Dec 2022 & 2023 - 7 Marks]

Answer: Recent trends in production/operations management relate to global competition & the impact it has on manufacturing firms. Some of the recent trends are :

1. **Global Market Place :** Globalization of business has compelled many manufacturing firms to have operations in many countries where they have certain economic advantage. This has resulted in a steep increase in the level of competition among manufacturing firms throughout the world.
2. **Production/Operations Strategy:** More & more firms are recognizing the importance of production/ operations strategy for the overall success of their business & the necessity for relating it to their overall business strategy.
3. **Total Quality Management (TQM):** TQM approach has been adopted by many firms to achieve customer satisfaction by a never-ending quest for improving the quality of goods & services.
4. **Flexibility :** The ability to adapt quickly to changes in volume of demand, in the product mix demanded, & in product design or in delivery schedules, has become a major competitive strategy & a competitive advantage to the firms. This is sometimes called as agile manufacturing.
5. **Time Reduction :** Reduction of manufacturing cycle time & speed to market for a new product provide competitive edge to a firm over other firms. When companies can provide products at the same price & quality, quicker delivery (short lead times) provide one firm competitive edge over the other.
6. **Technology :** Advances in technology have led to a vast array of new products, new processes & new materials & components. Automation, computerization, information & communication technologies have revolutionized the way companies operate. Technological changes in products & processes can have great impact on competitiveness & quality, if the advanced technology is carefully integrated into the existing system.
7. **Worker Involvement :** The recent trend is to assign responsibility for decision making & problem solving to the lower levels in the organisation. This is known as employee involvement & empowerment. Examples of worker involvement are quality circles & use of work teams or quality improvement teams.
8. **Re-engineering :** This involves drastic measures or break-through improvements to improve the performance of a firm. It involves the concept of clean-slate approach or starting from scratch in redesigning the business processes.
9. **Environmental Issues :** Today's production managers are concerned more & more with pollution control & waste disposal which are key issues in protection of environment & social responsibility. There is increasing emphasis on reducing waste, recycling waste, using less-toxic chemicals & using biodegradable materials for packaging.
10. **Corporate Downsizing (or Right Sizing):** Downsizing or right sizing has been forced on firms to shed their obesity. This has become necessary due to competition, lowering productivity, need for improved profit & for higher dividend payment to shareholders.
11. **Supply-Chain Management:** Management of supply-chain, from suppliers to final customers reduces the cost of transportation, warehousing & distribution throughout the supply chain.
12. **Lean Production:** Production systems have become lean production systems which use minimal amounts of resources to produce a high volume of high-quality goods with some variety. These systems use flexible manufacturing systems & multi-skilled workforce to have advantages of both mass production & job production (or craft production).

Q10. List down various major decision areas under Production & Operations management.(Any 10)**[June 2023 - 5 Marks]**

Answer:

1. Product selection
2. Facility Location selection
3. Demand Forecasting
4. Process selection & Layout decision
5. Capacity planning
6. Aggregate Planning, Master Production Schedule
7. MRP/MRP 1/DRP/ERP
8. Inventory Management
9. Supplier Selection/Sourcing
10. Process Management
11. Quality Management

12. Maintenance
13. Warehousing/Transportation
14. Reverse Logistics
15. Working Capital Management
16. Skill Management

Q11. "The Production Management of To-day presents certain characteristics which make it look totally different from what it was during the past. Specifically, To-day's production system is characterized by at least Four Features". In this Context Summarize the Said Features. **[June 2024 – 7 Marks]**

Answer: Today's production system is characterized by the following features as discussed below:

1. **Manufacturing as Competitive Advantage:**

   Unlike the past, today plants have excess capacities, competition is mounting & firms look & gain competitive advantage to survive & succeed. Production system offers vast scope to gain competitive edge & firms intend to exploit the potential. Total Quality Management, Time-Based Competition. Business Process Re-engineering (BPRE), Just-in-Time. Focused Factory, Flexible Manufacturing Systems, Computer Integrated Manufacturing & the Virtual Corporation are but only some techniques which the companies are employing to gain competitive advantage.

2. **Services Orientations:**

   Service sector is gaining greater relevance these days. The production system, therefore, needs to be organized keeping in mind the peculiar requirements of the service component. The entire manufacturing to be geared to serve (a) intangible & perishable nature of the services, (b) constant interaction with clients or customers, (c) small volumes of production to serve local markets, & (d) need to locate facilities to serve local markets.

3. **Disappearance of Smokestacks:**

   Protective labour legislation, environmental movement & gradual emergence of knowledge-based organizations have brought total transformation in the production system. Today's factories are aesthetically designed & built, environment friendly - in fact, they are homes away from homes. Going to factory every day is no more excruciating experience, it is like holidaying at a scenic spot.

4. **Small has Become Beautiful:**

   E.F. Schumacher, in his famous book Small is Beautiful, opposed giant organizations & increased specialization. He advocated, instead, intermediate technology based on smaller working units, community ownership, & regional workplaces utilizing local labor & resources. For him small was beautiful. Businessmen, all over the world, did not believe in Schumacher's philosophy. Inspired by economies of scale, industrialists went in for huge organizations & mass production systems.

2 OPERATIONS PLANNING

Q. Write a short note on the following concepts:

Q1	Aggregate Planning [Dec 21 – 3 Marks]
Ans	▪ It is an intermediate-term planning decision. It is the process of planning the quantity & timing of output over the intermediate time horizon (3 months to 1 year). ▪ Within this range, the physical facilities are assumed to be fixed for the planning period. Therefore, fluctuations in demand must be met by varying labour & inventory schedule. ▪ Aggregate planning seeks the best combination to minimise costs. It is called "Aggregate Planning" because the demand on facilities & available capacities is specified in aggregate quantities. ▪ For Instance, aggregate quantities of number of Automobile vehicles, Aggregate number of soaps etc. Intermediate Planning or Aggregate Planning, which is in between long range & short-term planning, which is concerned in generally acceptable planning, taking the load on hand & the facilities available into considerations. ▪ In aggregate planning the management formulates a general strategy by which capacity can be made to satisfy demand in a most economical way during a specific moderate time period, say for one year.

Q2. What do you mean by 'layout' in production planning system? Name various types of layout. **[June 15 - 6 Marks]**

Answer: Layout: A plant layout refers to the arrangement of machinery, equipment & other industrial facilities - such as receiving & shipping departments, tools rooms, maintenance rooms, employee amenities, etc., for the purpose of achieving the quickest & smoothest production at the least cost.

Types of Layout:

(a) Process layout.
(b) Product layout.
(c) Fixed position layout.
(d) Cellular Manufacturing (CM) layout.
(e) A combination of the above.

Q3. Briefly explain various methods of sales forecasting. **[June 17 - 10 Marks]**

Answer: Methods or techniques of sales forecasting: Different authorities on marketing & production have devised several methods or techniques of sales or demand forecasting. The sales forecasts may be result of what market people or buyers say about the product or they may be the result of statistical & quantitative techniques. The most common methods of sales forecasting are:

1. **Survey of buyer's inventions or the user's expectation method:** Under this system of sales forecasting actual users of the product of the concern are contacted directly & they are asked about their intention to buy the company's products in an expected given future usually a year. Total sales forecasts of the product then estimated on the basis of advice & willingness of various customers. This is most direct method of sales forecasting.

   The chief advantages of this method are:

   (a) Sales forecast under this method is based on information received or collected from the actual users whose buying actions will really decide the future demand. So, the estimates are correct.
   (b) It provides a subjective feel of the market & of the thinking behind the buying intention of the actual uses. It may help the development of a new product in the market.
   (c) This method is more appropriate where users of the product are numbered & a new product is to be introduced for which no previous records can be made available.
   (d) It is most suitable for short-run forecasting.

2. **Collective opinion or sales force composite method:** Under this method, views of salesmen, branch manager, area manager & sales manager are secured for the different segments of the market. Salesmen, being close to actual users are required to estimate expected sales in their respective territories & sections. The estimates of individual salesmen are then consolidated to find out the total estimated sales for the coming session. These estimates are then further examined by the successive executive levels in the light of various factors like proposed changes in product design, advertising & selling prices, competition etc. before they are finally emerged for forecasting.

3. **Group executive judgement or executive judgement method:** This is a process of combining, averaging or evaluating, in some other way, the opinions & views of top executives. Opinions are sought from the executives of different fields i.e. marketing; finance; production etc. & forecasts are made.
4. **Experts opinions:** Under this method, the organisation collects opinions from specialists in the field outside the organisation. Opinions of experts given in the newspapers & journals for the trade, wholesalers & distributors for company's products, agencies or professional experts are taken. By analysing these opinions & views. of experts, deductions are made for the company's sales, & sales forecasts are done.
5. **Market test method:** Under this method seller sells his product in a part of the market for sometimes & makes the assessment of sales for the full market on the bases of results of test sales. This method is quite appropriate when the product is quite new in the market or good estimators are not available or where buyers do not prepare their purchase plan.
6. **Trend projection method:** Under this method, a trend of company's or industry's sales is fixed with the help of historical data relating to sales which are collected, observed or recorded at successive intervals of time. Such data is generally referred to as time series.
7. **Moving average method:** This is another statistical method to calculate the trend through moving averages. It can be calculated as follows:

   An appropriate period is to be determined for which the moving average is calculated. While determining the period for moving averages, the normal cycle time of changes in the values of series should be considered so that short-term fluctuations are eliminated. As far as possible, the period for moving averages should be in odd numbers such as period of 3, 5 or 7 years. The period in even numbers will create a problem in centralising the values of averages. The calculated values of moving averages present the basis for determining the expected amount of sale.
8. **Criteria of a good forecasting method:** It cannot be said which method of sales forecasting is the best because everyone has merits & demerits of its own. The suitability of a method depends on various factors such as nature of the product, available time & past records, wealth & energy, degree of accuracy & the forecaster etc. of an enterprise.

Q4. Explain various factors to be considered while determining Economic Lot size for manufacturing. **[Dec 21 - 6 Marks]**

Answer:

(a) Usage rate: The rate of production of parts should match with the rate of usage of these parts in the assembly line.

(b) Manufacturing cost: Higher the lot size, lower will be the cost per unit produced because of distribution of set up costs for setting up production or machines & preparing paper work (production orders). But the carrying cost (handling & storing costs) will increase with increase in lot size.

(c) Cost of deterioration & obsolescence: Higher the lot size, higher will be the possibility of loss due to deterioration (items deteriorating)

Q5. Discuss with appropriate examples, various properties of aggregate planning. **[June 23 - 4 Marks]**

Answer:

(a) Both output & sales should be expressed in a logical overall unit of measuring. For example, an automobile manufacturing Company can say 1000 vehicles per year, without giving number of each variety of vehicle. Similarly, a paint industry can say 10000 litres of paint & does not mention quantities of each variety of colour.

(b) Acceptable forecast for some reasonable planning period, say one year.

(c) A method of identification & fixing the relevant costs associated with the plant. Availability of alternatives for meeting the objective of the organization.

(d) Ability to construct model that will permit to take optimal or near optimal decisions for the sequence of planning periods in the planning horizon.

(e) Facilities that are considered fixed to carry out the objective.

Q6. A solicitor's firm employs typists on hourly piece-rate basis for daily work. There are 4 typists & their charges & speed are different. It has been agreed that only one job will be given to one typist & the typist is paid for a full hour even when he works for a fraction of an hour. Find the least cost allocation for the following data: **[Dec 2013 - 10 Marks]**

Typist	Rate/hour	Number of pages typed/hour	Job	No. of pages
A	4	8	P	102
B	3	10	Q	135
C	5	11	R	110
D	3	9	S	85

Answer: Using given information, we first obtain the cost matrix, when different jobs are performed by different typists.

Total Cost Matrix

Typist	Job P	Job Q	Job R	Job S
A	$\frac{102}{8}$ = 12.75 i.e. 13 x 4 = 52	$\frac{135}{8}$ = 16.88 i.e. 17 x 4 = 68	$\frac{110}{8}$ =13.75 i.e. 14 x 4= 56	$\frac{85}{8}$ = 10.63 i.e.11 x 4 = 44
B	$\frac{102}{10}$ = 10.2 i.e. 11 x 3 = 33	$\frac{135}{10}$ = 13.5 i.e. 14 x 3 = 42	$\frac{110}{10}$ = 11 i.e. 11 x 3 = 33	$\frac{85}{10}$ = 8.5 i.e. 9 x 3 = 27
C	$\frac{102}{11}$ = 9.27 i.e. 10 x 5 = 50	$\frac{135}{11}$ = 12.27 i.e. 13 x 5 = 65	$\frac{110}{11}$ =10 i.e. 10 x 5 = 50	$\frac{85}{11}$ = 7.72 i.e. 8 x 5 = 40
D	$\frac{102}{9}$ = 11.33 i.e.12 x 3 = 36	$\frac{135}{9}$ = 15 i.e. 15 x 3 = 45	$\frac{110}{9}$ = 12.22 i.e.13 x 3 = 39	$\frac{85}{9}$ = 9.44 i.e. 10 x 3 = 30

On subtracting the minimum element of each row from all its elements, we obtain:

Reduced Cost Table 1

Typist	Job P	Job Q	Job R	Job S
A	8	24	12	0
B	6	15	6	0
C	10	25	10	0
D	6	15	9	0

On subtracting the minimum element of each column from all the elements, we obtain:

Reduced Cost Table 2

Typist	Job P	Job Q	Job R	Job S
A	2	9	12	0
B	0	0	0	0
C	4	10	4	0
D	0	0	0	0

Here, the minimum number of lines to cover all zeros is equal to 3, which is smaller than order 4, of the given matrix. The revised table is prepared by considering the least uncovered value, 2, & adjusting it with uncovered cell values & those lying at the intersection of lines.

Reduced Cost Table 3

Typist	Job P	Job Q	Job R	Job S
A	0	0	0	2
B	0	7	4	0
C	2	8	2	0
D	0	0	3	2

The minimum number of lines to cover all zeros equal 4, which matches with the order of the matrix. Assignment can be made as follows:

Typist	Job	Cost
A	P	52
B	Q	33
C	R	40
D	S	45
Total		**1,170**

Q7. If a firm sells 5000 units, its loss is Rs. 10,000. But if it sells 9000 units, its profit is Rs. 10,000. Calculate its
(a) Fixed Cost (b) BEP **[Dec 2013 - 2 Marks]**

Answer:

(a) Change in quantity of output = 9,000 – 5,000 = 4,000 units

Change in profit = Rs. 10,000 - (- Rs. 10,000) = Rs. 20,000

Unit contribution = $\frac{\text{Change in profit}}{\text{Change in output}} = \frac{20,000}{4,000}$ = Rs. 5

So, when output is 9,000 units

Total Contribution = Fixed cost + Profit = Rs.(5 x 9000) = Rs. 45,000 but given Profit, P = Rs. 10,000

Therefore, Fixed Cost = Total Contribution - Profit = Rs. 45,000 - Rs. 10,000 = Rs. 35,000

(b) Break-even point (units) = Fixed cost/Unit contribution = $\frac{35,000}{5}$ = 7,000 units

Q8. A steel plant has a design capacity of 50,000 tons of steel per day, effective capacity of 40,000 tons of steel per day & an actual output of 36,000 tons of steel per day. Compute efficiency of the plant & its utilisation. **[June 2014 - 2 Marks]**

Answer: Efficiency of the plant = $\frac{\text{Actual Output}}{\text{Effective Capacity}} = \frac{36,000}{40,000}$ x 100 = 90 %

Utilisation = $\frac{\text{Actual Output}}{\text{Design capacity}} = \frac{36,000}{50,000}$ x 100 = 72%

Q9. Two alternative set-ups, A & B are available for the manufacture of a component on a particular machine, where the operating cost per hour is Rs. 20.

Particulars	Set up A	Set up B
Components / Set up	4000 pieces	3000 pieces
Set up cost / year	Rs. 300	Rs. 1500
Production rate / hour	10 pieces	15 pieces

Which of these set-ups should be used for long range & economic production? **[June 2014 - 6 Marks]**

Answer : **Considering one. set-up.**

	Set-up A	Set-up B
Set up cost per year	Rs. 300/-	Rs. 1500/-
Operating hours / setup	$\frac{4,000}{10}$ = 400 hours	$\frac{3,000}{15}$ = 200 hours
Operating cost	400 x 20 = 78,000	200 x 20 = Rs. 4,000
Total manufacturing cost	300 + 8,000 = Rs. 8,300	1,500 + 4,000= Rs. 5,500
Manufacturing cost per piece	$\frac{8,300}{4,000}$ = Rs. 2.075	$\frac{5,5000}{3,000}$ = Rs. 1.8333

Assuming that the machine is used for production for one year having 2,000 lours of working. For annual production:

	Set-up A	Set-up B
No. of Set-ups	$\frac{2000}{400}$ = 5	$\frac{2000}{200}$ = 10
Setup cost per year	5 x 300 = 71,500	10 x 1,500 = Rs. 15,000
Nov of units produced per year	2,000 x 10 = Rs. 20,000	2,000 x 15 = Rs. 30,000
Total annual manufacturing cost	1,500 + 40,000 = Rs. 41,500	15,000 + 40,000 = Rs. 55,000
Total annual manufacturing cost	$\frac{8,300}{4,000}$ = Rs. 2.075	$\frac{5,500}{3,000}$ = Rs.1.8333

Since the manufacturing cost for set up B is less, use set up B for long range & economic production.

Q10. Monthly demand for a component is 1000 units. Setting up cost per batch is Rs. 120. Cost of manufacture per unit is Rs. 20. Rate of interest may be considered at 10% p.a. Calculate the EBQ. **[June 2014 - 2 Marks]**

Answer: Annual output = 1,000 units per month for 12 months = 48,000 units; Setup cost = 7,120

Annual Carrying cost (i.e., holding cost) of one unit of component for one year =10% of Rs. 20 = Rs. 2

Equation Batch Quantity (EBQ) = $\sqrt{\frac{2 \times \text{Annual output} \times \text{setup cost}}{\text{Annual cost of one unit}}} = \sqrt{\frac{2 \times 12{,}000 \times 120}{\text{Rs. } 2}}$

Q11. The following data on the exports of an item by a company during the various years fit a straight line, (for the time being, assume that, a straight line gives a good fit). Give a forecast for the years 2013 & 2014. **[June 2014 - 6 marks]**

Years	2004	2005	2006	2007	2008	2009	2010	2011	2012
No. of items	13	20	20	28	30	32	33	38	43

Answer: Let 'X' represent year & T represent export in order to use the normal equations for the least square line', we need; $\sum X$, $\sum y$, $\sum Xy$ & $\sum X^2$ .To simplify the calculation, arrange X in such a way that $\sum X=0$.

Therefore, we call the year 2008 as 0, 2007 as -1, & 2009 as +1 & likewise for the other years in the data. The rearrangement is shown in the table as follows:

X	Y	X	XY
-4	13	16	-52
-3	20	9	-60
-2	20	4	-40
-1	28	1	-28
0	30	0	0
1	32	1	32
2	33	4	66
3	38	114	-
4	43	16	172
$\sum X= 0$	$\sum Y = 257$	$\sum X^2=60$	$\sum Xy= 204$

The normal equations are:

Therefore, the equation of a straight line fitting the data is: Y =28.56 + 3.4 X

(a) Forecast for 2013, (i.e., X = 5): Y = 28.56 + 3.4(5) = 45.56

(b) Forecast for 2014, (i.e., X = 6): X = 28.56 + 3.4(6) = 48.96

Q12. XYZ manufacturing company planning to start its production activities has to decide on the location of the plant. Three locations are being considered:

Location A, B & C. The following data are available:

	Location A	Location B	Location C
Fixed costs (Rs. Lakhs per annum)	35	55	30
Variable cost (Rs. per annum)	350	250	400

The expected sales price of the product is Rs. 750 per unit. Find out:

(a) The range of annual production/sales volume for which each location is most suitable, &

(b) Which one of the three is the best location at the production/sales volume of 22,000 units?

Clearly mention the assumptions, if any. **[Dec 2014 – 8 Marks]**

Answer: (Amount in Lakh)

	Location A			Location B			Location C		
Units	**FC**	**VC**	**TC**	**FC**	**VC**	**TC**	**FC**	**VC**	**TC**
5,000	35	17.5	52.5	55	12.5	67.5	30	20	50

10,000	35	35.0	70.0	55	25.0	80.0	30	40	70
15,000	35	52.5	87.5	55	37.5	92.5	30	60	90
20,000	35	70.0	105.0	55	50.0	105.0	30	80	110
22,000	35	77.0	112.0	55	55.0	110.0	30	88	118
25,000	35	87.5	122.5	55	62.5	117.5	30	100	130

(a) Up to 10000 units most suitable location is **Location C.**
Between 10000 to 20000 units most suitable location is **Location A.**
Above 20000 units most suitable location is **Location B.**

(b) At a volume of production/sales of 22000 **Location B** is best to choose as it has least cost Rs. 110 lakh.

Q13. Calculate the number of components that can be produced in a month when available equipment hours are 480 per month, efficiency of utilization is 85%, & it takes 36 minutes of processing time in ' the equipment for each component. **[June 2015 - 2 Marks]**

Answer: Available equipment hour per month = 480 hours

If the utilization is 75% then number of hours worked = 480 x 0.85 = 408 hours.

Or = 24,480 Minutes

Number of components can be produced in a month = $\frac{24480}{36}$ = 680 Nos.

Q14. A department works on 8 hours shift, 288 days a year & has the usage data of a machine, as given below:

Product	Annual Demand (units)	Processing time (Standard time a hours)
A	325	5.0
B	450	4.0
C	550	6.0

Calculate (a) Processing time needed in hours to produce products A, B & C, (b) Annual production capacity of one machine in standard hours, & (c) Number of machines required., **[June 2015 -7 Marks]**

Answer:

Product	Annual demand(units)	Standard Processing time per unit (hrs.)	Processing time needed (hrs.)
A	325	5.0	325 x 5 = 1,625
B	450	4.0	450 x 4 = 1,800
C	550	6.0	550 x 6 = 3,300
			Total = 6,725

Annual production capacity of one machine in standard hours = 8 x 288 = 2,304 hours/year

Number of machines required = $\frac{\text{Work load per year}}{\text{Production capacity per machine}} = \frac{6,725}{2304}$ = 2.92 machines = 3 machines.

Q15. A department works on 8 hours per day, 250 days a year & has the usage data of a machine, as given below:

Product	Annual demand (units)	Processing time (standard time in hours)
X	200	4.0
Y	300	6.0
Z	400	3.0

Determine the number of machines required. **[June 2016 - 6 Marks]**

Answer:

Product	Annual demand (units)	Standard Processing Time in hours	Processing Time Needed (hours)
X	200	4.0	800
Y	300	6.0	1,800
Z	400	3.0	1,200
Total			**3,800**

Annual production capacity of one machine in standard hours = 8 x 250 = 2,000 hours per year

Number of machines required = $\frac{3,800}{2,000}$ = 1.9 machines = 2 machines.

Q16. Calculate the break-even point for the following: Production Manager of a unit wants to know, from what quantity he can use automatic machine against semi-automatic machine. **[Dec 2016 - 7 marks]**

Data	Automatic	Semi-automatic
Time for the job	2 minutes	5 minutes
Set up time	2 hours	1.5 hours
Cost per hour	Rs. 20	Rs. 12

Answer: Let x be the break-even quantity between automatic & semi-automatic machines. This means, for volume of output x, the total cost of manufacture is the same on both automatic & semi-automatic machines.

For quantity = x units

Total manufacturing cost of automatic machines = Rs. $\left(\frac{2.0 + 2x}{60}\right)$ x 20

Total manufacturing cost of semi-automatic machines = Rs. $\left(\frac{1.5 + 5x}{60}\right)$ x 12

If 'x' is the break-even quantity, then

$\left(\frac{2.0+2x}{60}\right)$ x 20 = $\left(\frac{1.5+5x}{60}\right)$ x 12

Or, $40 + \frac{2x}{3} = 18 + x$

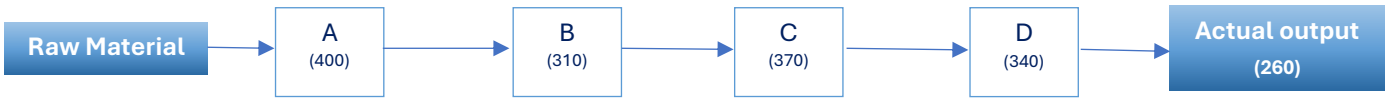
Or, $x - \frac{2x}{3} = 40-18 = 22$

Or, $\frac{x}{3} = 22$

Or, $x = 66$ units.

Therefore, for quantity up to 65, a semi-automatic machine will be cheaper. For quantity 66, both semiautomatic & automatic machines are equally costly. For quantity more than 66, automatic machine becomes cheaper than semi-automatic machine.

Q17. A firm has four work centres, A, B, C & D, in series with individual capacities in units per day shown in the figure below.



(a) Identify the bottle neck centre.

(b) What is the system capacity?

(c) What is the system efficiency? **[Dec 2017 - 9 marks]**

Answer:

(a) The bottle neck centre is the work centre having the minimum capacity. Hence, Work centre 'B' is the bottleneck centre.

(b) System capacity is the maximum units that are possible to produce in/ the system as a whole. Hence, system capacity is the capacity of the bottle neck centre i.e., 310 units.

(c) System efficiency = $\frac{\text{Actual output}}{\text{System capacity}} = \frac{260}{310}$ x 100 (i.e., maximum possible output) = 83.87%

Q18. The monthly requirement of raw material for a company is 3200 units. The carrying cost is estimated to be 25% of the purchase price per unit, in addition to Rs. 2.5 per unit. The purchase price of raw material is Rs. 24 per unit.

The ordering cost is Rs. 28 per order,

(a) You are required to find EOQ & Total cost.

(b) What is the total cost when the company gets a concession of 6% on the purchase price if it orders 3,200 units or more but less than 6,200 units per month?

(c) What happens when the company gets a concession of 15% on the in-purchase price when it orders 6,200 units or more?

(d) Which of the above-three ways of orders the company should adept? **[June 2018 - 10 Marks]**

Answer:

(a) D = 38,400 units per annum

C_0 = 28

C_h = 2.5 + 25% of 24 = 8.5

EOQ = $\sqrt{\frac{2 \times 28 \times 38,400}{8.5}}$ = 502.97 = 503 units (approx.)

Total Cost = $C_0+C_{rm}+C_h$

$=\left[\frac{38,000 \times 28}{503}\right]$ + (38,400 x 24) + $\left[\frac{503 \times 8.5}{2}\right]$

= 2,137.57 + 9,21,600 + 2,137.75 = **9,25,875.32**

(b) When the company has an option to order between 3,200 & 6,200 units, the EOQ should be calculated with a reduction in price by 6% (due to concession);

The purchase price = 94% of 24 = 22.56

D = 38,400 units per annum.

C_0 = 28.

C_n = 2.5 + 25% of 22.56 = 8.14

EOQ = $\sqrt{\frac{2 \times 28 \times 38,400}{8.5}}$ = 513.98 = 514 units (approx.)

Total Cost =$C_0+C_{rm}+C_h$

$=\sqrt{\frac{38,400 \times 28}{514}}$ + (38,400 x 22.56)+$\left(\frac{514 \times 8.14}{2}\right)$

= (2,091.828 + 8,66,304 + 2,091.98) = 8,70,487.8

(c) When the company orders more than 6,200 units purchase price =85% of 24 (because 15%) concession) =20.4;

D = 38,400 units per annum;

C_0 = 28

C_h= 2.5 + 25% of 20.4 = 7.6

EOQ= $\sqrt{\frac{2 \times 28 \times 38,400}{7.6}}$ = 531.92 = 532 units (approx.)

Total Cost = C_0 + C_{rm} + C_h

$=\left[\frac{38,000 \times 28}{532}\right]$ + (38,400 x 20.4) + $\left[\frac{532 \times 7.6}{2}\right]$

= 2,021.052 + 7,83,360 + 2,021.6 = 7,87,402.65

Comparing these costs, we notice that the cost is minimum (7,87,402.65) for (iii) order. Therefore, the company should adopt a policy of ordering 532 units per order.

Q19. With the help of following data, project the trend of sales for the next 5 years: **[Dec 2018 - 10 Marks]**

Years	2002	2003	2004	2005	2006	2007
Sales in Lakhs of Rupees	120	130	135	140	150	165

Answer: Computation of trend values of sales:

Year	Time deviations from the middle of 2004 & 2005 assuring 5 years = 1	Sales (in lakhs of Rs.)	Squares of time deviation	Product of time deviation & sales
	X	Y	X^2	XY
2002	-5	120	25	-600
2003	-3	130	9	-390
2004	-1	135	1	-135
2005	+1	140	1	+ 140
2006	+3	150	9	+ 450
2007	+5	165	25	+ 825
n = 6	$\sum X = 0$	$\sum X = 840$	$\sum X^2 = 70$	$\sum XY = 290$

Regression equation of Y on X : $\sum Y = a + bX$

To find the values of a & b: a = $\frac{\sum Y}{n} = \frac{840}{6} = 140$

b = $\frac{\sum XY}{\sum X^2} = \frac{290}{70} = 4.143$ approx.

Sales forecast for the next five years, i.e., 2008 to 2012:

$Y_{2008} = 140 + [\frac{29}{7} \times (+7)] = 169$ lacs

$Y_{2009} = 140 + [\frac{29}{7} \times (+9)] = 177.28$ lacs

$Y_{2010} = 140 + [\frac{29}{7} \times (+11)] = 185.57$ lacs

$Y_{2011} = 140 + [\frac{29}{7} \times (+13)] = 193.85$ lacs

$Y_{2012} = 140 + [\frac{29}{7} \times (+15)] = 202.14$ lacs

Q20. The present layout is shown in the figure. The manager of the department is intending to interchange the departments C & F in the present layout. The handling frequencies between the departments is given. All the departments are of the same size & configuration. The material handling cost per unit length travel between departments is same. What will be the effect of interchange of departments C & F in the layout? **[June 2019 - 10 Marks]**

A	C	E
B	D	F

From/To	A	B	C	D	E	F
A	-	0	80	150	60	10
B	-	-	90	0	90	110
C	-	-	-	40	0	5
D	-	-	-	-	160	20
E	-	-	-	-	-	60
F	-	-	-	-	-	-

Answer:

(a) The distance matrix of the present layout:

From / To	A	B	C	D	E	F
A	-	1	1	2	2	3
B	-	-	2	1	3	3
C	-	-	-	1	1	2
D	-	-	-	-	2	1
E	-	-	-	-	-	1
F	-	-	-	-	-	-

(b) Computation of total cost matrix (combining inter departmental material handling frequencies & distance matrix).

From / To	A	B	C	D	E	F	Total
A	-	0	80	300	120	30	530
B	-	-	180	0	270	220	670
C	-	-	-	40	0	10	50
D	-	-	-	-	320	20	340
E	-	-	-	-	-	60	60
F	-	-	-	-	-	-	-
Total							**1,650**

If the departments are interchanged, the layout will be represented as shown below.

A	F	E
B	D	C

(c) The distance matrix & the cost matrix of the new layout are shown:

From/To	A	B	C	D	E	F
A	-	1	3	2	2	1
B	-	-	2	1	3	2
C	-	-	-	1	1	2
D	-	-	-	-	2	1
E	-	-	-	-	-	1
F	-	-	-	-	-	-

(d) Total cost matrix for the modified layout:

From / To	A	B	C	D	E	F	Total
A	-	0	240	300	120	10	670
B	-	-	180	0	270	220	670
C	-	-	-	40	0	10	50
D	-	-	-	-	320	20	340
E	-	-	-	-	-	60	60
F	-	-	-	-	-	-	-
Total							**1,790**

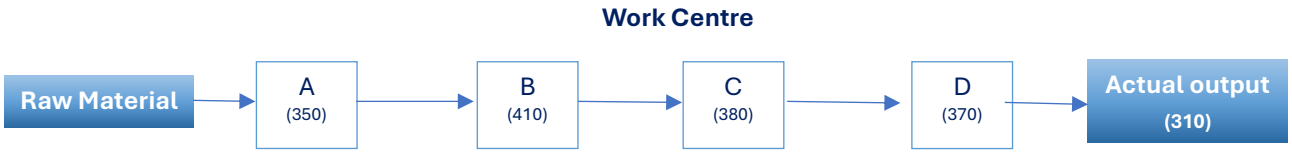
Interpretation & conclusion: The interchange of departments C & F increases the total material handling cost. Thus, it is not a desirable modification.

Q21. A firm has four work centres, A, B, C & D, in series with individual capacities in units per day shown in the figure below:

(a) Identify the bottle neck centre.

(b) Determine the system capacity.

(c) Determine the system efficiency. **[Dec 2019 - 9 Marks]**



Answer: A firm has four work centres.

Work Centre
Raw Material
A
(350)
B
(410)
C
(380)
D
(370)
Actual output
(310)

(a) The bottle neck centre is the work centre having the minimum capacity. Hence, work centre ' A ' is the bottleneck centre.

(b) System capacity is the maximum units that are possible to produce in the system as a whole. Hence, system capacity is the capacity of the bottle neck centre i.e., 350 units.

(c) System efficiency = Actual output/ System capacity = $\frac{310}{350}$ ×100 (i.e. maximum possible output) = 88.57%.

Q22. With the help of following of following data, project the trend of sales for the next 7 years: **[Dec 2021 - 8 marks]**

Years.	2005	2006	2007	2008	2009	2010
Sales (In Lakhs Rs.)	90	95	100	110	125	140

Answer: **Computation of trend values of sales**

Year	Time deviations from the middle of 2007 & 2008 assuming 6 months = 1-unit	Sales(in lakh Rs.)	Squares of time deviation	Product of time deviation & sales
0	X	Y	X^2	XY
2005	-5	90	25	-450
2006	-3	95	9	-285
2007	-1	100	1	-100
2008	+1	110	1	+110
2009	+3	125	9	+375
2010	+5	140	25	+700
n = 6	∑X = 0	∑Y = 660	$\sum X^2 = 70$	∑XY = 350

Regression equation of Y on X : Y = a + bX

To find the values of a & b

A = $\frac{\sum Y}{n} = \frac{660}{6}$ = 110 & b = $\frac{\sum XY}{X^2} = \frac{350}{70}$ = 5. Hence regression equation comes to Y = 110 + 5x

Sales forecast for the next years, i.e. 2011 to 2017

"Y2011 "= 110 + 5(+7) = 110 + 35 = Rs. 145" lakh "

"Y2012 "= 110 + 5(+9) = 110 + 45 = Rs. 155" lakhs "

"Y2013 "= 110 + 5(+11) = 110 + 55 = Rs. 165" lakhs "

"Y2014 "= 110 + 5(+13) = 110 + 65 = Rs. 175" lakhs "

"Y2015 "= 110 + 5(+15) = 110 + 75 = Rs. 185" lakhs "

"Y2016 "= 110 + 5(+17) = 110 + 85 = Rs.195" lakhs "

"Y2017 "= 110 + 5(+19) = 110 + 95 = Rs. 205" lakhs "

Q23. XYZ Co. Ltd. is committed to supply 25,000 components per annum to M/s ABC Co. On a steady daily basis. It is estimated that it costs 15 paise as inventory holding cost per component per month & that the setup per run of component manufacture is Rs. 350 . **[Dec 2021 - 6 Marks]**

(a) What is the optimum run size for component manufacture?

(b) What should be the interval between the consecutive optimum runs?

(c) Find out the minimum inventory holding cost.

Answer:

(a) Optimum Run size (EBQ)

- Annual holding cost per component: Rs. 0.15 x 12 = 1.8
- EBQ = sqrt$\left[2 \times \frac{25{,}000 \text{ x } 350}{1.8}\right]$
- EBQ = sqrt $\frac{1{,}75{,}00{,}000}{1.8}$
- EBQ = sqrt (97,22,222.22)
- EBQ = 3118 units

(b) Interval between consecutive runs

- interval = $\left[\frac{3118}{25{,}000}\right]$ x 3610
- Interval = 45 days

(c) Minimum inventory holding cost

- Average inventory level = $\frac{3{,}118}{2}$ = 1559 units
- Annual holding cost = 1,559 x 1.8
- Annual holding cost = 2,806.2

Q24. The productions (in thousand tonnes) of a fertilizer factory of ROMY Ltd. for the year 2013 through 2022 are given below:

Year	2013	2015	2016	2017	2018	2019	2022
Production (in thousand tonnes)	70	75	90	98	85	91	100

(Present calculation unto three decimal points.)

Required:

(a) Fit a straight line by the method of least squares & tabulate the trend values.

(b) Estimate production (in thousand tonnes) of fertilizer in the year 2020 & year 2025. **[Dec 2022 - 8 Marks]**

Answer:

(a) Fit a straight line

We use the equation of a straight-line y = a + bx, where y is the production & x is the year.

Step-by-Step Calculation:

1. Assign X values (years):
   - X = Year - 2013
   - X = 0,2,3,4,5,6,9
2. Calculate the sums:
   - Sum of X : 0 + 2 + 3 + 4 + 5 + 6 + 9 = 29
   - Sum of Y : 70 + 75 + 90 + 98 + 85 + 91 + 100 = 609
   - Sum of XY : (0^* 70) + (2^ * 75)+(3^ * 90)+(4^ * 98) + (5^* ┤ 85) + (6 * 91) + (9 * 100) = 2190
   - Sum of X squared: (0 squared) + (2 squared)+(3 squared) +(4 squared)+(5 squared)+(6 squared)+(9 squared) =185
3. Calculate a & b :
   - b = $\left(\frac{7 \times 2190 \times 609}{7 \times 185 - 29 \text{ Squared}}\right)$
   - b = $\left(\frac{15{,}330 - 17{,}661}{1{,}295 - 841}\right)$
   - b = $\frac{267}{454}$

- b is approximately 3.146
- a = $\left(\frac{609 - 3.146 \times 29}{7}\right)$
- a = $\left(\frac{609 - 91.234}{7}\right)$
- a = $\left(\frac{517.766}{7}\right)$
- a is approximately 73.966
- so, the equation is Y=73.966+3.146x

(b) Estimate Production for 2020 & 2025

1. For 2020 :
   - X=2020-2013=7
   - Y for 2020 = 73.966+3.146 x 7
   - Y for 2020 is approximately 95.988 thousand tonnes
2. For 2025 :
   - X = 2025 - 2013 = 12
   - Y for 2025 = 73.966 + 3.146 x 12
   - Y for 2025 is approximately 111.718 thousand tonnes

Q25. The Sales of CTV (Rs. In Million) of SONTON LTD. For the 5 years are given below:

Year	2014	2016	2018	2020	2022
Sales of CTV (Rs. ln Million)	18	21	23	27	16

Required: Estimate the Trend values of Sales of CTV for the year of 2021, 2024 & 2026. **[June 2023 - 6 Marks]**

Answer: **Computation of Trend values**

Years	Time deviation from 2018(X)	Sales of CTV(Rs. In millions) (Y)	Square of Time Deviation (X^2)	Product of Time deviation & Sales (XY)
2014	-4	18	16	-72
2016	-2	21	4	-42
2018	0	23	0	0
2020	2	27	4	54
2022	4	16	16	64
Total		**105**	**40**	**4**

Regression Equation of Y on X:Y = a + bX

To find the values of ' a ' & 'b';

a = Total of $\frac{Y}{n} = \frac{105}{5} = 21$; b= $\frac{\text{total of XY}}{\text{total of X}^2} = \frac{4}{40} = 0.1$

Hence, the regression equation comes to Y = 21 + 0.1X

With the help of this equation, we can project the trend values for years 2021, 2024 & 2026

For year 2021, X = 3 So Y = 21 + 0.1(3) = 21 + 0.3 = 21.3 (in millions Rs.) of sales

For year 2024, X = 6. So, Y = 21 + 0.1(6) = 21 + 0.6 = 21.6 (in millions Rs.) of sales

For year 2026, X = 8. So, Y = 21 + 0.1(8) = 21 + 0.8 = 21.8 (in millions Rs.) of sales

Q26. The following table gives the age of cars of SKODA Make & its Annual Maintenance Cost.

Age of Cars in Years (X)	2	4	6	8
Maintenance cost (in thousands of Rs.)(Y)	10	20	25	30

Required: (1) Fit a Linear Regression of Y on X **[Dec 2023 - 7 Marks]**

(2) Estimate: (a) Maintenance Cost for Age of Cars of 10 years; (b) Age of car in years for Maintenance cost of Rs. 50,000.

Answer:

Age of Cars in Years (X)	Maintenance Cost (in thousands of Rupees) (Y)	Squares of Age of Cars (X^2)	Product of Age & Maintenance Cost (XY)
2	10	4	20
4	20	16	80
6	25	36	150
8	30	64	240
∑X = 20	∑Y = 85	$\sum X^2 = 120$	∑XY = 490

Regression equation of Y on X is:

$Y = a + bX$

$\sum Y = na + b\sum X$

$\sum XY = a\sum X + b\sum X^2$

By putting the values, we have,

85 = 4a + 20b .....(1)

490 = 20a + 120b .....(2)

Solving (1) & (2) we have, a = 5 & b = 3.25

Required equation is Y = 5 + 3.25X

Maintenance cost for age of cars of 10 years

Y = 5 + 3.25 x 10; Y = 5 + 32.5 = Rs.37,500

Age of car in years for maintenance cost of Rs. 50,000

50 = 5 + 3.25X; 3.25X = 45; X = 45/3.25 = 13.85 years.

Q27. RONTEX Ltd., a medium size manufacturing Company has provided productions analysis of Coriander powder (in Lakh tonnes) for the years 2015 to 2023 as follows:

Year	2015	2017	2019	2021	2023
Productions of Coriander powder (in Lakh Tonnes)	54	63	69	81	48

Required:

(a) Using the methods of least Squares Analysis, a Straight-line value. **[June 2024 - 7 Marks]**

(b) Assess the estimated Production (in Lakh Tonnes) of Coriander Powder for the years 2014 & 2028.

Answer:

Years	Time Deviation X	Production (In Lakh Tonnes) y	X^2	Xy
2015	-4	54	16	-216
2017	-2	63	4	-126
2019	0	69	0	0
2021	+2	81	4	+162
2023	+4	48	16	+192
n = 5	∑x = 0	∑y = 0	$\sum X^2 = 40$	∑xy = +12

Y = a + bx	$A = \frac{\sum y}{n} = \frac{315}{5} = 63$	$B = \frac{\sum xy}{\sum x^2} = \frac{12}{40} = 0.3$

(b) Assessment of Sales (in Lakh Tonnes) for:

Year 2014 = 63 + 0.3 * (- 5) = 63 - 1.5 = 61.5 Lakh Tonnes.

Year 2028 = 63 + 0.3 * 9 = 63 + 2.7 = 65.7 Lakh Tonnes.

3 DESIGNING OF OPERATIONAL SYSTEM & CONTROL

Q1. Write short notes on Process Planning. **[Dec 2021 - 3 Marks]**

Answer: Process planning refers to the way production of goods or services is organised. It is the basis for decisions regarding capacity planning, facilities (or plant) layout, equipment and design of work systems. Process selection is necessary when a firm takes up production of new products or services to be offered to the customers. Three primary questions to be addressed before deciding on process selection are:

(a) How much variety of products or services will the system need to handle?

(b) What degree of equipment flexibility will be needed?

(c) What is the expected volume of output?

Q2. "The design of product is crucial to success in to-day's global competition". Justify the statement by providing the features of an excellent product design. **[June 2015 - 5 Marks]**

Answer: A good product design can improve the marketability of a product by making it easier to operate or use, upgrading its quality, improving its appearance, and/or reducing manufacturing costs.

A distinctive design may be the only feature that significantly differentiates a product. An excellent design includes usability, aesthetics, reliability, functionality, innovation, and appropriateness.

An excellent design provides competitive advantage to the manufacturer, by ensuring appropriate quality, reasonable cost & expected product features. Firms of tomorrow will definitely compete not on price and quality, but on product design.

The activities and responsibilities of product design include the following:

(a) Translating customer needs and wants into product and service requirements (marketing).

(b) Refining existing products (marketing).

(c) Developing new products (marketing, product design and production).,

(d) Formulating quality goals (quality assurance, production).

(e) Formulating cost targets (accounting).

(f) Constructing and testing prototype (marketing, production).

(g) Documenting specifications (product design).

Objectives of Product Design:

(a) The overall objective is profit generation in the long run.

(b) To achieve the desired product quality.

(c) To reduce the development time and cost to the minimum.

(d) To reduce the cost of the product.

(e) To ensure producibility or manufacturability (design for manufacturing and assembly).

Q3. How do you distinguish among Product Design, Process Design and Production Design? **[June 2015 - 3 Marks]**

Answer:

Product Design	Process Design	Production Design
Product design deals with conversion of ideas into reality.	Process design is a macroscopic decision-making of an overall process route for converting the raw material into finished goods.	A process converts inputs into outputs in a production system.

Q4. Discuss the term 'Process Strategy'. What does it involve? **[June 2017 - 6 Marks]**

Answer: A process strategy is an organisation's approach to process selection for the purpose of transforming resource inputs into goods and services (outputs). The objective of a process strategy is to find a way to produce goods and services that meet customer requirement and product specification (i.e., design specifications) within the constraints of cost and other managerial limitations. The process selected will have a long-term effect on efficiency and production as well as flexibility, cost, and quality of the goods produced. Hence it is necessary that a firm has a sound process strategy at the time of selecting the process.

Key aspects in process strategy include:

Make or buy decisions refer to the extent to which a firm will produce goods or provide services in-house or go for outsourcing (buying or subcontracting). Capital intensity refers to the mix of equipment and labour which will be used by the firm.

Process Flexibility refers to the degree to which the system can be adjusted to changes in processing requirements due to such factors as changes in product or service design, changes in volume of products produced and changes in technology.

Three process strategies: Virtually every good or service is made by using some variation of one of three process strategies. They are: **(a) process focus (b) repetitive focus (c) product focus.**

Q5. Discuss about the following process types to be implemented by a Production Manager as a strategy:

(a) Batch Process. (b) Repetitive Process. **[Dec 2017 - 7 Marks]**

Answer:

(a) Batch process: Batch processing is used when a moderate volume of goods or services is required and also a moderate variety in products or services. A batch process differs from the job process with respect to volume and variety. In batch processing, volumes are higher because same or similar products or services are repeatedly provided, examples of products produced in batches include paint, ice cream, soft drinks, books and magazines.

(b) Repetitive process: This is used when higher volumes of more standardised goods or services are needed. This type of processes characterised by slight flexibility of equipment (as products are standardised) and generally low labour skills. Products produced include automobiles, home appliances, television sets, computers, toys etc. Repetitive process is also referred to as line process as it includes production lines and assembly, lines in mass production. Resources are organised around a product or service and materials move in a line flow from one operation to the next according to a fixed sequence with little work-in- progress inventory. This kind of process is suitable to "manufacture-to-stock" strategy with standard products held in finished goods inventory. However, "assemble-to-order" strategy and "mass customisation", are also possible in repetitive process.

Q6. "Virtually all goods or services are made by using some variation of one of three process Strategies". Discuss about each of 3 process strategies. Also state situation during the decline stage of a product life cycle. **[June 2018 - 8 marks]**

Answer: A process strategy is an organisation's approach to process selection for the purpose of transforming resource inputs into goods and services (outputs). The objective of a process strategy is to find a way to produce goods and services that meet customer requirement and product specification (i.e., design specifications) within the constraints of cost and other managerial limitations. The process selected will have a long-term effect on efficiency and production as well as flexibility, cost, and quality of the goods produced. Three process strategies: Virtually every good or service is made by using some variation of one of three process strategies. They are:

(a) Process focus in a factory; these processes might be departments devoted to welding, grinding, and painting. In an office the processes might be accounts payable, sales, and payroll. In a restaurant, they might be bar, grill, and bakery. The process focuses on low volume, high variety products are also called job shop. These facilities are process focus in terms of equipment, layout, and supervision.

(b) Repetitive focus; falls between the product and process focus. The repetitive process is a product-oriented production process that uses modules. Modules are parts or components of a product previously manufactured or prepared, often in a continuous process. Fast-food firms are an example of repetitive process using modules.

(c) Product focus; are high volume, low variety processes; also called continuous processes. Products such as light bulbs, rolls of paper, beer, and bolts are examples of product process. This type of facility requires a high fixed cost, but low costs. The reward is high facility utilization.

Many products at some point will enter the decline stage. The decline stage is a significant reduction in sales volumes. Typically, this occurs for two main reasons:

1. There is a new product category in the market that provides a better solution and has provided enough incentive for consumers to switch on a widespread basis.
2. There has been a significant change in consumer lifestyles and that particular product is no longer relevant.

Most products into the decline phase due to "replacement" products being offered, primarily through enhanced technology or unique design. As mentioned above, the Apple iPod is a good example, where the smart phone technology includes a music player and has easier access to the Internet and is a more visual device. Therefore, provides significant usage and relative advantages over the iPod.

Q7. What are the various activities and responsibilities of product design? **[Dec 2018 - 6 Marks]**

Answer:

(a) Translating customer needs and wants into product and service requirements (marketing).

(b) Refining existing products (marketing).

(c) Developing new products (marketing, product design and production).

(d) Formulating quality goals (quality assurance, production).

(e) Formulating cost targets (accounting).

(f) Constructing and testing prototype (marketing, production).

(g) Documenting specifications (product design).

Q8. Examine the following types of Process decisions:

(a) Job Shop Process (b) Project Process **[June 2019 - 6 Marks]**

Answer: Examination of the following types of Process decisions:

(a) Job Shop Process: It is used in job shops when a low volume of high-variety goods are needed. Processing is intermittent, each job requires somewhat different processing requirements. A job shop is characterised by high customisation (made to order), high flexibility of equipment and skilled labour and low volume. A tool and die shop is an example of job shop, where **job process** is carried out to produce one-of-a kind of tools. Firms having job shops often carry out job works for other firms. A job shop uses a flexible flow strategy, with resources organised around the process.

(b) Project Process: It is characterised by high degree of job customisation, the large scope for each project and need for substantial resources to complete the project. Examples of projects are building a shopping centre, a dam, a bridge, construction of a factory, hospital, developing a new product, publishing a new book etc. Projects tend to be complex, take a long time and consist of a large number of complex activities. Equipment flexibility and labour skills can range from low to high depending on the type of projects.

Q9. What do you understand by Process Design and Selection? **[Dec 2019 - 8 Marks]**

Answer: Process Design is related to the overall sequences of operations required to achieve the product specifications. It specifies the type of work stations to be used, the machines and equipment necessary to carry out the operations. The sequence of operations is determined by (i) the nature of the product, (ii) the materials used, (iii) the quantities to be produced, and (iv) the existing physical layout of the plant.

The process design is related to the following:

(a) Characteristics of the product or service offered to the customers.

(b) Expected volume of output.

(c) Kinds of equipment's and machines available in the firm.

(d) Whether equipment's and machines should be of special purpose or general purpose.

(e) Cost of equipment's and machines needed.

(f) Kind of labour skills available, amount of labour available and their wage rates.

(g) Expenditure to be incurred for manufacturing processes.

(h) Whether the process should be capital-intensive or labour-intensive.

(i) Make or buy decision.

(j) Method of handling materials economically.

Q10. State reasons, why Production or Operations Strategy is directly influenced by product design? **[Dec 2021 - 4 Marks]**

Answer:

(a) As products are designed, all the detailed characteristics of each product are established.

(b) Each product characteristic directly affects how the product can be made or produced and

(c) How the product is made determines the design of the production system (production design) which is the heart of production and operations strategy.

Q11. Briefly describe 4 stages of Product Life Cycle. **[Dec 2021 - 6 Marks]**

Answer:

- The introduction stage is preceded by "production planning and development." This period requires greater investment. This investment should be gradually recouped as the sales pick up.
- The concept of life cycle would give the management an idea as to the time within which the original investment could be recouped.
- After testing, a product enters the introduction stage and the product will then become available in the national market.
- Sales would begin gradually as potential buyers learn of the product through advertising and other selling techniques.
- But the profits will be low as part of the investment is to be recouped besides heavy expenditure on selling.

- In the growth stage, both sales and profits will begin to increase. It is here that similar other new products begin to appear in the market as substitutes and offer competition.
- The management, therefore, should try to change its approach by changing its strategy from "buy my product" to "try my product".
- At the end of this stage, the distribution arrangement is likely to get completed and the prices, if necessary, are reduced a little. The third stage is the maturity stage.
- During this stage the manufacturers introduce new models or adopt methods such as trading-in, etc., to promote the sale of their brands with a view to retaining their position in the market.
- The number of buyers will continue to grow, but more slowly. In economic terms this is the stage where supply exceeds demand.
- Some of the promotional efforts may lengthen the span of this stage but they will not offer a permanent solution.
- At the final stage of decline, profit margins touch a low level, competition becomes severe and customers start using newer and better products. It is here that the story of a product ends-a natural but hard end.

Q12. State in brief what are the characteristics of Good Product Design (any 7). **[Dec 2022 & June 2024 - 7 Marks]**

Answer: A good product design must ensure the following:

1. **Function or performance:** The function or performance is what the customer expects the product to do to solve his/her problem or offer certain benefits leading to satisfaction. For example, a customer for a motor bike expects the bike to start with a few kicks on the kick peddle and also expects some other functional aspects such as pick-up, maximum speed, engine power and fuel consumption etc.
2. **Appearance or aesthetics:** This includes the style, colour, look, feel, etc. which appeals to the human sense and adds value to the product.
3. **Reliability:** This refers to the length of time a product can be used before it fails. In other words, reliability is the probability that a product will function for a specific time period without failure.
4. **Maintainability:** Refers to the restoration of a product once it has failed. High degree of maintainability is desired so that the product can be restored (repaired) to be used within a short time after it breaks down. This is also known as serviceability.
5. **Availability:** This refers to the continuity of service to the customer. A product is available for use when it is in an operational state. Availability is a combination of reliability and maintainability. High reliability and maintainability ensure high availability.
6. **Producibility:** This refers to the ease of manufacture with minimum cost (economic production). This is ensured in product design by proper specification of tolerances, use of materials that can be easily processed and also use of economical processes and equipment to produce the product quickly and at a cheaper cost.
7. **Simplification:** This refers to the elimination of the complex features so that the intended function is performed with reduced costs, higher quality or more customer satisfaction. A simplified design has fewer parts which can be manufactured and assembled with less time and cost.
8. **Standardization:** Refers to the design activity that reduces variety among a group of products or parts. For example, group technology items have standardized design which calls for similar manufacturing process steps to be followed.

Standard designs lead to variety reduction and results in economies of scale due to high volume of production of standard products. However, standardised designs may lead to reduced choices for customers.

9. **Specification:** A specification is a detailed description of a material, part or product, including physical measures such as dimensions, volume, weight, surface finish etc. These specifications indicate tolerances on physical measures which provide production department with precise information about the characteristics of products to be produced and the processes and production equipment to be used to achieve the specified tolerances (acceptable variations). Interchangeability of parts in products produced in large volumes (mass production and flow-line production) is provided by appropriate specification of tolerances to facilitate the desired fit between parts which are assembled together.
10. **Safety:** The product must be safe to the user and should not cause any accident while using or should not cause any health hazard to the user. Safety in storage, handling and usage must be ensured by the designer and a proper package has to be provided to avoid damage during transportation and storage of the product. For example, a pharmaceutical product while used by the patient, should not cause some other side effect threatening the user.

Q13. The Design Thinking can be thought of as a 5-stage process. Are these stages performed in a sequential order? Examine each stage of Design Thinking. **[June 2023 - 7 Marks]**

Answer: Design thinking is a non-linear, iterative process that seeks to understand users' needs, challenge assumptions, redefine problems and create innovative solutions to prototype and test. This is involving 5 phases - Empathize, Define, Ideate, Prototype and Test - it is most useful to tackle problems that are ill defined or unknown.

The 5 stages of Design Thinking:

The Hasso Plattner Institute of Design at Stanford (a.k.a the d. school) describes design thinking as a 5-stage process. It is to be noted that these stages are not always sequential and teams often run them in parallel, out of order and repeat them in an iterative fashion.

Step 1: Empathize - Research your users' needs:

Here, you should gain an empathetic understanding of the problem you're trying to solve, typically through user research. Empathy is crucial to a human centred design process such as design thinking because it allows you to set aside your own assumptions about the world and gain real insight into users and their needs.

Step 2: Define - state your users' needs and problems:

It's time to accumulate the information gathered during the Empathize stage. You then analyse your observations and synthesize them to define the core problems you and your team have identified. These definitions are called problem statements. You can create personas to help keep your efforts human centred before proceeding to ideation.

Step 3: Ideate - Challenge assumptions and create ideas:

Now you are ready to generate ideas. The solid background of knowledge from the first two phases means you can start to "think outside the box", look for alternative ways to view the problem and identify innovative solutions to the problem statement you've created. Brainstorming is particularly useful here.

Step 4: Prototype - start to create solutions:

This is an experimental phase. The aim is to identify the best possible solution for each problem found. Your team should produce some inexpensive, sealed down versions of the product (or specific features found within the product) to investigate the ideas you've generated. This could involve simply paper prototyping.

Step 5: Test - Try your solutions out:

Evaluators rigorously test the prototypes. Although this is the final phase, decision making is iterative. Teams often use the results to redefine one or more further problems. So, you can return to previous stages to make further iterations, alterations and refinements - to find or rule out alternative solutions.

Q14. You are working as a Production Manager in a Manufacturing unit. You are required to determine whether resources are to be organized around products or process in order to implement the flow strategy. In this context, describe in brief the basic process types to be chosen. (Any 7) **[Dec 2023 - 7 Marks]**

Answer: Process choice determines whether resources are organised around products or processes in order to implement the low strategy. It depends on the volumes and degree of customisation to be provided. These major process decisions are discussed in detail in the following paragraphs:

Process Choice: The production manager has to choose from five basic process types:

(a) Job shop process: It is used in job shops when a low volume of high-variety goods are needed. Processing is intermittent, each job requires somewhat different processing requirements. A job shop is characterized by high customization (made to order), high flexibility of equipment and skilled labour and low volume. A tool and die shop is an example of job shop, where job process is carried out to produce one-of-a kind of tools. Firms having job shops often carry out job works for other firms. A job shop uses a flexible flow strategy, with resources organized around the process.

(b) Batch process: Batch processing is used when a moderate volume of goods or services is required and also a moderate variety in products or services. A batch process differs from the job process with respect to volume and variety. In batch processing, volumes are higher because same or similar products or services are repeatedly provided, examples of products produced in batches include paint, ice cream, soft drinks, books and magazines.

(c) Repetitive process: This is used when higher volumes of more standardized goods or services are needed. This type of process is generally low labour skills. Products produced include automobiles, home appliances, television sets, computers, toys etc. Repetitive process is also referred to as line process as it include production lines and assembly lines in mass production. Resources are organized around a product or service and materials move in a line flow from one operation to the next according to a fixed sequence with little work-in-progress inventory. This kind of process is suitable to "manufacture-to-stock" strategy with standard products held in finished goods inventory. However, "assemble-to-order" strategy and "mass customisation" are also possible in repetitive process.

(d) Continuous process: This is used when a very highly standardised product is desired in high volumes. These systems have almost no variety in output and hence there is no need for equipment flexibility. A continuous process is the extreme end of high volume, standardised production with rigid line flows. The process often is capital intensive and operate round the clock to maximise equipment utilisation and to avoid expensive shut downs and shut ups. Examples of products made in continuous process systems include petroleum products, steel, sugar, flour, paper, cement, fertilisers etc.

(e) Project process: It is characterised by high degree of job customisation, the large scope for each project and need for substantial resources to complete the project. Examples of projects are building a shopping centre, a dam, a bridge, construction of a factory, hospital, developing a new product, publishing a new book etc. Projects tend to be complex, take a long time and consist of a large number of complex activities. Equipment flexibility and labour skills can range from low to high depending on the type of projects.

4 PRODUCTION PLANNING & CONTROL

Q1. Write short notes on Scheduling. **[June 2021 - 3 Marks]**

Answer:

- "Scheduling" is the next important function of production planning & control after "Routing".
- It determines the starting & the completion timings for each of the operations with a view to engage every machine & operator of the system for the maximum possible time & without imposing unnecessary burden over them.
- Scheduling is the determination of the time that should be required to perform each operation & also the time that should be required to perform the entire series as routed. Scheduling involves establishing the amount of work to be done & the time when each element of the work will start or the order of the work.
- Scheduling technique is an important technique of determining the starting & the completion timings of each operation & that of the total manufacturing process so that the man & machines can be utilized to the maximum.

Q2. List down various phases of the simulation process. **[June 2014 – 2 Marks]**

Answer:

(a) Definition of the problem & statement of objectives.
(b) Construction of an appropriate model.
(c) Experimentations with the model constructed,
(d) Evaluations of the results of simulations.

Q3. What are the main functions of production planning? **[Dec 2014 - 2 Marks]**

Answer:

(a) Estimating
(b) Routing
(c) Scheduling
(d) Loading

Q4. List the advantages of Method Study. **[Dec 2014 - 6 Marks]**

Answer:

- Work simplification.
- Improved working method.
- Improvement of quality of the products.
- The improvement of factory, shop & workplace layout.
- The improvement of the design of plant & equipment.
- Better working conditions/environment.
- Better material handling & lesser material handling cost.
- The improvement of processes & procedures.
- Improvements in the use of materials, machines & manpower.
- Less fatigue to operator.
- Optimum utilization of all resources.
- Higher safety to workmen.
- Shorter production cycle time.
- The improvement of the design of plant & equipment.
- Economy in human effort & the reduction of unnecessary fatigue.
- Higher job satisfaction for workmen.
- The development of a better physical working environment.
- Reduced material consumption & wastages.
- Reduced manufacturing cost & higher productivity.

Q5. Write a sentence or two on each of the various methods applied for finding the optimal solution for a given linear programming problem. What is 'non-negativity condition'? **[Dec 2014 - 5 Marks]**

Answer: **Methods of finding the optimal solution for a given linear programming problems:**

1	**Graphical method**	Linear programming which involves two or three variables can be solved graphically. Any feasible solution which maximises o minimises the objective function is optimal feasible solution.
2	**Simplex Method**	Any problem can be solved by this method which satisfies the conditions of linearity & certainty irrespective of the number of variables. In case of simplex method optimal solution is reached when net evaluation row contains either zeros or positive values in case of minimisation problem & in case of simplex method optimal solution is reached when net evaluation row contains either zeros or negative values in case of maximisation problem.
Non-negativity condition		The linear inequalities $x > 0$ & $y > 0$. These are included because x & y are usually the number of items produced & one cannot produce a negative number of items the smallest number of items one can produce is zero.

Q6. Classify the functions of Production Planning & Control. **[Dec 2014 - 9 Marks]**

Answer: The functions of Production Planning & Control can be classified under the following:

Materials	Raw materials, spare parts & components which must be available in the correct quantities & specifications at the right time.
Methods	Choosing the best method from several alternatives. It involves deciding the best sequence of operations for manufacturing the parts, building up subassemblies & major assemblies which in turn will make up the finished product, within the limitations of existing layout & workflow.
Machines & Equipment	Production processes or methods have a relationship to the production facilities (machines & equipment) available. Production Planning & Control is concerned with selection of machines & equipment's & also with maintenance policy, procedure & schedules, replacement policy & tooling. (Design & manufacture of tools).
Routing	Routing prescribes the flow of work in the plant & is related to consideration of layout of temporary storage locations for raw materials, components & semi processed parts, & of material handling systems. Routing is a basic PPC function.
Estimating	The processing times (both set up time & operation time per piece) required for the parts to be manufactured in-house are estimated & the standard time (both machine time & labour time) is established as performance standard.
Loading & Scheduling	Machines have to be loaded according to their capacity & capability. Machine loading is carried out in conjunction with routing (as indicated in process layouts or operations analysis & routing sheets) to ensure smooth workflow & the prescribed feeds, speeds of machines are adhered to as well as the estimated time (standard time which is the allowed time to do a job). .
Scheduling	Determines the utilisation of equipment & manpower & hence the efficiency of the plant. Scheduling determines the starting time & completion time for each & every operation for each & every part to be manufactured & sub-unit to be assembled so that the finished product is ready to be shipped to the customer as per the predetermined delivery schedules.
Dispatching	This is concerned with the execution of planning functions. Production orders & instructions are released according to the schedule, sequences indicated in route sheets,' & machine loading schedules are adhered to an authorisation is given for release of materials & tools to the operators to carry-out the work.
Expediting or Progressing	This means follow-up or keeping track of the progress made in completing the production as per schedules. This follows dispatching function logically. Dispatching initiates action on the shop floors whereas expediting ensures that the schedules are adhered to. It keeps a close liaison with the manufacturing work centres to provide a feed back to the PPC manager for prompt review of targets & schedules.

Inspection	This function relates to checking the quality in production & of evaluating the efficiency of the processes, methods & workers so that improvements can be made to achieve the desired level of quality.
Evaluating or Controlling	The objective of evaluation or controlling is to improve performance. Methods & facilities are evaluated to improve their performance. To sum up, we can state that PPC is a management tool, employed for the direction of the manufacturing operations & their co-ordination with other activities of the firm. In the production system, which is primarily defined by the dimensions of quantity, quality, time & price, the functions of PPC comprise.

Q7. What are the managerial considerations in Scheduling? **[Dec 2014 - 3 Marks]**

Answer:

- Scheduling is essentially the short-term execution plan of a production planning model. Production scheduling consists of the activities performed in a manufacturing company in order to manage & control the execution of a production process.
- A schedule is an assignment problem that describes in details (in terms of minutes or seconds) which activities must be performed & how the factory's resources should be utilized to satisfy the plan.
- In all these scheduling tasks, different criteria may be ' used in deciding which of several schedules is best.
- Criteria could be ranked from applying simple rules to determine which job has to be processed next at which work-centre or to the use of advanced optimizing methods that try to maximize the performance of the given environment.
- Those criteria may relate to the amount of time the machine or equipment might be idle.

In general, there are six criteria that may be used in evaluating different possible schedules. They are:

(a) Providing the product or service when the customer wants it.

(b) Minimising the length of time taken to produce that product or service.

(c) Minimising the level of work-in-progress (WIP) inventories.

(d) Minimising the amount of idle time of equipment or machine.

(e) Minimising the amount of idle time of employees; &

(f) Minimising costs.

Q8. With reference to Time Study, define the terms (a) Relaxation Allowance, (b) Contingency Allowance, (c) Process Allowance by providing appropriate examples. **[June 2015 – 6 Marks]**

Answer: With reference to time study definition of the following terms is as follows:

1	**Relaxation Allowance (RA)**	This allowance is given to the worker to overcome the fatigue due to physical exertion, posture, concentration, working condition & personal needs such as going to toilet, drinking water, etc., it usually varies from 10% to 20% of normal or basic time.
2	**Contingency Allowance (CA)**	This allowance is given for infrequent or non-repetitive activities such as obtaining special materials from stores, sharpening of tools, getting a special tool from the tool stores, & consultation with the supervisor. It is usually about 5% of normal or basic time.
3	**Process Allowance (PA)**	Allowance given to the worker to compensate himself for enforced idleness due to the nature of a process or operation; for e.g., working on automatic machine, electroplating etc., during which the worker is forced to be idle during a part of the work cycle.

Q9. Define simulation & identify its 4 phases. **[Dec 2015 – 5 Marks]**

Answer: Simulation: Simulation involves developing a model of some real phenomenon & then performing experiments on the- model evolved. It is a descriptive & not optimizing technique. To simulate is to initiate. In simulation, a given system is copied & the constants associated with it are manipulated in that artificial environment to examine the behaviour of the system.

Phases of the simulation process:

(a) Definition of the problem & statement of objectives

(b) Construction pf an appropriate model

(c) Experimentations with the model constructed

(d) Evaluations of the results of simulations.

Q10. Define Work Measurement **[Dec 2015 – 3 Marks]**

Answer: It is defined as the application of techniques designed to establish the work content of a specified task by determining the time required for carrying out the task at a defined standard of performance by a qualified worker. The application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance.

Q11. Define Motion Study. **[June 2016 – 5 Marks]**

Answer: Motion study is the science of eliminating wastefulness resulting from using unnecessary; ill-directed & inefficient motion. The aim of motion study is to find & perpetuate the scheme of least waste methods of labour.

The principles of motion economy are divided into three groups, viz.,

(a) Effective use of the operator

(b) Arrangement of the workplace

(c) Tools are equipment.

Q12. Describe the areas of Production Planning & Control. **[Dec 2016 – 6 Marks]**

Answer: Production Planning & Control encompasses the following areas:

1	**Materials**	Planning for procurement of raw materials, components & spare parts in the right quantities & specifications at the right time from the right source at the right price. Purchasing, storage, inventory control, standardisation, variety reduction, value analysis & inspection are the other activities associated with materials.
2	**Methods**	Choosing the best method of processing from several alternatives. It also includes determining the best sequence of operations (process plans) & planning for tooling, jigs & fixtures etc.
3	**Machines & Equipment**	Manufacturing methods are related to production facilities available in the production system. It involves facilities planning, capacity planning, allocation & utilization of plant & equipment, machines etc. .
4	**Manpower**	Planning for man power (labour, supervisory & managerial levels) having appropriate skills & expertise.
5	**Routing**	Determining the flow of work, material handling in the plant, & sequence of operations or processing steps. This is related to considerations of appropriate shop layout & plant layout, temporary storage locations for raw materials, components & semi-finished goods, & of materials handling system.
6	**Estimating**	Establishing operation times leading to fixation of performance standards both for workers & machines.
7	**Loading & Scheduling**	Machine loading is allocation of jobs to machines in conjunction with routing & with due consideration for capacity of machines & priority for jobs in order to utilize the machines to the maximum possible extent. Scheduling ensures that parts, sub-assemblies & finished products are completed as per required delivery dates.
8	**Dispatching**	This is concerned with the execution of the planning functions. It gives necessary authority to start a particular work which has already been planned under routing & scheduling functions.
9	**Expediting**	Means chasing, follow up or progressing which is done after dispatching function. It keeps a close liaison with scheduling in order to provide an efficient feedback & prompt review of targets & schedules.
10	**Inspection**	This, function is related to maintenance of quality in production & of evaluating the efficiency of the processes, methods & labour so that improvements can be made to achieve the quality standards set by product design.
11	**Evaluating**	The objective of evaluation is to improve performance. Performance of machines, processes & labour is evaluated to improve the same.
12	**Cost Control**	Manufacturing cost is controlled by wastage reduction, value analysis, inventory control & efficient utilization of all resources.

Q13. List the objectives of scheduling in an organisation. **[Dec 2016 – 5 Marks]**

Answer:

1. To prevent unbalanced use of time among departments & work centres or to evenly load all machines.
2. To utilise machines & labour in such a way that the output is produced within the established lead time so as to:
   (a) Deliver the products/services in time &
   (b) Complete production in the shortest cycle time possible at minimum total cost of production.
   (c) To reduce idle time of labour & machines, which might be caused due to waiting for materials, waiting for movement, waiting for inspection & waiting for want of work.
   (d) To fix up delivery dates for various manufacturing activities & for the finished products.
   (e) To increase the efficiency of production or productivity.

Q14. Discuss principles of scheduling. Explain briefly relationship between routing & scheduling. **[June 2018 - 8 Marks]**

Answer: 'Scheduling' is the next important function of production planning & control after 'Routing'. It determines the starting & the completion timings for each of. the operations with a view to engage every machine & operator of the system for the maximum possible time & without imposing unnecessary burden over them. Scheduling is the determination of the time that should be inquired to perform each operation & also the time that should be required to perform the entire series as routed.

Principles of Scheduling

1. **The principle of optimum task size:** Scheduling tends to achieve maximum efficiency when the task sizes are small, & all tasks of same order of magnitude.
2. **Principle of optimum production plan:** The planning should be such that it imposes an equal load on all plants.
3. **Principle of optimum sequence:** Scheduling tends to achieve the maximum efficiency when the work is planned so that work hrs. are normally used in the same sequence.

   The first principle has a tendency when applied, not only give good results but also to be self-correcting if it is ignored. **For example,** if in a functional batch production machine shop the loads imposed by different operations vary greatly in length it is possible that it will be necessary to break many of the long operations into one or more small batches, in order to get the other orders completed by due date. In effect, this principle only repeats the known advantage of maintaining a high rate of stock turn over, & of single-phase ordering. The second principle merely states that the obvious fact that there will be less idle time & waiting time, if all the plant is evenly loaded by the production planners, then if some of the machines are over loaded perhaps because direct labour cost on them are lower & others are idle for part of the time due to shortage of work. The third principle says about principle of flow. Sometimes it is also true if we sequence some jobs, which need the same machine set up, at a time, this avoids machine ancillary time needed, in case, the jobs of the above type are done at different times. **For example,** consider drilling a 10 mm hole in five different jobs may be done at a time so that the set-up time required for five jobs can be once only.

   Relationship between Routing & Scheduling:

   Both routing & scheduling are interconnected as scheduling is difficult without routing & routing is also not effective without scheduling. Routing is a prerequisite for scheduling while time to be taken may form the basis of routing & that is fixed by scheduling.

Q15. Describe the objectives of Production Planning & Control. **[Dec 2018 - 10 Marks]**

Answer:

- Analysing the orders to determine the raw materials & parts that will be required for their completion.
- Answering questions from customers & salesmen concerning the status of their orders.
- Assisting the costing department in making cost estimates of orders.
- Assisting the human resource departments in the manpower planning & assignment of men to particular jobs.
- Controlling the stock of finished parts & products.
- Determining the necessary tools required for manufacturing.
- Direction & control of the movement of materials through production process.
- Initiating changes in orders as requested by customers while orders are in process.
- Issuing requisitions for the purchase of necessary materials.
- Issuing requisitions for the purchase or manufacture of necessary tools & parts.
- Keeping the up-to-date records scheduled & in process.

- Maintaining stocks of materials & parts.
- Notifying sales & accounting of the acceptance of orders in terms of production feasibility.
- Preparing the route sheets & schedules showing the sequence of operation required to produce particular products.
- Production of work .orders to initiate production activities.
- Receiving & evaluating reports of progress on particular orders & initiating corrective action, if necessary.
- Receiving orders from customers.
- Revising plans when production activities cannot conform to original plans & when revisions in scheduled production are necessary because of rush orders.

Q16. Describe the different types of Production Control. **[Dec 2018 & 2023 - 10 Marks]**

Answer: Production Control can be of 6 types:

1. **Block Control:** This type of control is most prominent in textiles & book & magazine printing. In these industries it is necessary to keep things separated & this is the fundamental reason why industries resort to block control.
2. **Flow Control:** This type of control is commonly applied in industries like chemicals, petroleum, glass, & some areas of food manufacturing & processing. Once the production system is thoroughly designed, the production planning & control department controls the rate of flow of work into the system & checks it as it comes out of the system. But, under this method, routing & scheduling are done when the plant is laid out. That is to say, the production line which is established is well balanced & sequenced before production operations begin; this type of control is more prevalent in continuous production systems.
3. **Load Control:** Load control is typically found wherever a particular bottleneck machine exists in the process of manufacturing.
4. **Order Control:** The most, common type of production control is called order control. This type of control is commonly employed in companies with intermittent production systems, the so-called job-lot shops. Under this method, orders come into the shop for different quantities for different products. Therefore, production planning & control must be based, on the individual orders.
5. **Special Project Control:** Special production control is necessary in certain projects like the construction of bridges, office buildings, schools, colleges, universities, hospitals & any other construction industries. Under this type of control, instead of having sets of elaborate forms for tooling & scheduling, a man or a group of men keeps in close contact with the work.
6. **Batch Control:** Batch control is another important, type of production control which is frequently found in the food processing industries.

Q17. What are the objectives of Just-in-Time (JIT) manufacturing? **[Dec 2021 - 6 Marks]**

Answer: The specific goal of JIT manufacturing is to provide the right quality level at the right place. Customer demand always determines what is right. JIT tries to build only what internal & external customers want & when they want it.

Objectives of Just in Time (JIT) manufacturing:

- Produce only the products (goods or services) that customers want.
- Produce products only as quickly as customers want to use them.
- Produce products with perfect quality.
- Produce in the minimum possible lead times.
- Produce products with features that customers want & no others.
- Produce with no waste of labour, materials or equipment, designate a purpose for every movement to leave zero idle inventory.

Q18. Shin's Car Wash & Dry is an automatic, five-minute operation with a single bay. On a typical Saturday morning, cars arrive at a mean rate of ten /hrs., with arrivals tending to follow a Poisson distribution. Find the average number of cars in line. **[Dec 2013 – 5 Marks]**

Answer: Here, Given

λ = 10 cars /hrs.

μ = 1 per 5 minutes, 12 /hrs.

$Lq = \frac{\lambda^2}{\mu(\mu=\lambda)} \frac{10^2}{2 \times 12 \times (12-10)} \frac{100}{48}$ = 2.08 cars

Q19. "Production Control involves the various functions". In accordance with this align these said functions.

[June 2024 – 7 Marks]

Answer: The Functions involved in Production Control are discussed follows:

(a) Planning the production operations in detail.

(b) Routing, i.e., laying down the path for the work to follow & the order in which the various operations will be carried out,

(c) Scheduling, i.e., establishing the quantity of work to be done, & fixing the time table for performing the operations,

(d) Dispatching, i.e., issuing the necessary orders, & taking necessary steps to ensure that the time targets set in the schedules are effectively achieved,

(e) Follow-up, taking necessary steps to check up whether work proceeds according to predetermined plans & how far there are

(f) variances from the standards set earlier,

(g) Inspection, i.e., conducting occasional check-ups of the products manufactured or assembled to ensure high quality of the production.

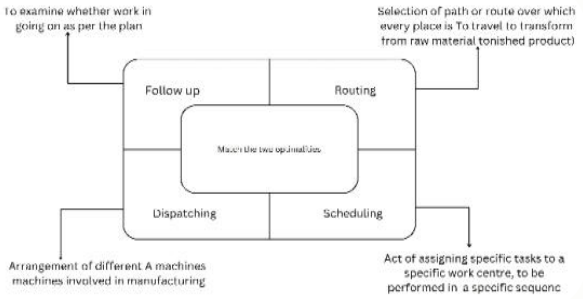


Figure: Technique of production Control

Q20. A company plans to fill four positions & it decides to. conduct aptitude tests & interviews for the same. While the aptitude tests are conducted by people from the clerical positions, the job interviews are held by the personnel from the management cadre. The job interviews immediately follow the aptitude test. The time required (in minutes) by each of the positions is given here, **[Dec 2013 - 5 Marks]**

Position	P1	P2	P3	P4
Aptitude Test	100	110	140	120
Job Interview	70	90	80	110

If it is desired to minimise the waiting time of the management personnel, in what order the position filling be handled?

Answer: From the given information, the optimal sequence can be determined using the algorithm. This would be P4, P2, P3 & P1.

Calculation of total elapsed Time T

Position	Aptitude Test		Job interview	
	Start	Finish	Start	Finish
P4	0	120	120	230
P2	120	230	230	320
P3	230	370	370	450
P1	370	470	470	540

The total elapsed time T is equal to 540 minutes as calculated above, while the idle time for the management personnel would be: 120 + 100 + 50 + 20 = **290 minutes.**

Q21. An Industrial Engineer, appointed to conduct a time-study for a job, has after observation, divided the job into 5 elements. He had noted the timings for four cycles of the job as below:

Element	Time in Minutes				Performance Rating (%)
	Cycle 1	Cycle 2	Cycle 3	Cycle 4	
1	1.327	1.254	1.351	1.269	85%
2	0.983	1.854	0.882	0.956	95%
3	1.894	1.821	1.928	1.963	100%
4	2.569	2.173	2.132	2.285	120%
5	1.358	1.139	2.561	1.438	100%

(a) Are there any outliners in the data i.e. probable errors in reading or recording data which should not be included in the analysis?

(b) Compute the basic time for the job. Also compute the standard time if a relaxation allowance of 13%, a contingency allowance of 4% & an incentive of 25% are applicable for the job. **[Dec 2014 - 7 Marks]**

Answer:

(a) The times for element no. 2 in cycle 2 & for element no. 5 in cycle 3 are suspect & should be disregarded as they vary very much as compared with time values for these elements in other cycles.

(b) The basic time or normal time is calculated on the basis of data . excluding the outliners as below:

Element	Mean actual time (min)	Performance rating (%)	Normal or basic time
1	1.3	85	$\frac{1.3 \times 85}{100} = 1.105$
2	0.94	95	$\frac{0.940 \times 95}{100} = 0.893$
3	1.902	100	$\frac{1.902 \times 100}{100} = 1.902$
4	2.29	120	$\frac{2.290 \times 120}{100} = 2.748$
5	1.312	100	$\frac{1.312 \times 100}{100} = 1.312$

Normal time for the total job which include all five elements = 7.96 minutes

Calculation of standard time

Standard time for the job = Normal time + Allowances

= 7.96 + $\frac{13}{100}$ x 7.96 + $\frac{4}{100}$ x 7.96 = 7.96 + 1.035 + 0.318 **= 9.313 minutes**

If 25% incentive allowance is given, total time allowed under

incentive scheme = 9.313 + $\frac{25}{100}$ x 9.313 = 9.313 + 2.328 = **11.641 minutes**

Q22. In a simulation operation, a firm's maintenance person received requests for service & provided service during an 8-hour period as shown below:

Request Arrival Time (Clock Time)	Service Time (Hrs.)
0	1.00
0.3	1.00
2.00	1.50
3.00	1.50
6.30	0.50

The maintenance labour cost is Rs. 150 /hrs., & the delay time cost is Rs. 500 /hrs. Find:

(a) The idle time cost for the maintenance person,

(b) The delay time cost for the machinery. **[Dec 2014 – 5 Marks]**

Answer: Calculation of machine down time:

Request Arrival time	Repair time reqd. with one-person Hrs.	Repair Time begins (clock time)	Repair time ends (clock time)	Machine down time (Hrs.)		
				Waiting time	Repair time	Total time
0.00	1.0	0.00	1.00	Nil	1.0	1.0
0.30	1.0	1.00	2.00	0.5	1.0	1.5
2.00	1.5	2.00	3.30	Nil	1.5	1.5
3.00	1.5	3.30	5.00	0.5	1.5	2.0
6.30	0.5	6.30	7.00	Nil	0.5	0.5
Total	**5.5 hrs.**			**1.0**	**5.5**	**6.5**

Idle time for the maintenance person = 8 - 5.5 = 2.5 hrs.

(a) Idle time cost for maintenance crew = 2.5 x 150 = Rs. 375

(b) Delay time or waiting time = 1.0 hour

Delay time cost for the machinery = 1.0 x 500 = Rs. 500

Q23. The time study of a machinery operation recorded average cycle time of 9.0 minutes. The analyst rated the observed worker as 90%. The firm uses a 0.15 allowance fraction. Compute the standard time **[June 2015 – 2 Marks]**

Answer: Average cycle time = 9.0 minutes

Normal time = 9.0 x 0.90 = 8.1 minutes

Standard Time = $\frac{81}{1-0.15}$ = 9.53 minutes

The standard time for this machinery operation would be set at 9.53 minutes, which is greater than the average cycle time observed. The average cycle time was adjusted for the rating factor (90%) & the allowance fraction (0.15).

Q24. A faculty in a college is planned to rise to strength of 60 staff members & then to remain at that level. The wastage of recruits depends upon their length of service & is as follows:

Year	1	2	3	4	5	6	7	8	9	10
Total % who left up to end of year	6	36	57	66	71	77	81	87	96	100

(a) Find the number of staff members to be recruited every year.

(b) If there are seven posts of Head of Department for which length of service is the only criterion of promotion, what will be average length of service after which a new entrant should expect promotion? **[Dec 2015 -7 Marks]**

Answer:

(a) With an intake of 100 staff members every year, the distribution of the length of service of the staff members, when equilibrium has been reached, shall be as follows:

Year	0	1	2	3	4	5	6	7	8	9	10	**Total**
No. of people Continuing	100	94	64	43	34	29	23	19	13	4	0	**423**

- Thus if 100 staff members are recruited every year, the total number of staff members after 10 years of service = 423 To maintain a strength of 60 staff members, we need to recruit 60 x $\frac{100}{423}$ = 14.18 staff members per year.
- It is assumed that those staff members who completed x years' service but left before x + 1 years' service, actually left immediately before completing x + 1 years.
- if .we assume that the staff members leave as soon as they complete x years of service, the total of the staff members would be 323.
- According to this, the recruitment necessary to have a staff members strength of 60 shall be equal to 60 x $\frac{100}{423}$ = 18.58 staff members per year. Since, in practice, the staff members may leave at any time of the year, the number of recruitments should be $\left[\frac{14.18+18.58}{2}\right]$ or 16 (app).

(b) If we recruit 16 persons every year then we want 7 seniors. Hence if we recruit 100 every year, we shall require $\frac{7}{16}$ x 100 = 44 (approx.) seniors.

It can be seen that 44 seniors will be available if we promote them during 6 year of their service

(0 + 4 + 13 + 19 +23 = 59 > 54).

Promotion of a newly recruited staff member will be due after completing 5 years & before putting in 6 years of service.

Q25. Calculate the standard production per shift of 8 hrs. duration, with the following data:

Observed time per unit = 5 minutes, Rating Factor - 120%, Total allowances = 30% of normal time. **[June 2016 – 6 Marks]**

Answer: Normal time per unit = 5 x 120/100 = 6 minutes.

Allowances = 6 x 30/100 = 1.8 minutes.

Standard time per unit = 6 + 1.8 = 7.8 minutes /units

Standard production in shift of 8 hrs. = $\frac{8 \times 60}{7.8}$ = 61.538 units.

Q26. Calculate standard time per article produced from data obtained by work sampling study: **[Dec 2015 – 7 Marks]**

Total No. of observations	2597
No. of working observations	2000
No. of units produced in 100 hrs. duration	5000 numbers
Proportion of manual labour	3/4
Proportion of machine time	1/4
Observed rating factor	120%
Total allowances	15% of normal time.

Answer:

Actual working time in the duration of 100 hrs. = 100 x $\frac{2,000}{2,597}$ = 77.01 hrs.

Time taken per article = $\frac{77.01 \times 60}{5,000}$ = 0.924 minute

Observed manual labour time per article = 0.924 x $\frac{3}{4}$ = 0.693 minute

Observed machine time per article = 0.924 x $\frac{1}{4}$ = 0.231 minute

Normal labour time per unit = $\frac{\text{Observed time}}{\text{unit}}$ x Rating factor = 0.693 x 1.20 = 0.8316 minutes

Standard labour time per unit= 0.8316 + $\frac{15}{100}$ x 0.8316 = 0.9563-minute Standard time per unit of article produced

= 0.9563 + 0.231 = **1.187 minute**

Q27. The work-study engineer carries out the work sampling study for 120 hrs. The following observations were made for a machine shop: **[Dec 2015 – 6 Marks]**

Total number of observations	7000
No. of Idle activities	1200
Ratio between manual to machine elements	3:1
Average rating factor	120%
Total number of jobs produced during study	800 units
Rest & personal allowances	17%
Compute the standard time for the job.	

Answer:

(a) Overall time per unit (To) = $\frac{\text{Duration of study}}{\text{Number of jobs produced during study}} = \frac{12 \times 60}{800}$ = 9 min.

(b) Effective time per piece (Te) = T_0 x $\frac{\text{Production observation}}{\text{total observation}}$ = 9 x $\frac{5,800}{7,000}$ = 7.46 min.

The effective time is to be segregated into manual time & machine element time.

Machine controlled time per piece (Tm) = 7.46 x 1/4 = 1.87 min.

Hand controlled time per piece (T_h) = 7.46x3/4 = 5.59 min.

Normal time per piece = Tm + T_h x performance rating = 1.87 + 5.59 x 1.2 = 8.58 min.

Standard time per piece = 8.58 (1 + 0.17) = 10.04 minutes.

Q28. Calculate standard time per article produced from data obtained by work sampling study: **[June 2017 - 10 Marks]**

Total no. of observations	2,600
No. of working observations	2,000
No. of units produced in 100 hrs. duration	5,000 numbers
Proportion of manual labour	3/4
Proportion of machine time	1/4
Observed rating factor	120%
Total allowances	15% of normal time

Answer:

1. Actual working time in the duration of-100 hrs. = 100 x $\frac{2,000}{2,600}$ = 76.923 hrs.
2. Time taken per article = $\frac{76.923 \times 60}{5,000}$ = 0.923 minute
3. Observed manual labour time per article = 0.923 x $\frac{3}{4}$ = 0.6922 minute
4. Observed machine time per article = 0.923 x $\frac{1}{4}$ = 0.230 minute
5. Normal labour time per unit = $\frac{\text{Observed time}}{\text{unit}}$ x Rating factor = 0.6922 x 1.20 = 0.8306 minute
6. Standard labour time per unit = 0.8306 + $\frac{15}{100}$ x 0.8306 = 0.9552 minute
7. Standard time per unit of article produced = 0.9552 + 0.230 = 1.185 minutes.

Q29. A Bakery shop sells bakery items. Past data of demand per week in hundred kilograms with frequency is given below:

Demand/Week	0	6	12	18	24	30
Frequency	1	12	19	8	6	4

Using the following sequence of random numbers, generate the demand for the next 10 weeks. Also find out the average demand per week. **[June 2017 - 10 Marks]**

Random numbers	12	27	18	58	43	75	31
	62	47	35	53	42	68	71

Answer:

Random No. Range Table for demand				
Demand per week	**Frequency**	**Probability**	**Cumulative Probability**	**Range**
0	1	02	02	0-1
6	12	24	26	2 - 25
12	19	38	64	26 - 63
18	8	16	80	64 - 79
24	6	1-2	92	80 - 91
30	4	08	1.00	92 - 99
	$\sum f = 50$	**1.00**		

Simulated Values for next 10 weeks		
Weeks	**R. Nos.**	**Demand**
1	12	6
2	27	12
3	18	6
4	58	12

5	43	12
6	75	18
7	31	12
8	62	12
9	47	12
10	35	12
		114

Average weekly demand = $\frac{114}{10}$ = 11.4

Q30. An incentive scheme allows proportionate production bonus beyond 100% performance level.

Calculate the amount of :

(a) Incentive bonus

(b) Total payment received by an operator on a particular day during which the following particulars apply:

Operation	Assembling a table clock set
Work Content	40 Standard minutes per assembled set
Attended Time	8 Hrs.
Time spent on unmeasured work	3 Hrs.
Number of sets assembled during the day	10
Wage rate	Rs. 5 /hrs.

(c) What is the net labour productivity achieved by the operator during the day? **[June 2017 – 6 Marks]**

Answer: Total standard minutes worked during the day = 40 x 10 = 400, working time = 8 - 3 = 5 hrs. = 300 minutes.

Performance = $\frac{400 \times 100}{300}$ = 133.34% or 0.3333

(a) Incentive bonus = 0.3333 x 5 x 5 = Rs. 8.33 for 5 hrs. on measured work

(b) Guaranteed wage for 8 hrs. = 8 x 5 = Rs. 40; Total earnings for the day = Rs. (8.33 + 40) = Rs. 48.33

(c) Net labour productivity = $\frac{\text{Output in units}}{\text{Net person hrs.}} = \frac{10}{5}$ = 2 sets /hrs.

Q31. Workers come to a tool store room to enquire about special tools (required by them) for accomplishing a particular project assigned to them. The average time between the two arrivals is 60 seconds & the arrivals are assumed to be in Poisson distribution. The average service time (of the tool room attendant) is 48 sec. Determine:

(a) Average Queue Length

(b) Average Length of non-empty queues

(c) Average number of workers in system including the worker being attended. **[Dec 2017 - 9 Marks]**

Answer: Arrival Rate: $\lambda = \frac{60}{60}$ per second = 1 per minute

Service Rate: $\mu = \frac{60}{48}$ per second = 1.25 per minute

(a) Average Queue Length:

$$L_q = \frac{\lambda}{\mu}\left[\frac{\lambda}{(\mu-\lambda)}\right] = \frac{1}{1.25} \times \frac{1}{1.25-1} = \frac{1}{1.25 \times 0.25} = \frac{16}{5} = 3.2 \text{ workers}$$

(b) Average Length of non-empty queues:

$$L_n = \left[\frac{\mu}{(\mu-\lambda)}\right] = \frac{1.25}{1.25-1} = \frac{1.25}{0.25} = 5 \text{ workers}$$

(c) Average number of workers in system:

$$L_s = \left[\frac{\lambda}{(\mu-\lambda)}\right] = \frac{1}{1.25-1} = \frac{1}{0.25} = 4 \text{ workers}$$

Q32. The below Table shows the time remaining (number of days until due date) & the work remaining (number of days' work) for 5 jobs which were assigned the Letters A to E as they arrived to the shop. Sequence these jobs by priority rules viz., (i) FCFS (ii) EDD (iii) LS (iv) SPT (v) LPT. **[Dec 2017 - 10 Marks]**

Job	Number of days until due date	Number of days' work remaining
A	9	5
B	4	7
C	5	3
D	6	6
E	8	2

Answer: Numerical: The below Table shows the time remaining

Job	Number of days until due date	Number of days work remaining
A	9	5
B	4	7
C	5	3
D	6	6
E	8	2

(a) FCFS (First come first served): Since the jobs are assigned letters A to E as they arrived to the shop, the sequence according to FCFS priority rule is ABCDE.

(b) EDD (Early Due Date job first) rule: Taking into account the number of days until due date, the sequence of jobs as per EDD rules is B C D E A (4 5 6 8 9).

(c) L.S. (Least slack) rule also called as Minimum slack rule. Calculation of slack:

Slack = (Number of days until due date) - (Number of days work remaining)

Job	Slack	(Days)
A	9-5	4
B	4-7	(-3)
C	5-3	2
D	6-6	0
E	8-2	6

Sequence: B D C A E
(-3 0 -2 4 6)

SPT (Shortest Processing Time job first) also referred as SOT (Shortest Operation time job First) rule or MINPRT (Minimum Processing time job first) rule.

Sequence: E C A D B
(2 3 5 6 7)

LPT (Longest Processing time job first) also referred to as LOT (Longest operation time job first) rule.

Sequence: B D A C E
(7 6 5 3 2)

Q33. A department works on 8 hrs. shift, 285 days a year & has the usage data of a machine, as given below:

Product	Annual Demand (units)	Processing time (Standard time in hrs.)
A	360	7.0
B	435	5.0
C	570	6.0

Calculate:

(a) Processing time needed in hrs. to produce products A, B & C,

(b) Annual production capacity of one machine in standard hrs.,

(c) Number of machines required. **[Dec 2017 – 6 Marks]**

Answer:

(a) The processing time needed in hrs. to produce products A, B & C in the quantities demanded visiting the standard time data.

Product	Annual Demand (units)	Processing time Standard time in hrs.)	Processing time needed (hrs.)
A	360	7.0	360 x 7 = 2,520
B	435	5.0	435 x 5 = 2,175
C	570	6.0	570 x 6 = 3,420
Total			**8,115 hrs.**

(b) Annual production capacity of one machine in standard hrs. = 8 x 285 = 2,280 hrs/year

(c) Number of machines required = $\frac{\text{Work load per year}}{\text{Preduction capacity per machine}} = \frac{8,115}{2,280}$ = 3.5592 machines **= 4 Machines**

Q34. A blacksmith supervisor in his workshop is considering how he should assign the four jobs that are to be performed, to four of the workers under him. He wants to assign the jobs to the workers such that the aggregate time to perform the jobs is the least. Based on previous experience, he has the information on the time taken by the four workers in performing these jobs & the same is given in the table below: **[June 2018 - 8 Marks]**

Time Taken (in minutes) by 4 Workers

Worker	Job			
	A	B	C	D
1	46	40	51	68
2	57	42	63	55
3	49	53	48	64
4	41	45	61	55

Solve the assignment problem for optimal solution using Hungarian Method.

Answer:

Step 1: The minimum value of each row is subtracted from all elements in the row. It is shown in the reduced cost table, also called opportunity cost. table, given below:

Table 1: Reduced Cost Table - 1

Worker	Job			
	A	**B**	**C**	**D**
1	6	0	11	28
2	15	0	21	13
3	1	5	0	16
4	0	4	20	14

Step 2: For each column of this table, the minimum value is subtracted from all the other values. The columns that contain a zero would remain unaffected by this operation. Hence, only the fourth column values would change. Table -2 shows this.

Table 2: Reduced Cost Table - 2

Worker	Job			
	A	**B**	**C**	**D**
1	6	0	11	15

2	15	0	21	0
3	1	5	0	3
4	0	4	20	1

Step 3: Draw the minimum number of lines covering all zeros. As a general rule, we should first cover those rows/columns which contain larger number of zeros. Table - 3 shows this.

Table - 3

Worker	Job			
	A	B	C	D
1	6	0	11	15
2	15	0	21	0
3	1	5	0	3
4	0	4	20	1

Step 4: Since the number of lines drawn is equal to 4 (=n), optimal solution is obtained. The assignments are made after scanning the rows & columns for unit zeros. Assignments made are shown with squares as shown in Table 4.

Table - 4: Assignment of Jobs

Worker	Job			
	A	B	C	D
1	6	[0]	11	15
2	15	~~0~~	21	[0]
3	1	5	[0]	3
4	[0]	4	20	1

Assignments are made in the following order. Rows 1, 3, & 4 contain only one zero each. So, assigned 1-B, 3-C, & 4-A. Since worker 1 'has been assigned job B, we cross the zero in the second column of the second row. After making these assignments, only worker 2 & job D are left for assignment. The final pattern of assignments is 1-B, 2-D, 3-C, & 4-A, involving a total time of 40 + 55 + 48 + 41 = 81 min. This is the optimal solution to the problem.

Q35. At a tool service centre, the arrival rate is 3 /hrs. & service potentials 4 /hrs. Simple queue conditions exist. The hourly wage paid to. the attendant at the service centre is Rs. 2 /hrs. & the hourly cost of a machinist away from his work is Rs. 5.

Calculate:

(a) The average number of machinists being served or waiting to be served at any given time.

(b) The average time a machinist spends waiting for service.

(c) The total cost of operating the system for an eight-hour day.

(d) The cost of the system if there were two attendants working together as a team, each paid Rs. 2 /hrs. & each able to service on average 3/hrs. **[June 2018 – 8 Marks]**

Answer: At a tool service centre, the arrival rate is 3 /hrs. & the service potentials are 4 /hrs.

Arrival Rate: $= \lambda = 3$ /hrs.

Service Rate: $= \mu = 4$ /hrs.

(a) The average number of machinists being served or waiting to be served at any given time:

$$L_n = \frac{\lambda}{\mu - \lambda} = 3\%(4-3) = 3$$

(b) The average time a machinist spends waiting for service:

$$W_a = \frac{(\lambda/\mu)\times 1}{\mu-\lambda} = \frac{(3/4)\times 1}{(4-3)} = 0.75 \text{ hours} = 45 \text{ minutes.}$$

(c) Average time in the system:

$$Ws = \frac{1}{\mu-\lambda} = 1/(4-3) = 1\text{hr.}$$

Average number of machinists in the system = 3 [As per (i) above]

Cost of three machinists being away from work = $5 \times 3 = 15$ /hrs.

Attendant cost = 2 /hrs.

Total Cost / hour = 17 /hrs.

The total cost of operating the system for an eight-hour day : $17 \times 8 = 136$

It is assumed that there is still a single service point, but the average service rate is now = 6 /hrs.

- Now $\lambda = 3$ /hrs. , $\mu = 6$ /hrs.
- Average number in the system $L_n = \frac{\lambda}{\mu-\lambda} = \frac{3}{6-3} = 1$

  Average time spent in the system $W_S = \frac{1}{\mu-\lambda} = 1/(6-3) = 1/3$ hours. $= (1/3) \times 60 = 20$ minutes.

Machinists Cost $\left[\frac{1}{3}\text{hr} \times 5\right]$	1.67
Attendant Cost	4.00
Total Cost	**5.67**

Cost per 8-hour day = $5.67 \times 8 = 45.36$

Q36. The following jobs have to be shipped a week from now (week has 5 working days)

Job	A	B	C	D	E	F
Number of day's work remaining	4	5	8	7	6	3

Sequence the jobs according to priority established by:

(a) Least slack rule

(b) Critical ratio rule **[June 2018 – 8 Marks]**

Answer:

(a) **Least Slack Rule:** Slack = Number of days until due date - Number of days works remaining

Job	(5 Days) Slack	(Days)
A	(5 - 4)	1
B	(5 - 5)	0
C	(5 - 8)	(-3)
D	(5 - 7)	(-2)
E	(5 - 6)	(-1)
F	(5 - 3)	(2)

	C	D	E	B	A	F
Sequence	-3	-2	-1	0	1	2

(b) Calculation of Critical Ratio:

Critical Ratio = $\frac{\text{Available time}}{\text{Operation time}}$

Critical Ratio for job A= $\frac{5}{4}$ = 1.25

Critical Ratio for job B = $\frac{5}{5}$ = 1.00

Critical Ratio for job C = $\frac{5}{8}$ = 0625

Critical Ratio for job D = $\frac{5}{7}$ = 0.714

Critical Ratio for job E = $\frac{5}{6}$ = 0.833

Critical Ratio for job F = $\frac{5}{3}$ = 1.667

Job having least critical ratio is given the first priority & so on.

Sequence	C	D	E	B	A	F
Critical Ratio	0.625	0.714	0.833	1.00	1.25	1.667

Q37. Find initial Feasible Solution by North-West Corner method.

	W1	W2	W3	W4	SUPPLIES
F1	47	59	55	57	150
F2	44	54	52	59	270
F3	49	64	59	61	370
F4	51	63	54	60	230
DEMAND	210	330	260	220	

W_i = Warehouse

F_i = Factory & Cell entries are unit costs. **[Dec 2018 - 6 Marks]**

Answer: **Initial Feasible Solution by North- West Corner method.**

	W1	W2	W3	W4	SUPPLIES
F1	[150] 47	59	55	57	150
F2	[60] 44	[210] 54	52	59	270
F3	49	[120] 64	[250] 59	61	370
F4	51	63	[10] 54	[220] 60	230
DEMAND	210	330	260	220	

Q38. A project consists of four major jobs, for which four contractors have submitted tenders. The tender amounts, in thousands of Rupees, are given below: **[June 2019 – 8 Marks]**

Contractor	Jobs			
	A	B	C	D
1	110	98	75	95
2	85	95	115	65
3	105	135	125	98
4	95	95	75	95

Find the assignment, which minimizes the total cost of the Project. Each contractor has to be assigned one job.

Answer: The given problem is a standard minimization problem. Subtracting the minimum element of each row from all its elements in turn, the given problem reduces to:

Q39. A departmental store is running a snack items selling outlet. Past data of snack items' demand per week in hundred kgs with frequency is given below:

Demand/Week	0	6	12	18	24	30
Frequency	3	10	9	20	6	2

Using the following sequence of random numbers, generate the demand for next 10 weeks. Also find out the average demand per week. **[Dec 2018 - 10 Marks]**

Random	21	34	48	97	72	31	45	56
Numbers	47	37	82	44	67	75	63	

Answer:

Random No. Range Table for demand

Demand per week	Frequency	Probability	Cumulative Probability	Range
0	3	0.06	0.06	0-5
6	10	0.20	0.26	6-25
12	9	0.18	0.44	26-43
18	20	0.40	0.84	44-83
24	6	0.12	0.96	84-95
30	2	0.04	1.00	96-99
	$\sum f = 50$	1.00		

Simulated value for next 10 weeks

Weeks	R. Nos.	Demand
1	21	6
2	34	12
3	48	18
4	97	30
5	72	18
6	31	12
7	45	18
8	56	18
9	47	18
10	37	12
	Total	**162**

Average Weekly Demand: $\frac{162}{10}$ = 16.2

Contractor	Jobs			
	A	B	C	D
1	35	23	0	20
2	20	30	50	0
3	7	37	27	0
4	20	20	0	20

Now subtract the minimum element of each column from all of its elements in turn. Draw the minimum number of lines, horizontal or vertical, so as to cover all zeros:

Contractor	Jobs			
	A	B	C	D
1	~~28~~	~~3~~	~~0~~	~~20~~
2	13	10	50	0
3	0	17	27	0
4	13	0	0	20

Since the minimum number of lines to cover all zeroes is equal to 4 (= order the matrix), this matrix will give optimal solution. The optimal assignment is made in the matrix below:

Contractor	Job			
	A	B	C	D
1	28	3	[0]	20
2	13	10	50	[0]
3	[0]	17	27	~~0~~
4	13	0	~~0~~	20

The optimal assignment is:

Contractors	Job	Cost (in thousands of Rupees)
1	C	75
2	D	65
3	A	105
4	B	95

Hence, total minimum cost of project will be **Rs. 3,40,000.**

Q40. A Taxi operator is planning to open a computerized ticket counter in the center of the city, staffed by one ticket agent. It is estimated that requests for tickets & information will average 18 /hrs., & requests will have a Poisson distribution.

Service time is assumed to be exponentially distributed. Previous experience with similar computerized operations suggests that mean service time should average about 2.5 minutes per request.

Determine each of the following:

(a) System utilization

(b) Percentage of time the server (agent) will be idle.

(c) The expected number of customers waiting to be served

(d) The average time customers will spend in the system. **[June 2019 - 8 Marks]**

Answer:

Arrival Rate $= \lambda = 18$ customers /hrs.

Service Rate $= \mu = 1/$ service time$= \frac{1 \text{ customer}}{2.5 \text{ minutes}} \times 60 \text{ minute} = 24$ customers /hrs.

(a) System Utilization $= p = \lambda M\mu = \frac{18}{(1\times24)} = 0.75$

(b) Percentage idle time $= 1 - p = 1 - 0.75 = 0.25$, or 25 %

(c) Expected no. of customers waiting to be served $= Lq = \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{18^2}{24 \times (24-18)} = 2.25$ customers

(d) Average time customers will spend in the system $= W_s = \frac{L_q}{\lambda} + \frac{1}{\mu} = \frac{2.25}{18} + \frac{1}{24} = 0.1667$ hrs $= 10$ minutes.

Q41. Table shows the time remaining (number of days until due date) & the work remaining (number of days still required to finish the work) for 5 jobs which were assigned the letters A to E as they arrived to the shop. Sequence these jobs by priority rules viz., (i) FCFS, (ii) EDD, (iii) LS, (iv) SPT & (v) LPT. **[June 2019 – 10 Marks]**

Job	Number of days until due date	Number of days of work remaining
A	10	8
B	4	5
C	8	7
D	11	4
E	5	9

Answer:

Job	Number days until due date	Number of days of work remaining
A	10	8
B	4	5
C	8	7
D	11	4
E	5	9

(a) FCFS (First come first served): Since the jobs are assigned letters A to E as they arrived /to the shop; the sequence according to FCFS priority rule is ABCDE

(b) EDD (Early due date job first) rule: Taking into account the number of days until due date, the sequence of jobs as per EDD rules is

Job	B	E	C	A	D
No. of days until due date	4	5	8	10	11

(c) L.S. (Least slack) rule also called as Minimum slack rule.

Calculation of Slack:

Slack = (Number of days until due date) - (Number of days of work remaining)

Job	No. of days until/due date	No. of days of work remaining	Slack (Days)
A	10	8	10 – 8 = 2
B	4	5	4 - 5 = 1
C	8	7	8 – 7 = 1
D	11	4	11- 4 = 7
E	5	9	5 - 9 = -4

Sequence:

Job	E	B	C	A	D
Slack	-4	-1	1	2	7

Here the jobs are sequenced in ascending order of magnitude of their respective slacks.

(d) SPT (Shortest Processing Time job first) also referred as SOT (Shortest Operation Time job first) rule or MINPRT (Minimum Processing Time job first) rule. As per this rule, jobs are sequenced in ascending order of magnitude of their respective processing time.

Sequence:

Job	D	B	C	A	E
Processing Time (Days)	4	5	7	8	9

(e) LPT (Longest Processing Time job first) also referred to as LOT (Longest Operation Time job first) rule.

As per this rule jobs are sequenced in descending order of magnitude of their respective processing times.

Sequence:

Job	E	A	C	B	D
Processing Time (Days)	9	8	7	5	4

Q42. Find the Initial Feasible Solution by North-West Corner method.

	W1	W2	W3	W4	Supplies
F1	10	12	14	18	210
F2	25	19	21	30	330
F3	18	16	11	23	430
F4	28	34	17	15	290
Demand	270	390	320	280	

W_j = Warehouse

F_i = Factory

Cell entries are unit costs in Rs. **[Dec 2019 – 8 Marks]**

Answer: The Initial Feasible Solution:

	W1	W2	W3	W4	Supplies
F1	10 **210**	12	14	18	210
F2	25 60	19 **270**	21	30	330
F3	18	16 **120**	11	23 310	430
F4	28	34	17 **10**	15 **280**	290
Demand	270	390	320	280	

W_j = Warehouse

F_i = Factory

Cell entries are unit costs in Rs.

Q43. A retailer is dealing with FMCG items. The table, as given below, presents the past data of demand per week in hundred kgs with frequency.

Demand/Week	0	5	10	15	20	25
Frequency	3	7	5	11	18	6

Using the following sequence of the random numbers, generate the demand for the next 10 weeks. Also find out the average demand per week. **[Dec 2019 – 8 Marks]**

Random No.	27	43	50	11	16	36
	58	64	51	38	18	47

Answer:

Random No. Range Table for Demand				
Demand per week	**Frequency(f)**	**Probability ($p = \frac{f}{\Sigma f}$)**	**Cumulative probability**	**Range of Random no.**
0	3	0.06	0.06	0 - 5
5	7	0.14	0.20	6 - 19

10	5	0.10	0.30	20 - 29
15	11	0.22	0.52	30 - 51
20	18	0.36	0.88	52 - 87
25	6	0.12	1.00	88 - 99
	$\sum f = 50$	1.00		

Simulated Value for next 10 weeks		
Weeks	**Random nos.**	**Demand**
1	27	10
2	43	15
3	50	15
4	11	05
5	16	05
6	36	15
7	58	20
8	64	20
9	51	15
10	38	15
Total	**-**	**135**

Average weekly demand is $\frac{135}{10}$ =13.5

Q44.

Job	Machine A	Machine B
1	6	4
2	5	2
3	3	8
4	1	6
5	9	5
6	7	2

In a factory, there are 6 jobs to perform, each of which should go through two machines A & B, in the order AB. The processing timings (in hours) for the jobs are given here. You are required to determine the sequence for performing the jobs that would minimize the total elapsed time, T. What is the value of T ? **[Dec 2021 – 8 Marks]**

Answer: Value of $T = 33$ hours

We need to determine the sequence for performing the jobs that would minimize the total elapsed time (T).

Steps to Find the Optimal Sequence:

1. Identify the shortest processing time among all jobs.
2. If the shortest time is on Machine A, place that job as early as possible in the sequence.
3. If the shortest time is on Machine B, place that job as late as possible in the sequence.
4. Remove the scheduled job from the list & repeat the process until all jobs are scheduled.

Step-by-Step Process:

- Identify the shortest time: Job 4 on Machine A: 1 hour
- Place Job 4 first in the sequence: Sequence: Job 4, Remaining Jobs: 1, 2,3,5,6
- Identify the next shortest time: Job 2 on Machine B: 2 hours

- Place Job 2 last in the sequence: Sequence: Job 4, Job 2, Remaining jobs: 1,3,5,6
- Identify the next shortest time: Job 6 on Machine B: 2 hours
- Place Job 6 before Job 2 in the sequence: Sequence: Job 4, Job 6, Job 2, Remaining jobs: 1, 3, 5
- Identify the next shortest time: Job 3 on Machine A: 3 hours
- Place Job 3 after Job 4 in the sequence: Sequence: Job 4, Job 3, Job 6, Job 2, Remaining jobs: 1,5
- Identify the next shortest time: job 1 on Machine B: 4 hours
- Place Job 1 before Job 6 in the sequence: Sequence: Job 4, Job 3, Job 1, Job 6, Job 2, Remaining jobs: 5
- Place the remaining job: Sequence: Job 4, Job 3, Job 1, Job 5, Job 6, Job 2

Final Sequence:

Job 4, Job 3, Job 1, Job 5, Job 6, Job 2

Calculate Total Elapsed Time (1):

Job 4: Machine A: 1 hour (0 to 1), Machine B: 6 hours (1 to 7)

Job 3: Machine A: 3 hours (1 to 4), Machine B: 8 hours (7 to 15)

Job 1: Machine A: 6 hours (4 to 10), Machine B: 4 hours (15 to 19)

Job 5: Machine A: 9 hours (10 to 19), Machine B: 5 hours (19 to 24)

Job 6: Machine A: 7 hours (19 to 26), Machine B: 2 hours (26 to 28)

Job 2: Machine A: 5 hours (26 to 31), Machine B: 2 hours (31 to 33)

Summary:

The value of T, the total elapsed time, is 33 hours.

Q45. The following table shows the time remaining (number of days until due date) & the work remaining (number of days still required to finish the work) for 5 jobs of ZBA Ltd. which were assigned the letters A to E as they arrived to the shop.

[Dec 2022 - 9 Marks]

Job	Number of days until due date	Number of days of work remaining
A	12	13
B	7	9
C	2	5
D	8	4
E	4	1

Required:

Sequence the jobs according to priority rules established by (a) First cum first served (FCFS) (b) Early due date job first (EDD) (c) Least slack (LS) (d) Shortest processing time job first (SPT) & (e) Longest processing time job first (LPT).

Answer:

(a) FCFS (First come first served): Since the jobs are assigned letters A to E as they arrived to the shop, the sequence according to FCFS priority rule is A B C D E.

(b) EDD (Early due date job first) rule: Taking into account the number of days until due date, the sequence of jobs as per EDD rules is

Job	C	E	B	D	A
Number of days until due date	2	4	7	8	12

(c) L.S. (Least slack) rule also called as Minimum slack rule.

Calculation of slack: Slack = (Number of days until due date) (Number of days of work remaining)

Job	Number of days until due date	Number of days of work remaining	Slack (days)
A	12	13	12 – 13 = -1
B	7	9	7 - 9 = -2
C	2	5	2 - 5 = -3
D	8	4	8 - 4 = 4
E	4	1	4 - 1 = 3

Sequence

Job	C	B	A	E	D
Slack	-3	-2	-1	3	4

Here, the jobs are sequenced in ascending order of magnitude of their respective slacks.

(d) SPT (Shortest Processing Time job first) also referred as SOT (Shortest Operation time job First) rule or MINPRT (Minimum Processing time job first) rule. As per this rule, jobs are sequenced in ascending order of magnitude of their respective processing time.

Job	E	D	C	B	A
Processing time (days) / Number of days of work remaining	1	4	5	9	13

(e) LPT (Longest Processing time job first) also referred to as LOT (Longest operation time job first) rule. As per this rule jobs are sequenced in descending order of magnitude of their respective processing times.

Job	A	B	C	D	E
Processing time (days) / Number of days of work remaining	13	9	5	4	1

Q46. MABUN Ltd. a company producing industrial adhesives has four sales representatives who are to be assigned to four outlets in metro cities. The monthly sales (in lakh) increase estimated for each salesman for different sales territories is shown in the following table:

Salesman	City A	City B	City C	City D
I	47	40	33	26
II	35	30	25	20
III	35	30	25	20
IV	29	25	21	17

Required:

(a) Find the optimum assignment of salesmen to outlets (cities).

(b) Find the total maximum sales (in lakh) increase per month. **[Dec 2022 - 8 Marks]**

Answer: (a) Relative Loss Matrix

Sales Man \ City	A	B	C	D
1	0	7	14	21
II	12	17	22	27
III	12	17	22	27
IV	18	22	26	30

As this is a problem of Maximization, the same is converted to one of Minimization by firming a Relative Loss Matrix where all the elements of the given matrix are subtracted from the highest element of the matrix (which is 47 in this case

Matrix after Row Operation

Sales Man \ City	A	B	C	D
I	0	7	14	21
II	0	5	10	15
III	0	5	10	15
IV	0	4	8	12

Matrix after Column Operation

City / Sales Man	A	B	C	D
I	0	3	6	9
II	0	1	2	3
III	0	1	2	3
IV	0	0	0	0

Here minimum no. of horizontal and vertical straight lines to cover all the zeros = 2 ≠ Order of the matrix. So, the solution is optimal.

Improved Matrix (Non-Optimal)

City / Sales Man	A	B	C	D
I	0	2	5	8
II	0	0	1	2
III	0	0	1	2
IV	1	0	0	0

Here minimum no. of horizontal and vertical straight lines to cover all the zeros = 3 ≠ Order of the matrix. So, the solution is optimal.

Further Improved Matrix [Optimal Solution (i)].

City / Sales Man	A	B	C	D
I	[0]	2	4	7
II	0	[0]	0	1
III	0	0	[0]	1
IV	2	1	0	[0]

Here minimum no. of horizontal and vertical straight lines to cover all the zeros = 4 ≠ Order of the matrix. So, the solution is optimal.

Further Improved Matrix [Optimal Solution (ii)]

City / Sales Man	A	B	C	D
I	[0]	2	4	7
II	0	0	[0]	1
III	0	[0]	0	1
IV	2	1	0	[0]

(b)

Rs. in lakh					
Assignment as per Solution (i)			**Assignment as per Solution (ii)**		
Sales man	**City**	**Sales**	**Sales man**	**City**	**Sales**
I	A	47	I	A	47
II	B	30	II	C	25
III	C	25	III	B	30
IV	D	17	IV	D	17
Total		**119**	**Total**		**119**

Q47. The counter of a Ration shop experiences the arrival of 25 customers during peak working hours. Service time will have Poisson Distribution. Experience suggests that mean service time should average about two minutes per customer.

Determine each of the following:

(a) System utilization

(b) Percentage of time the server (agent) will be idle

(c) The expected number of customers waiting to be served

(d) The average time customers will spend in the system. **[Dec 2022 – 8 Marks]**

Answer: Arrival rate $= 25$ customers /hrs.; Service Time $= 60/2 = 30$ customers /hrs.

(a) System Utilization $= \frac{25}{30} = 0.83$

(b) Percentage of time the server (Agent) will be idle $= 1 - 0.83 = 0.17$ or 17%

(c) Expected number of customers waiting to be served $= \frac{[(25)^2]}{[30(30-25)]} = \frac{625}{150} = 4.167$ customers

(d) Average time customers will spend in the system $= \frac{4.167}{25} + \frac{1}{30} = 0.167 + 0.033 = 0.20$ hours $= (0.20 \times 60) = 12$ minutes

Q48. Below table shows the time remaining (number of days until due date) & the work remaining (number of days still required to finish the work) for 5 jobs which were assigned the letters A to E as they arrived to the shop.

Job	Number of days until due date	Number of days of work remaining
A	6	3
B	4	8
C	2	5
D	8	6
E	7	2

Required:

(a) Sequence the jobs according to priority established by:

(b) Early Due Date (EDD) Rule

(c) Least Slack (LS) Rule

(d) Longest Processing Time (LPT) Rule

(e) Critical Ratio Rule **[June 2023 – 8 Marks]**

Answer:

(a) EDD (Early due date job first) rule: Taking into account the number of days until due date, the sequence of jobs as per EDD rules is

Job	C	B	A	E	D
Number of days until due date	2	4	6	7	8

(b) L.S. (Least slack) rule also called as Minimum slack rule.

Calculation of slack: Slack = (Number of days until due date) (Number of days of work remaining)

Job	Number of days until due date	Number of days of work remaining	Slack (days)
A	6	3	$6 - 3 = 3$
B	4	8	$4 - 8 = -4$
C	2	5	$2 - 5 = -3$
D	8	6	$8 - 6 = 2$
E	7	2	$7 - 2 = 5$

Sequence

Job	B	C	D	A	E

Slack	-4	-3	2	3	5

Here the jobs are sequenced in ascending order of magnitude of their respective slacks.

(c) LPT (Longest Processing time job first) also referred to as LOT (Longest operation time job first) rule. As per this rule, jobs are sequenced in descending order of magnitude of their respective processing times.

(d) Critical Ratio Rule:

$$\text{Critical Ratio} = \frac{\text{Number of days until due date}}{\text{Number of days of work remaining}}$$

Critical ratio for Job A $= 6/3 = 2$

Critical ratio for Job B $= 4/8 = 0.5$

Critical ratio for Job C $= 2/5 = 0.4$

Critical ratio for Job D $= 8/6 = 1.33$

Critical ratio for Job E $= 7/2 = 3.5$

Job having least critical ratio is given the first priority & so on.

Job	C	B	D	A	E
Critical Ratio	0.4	0.5	1.33	2	3.5

Q49. A factory of SPON LTD. Manufactures 3 products which are processed through 3 different production stages. The time required to manufacture one unit of each of the three products & the daily capacity of the stages are given in the following table:

State	Time/Unit in minutes			Stage capacity (minutes)
	Product 1	Product 2	Product 3	
1	1	2	1	430
2	3	-	2	460
3	1	4	-	420
Profit/Unit	Rs. 3	Rs. 2	Rs. 5	

Required: **[June 2023 - 5Marks]**

Develop a linear programming model to determine how many products to be manufactured to maximize profit.

Answer: Let number of units to be manufactured of Product 1 be X, Product 2 be Y & Product 3 be Z

Linear Programming Problem (LPP) is Objective Function:

Maximize $Z = 3X + 2Y + 5Z$

Subject to constraints:

$X + 2Y + Z \leq 430$

$3X + 2Z \leq 460$

$X + 4Y \leq 420$

$X, Y, Z \geq 0$

Q50. TANEESA, a car rental Agency has collected the following parameters on the demand for five-seater vehicles over the past 50 days.

Daily demand	5	6	7	8	10
No. of days	4	10	16	14	6

The agency has only 7 cars currently. [Given: Random numbers: 15,48,71,56,90]

Required:

(a) Using the Random numbers stated supra, develop 5 days of demand for the car rental agency.

(b) Calculate the average number of cars rented per day for the 5 days.

(c) Assess how many rentals will be lost over the 5 days. **[June 2023 – 6 Marks]**

Answer: **Random Number Coding**

Daily Demand	Number of days	Probability	Cumulative Probability	Random Number Coding
5	4	0.08	0.08	00 – 07
6	10	0.20	0.28	08 – 27
7	16	0.32	0.60	28 – 59
8	14	0.28	0.88	60 – 87
10	6	0.12	1.00	88 – 99
Total	**50**			

(a) Calculation of daily demand based on random numbers given:

Days	Random Number	Daily Demand
1	15	6
2	48	7
3	71	8
4	56	7
5	90	10

(b) Average number of cars rented per day = 6.8 cars

(c) Rentals those shall be lost = 4 Nos.

Q51. In a job shop operation of ZINT Ltd., 5 jobs may be performed on any four machines. The hours are required for each job on each Machine are presented in the following table.

Machine Job	1	2	3	4
A	6	2	5	2
B	2	5	8	7
C	7	8	6	9
D	6	2	3	4
E	9	3	8	9

The plant foreman would like to assign the jobs so that the total time is minimized.

Required: Develop the Optimal assignment of jobs to Machines & Assess the Corresponding Total Time (in hours) & also identify the job which will be left unassigned. **[Dec 2023 – 7 Marks]**

Answer:

Step 1: Since the number of Jobs are not equal to the number of Machines, a dummy Machine - 5 is created. The time (in hours) Consumed by any Job for the dummy Machines - 5 is 0.

Machines Job	1	2	3	4	5
A	6	2	5	2	0
B	2	5	8	7	0
C	7	8	6	9	0
D	6	2	3	4	0
E	9	3	8	9	0

Step 2: Column Operation

Machines Job	1	2	3	4	5
A	4	0	2	0	0
B	0	3	5	5	0

C	5	6	3	7	0
D	4	0	0	2	0
E	7	1	5	7	0

Here minimum no. of Horizontal & Vertical Straight lines to cover all the Zeros = 4* order of Matrix (5), So, Solution is non-optimal.

Step 3: Subtract ⊥ from every uncovered value & add ⊥ to every value at the intersection of two lines. Draw the number of lines to cover all Zeros.

Improved Matrix

Machines Job	1	2	3	4	5
A	4	0	2	0	1
B	0	3	5	5	1
C	4	5	2	6	0
D	4	0	0	2	1
E	6	0	4	6	0

Here minimum no. of Horizontal & Vertical Straight lines to cover all the Zeros = 5 order of Matrix.

So, the solution is optimal. Hence, the optimal assignment is made in the matrix below.

Machines Job	1	2	3	4	5
A	4	0	2	[0]	1
B	[0]	3	5	5	1
C	4	5	2	6	[0]
D	4	0	[0]	2	1
E	6	[0]	4	6	0

The optimal assignment & corresponding Time are as follows:

Jobs	Machine	Time (in hours)
A	4	2
B	1	2
C	5 (Dummy)	0
D	3	3
E	2	3
		10

Minimum Time is 10 hours & Unassigned Job is C.

Q52. RAGON (P) & Co. has a single machinist in a repair shop. He works eight hours a day & on an average four machines break each day. It takes on the average one hour to repair a machine. Simple queue conditions exist.

Required:

(a) Identify the expected number of machines on the repair shop.

(b) Determine the expected number of machines in the shop on which the machinist has not started to work.

(c) Assess the average down-time (waiting for repairs or undergoing repairs) per machine?

(d) The average time a machine waits for service would be how much? **[Dec 2023 – 7 Marks]**

Answer: Mean arrival rate: $\lambda = \frac{1}{2h}$; Mean service rate: $\mu = \frac{1}{1h}$

Traffic intensity (or utilization factor): $p = \frac{\lambda}{\mu} = \frac{1/2}{1} = \frac{1}{2}$

1. The expected number of machines in the repair shop: $Ls = \frac{\lambda}{\mu-\lambda} = \frac{1/2}{1-1/2} = 1$

2. Expected number of machines in the shop on which the mechanist has not started to work: $Lq = \frac{p^2}{1-p} = \frac{(1/2)^2}{1-\frac{1}{2}} = 0.5$

3. The average down time (waiting for repairs or undergoing repairs) per machine: $Ws = \frac{1}{\mu-\lambda} = \frac{1}{1-\frac{1}{2}} = 2$ hours

4. The average time a machine waits for service: $Wq = \frac{q}{(\mu-\lambda)} = \frac{1}{2} \times 2 = 1$ hour.

Q53. In a Book Sales Emporium of PRANTIK (B) Ltd., four Salesmen A, B, C & D are available in four Counters P, Q, R & S. Each Salesman can handle any counter. Their Services (in hours) of each counter, when manned by each Salesman is given below:

	Counter			
Salesman	**P**	**Q**	**R**	**S**
A	30	46	34	22
B	11	20	11	5
C	28	43	28	18
D	14	23	17	8

Required:

(a) Analyze & Assign the Salesmen to appropriate counters so as to minimize the service time.

(b) Assess the total service times (in hours). **[June 2024 – 7 Marks]**

Answer:

	Counter			
Salesman	**P**	**Q**	**R**	**S**
A	30	46	34	22
B	11	20	11	5
C	28	43	28	18
D	14	23	17	8

Required:

(a) Analyze & Assign the Salesmen to appropriate counters so as to minimize the service time.

(b) Assess the total service times (in hours).

Answer:

Step 1: Matrix after Row Operation.

	Counter			
Salesman	**P**	**Q**	**R**	**S**
A	8	24	12	0
B	6	15	6	0
C	10	25	10	0
D	6	15	9	0

Step 2: Matrix Column Operation.

	Counter			
Salesman	**P**	**Q**	**R**	**S**
A	2	9	6	0
B	~~0~~	~~0~~	~~0~~	~~0~~
C	4	10	4	0
D	~~0~~	~~0~~	~~3~~	~~0~~

The numbers of allocated cells are not equal to the number of rows. Hence, the solution is not optimal

1. The revised table is prepared by considering the least uncovered value 2, & adjusting it with uncovered cell values & those lying at the intersection of lines.

	Counter			
Salesman	**P**	**Q**	**R**	**S**
A	0	7	4	0
B	0	0	0	2
C	4	8	2	0
D	0	0	3	2

2. Minimum number of lines to cover all zeros equal 4 which matches with the order to the Matrix (as shown in Table-3). Assignments made are shown with squares as shown in Table - 4.

	Counter			
Salesman	**P**	**Q**	**R**	**S**
A	[0]	7	4	0
B	~~0~~	~~0~~	[0]	2
C	4	8	2	[0]
D	~~0~~	[0]	3	2

The optimal assignment is:

Sales	Counter	Service time (Hours)
A	P	30
B	R	11
C	S	18
D	Q	23
	Total	**82**

Q54. A production line of ZFORD (M) Ltd., turns out about trucks per day; fluctuations occur for many reasons. The production can be described by a probability distribution as follows:

Production Per day	Probability	Production per day	Probability
45	0.03	51	0.15
46	0.05	52	0.10
47	0.07	53	0.07
48	0.10	54	0.05
49	0.15	55	0.03
50	**0.20**		

Finished trucks transported by a Train at the end of the day. The train capacity is only 51.

[Given: Random number: 37,35,63,25,50,71,95,16,55 & 53]

Required:

(a) Using the Random numbers stated Supra, Simulate the productions & waiting of trucks in the factory for the first 10 days.

(b) Evaluate the average number of trucks waiting in the Factory.

(c) Assess what will be the average number of empty spaces on the train. **[June 2024 – 7 Marks]**

Answer:

1. Statement showing allocation of Random Numbers

Production per Day	Probability	Cumulative Probability	Random Number Assigned
45	0.03	0.03	00 - 02
46	0.05	0.08	03 - 07
47	0.07	0.15	08 - 14
48	0.10	0.25	15 - 24
49	0.15	0.40	25 - 39
50	0.20	0.60	40 - 59
51	0.15	0.75	60 - 59
52	0.10	0.85	75 - 84
53	0.07	0.92	85 - 91
54	0.05	0.97	92 - 96
55	0.03	1.00	97 - 99

Simulation Work Sheet:

SN	Random No.	Production Per day	Capacity of Train	No. of Trucks waiting in the Factory	Trucks Shipped	No. of Empty space on the Train
01	37	49	51	-	49	2
02	35	49	51	-	49	2
03	63	51	51	-	51	-
04	25	49	51	-	49	2
05	50	50	51	-	50	1
06	71	51	51	-	51	-
07	95	54	51	3	51	-
08	16	48	51	-	51	3
09	55	50	51	-	50	1
10	53	50	51	-	50	1
Total				**3**		**12**

2. Average number of Trucks waiting in the factory = 0.30
3. Average number of empty spaces in the train = 1.20

5 PRODUCTIVITY & QUALITY MANAGEMENT

Q1. Identify the relationship between R & D Inputs & Output. **[Dec 2013 – 5 Marks]**

Answer: Some important variables determining R & D efforts & its success have been identified as follows:

(a) The size of the operation has been found to be positively related to the success of R & D.

(b) The presence of technological opportunities in the industry leads to better R & D efforts.

(c) The philosophy & genuine efforts of the management are necessary for successful R & D efforts.

(d) The contribution of individual researchers to R & D has been found to be quite substantial.

(e) R & D efforts are likely to be more effective where growth prospects are good & profits are likely to be high.

(f) Diversification is positively related to the R & D efforts, as there is scope of their utilization.

(g) A number of studies have suggested a strong relationship between R & D & the marketing opportunities for a new product. Market opportunities have been found to contribute three times more than technical opportunities as sources for innovations.

Q2. Kindly mention the Principles of Total Quality. **[Dec 2013 – 2 Marks]**

Answer:

1. Quality oriented management
2. Focus on customer
3. Involving (entire) work force
4. Continuous improvement
5. Supplier Partnership
6. Measuring performance

Q3. What are the advantages of KAIZEN Technique? **[Dec 2013 – 4 Marks]**

Answer: Kaizen is focused on making small improvements on a continuous basis. In simple terms Kaizen is Japanese for 'a change for better', which results in 'continuous improvement'.

The advantages of KAIZEN are as follows :

1. Kaizen involves every employee in process of change mostly in small, incremental changes. It focuses on identifying problems at their own source, solving them at their own source, & changing standards to ensure the problem stays solved forever, *
2. By involving employees, they start looking about change at their environment to bring up results in their work area & improved morale as employee begins to find work more enjoyable & easier.
3. Kaizen reduces waste in area such as employee skills, waiting time, transportation, worker motion, over production, excess in inventory, quality & process.
4. Kaizen improves product quality, use of capital, production capacity, communications, space utilization & employee retention.
5. Incorporation of visual action-oriented tasks.

Q4. State the three models of Productivity Measurement. **[Dec 2013 – 4 Marks]**

Answer: The models of Productivity Measurement can be classified into three on the basis of the type & coverage of the output & input variables,

(a) Ratio method (b) Production Function method (c) POP method.

Q5. Briefly state the role of Information Technology in Production/ Operations Management. **[June 2014 – 3 Marks]**

Answer : Information technology is crucial to operations everywhere along the supply chain & to every functional area. Computer based information technology, in particular, has greatly influenced how operations are managed & how offices work. It makes cross-functional co-ordination easier & links a firm's basic processes. In a manufacturing plant, information technologies can link people with the work centres, data bases & computers.

Q6. You are appointed as a Consultant to implement ISO- 9000 in a firm. Suggest various steps to be taken for implementing this. **[June 2014 – 10 Marks]**

Answer: Implementation of ISO 9000 affects the entire organization right from the start. If pursued with total dedication, it results in 'cultural transition' to an atmosphere of continuous improvement.

Suggestions to be taken for Implementing ISO-9000 are following:

Step 1: Commitment from Top Management

The top management of an organization should be determined & committed to implement a quality management system. No quality initiative within an organization can succeed without commitment from top management. Top management can demonstrate to their clients that the organization is committed to quality through the certification & registration of the SO 9000 standard. Top management should thus come to the realization that overall business efficiency would be improved by means of a quality management system.

Step 2: Establishing an Implementation Team

People are responsible for the implementation of ISO 9000. An implementation team, headed by a Service Provider & a Management Representative (MR), is to be established. The Service Provider & MR are the coordinators & are responsible for planning & overseeing the implementation of the quality management system. They are thus, the link between top management & the ISO 9000 registrar. All departments within the organization should be represented on the implementation team.

Step 3: Conducting ISO 9000 Awareness Programs

Conducting ISO 9000 awareness programs will inform all employees about the aim of a quality management system. These include the advantages offered to customers & employees, their respective responsibilities & roles within the system, & how the quality management system operates. The benefits that an organization hopes to realize through a quality management system implementation should be emphasized through ISO 9000 awareness programs.

Step 4: Providing Training

All personnel & all areas in an organization are affected by a quality management system. Training regarding the quality management system should thus be provided for all employees. The quality management system implementation plan should make provision for this training. All basic concepts of quality management systems & its impact on the organization should be covered.

Step 5: Conducting an Initial Status Survey

A quality management system conforming to the ISO 9000 standard should be created. However, this does not preclude incorporating, adapting, or adding onto quality programs that already exist. Thus, this step basically involves comparing an organization's existing quality management system (if there is one) with the requirements of ISO 9001:2008.

Step 6: Creating a Documented Implementation Plan

Once an organization's quality management system has been compared with the ISO 9001:2008 standard, a documented implementation plan is used to address any non- conformance. The documented implementation plan identifies & describes processes in order to make the organization's current quality management system in full compliance with the ISO 9000 standard.

The implementation plan should be thorough & specific, detailing:

- Quality documentation to be developed
- Objective of the system
- Pertinent ISO 9001: 2008 section
- Person or team responsible
- Approval required
- Training required
- Resources required
- Estimated completion date

Step 7: Developing a Quality Management System Documentation

Documentation is an area where non-conformance regarding quality management systems is very common. In order to avoid these non-conformities documentation of a quality management system should include the following:

- Documented statements of a quality policy & quality objectives.
- Documented procedures & records required by the standard of ISO 9001:2008.
- Documents needed to ensure effective planning, operation & control of its processes.

Step 8: Control of Documents

In order to control quality management system documentation, a documented system should be created. The creation, approval, distribution, revision, storage, & disposal of various types of documentation are thus managed. Document control systems should be as easy & simple to operate as possible. However, it should still be sufficient enough to meet the requirements of ISO 9001:2008.

Step 9: Implementation

In. large organizations, it is best to implement the quality management system being documented as the documentation is developed. This is in stark contrast to smaller organizations, where the quality management system is implemented throughout the organization all at once. During phased implementation, however, an evaluation can take place regarding the effectiveness of the system in different areas.

Through management review & an internal quality audit, the implementation progress is monitored to ensure that the quality management system is effective & thus, conforms to the ISO 9000 standard.

Step 10: Internal Quality Audit

The effectiveness of the installed system should be checked regularly by means of an internal quality audit. Below are some reasons for conducting an internal quality audit into a quality management system:

- To ensure that the quality management system conforms to the quality management system requirements established by the organization, as well as to the requirements of the ISO 9001:2008 standard; &
- To ensure that the quality management system is implemented & maintained in an effective manner.

Step 11: Reviewing by Management

A management review should be conducted three to six months after quality management system implementation took place. The reasons for conducting management reviews are to ensure continuous effectiveness, adequacy & suitability of the quality management system.

Step 12: Pre-assessment Audit

Before applying for certification, a pre-assessment audit usually takes place. Certification bodies provide a qualified but independent guditor to conduct this service. Some degree of confidence is gained before application for certification, if the pre-assessment audit goes well.

Step 13: Certification & Registration

A formal application for certification is made at a certification body as soon as the quality management system has been operating for a few months & has stabilized. An audit of the documents (known as an adequacy audit) is first carried out, & if it conforms to 'the requirements of the quality standard, it is followed by an on-site audit. A certificate is only awarded to the organization if the certification body is satisfied with the workings of the system. However, the certificate is valid for a period of three years only, after which the certification body will carry out periodic surveillance audits.

Step 14: Continual Improvement

Certification to ISO 9000 should not be an end. The organization should continually seek to improve the effectiveness & suitability of the quality management system through the use of:

- Quality policy
- Quality objectives
- Audit results
- Analysis of data
- Corrective & preventive actions
- Management review

ISO 9001:2008 provides a methodology for continual improvement

Q7. State the 3 levels of quality. **[June 2014 - 3 Marks]**

Answer: 3 levels of Quality:

(a) Organization level: Satisfying requirements of external customers.

(b) Process level: Meeting the needs of internal customers.

(c) Performer level (job level or task design level): Meeting & maintaining the requirements of accuracy, completeness innovation, timeliness & cost.

Q8. Write the formula for Input Efficiency & Effectiveness. **[Dec 2014 - 2 Marks]**

Answer: Input efficiency = $\frac{\text{Actual consumption}}{\text{Desired or standard consumption Effectiveness}} = \frac{\text{Target achieved}}{\text{Target achievable}}$

Q9. State the 4 generic components of technological innovation. **[Dec 2014 - 4 Marks]**

Answer: The technological innovation system is a concept developed within the scientific field of innovation studies which serves to explain the nature & rate of technological change.

Generic components of technological innovation Four generic components of technological innovation are as follows:

Basic research	It is research for the advancement of scientific knowledge that has no specific commercial uses.
Applied research	It is research for the advancement of scientific knowledge that has specific potential commercial uses.
Development	It is technical activity concerned with translating basic or applied research results into products or processes.
Implementation	It is activity concerned with designing & building pilot models, equipment, & facilities, & initiating the marketing channels for products or services emerging from research & development.

Q10. State the 8 Most Common Benchmarking Errors. **[Dec 2014 - 8 Marks]**

Answer:

Lack of self-knowledge	unless you've thoroughly analysed your own operations, your benchmarking efforts will not pay off. You have to know how things work in your company, how effective your current processes are, & what factor are critical. That's why internal benchmarking is an important first step.
Benchmarking everything	Be selective. Benchmarking another company's employee food service will usually not be worth the time, energy & cost. Your TQM effort as a whole will point out the areas where benchmarking is most likely to pay off.
Benchmarking projects	are broad instead of focused. The more specific the project, the easier it is & the more likely it will generate useful ideas. Benchmark a successful company's hiring procedures, not their entire human resources operations. Focus on accounts receivable handling, hot the accounting department as a whole. -
Benchmarking produces reports	not action. Studies have indicated that 50% of benchmarking projects result in no specific changes. The process is not an academic exercise. It should be geared toward generating & implementing actual changes.
Benchmarking is not continuous	Benchmarking is a process, even before you reach the benchmark you've set, you should take another look at your partner's performance, or at other companies. New goals should be established & new techniques adopted. The process never ends.
Setting Too Many Goals	When you start setting goals, you may see many things that you want to accomplish. So, you start setting goals in all areas. The problem with this is that you have a fixed amount time & energy. If you try to focus on many different goals at once, you can't give individual goals the attention they deserve.
Participants are not motivated	Make sure benchmarking team members have the time to do the job. Even if the project is simply added on their regular jobs, make sure each has a stake in the success of the project. Don't consider benchmarking as "busy work" to be assigned to a group of low-level employees.
Too much data	Actions are what's important, not information for its own sake. Don't measure benchmarking success by quantity of information. Always focus on key issues.

Q11. What are the different approaches to overcome hurdles in the management of productivity improvements? **[June 2015 - 2 Marks]**

Answer: The different approaches to overcome hurdles in the management of productivity improvements are as follows:

(a) Management by internal motivation (i.e., KAIZEN).

(b) Management by incentives.

(c) Management by fear.

Q12. What is TQC & what are its principles? **[June 2015 - 5 Marks]**

Answer: TQC is Total Quality Control, it is quality control & improvement from shop floors to board rooms. It is an effective system for integrating quality development, quality maintenance & quality improvement efforts of various groups in an organization.

Principles of Total Quality Control (TQC)

(a) Top management policies-Zero defects, continuous improvement etc.
(b) Quality control training for everyone.
(c) Quality at product/service design stage.
(d) Quality materials from suppliers.
(e) Quality control in production (SQC).
(f) Quality control in distribution, installation & usage.

Q13. As a Consultant what would be your suggestions to a Production Manager for managing technological changes? **[June 2015 - 5 Marks]**

Answer: As a consultant my suggestions to production managers for managing technology changes are as follows:

(a) Make a master plan for automation.
(b) Find out the risks in going for automation.
(c) Establish a new production technology or technology development department.
(d) Allow plenty of time for the completion of automation projects.
(e) Do not try to automate everything at once.
(f) People are the key to the successful implementation of automation projects.
(g) Companies moving too slowly in adopting new production technology, may be left behind others.

Q14. Write a line to define the following terms with reference to measuring productivity:
(a) Validity (b) Completeness (c) Compatibility (d) Inclusiveness
(e)Timeliness (f) Cost effectiveness (g) Partial productivity **[June 2015 – 7 Marks]**

Answer:

Measuring Productivity: Bain suggests that a good productivity measure should possess the following properties. The more closely the measurement meets these criteria, the more useful it is for improving productivity.

(a)	**Validity**	It reflects accurately the changes in productivity.
(b)	**Completeness**	It takes into consideration all components of both the output & the input for a given productivity ratio.
(c)	**Compatibility**	It enables the accurate measurement of a productivity change between periods.
(d)	**Inclusiveness**	It takes into account & measures separately the productivity of all activities.
(e)	**Timeliness**	It ensures that data is provided soon enough for managerial action to be taken when problems arise.
(f)	**Cost effectiveness**	It obtains measurement in a manner that will cause the least interruption possible to the ongoing productive efforts of the firm.
(g)	**Partial Productivity**	This measures productivity of one factor or input, keeping other factors or inputs constant or unchanged.

Q15. Define Quality Triology under Total Quality Management. **[Dec 2015 - 2 Marks]**

Answer: Under Total Quality Management quality Juran takes a holistic approach to quality & his concept of quality revolves around what is called a quality trilogy, which is composed of:

(a) Quality planning
(b) Quality control
(c) Quality improvement.

Q16. "Higher productivity has. manifold advantages." State these advantages. **[Dec 2015 - 6 Marks]**

Answer:

1. To the Individual Concern:
   (a) Higher productivity means more wages directly to the piece-workers & more production bonus to all workers. It means satisfied staff & harmonious staff relations.
   (b) The factory earns more profit because of the reduction in costs.
   (c) Continuous higher productivity may induce the management to reduce selling prices so that sales & production may increase.
2. To the Industry: Higher productivity in some concerns will enable less efficient firms to follow them for their own survival.
3. To the Government:
   (a) Higher profits earned by factories will bring more revenue to the government by taxation.
   (b) Export trades may develop bringing more foreign exchange to the nation.
   (c) Overall higher productivity will raise an all-round standard of labour.

Q17. Explain ' 8 Steps Benchmarking Process'. **[Dec 2015 – 6 Marks]**

Answer:

1. Select Benchmarking subject & appropriate team
2. Identify performance indicators & Drivers
3. Select Benchmark partners
4. Determine data collection method & collect data
5. Analyse performance gaps.
6. Communicate Findings & identify projects to close gaps
7. Implement plans & monitor results
8. Recalibrate benchmarks.

Q18. Write the formula for Input Efficiency. **[June 2016 – 2 Marks]**

Answer: Input Efficiency = $\frac{\text{Actual Consuption}}{\text{Desired or Standard Consumption}}$

Q19. List the benefits of Benchmarking. **[June 2016 – 8 Marks]**

Answer:

- Benchmarking is particularly helpful in validating proposals for change.
- Benchmarking of 10 results in creative imitation & adoption of new practices that overcome previous industry barriers.
- This search for diversity & for innovative breakthroughs, applied elsewhere is at the core of benchmarking benefits.
- By sharing information, all parties' benefits, because it is difficult to excel in all activities.
- Sharing information & data is often first hurdle to be overcome in the Benchmarking process.
- Do not, however, attempt benchmarking in areas in which trade secrets or sensitive information determines the outcome of the process.
- Benchmarking, used in conjunction with other quality techniques or used alone, can influence how an organisation operates.
- If the search for "Best", or just "Better" practices is performed correctly, then the likelihood of successful outcomes is quite high.

Q20. List causes of low productivity in the Indian context. **[Dec 2016 -2 Marks]**

Answer:

- In the Indian context, the causes of low productivity have their origin in two distinct sources.
- The first category consists of the exogenous or external factors like shortages of essential inputs-power, raw materials, transport facilities etc. - over which the management of an enterprise has little or no control.
- The second basket contains the endogenous or internal factors mainly
- in the form of system deficiencies preventing the optimum utilisation of resources.

Q21. A firm uses Rs. 20,00,000 in capital & 20,000 labour hrs. per year to produce Rs. 2,00,00,000 in product. What is the partial productivity of labour? **[Dec 2013 - 1 Marks]**

Answer : Partial productivity of labour = $\frac{\text{Total Output}}{\text{Labour hour}} = \frac{2,00,00,000}{20,000}$ = **Rs. 1,000**

Q22. Compute productivity per machine hour with following data. Also draw your interpretation. **[June 2014 - 2 Marks]**

Month	No. of machines	Working hrs.	Production units
March	400	225	99,000
April	500	200	1,00,000
May	600	250	1,35,000

Answer:

Productivity per machine hour = $\frac{\text{Number of unit Produced}}{\text{Machine hrs.}}$

Productivity per machine hour for March = $\frac{99,000}{90,000}$ = 1.1 units

Productivity per machine hour for April = $\frac{1,00,000}{1,00,000}$ = 1 unit

Productivity per machine hour for May = $\frac{1,35,000}{1,50,000}$ = 0.9 unit

Interpretation: Though the total production in number of units is increasing, the productivity is declining.

Q23. A worker is employed for 11 hrs. During this period, he takes 7 hrs. to complete a job with the standard time of 6 hrs. Calculate the productivity of the worker as a percentage. **[Dec 2014 - 2 Marks]**

Answer: Productivity = $\frac{\text{Standard hrs.of output}}{\text{Clock hrs.Scheduled}} = \frac{6}{11}$ x 100 = 54.55%

Q24. Compute productivity per machine hour with following data. Also draw your interpretation. **[Dec 2015 – 5 Marks]**

Month	No. of machines employed	Working hrs.	Production Units
July	400	225	99,000
August	500	200	1,00,000
September	600	250	1,35,000

Answer: The table is drawn as under:

Month	No. of machines employed	Working hrs.	Machine Hrs.	Production Units
July	400	225	90,000	99,000
August	500	200	1,00,000	1,00,000
September	600	250	1,50,000	1,35,000

We know, p = Productivity per machine hour = $\frac{\text{Number of units produced}}{\text{Machine hrs.}}$

For July p = $\frac{99,000}{90,000}$ = 1.1

August p = $\frac{1,00,000}{1,00,000}$ = 1

September p = $\frac{1,35,000}{1,50,000}$ = 0.9

Interpretation: Though the total production in number of units is increasing, the productivity is declining.

Q25. Compute productivity per machine hour with following data. Also draw your interpretation. **[June 2016 - 4 Marks]**

Month	No. of machines employed	Working hrs.	Production Units
January	400	220	99,000
February	550	180	1,00,000
March	580	220	1,25,000

Answer:

Month	No. of Machines employed	Working hrs.	Machine hrs.	Production units
January	400	220	88,000	99,000
February	550	180	99,000	1,00,000
March	580	220	1,27,600	1,25,000

Productivity per machine hour, for

January = $\frac{99,000}{88,000}$ = 1.125

February = $\frac{1,00,000}{99,000}$ = 1.01

March = $\frac{1,25,000}{1,27,000}$ = 0.9796

Interpretation: Total production in number of units is increasing however, the productivity is declining.

Q26. Compute productivity per machine hour with following data. Also draw your interpretation. **[Dec 2016 – 7 Marks]**

Month	No. of machines employed	Working hrs.	Production units
July	390	210	95,000
August	540	170	1,00,000
September	570	230	1,30,000

Answer:

Month	No. of machines employed	Working hrs.	Machine hrs.	Production units
July	390	210	81,900	95,000
August	540	170	91,800	1,00,000
September	570	230	1,31,100	1,30,000

P = Productivity per machine hour = $\frac{\text{Number of units produced}}{\text{Machine hrs.}}$

For July P = 95,0000/ 81,900= 1.160
August P = 1,00,000/91,800= 1.089
September P = 1,30,000/1,30,000= 0.992

Interpretation: Though, the total production in number of units is increasing, the productivity is declining.

Q27. The following data is available for a manufacturing unit:

No. of operators	16
Daily working hrs.	8
No. of days per month	25
Standard production per month	400 units
Standard labour hrs. per units	8

The following information was obtained for June 2019:

Man, days lost due to absenteeism	36
Units produced	300
Idle time	260-man hrs.

Find the following:
(a) Percent absenteeism
(b) Efficiency of utilization of labour

(c) Productive efficiency of labour

(d) Overall productivity of labour in terms of units produced per man per month. **[Dec 2019 - 8 Marks]**

Answer:

(a) Percent absenteeism = $\frac{\text{No.of Hrs.lost in absenteeism in a month}}{\text{Total working hrs.per month}}$ x 100 = $\frac{36 \times 8}{16 \times 25 \times 8}$ = 0.09 x 100 = 9%

(b) Efficiency of utilization of labour = $\frac{\text{Standard labour hour to produce 300 units}}{\text{Total labour hour}}$ x 100 = $\frac{300 \times 8}{16 \times 25 \times 8}$ x 100 =75%

(c) Determination of Productive efficiency of labour:

Standard time required to produce 300 units = 300 x 8 = 2400 labour hrs. In June 2019, man hrs. lost = 36 x 8 = 288

In June 2019, Idle time (in hrs.) = 260 Total loss of time = 548 hrs. Productive hrs. available in June 2019 = 16 x 25 x 8 = 3,200 hrs. Less, Total loss of time: 548 hrs.

Actual Labour hrs. = 3200 - 548 = 2,652 hrs Productive efficiency of labour = $\frac{\text{Standard Labour hrs.}}{\text{Actual labour hrs.}}$ x 100 = $\frac{2,400}{2,652}$ x 100 = 90.497% = 90.50 % (approx.)

(d) Overall productivity of labour in terms of units produced per man per month: 16 men produce 400 units, Standard labour productivity = $\frac{400}{16}$ = 25 units In June 2019, overall productivity = $\frac{300}{16}$ = 18.75 units

i.e. productivity falls by $\frac{25 - 18.75}{25}$ x 100 = 25%

Q28. You are working as a Production Manager in a manufacturing unit. The executive management of this company has decided to go for the ISO certification for this unit. For this purpose, you are appointed as a Management Representative to ensure successful implementation of ISO certification. Now answer the following:

(a) What are all those broad activities that you have to consider for such responsibility?

(b) What are the five standards associated with ISO 9,000 series, that you have to thoroughly refer to, for finding out the best fitment for your unit?

(c) In which scenarios, ISO certification is a must, & is particularly helpful?

(d) When is it reviewed? **[Dec 2021 - 12 Marks]**

Answer:

(a) ISO certification is an elaborate & expensive process.

- You need to document how workers of your unit perform every , function that affects quality & install mechanisms to ensure that, they follow on expected lines.
- ISO 9000 certification entails a complex analysis of management systems & procedures. Rather than judging the quality of a particular product, ISO 9000 evaluates the management of the entire manufacturing process, from purchasing, to design, to training.
- You must fill out a report & then be certified by a team of independent auditors. With certification comes registration in an ISO directory, that your firm can refer to, for a list of certified companies.
- They are generally given preference over unregistered companies,

(b) Quality System:

- 9001 Model for Quality Assurance in Design, Production, Installation & Servicing. (To be used when conformance to specified requirements is to be assured by the supplier during several stages that may include design/development, production, installation & servicing).
- 9002 Model for Quality Assurance in Production & Installation. (To be used when conformance to specified requirements is to be assured by the supplier during production & installation).
- 9003 Model for Quality Assurance in Final Inspection Test. (To be used when conformance to specified requirements is to be assured by the supplier solely at final inspection & test).
- Guidelines for Use: 9000 Quality Management & Quality Assurance Standards - Guidelines for Selection & Use 9004 Quality Management & Quality System Elements - Guidelines

(c) ISO certification is a must for doing business with any member of the EU.

In addition to the benefits of accessing the EU, ISO 9000 certification & registration is particularly helpful for companies that do not currently have a quality management system, as it provides guidelines for establishing the system & making it effective.

(d) ISO standards are reviewed every 5 years & revised, if needed. This helps ensure they remain useful tools for market place.

Q29. The Quantitative Parameters pertaining to a machine extracted from the records of a manufacturing unit of SONIX Ltd. are as given below:

Working days for month	25
Hrs. worked per day	8
Standard Minutes per unit of production:	-
Operator Time (Minutes)	12
Machine Time (Minutes)	36
Total time per unit (Minutes)	48
Number of Operators	1
Number of Machines	1

(No. of Units to be. Rounded off to the nearest integer)

Required:

(a) If the plant is operated at 80% efficiency & the operator is working at 100% efficiency, calculate the output (units) per month. **[June 2023 – 4 Marks]**

(b) If the Machine productivity is reduced by 10% over existing level, assess the output (in units) per month.

Answer:

If plant is operated at 80% efficiency.

Output per month = 200 units

If the machine productivity is reduced by 10% over existing level.

Output per month = 184 units.

Given Data:

Working days per month: 25

Hrs. worked per day: 8

Standard minutes per unit of production:

- Operator time: 12 minutes
- Machine time: 36 minutes
- Total time per unit: 48 minutes

Number of operators: 1

Number of machines: 1

- Plant efficiency: 80%
- Operator efficiency: 100%

To Find:

1. Output (units) per month at 80% efficiency.
2. Output (units) per month if machine productivity is reduced by 10%.

Calculations:

Output per month at 80% efficiency:

Step-by-Step Process:

1. Calculate total working minutes per month:
   - Total working hrs. per month = 25 days x 8 hrs./day = 200 hrs.
   - Total working minutes per month = 200 hrs. x 60 minutes/hour = 12000 minutes
2. Calculate effective working minutes considering plant efficiency:
   - Effective working minutes = Total working minutes per month * Plant efficiency

- Effective working minutes = 12,000 minutes x 80% = 12,000 x 0.8 = 9600 minutes

3. Calculate output units per month:
   - Total time per unit = 48 minutes (sum of operator time & machine time)
   - Output units = $\frac{\text{Effective working minutes}}{\text{Total time per unit}}$
   - Output units = $\frac{9600}{48}$ minutes per unit = 200 units

So, the output per month at 80% efficiency is 200 units.

Output per month if machine productivity is reduced by 10%:

Step-by-Step Process:

1. Calculate new machine time per unit:
   - Machine time is reduced by 10%, so new machine time = 36 min x 110% = 36 x 1.1 = 39.6 minutes = 40 minutes
2. Calculate new total time per unit:
   - New total time per unit = Operator time + New machine time
   - New total time per unit = 12 minutes + 40 minutes = 52 minutes
3. Calculate new output units per month:
   - Output units = $\frac{\text{Effective working minutes}}{\text{New total time per unit}}$
   - Output units = $\frac{9600}{52}$minutes per unit = 184 units

6 PROJECT MANAGEMENT, MONITORING & CONTROL

Q1. List the various elements of the framework for Project Management Issues. **[Dec 2015 - 2 Marks]**

Answer: As per McKinsey & Co., management consultants there are seven points/elements Framework for Project Management Issues which are given below

1	Strategy	The high-level requirements of the project & means to achieve them.
2	Structure	The organizational arrangement to carry out the project.
3	Systems	The methods for work to be designed, monitored & controlled.
4	Staff	Selection, recruitment, management & leadership of staff working on the project.
5	Skills	The management & technical tools available to the project manager & the staff.
6	Style/culture	The underlying way of working & interrelating within the work team or organization.
7	Stakeholders	Individuals & groups who have an interest in the project process & outcome.

Q2. Define 'Load Chart'. **[June 2016 - 2 Marks]**

Answer: A load schedule or load chart is a device for comparing the actual load (labour hours & machine hours) required to produce the products as per the MRS against the available capacity (labour hours & machine hours) in each week.

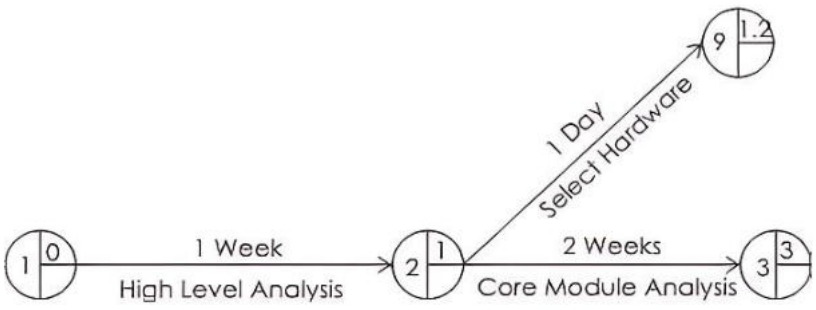
Q3. Define 'Critical path'. **[Dec 2016 - 2 Marks]**

Answer:

- A critical path is a chain of sequential activities beginning with the project start & ending with its completion.
- Several or many path may exist through the network. Work may proceed on many independent paths concurrently, but, of course, work may proceed on an activity only after all the necessary predecessor activities in its path have been completed.
- All activities, hence all paths, must be completed before the project is finished.
- The path through the network that has the longest expected completion time & is expected to determine the completion date of the project is called the critical path.

Q4. Draw a Circle & Arrow Diagram to show two activities, that cannot be started until the first activity has been completed. **[Dec 2021 - 4 Marks]**

Answer: Indicative example of Circle & Arrow Diagram Here the activities of 'Select Hardware' & 'Core Module Analysis' cannot be started until 'High Level Analysis' has been completed.



Q5. For a network shown in figure, normal time, crash time, & normal costs are given in the table; construct the network by crashing it to optimum value & calculate the critical path, project duration, activities with least cost slope & optimum project cost. Indirect cost is given as Rs. 95 /day. **[Dec 2013 - 10 Marks]**

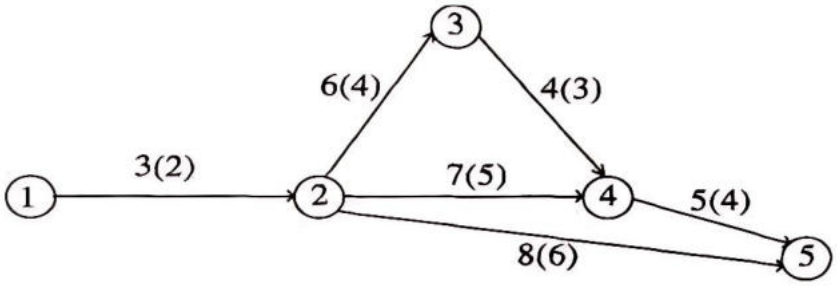
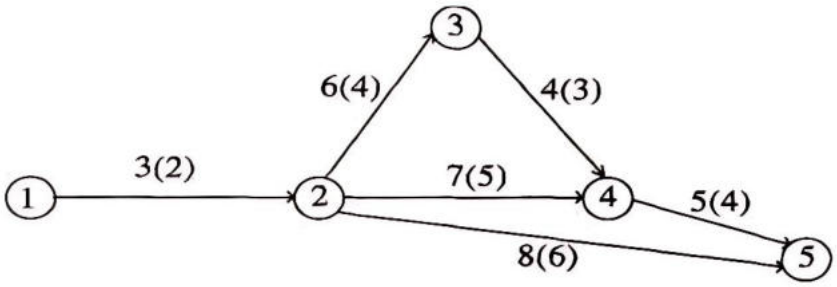


Table: Activity Relationship

Activity	Normal		Crash	
	Time (days)	Cost	Time (days)	Cost
1 - 2	3	300	2	400
2 - 3	6	480	4	520
2 - 4	-	2,100	5	2,500
2 - 5	8	400	6	600
3 - 4	4	320	3	360
4 - 5	5	500	4	520



In the given network critical path is 1-2-3-4-5 & the period duration is 18 days.

Cost slope Table

Activity	Normal		Crash		Crash	Normal	Cost
	Time(days)	Cost	Time(days)	Cost	Cost - Normal Cost (a)	Time-Crash Time (b)	Slope (a)/(b)
1-2	3	300	2	400	100	1	100
2-3	6	480	4	520	40	2	20
2-4	7	2,100	5	2,500	400	2	200
2-5	8	400	6	600	200	2	100
3-4	4	320	3	360	40	1	40
4-5	5	500	4	520	20	1	20

Table showing the different paths in the network with its durations

Path	Sequence	Target Time	Time Crashed at Various Stages		
			2 - 3	3 - 4	4 - 5
P1	1 - 2 - 3 - 4 - 5	18	16	14	15
P2	1 - 2 - 4 - 5	15	15	15	14
P3	1 - 2 - 5	11	11	11	11

From the table it is clear that Critical Path activities, 2-3 & 4-5, have least cost slopes.

Therefore, crashing the activities 2 - 3 & 4 - 5 by 2 days & 1 day respectively,

Project Duration = 18 - 3 = 15 days.

Cost of project = Normal Cost + Extra Crashing Cost + Indirect Cost

= (300 + 480 + 2,100 + 400 + 320 + 500) + (2 x 20 + 1 x 20) + 15 x 95 = Rs. 5,585

In second stage, crashing the least cost slope activity 3 - 4 on critical path by 1 day,

Project duration = 14 days.

Cost of Project = Normal cost + extra crashing cost + indirect cost

= 4100 + (20 x 2 + 1 x 20 + 1 x 40) + 14 x 95 = Rs. 5,530

The total project cost with normal activities (without crashing)

= Normal cost + Indirect Cost for 18 days

= 4100+ (18 x 95) = Rs. 5,810

Therefore, the optimum cost of the project is Rs. 5,530.

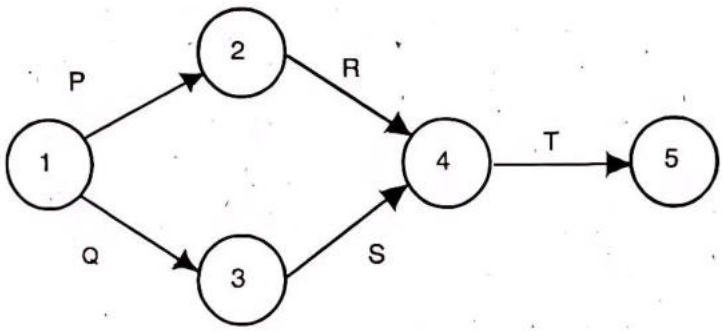
Q6. A project consists of five activities. Activities P & Q run simultaneously. The relationship among the various activities is as follows:

Activity	Immediate Successor
P	R
Q	S

Activity T is the last operation of the project & it is also immediate successor to R & S. Draw the network of the project.

[June 2014 & 2016 - 2 Marks]

Answer: Network of the project will be as follows:



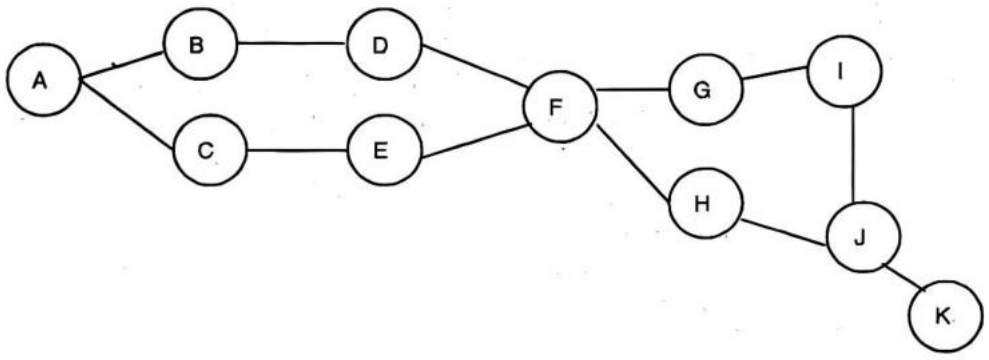
Q7. A project consists of eleven activities A, B, C, D, E, F, G, H, I, J & K. The relationship among various activities is as follows: **[June 2017 - 6 Marks]**

Activity	Preceding Activity
A	-
B	A
C	A
D	B
E	C
F	D, E
G	F
H	F

I	G
J	I, H
K	J

Draw the network diagram.

Answer:

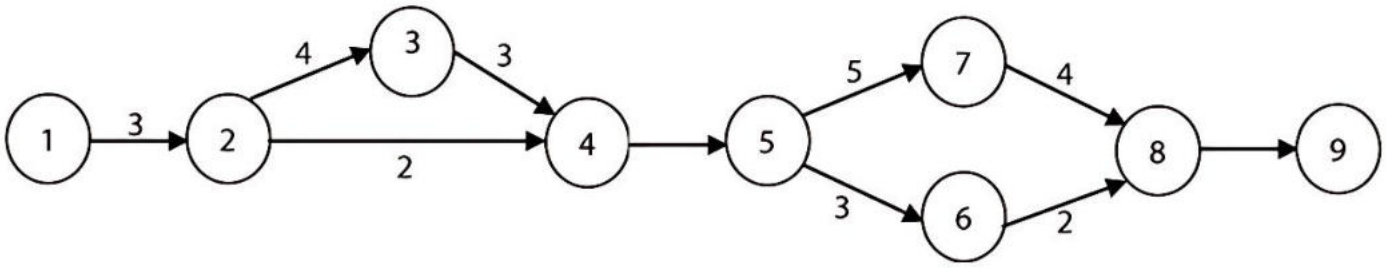


Q8. Draw the network for the following activities & find critical path & total duration of the project.

[Dec 2017 – 6 Marks]

Activity	Duration (months)
1 - 2	2
2 - 3	3
2 - 4	1
3 - 4	2
4 - 5	3
5 – 6	2
5 – 7	4
6 - 8	1
7 - 8	3
8 - 9	4

Answer: Network diagram:



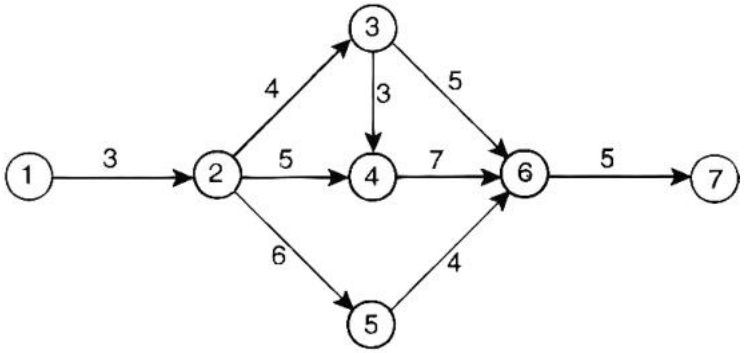
Paths	Duration (months)
1 – 2 – 3 – 4 – 5 – 7 – 8 - 9	2 + 3 + 2 + 3 + 4 + 3 + 4 = 21 (Critical path)
1 - 2 - 3 - 4 - 5 - 6 - 8 - 9	2 + 3 + 2 + 3 + 2 + 1 + 4 = 17
1 - 2 - 4 – 5 - 7 - 8 - 9	2 + 1 + 3 + 4 + 3 + 4 = 17
1 - 2 - 4 - 5 - 6 - 8 - 9	2 + 1 + 3 + 2 + 1 + 4 = 13

Q9. Draw the network for the following activities & find the critical path & total duration of the project.

Activity	Duration (months)
1 - 2	3
2 - 3	4
2 - 4	5
2 - 5	6
3 - 4	3
3 - 6	5
4 - 6	7
5 - 6	4
6 - 7	5

[Dec 2018 – 6 Marks]

Answer: Network diagram:



Paths & their durations:

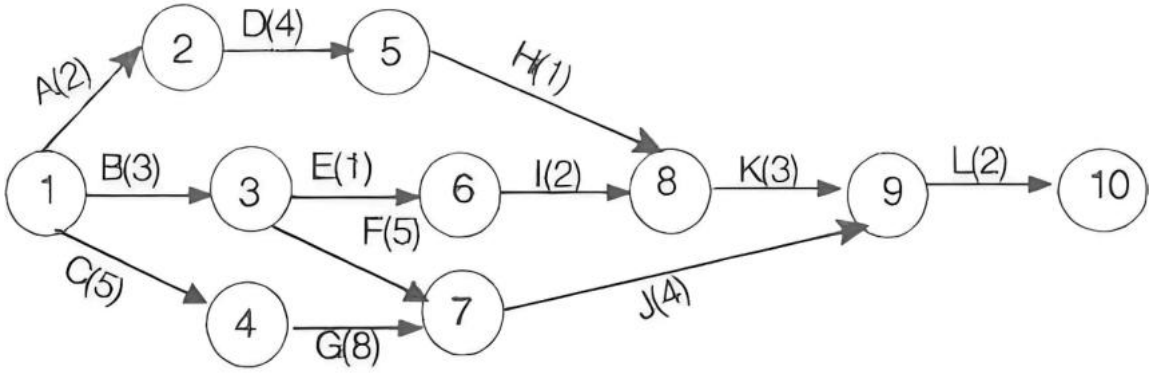
1 - 2 - 3- 6 - 7 → 3 + 4 + 5 + 5	17 months
1 - 2 - 3 - 4 - 6- 7 → 3 + 4 + 3 + 7 + 5	22 months → Critical Path
1 - 2 - 4 - 6 - 7 → 3 + 5 + 7 + 5	20 months
1 - 2 - 5 - 6 -7 → 3 + 6 + 4 + 5	18 months

Q10. Draw the network for the following activities & find the Critical Path & Total duration of the project.

Activity	Predecessor	Duration (months)
A	-	2
B	-	3
C	-	5
D	A	4
E	B	1
F	B	5
G	C	8
H	D	1
I	E	2
J	F, G	4
K	H, I	3
L	K, J	2

[Dec 2019 - 6 Marks]

Answer:



Calculation of Critical path:

(a) A - D - H - K - L = 2 + 4 + 1 +3+ 2= 12

(b) B -E - l – K - L = 3 + 1+ 2 + 3 + 2 = 11

(c) B - F - J - L = 3 + 5 + 4 + 2 = 14

(d) C - G - J - L- = 5 + 8 + 4 + 2 = 19 = Critical Path (Project duration)

Q11. AXON TECH Ltd. has recently won a contract for the installation of a die casting machine & its associated building construction work at a local factory of large national firm of electronic engineers. Project manager has listed down the activities in the project as under

Activity Identification		Preceding Activities	Duration (Days)
A	1 - 2		1
B	2 - 3	A	3
C	2 - 4	A	15
D	2 - 5	A	1
E	3 - 5	B	10
F	4 - 5	C	6
G	5 - 6	D, E, F	1
H	6 - 7	G	1
I	6 - 8	G	15
J	7 - 8	H	2

Required:

(a) Draw the network for the project.

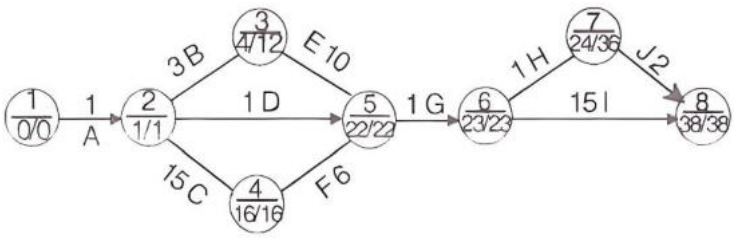
(b) What are the possible paths with duration of the project?

(c) Identify the critical path with duration of the project.

(d) Find Total Float, Free Float & Independent Float of the activities D, E, H & J of the Project. **[Dec 2022 – 10 Marks]**

Answer:

(a)



(b)	**The Possible Paths:**	
	1 - 2 – 3 – 5 - 6 - 7 - 8	18 Days
	1 - 2 - 5 - 6 - 7 - 8	6 Days
	1 - 2 – 5 - 6 - 8	18 Days
	1- 2 - 4 - 5 - 6 -7 - 8	26 Days
	1 - 2 – 4 - 5 - 6 - 8	38 Days
(c)	Critical Path & Duration: 1 - 2 - 4 - 5 - 6- 8 & duration is 38 Days	

(d)	Activity	Total Float (Days)	Free Float (Days)	Independent Float (Days)
	D	20	20	20
	E	8	8	0
	H	12	0	0
	J	12	12	0

Q12. Prantik (P) Ltd., a publisher, is preparing to produce the second edition of a Project Management Text Book. The activities required & their estimated times are as follows:

Activity & Identification		Estimated duration in days		
		Optimistic	Most Likely	Pessimistic
A	1 - 2	1	1	7
B	1 - 3	1	4	7
C	1 - 4	2	2	8
D	2 - 5	1	1	1
E	3 - 5	2	5	14
F	4 - 6	2	5	8
G	5 - 6	3	6	15

Required:

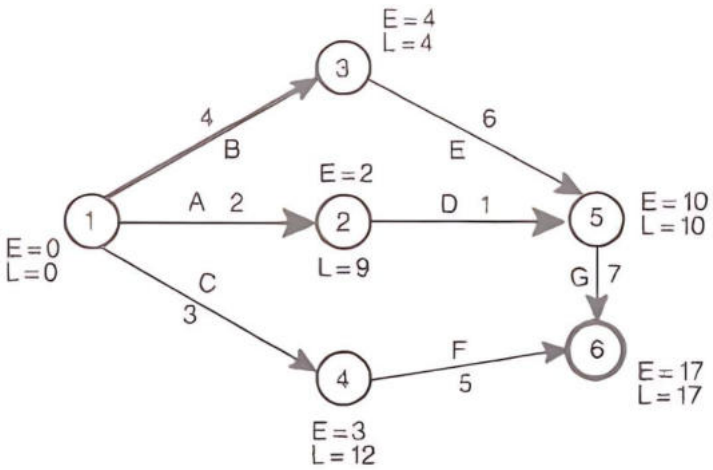
(a) Draw the project network & identify all the paths through it.

(b) Assess the expected duration & variance for each activity & also project length.

(c) Identify the critical path & assess the EST, EFT, LST, LFT & total float for each activity. **[June 2023 - 10 Marks]**

Answer:

(a) The Network is drawn as shown below:



Identification of Paths are:

(1) 1 - 3 - 5 - 6

(2) 1 - 2 - 5 - 6

(3) 1 - 4 - 6

(ii) & (iii)

Activity & Identification	T_θ =	V_t =	EST	EFT	LST	LFT	Total	Flats
								Free (TF - HS)
A	1 - 2	2	1	0	2	7	9	7
B	1 - 3	4	1	0	4	0	4	0
C	1 - 4	3	1	0	3	9	12	9
D	2 - 5	1	0	2	3	9	10	7
E	3 - 5	6	4	4	10	4	10	0
F	4 - 6	5	1	3	8	12	17	9
G	5 - 6	7	4	10	17	10	17	0

Project Length = 17 Days

Critical Path: B - E - G (1 - 3 - 5 - 6)

Q13. TINTEX LTD., a construction company has an opportunity to submit a bid for the construction of a new apartment building. From specifications provided by the developer, a PERT Network for the project has been developed & the estimate of optimistic, most likely & pessimistic, completion duration in days (a, m & b respectively) for each activity are shown below:

Activity & Identification	Estimated Time in Days			
		Optimistic (a)	Most likely (m)	Pessimistic (b)
A	1-2	15	20	25
B	1-3	20	25	30
C	2-3	6	10	14
D	2-4	8	12	16
E	3-4	2	6	10
F	4-5	6	10	14

Required: **[Dec 2023 – 7 Marks]**

(a) Assess the expected Time (in days) of the project.

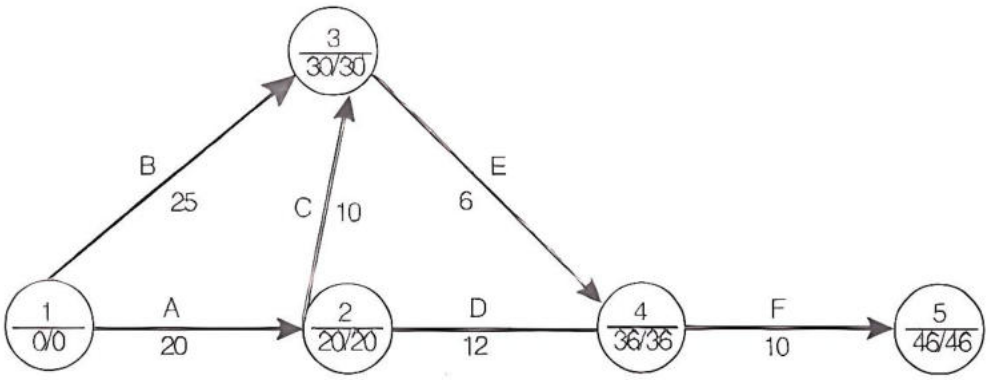
(b) Draw the Project Network & identify all paths through it.

(c) Identify the Critical Path with its duration & assess the Total Float & Free Float of each activity of the Project.

Answer: (a) Expected Time (in days).

Activity & Identification		(a)	(m)	(b)	$te = \frac{a + 4m + b}{6}$
A	1 - 2	15	20	25	20
B	1 - 3	20	25	30	25
C	2 - 3	6	10	14	10
D	2 - 4	8	12	16	12
E	3 - 4	2	6	10	6
F	4 - 5	6	10	14	10

(b)



(c) Critical Path with duration of the project: (A - C - E - F) 1 - 2 - 3 - 4 - 5 & duration 46 days.

The floats for each Activity are assessed below:

Activity & Identification		Expected Time	EST	EFT	LST	LFT	Total	Flats
								Free (TF - HS)
A	1 - 2	20	0	20	0	20	0	0
B	1 - 3	25	0	25	5	30	5	5
C	2 - 3	10	20	30	20	30	0	0
D	2 - 4	12	20	32	24	36	4	4
E	3 - 4	6	30	36	30	35	0	0
F	4 - 5	10	36	46	36	46	0	0

Q14. ZOTECH Ltd., has recently won a Contract for the installation of a die casting machine at a local factory of a large national firm of electronic Engineers. The following table gives the various activities in this job & normal duration (in days) there of **[June 2024 – 7 Marks]**

Activity & Identification		Preceding Activities	Duration (days)
A	1 - 2	-	2
B	2 – 3	A	3
C	2 - 4	A	15
D	2 - 5	A	3
E	3 - 5	B	12
F	4 - 5	C	8
G	5 - 6	D, E & F	3
H	6 - 7	G	12

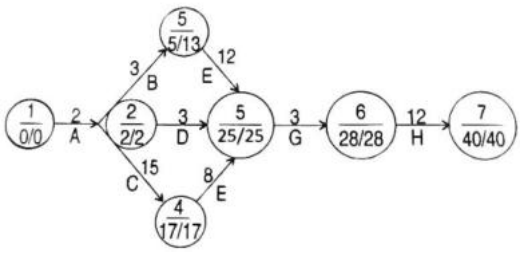
Required:

(a) Design the PERT Network diagram & indicate all paths through it.

(b) Identify the Critical Path & its duration (in days).

(c) Analyze & Assess the Total Float, Free Float & Independent Float of Each activity.

Answer:



NETWORK

Critical Path & duration (in days) 1 - 2 - 4 - 5 - 6 - 7 & 40 days.

Activity & Identification	Duration (Days)	DAYS							
		EST	LST	EFT	LFT	Total Float	Free Float	Independent Float Free	Tail
A	1 - 2	2	0	0	2	2	0	0	0
B	2 - 3	3	2	10	5	13	8	0	0
C	2 - 4	15	2	2	17	17	0	0	0
D	2 - 5	3	2	22	5	25	20	20	20
E	3 - 5	12	5	13	17	25	8	8	0
F	4 - 5	8	17	17	25	25	0	0	0
G	5 - 6	3	25	25	28	28	0	0	0
H	6 - 7	12	28	28	40	40	0	0	0

7 ECONOMICS OF MAINTENANCE & SPARES MANAGEMENT

Q1. Distinguish between Regular Spares & Insurance Spares. **[Dec 2014 - 2 Marks]**

Answer:

Regular Spares: There are the spares which are required in large quantity at more or less periodical interval as & when the break downs occur.

Insurance Spares: Insurance spares are irregularly consumed spares. These are of high value & are not required for routine maintenance but would cause a lengthy shut-down of vital equipment or the entire plant in case they are not available besides would cause high stock out cost.

Q2. What are the limitations of Preventive Maintenance? **[Dec 2013 - 2 Marks]**

Answer: Disadvantages of Preventive Maintenance:

(a) Requires skilled personnel.

(b) Requires costly monitoring equipment's.

(c) Greater Annual Cost if it is not applied from the beginning of the equipment installation.

(d) Need for spare parts storage.

Q3. Justify your choice between 'Preventive Replacement' & 'Breakdown Replacement'. **[Dec 2014 - 3 Marks]**

Answer:

- **Preventive Maintenance:** Preventive Maintenance is a daily maintenance (cleaning, inspection, oiling & re-tightening), design to retain the healthy condition of equipment & prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance.
- **Breakdown maintenance:** Breakdown maintenance is when the organization only conducts maintenance on a piece of equipment when the equipment breaks down. A better maxim goes "An ounce of prevention is worth a pound of cure". Sorry, if anybody waits until the equipment breaks down, he pays for lost production, higher cost of parts, overtime & all associated "collateral damage".

Q4. What are the objectives of maintenance management? **[June 2015 - 7 Marks]**

Answer: Minimizing the loss of productive time because of equipment failure (i.e., minimizing idle time of equipment due to break down).

(a) Minimizing the repair time & repair cost.

(b) Minimizing the loss due to production stoppages.

(c) Efficient use of maintenance personnel & equipment.

(d) Prolonging the life of capital assets by minimizing the rate of wear & tear.

(e) To keep all productive assets in good working condition.

(f) To maximize efficiency & economy in production through optimum use of facilities.

(g) To minimize accidents through regular inspection & repair of safety devices.

(h) To minimize the total maintenance cost which includes the cost of repair, cost of preventive maintenance & inventory carrying costs due to spare parts inventory.

(i) To improve the quality of products & to improve productivity.

Q5. Categorize spare parts for stocking policy analysis under Spare Parts Management. **[Dec 2015 - 2 Marks]**

Answer: Spare part can be classified in for categories for stocking policy analysis under Spare Parts Management as follows:

(a) Regular Spares: These are required regularly & so, in substantial numbers.

(b) Insurance Spares: Spares of this class have a very high reliability & are required rarely, if ever, during the life time of an equipment besides being a high cost item.

(c) Capital Spares: Regular spares & Insurance spares are two ends of the spectrum; Capital spares fall somewhere in between. A few-say five or ten-of these spares are required, over the lifetime of an equipment.

(d) Rotable Spares: The effectiveness of maintenance can be evaluated in terms of maintenance costs incurred, equipment down time etc. Formula for maintenance cost index

Q6. State formula for maintenance cost index (as a %) to measure maintenance effectiveness. **[Dec 2015 - 2 Marks]**

Answer: These are repairable & re-usable spares, such as a jet engine or an electric motor which can be reconditioned after failure & put back in operation.

Q7. Explain the term 'rescue maintenance' under System Maintenance. **[Dec 2015 - 2 Marks]**

Answer: Rescue maintenance refers to previously undetected malfunctions or such sudden changes that were not anticipated but require immediate solution. Rescue maintenance is unplanned, thus a system that is properly developed, & tested should have few occasions of rescue maintenance.

Q8. List the major areas & types of maintenance an organization may use in those areas. **[Dec 2015 - 4 Marks]**

Answer: The major areas of maintenance are:

Civil Maintenance	Building construction & maintenance, maintaining service facilities such as water, gas, steam, compressed air, heating & ventilating, air conditioning, painting, plumbing & carpentry work. Also included in civil maintenance are janitor, service, house-keeping, scrap disposal, fencing, landscaping, gardening, & maintaining drainage, lawns & firefighting equipment's.
Mechanical Maintenance	Maintaining machines & equipment's, transport vehicles, material handling equipment's, steam generators, boilers, compressors, & furnaces. Lubricating the machines is also part of mechanical maintenance work.
Electrical Maintenance	Maintaining electrical equipments such as generators, transformers, switch gears, motors, telephone systems, electrical installations, lighting, fans, meters, gages, instruments, control panels & battery charging.

Q9. Expand TPM. Identify various activities a TPM system is encompassed of, with influence on equipment up time. **[Dec 2015 - 5 Marks]**

Answer: TPM is a comprehensive system of equipment maintenance that encompasses all activities with any influence on equipment up time (i.e., working time). These activities are:

Regulating basic conditions	TPM advocates keeping a well-organized shop floor which should be very clean.
Adhering to proper operating procedures	The most significant cause of failure is operators deviating from procedures & introduce errors & variance into the process.
Restoring deterioration	TPM requires diligent efforts to discover & predict deterioration in equipment & then follow standard repair methods to eliminate any source of variation in the system.
Improving weaknesses in design	TPM tries to identify & correct any defects in equipment designs that contribute to break-downs or complicate maintenance.
Improving operation & maintenance skills	Equipment users (i.e., workers) contribute to TPM by learning & following correct operating procedures to prevent errors & correct any problems on the first attempt. TPM enhances the skill of both users & maintenance workers through education & training.

Q10. List the various steps in Maintenance Planning. **[June 2016 - 8 Marks]**

Answer: Steps in Maintenance Planning:

1. Know the equipment to be maintained, available technique for maintenance & the facilities available to carry out maintenance work.
2. Establish the priorities of maintenance activities by categorizing the activities as emergency work, priority work & non-priority work.
3. Investigate the maintenance work to be done at the workstation to, - ascertain physical access & space limitations, facilities for lifting & handling (moving), facilities for disposal of water, oil, gas & other hazardous materials, space for keeping the dismantled parts etc.

4. Develop the repair plan on the basis of:
   (a) Recommendation of original equipment manufacturer.
   (b) Technical experience.
   (c) Equipment history.
   (d) Management decision for a new technique of maintenance work.
5. Prepare a list of maintenance materials & spare parts required.
6. Prepare a list of special tools & special facilities such as material handling equipments (such as crane) required.
7. Estimate the time required to do the maintenance work.
8. Provide for necessary safety devices & safety instructions.

Q11. 'Computers have entered the maintenance function in a big way.' List two important areas in maintenance where computer assistance is taken. **[Dec 2016 - 2 Marks]**

Answer: Key areas in maintenance where computer assistance is taken are:

(a) Scheduling maintenance projects.
(b) Maintenance cost reports by production department, cost category & other classifications.
(c) Inventory status reports for maintenance part & supplies.
(d) Parts failure data.
(e) Operations analysis studies which may include computer simulation, waiting lines, & other analytical programmes.

Q12. Write down the formula for the following which are used for measuring maintenance effectiveness:
(a) Down-time index (as a %)
(b) Maintenance cost index as a percentage. **[Dec 2016 - 4 Marks]**

Answer:

(a) Down time index (as a %): $\frac{\text{Down time per week}}{\text{Available machine hours per week}}$ x 100

(b) Maintenance cost index (as a %): $\frac{\text{Annual Maintenance cost}}{\text{Cost of Production)}}$ x 100

Q13. List the information to be collected before scheduling maintenance activities. **[Dec 2016 - 8 Marks]**

Answer:

(a) Manpower (maintenance crew) available.
(b) Pending maintenance work (in terms of man hrs. backlog).
(c) Availability of machine or equipment for preventive maintenance service.
(d) Availability of proper tools, handling equipments, consumables, spare parts etc.
(e) Availability special maintenance equipments if any, special fixtures & tools, cranes, etc.
(f) Whether additional manpower is available at outside sources to be hired when needed.
(g) When to start the maintenance work & when it should be completed,
(h) Previous maintenance history records or charts.

Q14 . RONTIX Ltd., a fleet owner finds from its past records that the cost per year of running a truck whose purchase price is Rs. 6,00,000 are as given below:

Year	1	2	3	4	5	6	7	8
Running Costs (in Thousand)	100	120	140	180	230	280	340	400
Re-Sales Price (in Thousand)	300	150	75	37.50	20	20	20	20

(Assume that Cost of Money is zero.)

Required:

(a) Assess the average annual cost of truck for each year.
(b) Analyze & Infer at what age should the truck be replaced on economic consideration. **[June 2024 - 7 Marks]**

Answer:

1. The average Annual Costs to date for each year are assessed

Cost of Owning & Operating Truck (In Thousand)

Year	Running Cost	Cumulative Running Costs	Resale Value	Depreciation (Capital Cost)	Total Costs	Average Cost / Year
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	100	100.0	300.0	300.0	400.0	400.00
2	120	220.0	150.0	450.0	670.0	335.00
3	140	360.0	75.00	525.0	885.0	295.00
4	180	540.0	37.50	562.5	1,102.0	275.63
5	230	770.0	20.00	580.0	1350	270.63
6	280	1,050.0	20.00	580.0	1,630	271.67
7	340	1,390.0	20.00	580.0	1,970	281.43
8	400	1,790.0	20.00	580.0	2,370	296.25

2. After analysis of the parameter stated Supra, we conclude that the truck should be replaced at the end of the 50 year, of which average annual Cost (Rs. 2,70,000) is minimum; otherwise the average annual cost would increase after 50 year.

Q15. Arzuu Ltd.'s records of breakdowns of its machines for a 300-day work year are as shown below:

No. of breakdowns	Frequency in days
0	**40**
1	**150**
2	**70**
3	**30**
4	**10**
	300

The firm estimates that each breakdown costs Rs. 600 & is considering adopting a preventive maintenance program which would cost Rs. 200 per day & limit the number of breakdowns to an average of one per day. What is the expected annual savings from preventive maintenance program? **[Dec 2013 - 5 Marks]**

Answer:

No. of Breakdowns (x)	Frequency of breakdowns in days i.e., f(x)	Probability distribution of breakdowns P(x)	Expected value of breakdowns (x) x P (x)
0	40	$\frac{40}{300}$ = 0.133	NIL
1	150	$\frac{150}{300}$ = 0.500	0.500
2	70	$\frac{70}{300}$ = 0.233	0.466
3	30	$\frac{30}{300}$ = 0.100	0.300
4	1.0	$\frac{10}{300}$ = 0.033	0.132
Total	**300**	**1.000**	**1.400**

Total no. of breakdowns per day = 1.40

Cost of breakdown per day = 1.40 x Rs. 600 = Rs. 840

Cost of preventive maintenance programme per day = Rs. 200 + Rs. 600 = Rs. 800

Expected annual savings from the preventive maintenance programme = Rs. (840-800) x 300 days = Rs. 12,000

Q16. The main shaft of calcinator has a very high reliability of 0.990. The equipment comes from abroad & has a high downtime cost associated with the failure of this shaft. This is estimated at Rs. 2 crores as the costs of sales lost & other relevant costs. However, this spare is quoted at Rs. 10 Lakh at present. Should the shaft spare be procured along with the equipment & kept or not? **[June 2014 - 2 Marks]**

Answer: Reliability of machine = 0.990

Number of Standby units A	Reliability B	Device Cost Rs. C	Loss due to failure (1 - column B) 2,00,00,000 D	Total Cost Rs. E
0	0.990	10,00,000	2,00,000	12,00,000
1	0.9999	20,00,000	2,000	20,02,000

Total cost is minimum when shaft spare is not procured.

Therefore, no need to buy shaft at the time of procurement of calcinatory.

Or

The expected down-time cost calcinatory = (Probability of failure) x (Cost when break-down occurs) = (1 - 0.990) x (Rs. 2 crore) = Rs. 2 lakhs However, the cost of procuring the spare now is Rs. 10 lakhs. Therefore, expected cost of downtime is less than the cost of spare; hence there is no need to buy shaft at the time of procurement of calcinator.

Q17. An engineering firm has a machine whose purchase price is Rs. 85,000. The expected maintenance costs & resale price in different years are as given below:

Year	1	2	3	4	5	6	7
Maintenance Cost	1,200	1,400	1,800	2,600	3,200	4,100	5,200
Resale Value (Rs. Thousand)	80	76	71	67	63	58	52

After what time interval should the machine be replaced? **[Dec 2014 - 6 Marks]**

Answer:

Year	Maintenance Cost, M_1	Cum. Maintenance Cost, ΣM_1	C - S	T(n)	A(n)
(i)	(ii)	(iii)	(iv)	(v) = (iii)+(iv)	(vi) - (v)/n
1	1,200	1,200	5,000	6,200	6,200
2	1,400	2,600	9,000	11,600	5,800
3	1,800	4,400	14,000	18,400	6,133
4	2,600	7,000	18,000	25,000	6,250
5	3,200	10,200	22,000	32,200	6,440
6	4,100	14,300	27,000	41,300	6,883
7	5,200	19,500	33,000	52,500	7,500

Where:

C - Purchase price of machine; S - Scrap Value of machine at the end of n years,

Here minimum A(n) - Rs. 5800, for n = 2; The machine should therefore be replaced every 2 years.

Q18. The main shaft of Calcinator has a very high reliability of 0.980. The equipment comes from abroad & has a high downtime cost associated with the failure of this shaft. This is estimated at Rs. 1.80 crores as the costs of sales lost & other relevant costs. However, this spare is quoted at Rs. 10 lakhs at present. Should the shaft spare be procured along with the equipment & kept or not? **[June 2016 - 4 Marks]**

Answer: Expected Cost of down time = (1 - 0.980) x 1.80 = Rs. 0.036 crores = **Rs. 3.6 lakhs**

However, the cost of procuring the spare now is Rs. 10 lakhs. Therefore, expected cost of downtime is less than the cost of spare, hence spare need not be purchased along with equipment.

Q19. A firm is using a machine whose purchase price is Rs. 15,000. The installation charges amount to Rs. 3,500 & the machine has a scrap value of only Rs. 1,500 because the firm has a monopoly of this type of work. The maintenance cost in various years is given in the following table: **[June 2015 - 5 Marks]**

Year	1	2	3	4	5	6	7	8	9
Maintenance Cost	260	760	1100	1600	2200	3000	4100	4900	6100

The firm wants to determine after how many years should the machine be replaced on economic considerations, assuming that the machine replacement can be done only at the year end.

Answer: Cost of machine, (C) = Rs. 15,000 + Rs. 3,500 = **Rs. 18,500;** Scrap value, (S) = **Rs. 1,500**

Determination of Optimal Replacement Period

Year	Maintenance Cost, M_1t	Cum. Main. Cost, ΣEM_1	Depreciation (C-S)	Total Cost T(n)	Annual Cost A(n)
(i)	(ii)	(iii)	(iv)	(v) = (iii) + (iv)	(vi) = (v)/n
1	260	260	17,000	17,260	17,260
2	760	1.020	17,000	18,020	9.010
3	1,100	2,120	17,000	19,120	6,373
4	1,600	3,720	17,000	20,720	5,180
5	2,200	5,920	17,000	22,920	4,584
6	3,000	8,920	17,000	25,920	4,320
7	4,100	13,020	17,000	30,020	**4,288**
8	4,900	17,920	17,000	34,920	4,365
9	6,100	24,020	17,000	41,020	4,557

Here the lowest average cost, A (n), is Rs. 4,288 approximately, which corresponds to n = 7.

Therefore, the machine may be replaced every 7 years.

Q20. A Public Transport Company is experiencing the following number of breakdowns for months over the past 2 years in their new fleet of vehicles: **[Dec 2017 - Marks]**

Number of breakdowns	0	1	2	3	4
Number of months this occurred	3	6	9	4	2

Each breakdown costs the company an average of Rs. 2,500. For a cost of Rs. 1,700/ month, preventive maintenance can be carried out to limit the breakdowns to an average of one per month. Which policy is suitable for the company?

Answer: After converting frequencies to probability distribution & determining expected cost/month of breakdowns, get:

Number of breakdowns	Frequency in months	Frequency in percent	Expected value
0	3	$\frac{3}{24}$ = 0.125	0
1	6	$\frac{6}{24}$ = 0.25	0.25
2	9	$\frac{9}{24}$ = 0.375	0.75
3	4	$\frac{4}{24}$ = 0.167	0.5
4	2	$\frac{2}{24}$ = 0.083	0.334
		Total: 1	**Total: 1.834**

Breakdown cost/month; Expected cost = 1.834 x Rs. 2500 = Rs. **4,585.**

Preventive maintenance cost/month:

Average cost of one breakdown/month	Rs. 2,500
Maintenance contract cost/month	Rs. 1,700
Total	**Rs. 4,200**

Thus, preventive maintenance policy is suitable for the fir

Q21. Reddy Transport Company (RTC) has a fleet of 50 trucks. The past data on the breakdown of the trucks show the following probability distribution (for a new truck as well as for one which has been repaired after a breakdown).

Months after Maintenance	Probability of Breakdown
1	0.10
2	0.20
3	0.30
4	0.40

Each breakdown costs Rs. 3,000 on. an average, which includes cost of time lost & cost of materials & manpower.

The manager of RTC knows the importance of preventive maintenance. He estimates the costs of the preventive maintenance to be Rs. 500 per such preventive action. What should be the appropriate maintenance policy in terms of the mix of preventive & breakdown. **[Dec 2016 - 10 Marks]**

Answer: First, let us compute the cost of a totally breakdown maintenance policy. The expected number of months between failures = 0.1 (1) + 0.2 (2) + 0.3 (3) + 0.4 (4) = 3.0

Cost /month of totally breakdown maintenance policy $\frac{\text{(No.of trucks) (Cost per breakdown)}}{\text{(Expected number of months between failures)}} = \frac{(50)\ (Rs.3,000)}{3.0}$ = Rs. 50,000

Now, let us compute the costs of following different periodicities of preventive maintenance.

1. **Preventive maintenance (PM) period one month:** No. of breakdowns within period of 1 month: B_1 = (50) x (0.1) = 5

Cost of breakdown (5 x Rs. 3,000)	Rs. 15,000
Cost of. preventive maintenance (Rs. 500 x 50)	Rs. 25,000
Total Cost during the PM period	**Rs. 40,000**

Hence, cost per month for this policy is = Rs. 40,000 ÷ 1 = Rs. 40,000

2. **Preventive maintenance (PM) period 2 months:** No. of breakdowns within 2 months: B_2 = (50) x (0.1 + 0.2) + (50) x (0.1) x (0.1) = 15.5

Cost of breakdown [(15.5) x Rs. 3,000]	Rs. 46,500
Cost of prev. maintenance (Rs. 500 x 50)	Rs. 25,000
Total cost during the PM period	**Rs. 71,500**

Hence, cost per month for this policy: Rs. 71,500 ÷ 2 months = Rs. 35,750

3. **Preventive maintenance period 3 months:** No. of breakdowns within 3 months:

B_3 = (50) x (0.1 + 0.2 + 0.3) + (50 x 0.1) (0.1 + 0.2) + (50 x 0.1 x 0.1) (0.1) = 30+1.5 + 0.05 = 31.55

Cost of breakdown (31.55 x Rs. 3,000)	Rs. 94,650
Cost of preventive maintenance (50 x Rs. 500)	Rs. 25,000
Total	**Rs. 1,19,650**

Hence, cost per month for this policy = Rs. 1,19,650 + 3 months = Rs. 39,883.33

4. **Preventive maintenance period 4 months:** No. of breakdowns within 4 months

B_4 = [(50) x (1.0)] + [(50) x (0.1) x (0.1 + 0.2 + 0.3) + (50 x 0.1 x 0.1) x (0.1 + 0.2)+ (50x0.1 x 0.1 x 0.1) x (0.1)+ (50 x 0.1 x 0.2) x (0.1)] + [(50 x 0.2) x (0.1 + 0.2) + (50 x 0.2 x 0.1) x (0.1)] + [(50 x 0.3 x (0.1)] = 57.855

Cost of breakdown [(57.855) x (Rs. 3,000)]	Rs. 1,73,565
Cost of preventive maintenance (50 x Rs. 500)	Rs. 25,000
Total	**Rs. 1,98,565**

Hence, cost per month for this policy is Rs. 1,98,565 + 4 months = Rs. 49,641.25 Comparing the costs per month of different policies, we see that the policy of preventive maintenance every two months is the most economic policy.

Q22. Product A has a Mean Time Between Failures (MTBF) of 35 hrs. & a Mean Time to Repairs (MTTR) of 6 hrs. Product B has a MTBF of 45 hrs., & has a MTTR of 3 hrs.

(a) Which product has higher reliability?

(b) Which product has greater maintainability?

(c) Which product has greater availability? **[June 2017 - 10 Marks]**

Answer:

(a) Product B, with the higher MTBF (i.e. 45 hrs.) than product A (i.e. 35 hrs.), is more reliable since it has lesser chances for failure during servicing.

(b) The MTTR means time taken to repair a machine. Thus, lesser MTTR (of 3 hrs.) pertaining to Product B vis-a-vis of 6 hrs. of Product A makes Product B to have greater maintainability.

(c) Availability of a machine/product = $\frac{\text{MTBF}}{(\text{MTBF} + \text{MTTR})}$

Thus, Availability of Product A = $\frac{35}{35+6} = \frac{35}{41}$ = 85.366% Availability of Product B = $\frac{45}{45+3} = \frac{45}{48}$ = 93.75%

Hence, Product B has more availability.

Q23. A cab operations company is experiencing the following number of breakdowns for months over the past 2 years in their new fleet of cabs:

Number of breakdowns	0	1	2	3	4
Number of months this occurred	3	7	9	4	1

Each breakdown costs the firm an average of Rs. 2,500. For a cost of Rs. 1,600 /month, preventive maintenance can be carried out to limit the breakdowns to an average of 1/month. Which policy is suitable for firm? **[June 2018 – 8 Marks]**

Answer:

(A)	(B)	(C)	(A x C)
No. of Break down	**Freq**	**Freq (a/b) in month**	**Expected Value**
0	3	0.13	0
1	7	0.29	0.29
2	9	0.38	0.76
3	4	0.16	0.48
4	1	0.04	0.16
		Total	**1.69**

Break down Cost per month × Expected = $2{,}500 \times 1.69 = \text{Rs. } 4225$

Preventive Maintenance Cost per month:

Average Cost of One Breakdown	2,500
Maintain Contract Cost Per Month	1,600
Total	**4,100**

Thus, Preventive Policy is suitable for the firm.

Q24. An automotive firm is using a machine whose purchase price is Rs. 18,000.

The Installation charges amount to Rs. 3,800 & machine has a scrap value of only because the firm has a monopoly of this type of work. The maintenance cost in various years is given in the following table:

Year	1	2	3	4	5	6	7	8	9
Maintenance cost	250	720	1,200	1,700	2,300	3,200	4,300	4,800	6,300

The firm wants to determine after how many years should the machine be replaced on economic considerations, assuming that the machine replacement can be done only at the year end. **[Dec 2018 - 10 Marks]**

Answer: An automotive firm is using a machine:

Cost of machine, $C = Rs.\ 18{,}000 + 3{,}800 = 21{,}800$; Scrap Value, $S = Rs.\ 1{,}800$

Year	Maintenance Cost, Mj	Cumulative Maintenance Cost, ∑Mj	C - S	Total Cost	Annual Cost $A_{(n)}$
(i)	(ii)	(iii)	(iv)	(v) = (iii) + (iv)	$(vi) = (v)/n$
1	250	250	$21{,}800 - 1{,}800 = 20{,}000$	20,250	20,250
2	720	970	20,000	20,970	10,485
3	1,200	2,170	20,000	22,170	7,390
4	1,700	3,870	20,000	23,870	5,967.5
5	2,300	6,170	20,0020	26,170	5,234
6	3,200	9,370	20,000	29,370	4,895
7	4,300	13,670	20,000	33,670	4,810
8	4,800	18,470	20,000	38,470	4,808.8
9	6,300	24,770	20,000	44,770	4,974.4

Lowest average cost is Rs. 4,808.8 approx., which corresponds to $n = 8$ in above table. Thus, machine needs to be replaced every 8 year.

Q25. Electronic device component manufacturing. company carries out the 'A' components testing for 2,500 hrs. A sample of 100 ''A' components was put through this quality test during which two components failed. If the average usage of the electronic device by the customer is 5 hrs./day & if 12,000 such devices were sold, then in 1 year how many ' A ' components were expected to fail, what is mean time between failures for these components? **[June 2019 - 6 Marks]**

Answer: The total test time $= (100$ Components$) \times 2500$ hrs. $= 250{,}000$ componenthours.

There are two components which have failed & hence the total time is to be adjusted for the number of hrs. lost due to the failures during the testing.

The lost hrs. are computed as $= \frac{(2 \times 2500)}{2} = 2{,}500$ hrs.

The assumption is made here is that each of the failed tubes have lasted an average of half of the test period.

Therefore, the test shows that there are two failures during $(2{,}50{,}000 - 2500) = 2{,}47{,}500$ component hrs. of testing.

During 365 days a year (4 hrs. a day) for 12,000 components the number of expected failures $= \frac{(2 \times 12{,}000 \times 365 \times 5)}{2{,}47{,}500} = 176.97 = 177$ components approximately.

Mean time between failures $= 2{,}47{,}500$ components hrs. of testing $/2$ failures $= 1{,}23{,}750$ components hrs. per failure $= 1{,}23{,}750/(5/365) = 67.8$ components year per failure.

Q26. SONTECH Ltd., a Solar manufacturing company has observed the following no. of breakdowns in new Lantern over the past year:

No. of breakdowns	0	1	2	3
No. of months it occurred	3	6	2	1

It costs the company Rs. 2,000 to rectify a lantern. For a cost of Rs. 600 per month, preventive maintenance can be carried out of limit the breakdown to one per month.

Required: **[June 2023 - 5 Marks]**

Which policy is suitable for the company? Support your answer with needful calculations & justification

Answer:

No. of Breakdowns (1)	Frequency of breakdowns in months (2)	Probability (3)	Expected value $(4) = (1) \times (3)$
0	3	$3/12 = 0.25$	0
1	6	$6/12 = 0.50$	0.50
2	2	$2/12 = 0.167$	0.334

3	1	$1/12 = 0.083$	0.249
Total	**12**	**1.00**	**1.08**

Total number of breakdowns per month $= 1.08$

Cost of breakdown per month $= 1.08 \times 2{,}000 = \text{Rs. } 2{,}160$

Cost of preventive maintenance program per month $= \text{Rs. } 600 + \text{Rs. } 2{,}000 = \text{Rs. } 2{,}600$

Expected annual savings from preventive maintenance program = 2,160 - 2600 x 12 = -440 x 12 = Rs. 5,280

Comment: Preventive maintenance policy is not suitable for the Company. It is better if the Company rectifies the lantern as & when breakdown occurs.

Q27. A firm is using a machine whose purchase price is -. The installation charges amount to Rs. 3,500 /- & the machine has scrap value of Rs. 1,500 because the firm has a monopoly of this type of work. The maintenance cost in various years is given in the following table:

Year	1	2	3	4	5	6	7	8	9
Maintenance Cost	250	760	1,200	1,800	2,500	3,200	4,100	5,000	6,000

(a) Find out Cost of machine. Calculate the replacement period of the machine.

(b) Determine the Optimal Replacement Period. **[Dec 2021 - 8 Marks]**

Answer:

1. Cost of the Machine:

The cost of the machine includes the purchases price & installation charges.

Total cost of the machine:

Cost of machine = Purchase price + Installation charges

Cost of machine $= \text{Rs. } 12{,}000 + \text{Rs. } 3{,}500$

Cost of machine $= \text{Rs. } 15{,}500$

2. Calculate the Replacement Period:

Step-by-Step process:

(a) Calculate the total cost for each year including maintenance costs:

For each year, add the cumulative maintenance costs to the cost of the machine & subtract the scrap value.

(b) Calculate the average cost for each year:

The average cost for each year is the total cost up to that year divided by the number of years.

Calculations:

Year	Maintenance Cost	Cumulative Maintenance Cost	Total Cost	Average Cost
1	250	250	14,250	14,250
2	760	1,010	14,910	7,455
3	1,200	2,210	16,110	5,370
4	1,800	4,010	18,010	4,502.5
5	2,500	6,510	20,510	4,102
6	3,200	9,710	23,710	3957.67
7	4,100	13,810	27,810	3972.86
8	5,000	18,810	32,810	4,101.25
9	6,000	24,810	38,810	4,312.22

Summary:

1. Cost of the machine
2. Replacement period of the machine: 6 year
3. Optimal replacement period. The machine may best be replaced every 6 years, as the lowest average cost is Rs. 3,951.67 in the 6 year.

$* 12{,}000 + 3{,}500 - 1{,}500 + 250 = \text{Rs. } 14{,}250$

Q28. ANEX Ltd. an Engineering firm is using a machine whose purchase price is. The installation charges amount to & the machine has a scrap value of only Rs. 1,400 because the firm has a monopoly of this type of work. The maintenance cost in various years as is shown below:

Year	1	2	3	4	5	6	7	8	9
Cost	300	850	1,300	1,900	2,600	3,300	4,200	6,000	7,500

Required:

(a) Determine after how many years should the machine be replaced on economic considerations (Assuming that machine replacement can be done only at the year-end).

(b) What will be the average cost of Replacement? **[Dec 2022 - 6 Marks]**

Answer: Cost of Machine $(C) = \text{Rs. } 13{,}000$ (Purchase Price) $+ \text{Rs. } 3{,}700$ (Installation charges) = Rs. 16,700, Scrap Value (S) = Rs. $1{,}400$

Year	Maintenance Cost	Cumulative Maintenance Cost	Cost of machine (less) Scrap value	Total Cost	Annual Cost
(i)	(ii)	(iii)	(iv)	(v) = (iii) + (iv)	$(vi) = (v)/n$
1	300	300	15,300	15,600	15,600
2	850	1,150	15,300	16,450	8,225
3	1,300	2,450	15,300	17,750	5,916.67
4	1,900	4,350	15,300	19,650	4,912.50
5	2,600	6,950	15,300	22,250	4,450
6	3,300	10,250	15,300	25,550	4,258.33
7	4,200	14,450	15,300	29,750	4,250
8	6,000	20,450	15,300	35,750	4,468.75
9	7,500	27,950	15,300	43,250	4,805.55

(a) Lowest average cost is Rs. $4{,}250$; which corresponds to $n = 7$ in the above table. Thus, machine needs to be replaced every 7 year (on economic considerations).

(b) Average cost of replacement will be Rs. $4{,}250$ in this case.

Q29 The Management of BB HOTEL IN is considering periodic replacement of light bulbs fitted in its rooms. There are 200 rooms in the hotel & each room has 5 bulbs. The Management is conducting a study on the life of the light bulbs. The following mortality rates have been observed for the light bulbs.

Month of USE	1	2	3	4	5
Percent of bulbs failing by that month	10	15	25	30	20

There are 1000 light bulbs in use & it costs Rs.100 to replace an individual bulb which has burnt out. If all bulbs were replaced simultaneously, it would cost Rs. 20 per bulb. It is proposed to replace all bulbs at fixed intervals, whether or not they have burnt out & to continue replacing burnt out bulbs as they fail.

Required:

(a) Examine the number of light bulbs to replace every month.

(b) Calculate the average monthly cost (Rs.) of individual replacement.

(c) Identify at what interval of time the Management of BB Hotel IN should replace all the light bulbs & which policy of replacement would economical. **[Dec 2023 – 7 Marks]**

Answer:

(a) No. of light bulbs to be replaced every month - 299 bulbs.

(b) The average monthly cost of the individual replacement

(c) Group replacement: Initial Cost Rs. 20,000

The optimum replacement cycle under Group replacement is given under:

Month	No. of light bulbs to be replaced	Monthly cost of Individual replacement @ Rs. 100 / bulb	Cumulative cost of Individual replacement	Total cost of individual replacement as well as Group replacement	Average monthly cost
1	100	10,000	10,000	30,000	30,000
2	160	16,000	26,000	46,000	23,000
3	281	28,100	54,100	74,100	24,700
4	377	37,700	91,800	1,11,800	27,950
5	350	35,000	1,26,800	1,46,800	29,360

Since the Average Cost as stated Supra is lowest in 2nd Month the optimal interval i.e. replacement is in 2 months. So, the Management of BB Hotel should replace all light bulbs in every two months. Further since the average Cost Rs. 23,000 is less than Rs. 29,900 of individual replacement, the Group Replacement Policy is economical & better.

Q30. RST Company has kept records of breakdown of its machines for 300 days work year as shown below:

No. of Breakdown	Frequency in days
0	50
1	140
2	60
3	30
4	20
Total:	300

Company estimates that each breakdown costs Rs. 600 & is considering adopting a preventive maintenance program which would cost Rs. 250 /day & limit the number of breakdowns to an average of one per day. What is the expected annual savings from preventive maintenance program? **[Dec 2019 - 10 Marks]**

Answer: Step 1:

No. of Breakdowns (X)	Frequency of breakdowns in days; i.e. $f(x)$	Probability distribution of break downs; i.e. $p(x)$	Expected value of breakdown $X(x)$
0	50	$\frac{50}{300} = 0.167$	Nil
1	140	$\frac{140}{300} = 0.466$	0.466
2	60	$\frac{60}{300} = 0.200$	0.400
3	30	$\frac{30}{300} = 0.100$	0.300
4	20	$\frac{20}{300} = 0.067$	0.268
Total	**300**	**1.000**	**1.434**

Step 2: Total no. of breakdowns per day $= 1.434$

Cost of breakdown per day $= 1.434 \times 600 = 860.4$

Cost of preventive maintenance program per day $= \text{Rs. } 250 + 600 = 850$

Expected annual savings from the preventive maintenance program $= (860.4 - 850) \times 300 = 10.4 \times 300 = \text{Rs. } 3,120$

STRATEGIC MANAGEMENT - INTRODUCTION

Q. Write a short note on the following concepts:

Q1	Time Frame of Objectives	**[Dec 2017 - 3 Marks]**
Ans	▪ Objectives are timeless, enduring, & unending; goals are temporal, time-phased, & intended to be superseded by subsequent goals because objectives relate to' the ongoing activities of an organisation, their achievement tends to be open-ended in the sense of not being bounded by time. ▪ For example, survival objective of a business organization is never completely attained since failure is always a future possibility.	
Q2	Stages of Strategic Management Framework	**[Dec 2018 - 4 Marks]**
Ans	Basic framework of strategic management involves five stages: **Stage 1:** Organisation analyse about their present situation in terms of their Strengths, Weaknesses, Opportunities & Threats. **Stage 2:** Organisations setup their missions, goals & objectives by analysing where they want to go in future. **Stage 3:** Organisation analyses various strategic alternatives to achieve their - goals & objectives. The alternatives are analysed in terms of what business portfolio/product mix to adopt, expansion, merger, acquisition & divestment options etc. are analysed to achieve the goals. **Stage 4:** Organisations select the best suitable alternatives in line with their SWOT analysis **Stage 5:** This is implementation stage in which organisation implement & execute the selected alternatives to achieve their strategic goals & objectives.	
Q3	Importance of Strategic Management.	**[Dec 2021 - 3 Marks]**
Ans	▪ Discover organization strengths & weaknesses. ▪ Identify the available opportunities & possible threats. ▪ Discover the objectives & goals in line with organizations strengths & available opportunities. ▪ Implement changes to overcome weaknesses & manage the threats. ▪ Provide vision/mission or direction to future of organizations.	

Q4. Mention the factors by which the choice of strategy is influenced. **[June 2014 - 4 Marks]**

Answer:

- Choice of strategy is a decision-making process of a choice from among alternative strategies.
- It is the process of comparing the impact of the possible strategies on the firm & it implies trade-off between courses of action.
- These decisions involve focusing on a few alternatives, considering the selection factors, evaluating the alternatives & making the actual choice.
- Choice of Strategy is Influenced by following factors:

1	**External constraints**	Choice of strategy is governed by the extent & degree of the firm's dependence on owners, customers, suppliers, & the government.
2	**Intra-Organisational Forces**	Decisions are influenced by the power play among different interest groups & by the degree of uncertainty.
3	**Values & preferences & managerial attitudes towards risk**	▪ Evaluation of strategy is determined by personal values - truth, knowledge etc. & attitude towards risk. Risk lover prefers high risky projects with high return. ▪ Risk avoiders prefers safer options.
4	**Impact of past strategy**	The choice of strategy may be influenced by the earlier strategy because it is starting point in the formulation of new strategy & decision maker is involved in past strategy.
5	**Time constraint**	Choice of strategy is influenced by the time dimension i.e., whether it will be short term or long term, whether it has immediate action or not.

Q5. State 3 operative levels of strategy in corporate management structure. How they help the management?

[June 2016 - 8 Marks]

Answer: Decision-making hierarchy of a corporate structure firm typically comprises 3 operative levels of strategy as:

Corporate level	▪ At the highest level of the decision-making hierarchy is the corporate level, composed principally of a board of directors, chief executive & the administrative personnel. ▪ They are responsible for the firm's financial performance & for the achievement of the non-financial goals, such as enhancing the firm's image & fulfilling its social responsibilities. ▪ This top-level strategy is mainly concerned with defining how the business will remain sustainable in the long run. ▪ They are focused on maximizing long term profitability & creating business growth & value.
Business level	▪ In the middle of the decision-making hierarchy is the business level, composed principally of business & corporate managers. ▪ These managers must translate the statements of direction & intent generated at the corporate level into concrete objectives & strategies for individual business divisions or Strategic Business Units - SBUs. ▪ This strategy is a comprehensive for providing objectives for SBUs, allocation of resources among functional areas & coordination between them for making contribution to the achievement of the corporate level objectives.
Functional level	▪ At the bottom - i.e. operating divisions & departments of the decision-making hierarchy is the functional level, composed principally of functional managers, such as production, marketing, personnel, finance, sales, HRM, R&D, etc. ▪ Decisions of the functional levels are often described as 'tactical decision'. ▪ The issues of functional level strategy are mainly related to business processes & the value chain. ▪ This strategy is focused on improving the effectiveness of a business at an operational level. ▪ This level strategy has the narrowest scope of the 3 strategy levels. ▪ A clear understanding of the 3 operative levels strategy in decision making hierarchy help the organization in the following ways: (1) To set-up realistic objectives, (2) To develop plans & policies for achieving the set objectives, (3) To ensure that the business remains sustainable & create business growth & business value in the long term. ▪ These 3 strategy levels are not completely independent of each other & must be developed & implemented in a co-ordinate manner.

Q6. State the value of a firm's vision & mission. **[Dec 2016 - 8 Marks]**

Answer:

- The firm's vision is a picture of what it wants to be & what it wants to ultimately achieve.
- The firm's mission is based on its vision.
- It specifies the businesses in which the firm intends to compete & the customers it intends to serve.
- The value of having a vision & mission is that they inform the following 3 questions to the stakeholders:
  (a) What the firm is?
  (b) What it seeks to accomplish?
  (c) Who it seeks to serve?
- A successful vision is inspirational.
- The mission is more concrete & guides employees' behaviour as they achieve the firm's vision.
- Research shows that an effectively formed vision & mission positively impacts firm performance in terms of growth in sales, profits, employment, net worth of the organization & the development of nation as well as welfare of the society at a large extent.

Q7. Enlist the advantages of Strategic Management. **[June 2017 - 6 Marks]**

Answer:

1	**Discharges Board Responsibility**
	The first reason that most organizations state for having a strategic management process is that it discharges the responsibility of the Board of Directors.
2	**Forces an Objective Assessment**
	▪ Strategic management provides a discipline that enables the board & senior management to actually take a step back from the day-to-day business to think about the future of the organization. ▪ Without this discipline, the organization can become solely consumed with working through the next issue or problem without consideration of the larger picture.
3	**Provides a Framework for Decision-Making**
	▪ Strategy provides a framework within which all staff can make day-to-day operational decisions & understand that those decisions are all moving the organization in a single direction. ▪ It is not possible - nor realistic or appropriate for the board to know all the decisions the executive director will have to make, nor is it possible - nor realistic or practical for the executive director to know all the decisions the staff will make. ▪ Strategy provides a vision of the future, confirms the purpose & values of an organization, sets objectives, clarifies threats & opportunities, determines methods to leverage strengths, & mitigate weaknesses - at a minimum.
4	**Supports Understanding & Buy-in**
	Allowing the board & staff participation in the strategic discussion enables them to better understand the direction, why that direction was chosen & the associated benefits. For some people simply knowing is enough; for many people, to gain their full support requires them to understand.
5	**Enables Measurement of Progress**
	▪ A strategic management process forces an organization to set objectives & measures of success. ▪ The setting of measures of success requires that the organization first determine what is critical to its ongoing success & then forces the establishment of objectives & keeps these critical measures in front of the board & senior management.
6	**Provides an Organizational Perspective**
	▪ Addressing operational issues rarely looks at the whole organization & the interrelatedness of its varying components. ▪ Strategic management takes an organizational perspective & looks at all the components & the interrelationship between those components in order to develop a strategy that is optimal for the whole organization & not a single component.

Q8. List down some guidelines for formulation of the "Mission Statement". **[June 2017 - 6 Marks]**

Answer:

Organization cannot declare the mission just on some great whim & fancy, it should be based on organizations existing capabilities & achievable milestones.

Here are some guidelines for formulation of "mission" statement:

- It should be based on existing business capabilities "Who we are & what we do?"
- It should follow the long-term strategy principles.
- Profit making should not be the only mission of organisation.
- It should be logical extension of business existing capabilities.
- It should clearly & precisely present the future orientation of business.
- It should include achievable missions.
- It should be stated in a form that it becomes the motivating force to every member of organization.

Q9. Explain, in one or two statements, a Company mission. State any three major objectives. **[Dec 2017 - 6 Marks]**

Answer: A Company Mission:

The mission is a broadly framed but enduring statement of company intent. It embodies the business philosophy of strategic decision makers; implies the image the company seeks to project; reflects the firm's self-concept; indicates the principal product or service areas and primary customer needs the company will attempt to satisfy. In short, the mission describes the product, market, and technological areas of emphasis for the business in a way that reflects the values and priorities of the strategic decision makers.

Objectives:

(1) To ensure unanimity of purpose within the organisation.

(2) To provide a basis for motivating the use of the organisation's resources.

(3) To develop a basis, or standard, for allocating organisational resources.

(4) To establish a general tone or organisational climate, for example, to suggest a business-like operation.

(5) To serve as a focal point for those who can identify with the organisation's purpose and direction, and to deter those who cannot from participating further in the organisation's activities.

(6) To facilitate the translation of objectives and goals into a work structure involving the assignment of tasks to responsible elements within the organisation.

(7) To specify organisational purposes and the translation of these purposes into goals in such a way that cost, time, and performance parameters can be assessed and controlled.

Q10. Identify basic elements of strategic vision & discuss about the important purposes served by such strategic vision. **[June 2018 - 4 Marks]**

Answer:

Strategic Vision specifies primarily 3 elements:

(1) Forming a mission statement that defines what business the company presently is in? & "who we are & where we are now?"

(2) Using this mission statement as base to define long term path by indicating choices about "Where we are going?"

(3) Finally, communicating above strategic vision in clear & committed term.

Strategic Vision has important purposes, such as:

(a) Clearly provides the direction that company wants to follow.

(b) Identify the need of changing from existing direction or products, if stated in vision statement.

(c) Create passionate environment in the organisation to steer the company with great excitement in selected direction.

(d) Create creativity in every member of company to prepare company for future.

(e) Promote entrepreneurship.

Q11. There are primarily 3 levels of strategies in the organisation. List the 3 levels. Build up one or two meaningful sentences to clarify the role of each level. **[Dec 2018 - 8 Marks]**

Answer: There are primarily 3 levels of strategies in the organisation:

Corporate Level	▪ The corporate level of management consisting of the chief executive officer - CEO, other senior executives, the board of directors, & corporate staff, empowered in decision-making within the organisation, is to oversee the development of strategies for the whole organisation. ▪ This role includes defining the mission & goals of the organisation, determining what businesses it should be in, allocating resources among the different businesses, formulating & implementing strategies that span individual businesses, & providing leadership for the organisation.
Business Level	▪ A business unit is a self-contained division - with its own functions-for example, finance, purchasing, production, & marketing departments that provides a product or service for a particular market. ▪ The strategic role of these managers is to translate the general statements of direction & intent that come from the corporate level into concrete strategies for individual businesses.
Functional Level	▪ Functional-level managers are responsible for the specific business functions or operations - human resources, purchasing, product development, customer service, & so on that constitute a company or one of its divisions. ▪ Thus, a functional manager's sphere of responsibility is generally confined to one organizational activity, whereas general managers oversee the operation of a whole company or division.

Q12. What is a Company Mission? List the guidelines for formulation of 'mission' statement. **[June 2019 - 8 Marks]**

Answer:

- The mission is a broadly framed but enduring statement of company intent.
- It embodies the business philosophy of strategic decision makers; implies the image the company seeks to project; reflects the firm's self-concept; indicates the principal product or service areas & primary customer needs the company will attempt to satisfy.
- In short, the mission describes the product, market, & technological areas of emphasis for the business & it does so in a way that reflects the values & priorities of strategic decision makers.

Guidelines for formulation of "mission" statement:

(a) It should be based on existing business capabilities "Who we are & what we do".
(b) It should follow the long-term strategy principles.
(c) Profit making should not be the only mission of organisation.
(d) It should be logical extension of business existing capabilities.
(e) It should clearly & precisely present the future orientation of business.
(f) It should include achievable missions.
(g) It should be stated in a form that it becomes the motivating force to every member of organisation.
(h) Mission statement once formed shall be communicated to every member of organisations.
(i) It should include interest of customers & society.

Q13. Define the term 'strategy' & list the characteristics of a strategic decision. **[Dec 2019 - 8 Marks]**

Answer:

- Strategy can be defined as the direction & scope of an organisation over the long term, which achieves advantage for the organisation through the configuration of resources within a changing environment & to fulfil stakeholder expectations.
- The definition of strategy encompasses a comprehensive master approach that states how the corporation will achieve its mission & objectives.
- It maximizes competitive advantage & minimizes competitive disadvantage.

The characteristics of a strategic decision/strategy are as follows:

(1) Strategy is likely to be concerned with long-term direction of an organisation.
(2) Strategic decisions are normally about trying to achieve some advantage for the organisation over competition.
(3) Strategy is likely to be concerned with the scope of the organization's activities.
(4) Strategy can be seen as matching the resources & activities to the environment in which it operates.
(5) Strategy can be seen as stretching an organization's resources & competences to create new opportunities or to capitalize on them.
(6) Strategies sometimes require major resource changes for an organisation.
(7) Strategic decisions are likely to affect operational decisions.
(8) The strategy of an organisation is affected not only by environmental factors & resource availability but also by the values & expectations of those who have power in & around the organisation.

Q14. Enumerate the need for an Explicit Mission. How does a company's mission statement differ from its strategic vision? **[Dec 2022 - 6 Marks]**

Answer:

- **The need for an explicit mission arises for varied reasons:**
  (1) Unanimity of purpose,
  (2) Motivating the use of the organization's purpose,
  (3) Develop a basis for use of the organization's resources,
  (4) Facilitate the translation of objectives into a work structure.
  (5) Cost, time, & performance parameters can be controlled.
  (6) Specify organizational purpose & assign tasks.
- A strategic vision portrays a company's aspirations for its future destination. A company's mission describes its purpose & its present business.

- A company's mission describes its purpose & its present business - who we are, what we do, & why we are here. It announces what the company is providing to society; either a service or a product.
- The mission contains few specific directives, only broadly outlined or implied objectives & strategies. Characteristically, it is a statement of attitude, outlook, & orientation rather than of details & measurable targets.

Q15. Define Strategy. Explain the 3 types of strategy usually considered by typical business firm. **[June 2023 -7 Marks]**

Answer:

Strategy" can be defined as the direction & scope of an organisation over the long term, which achieves advantage for the organisation through the configuration of resources within a changing environment & to fulfil stakeholder expectations.

The 3 types of Strategy:

Corporate Strategy	▪ Concerned with overall purpose & scope of an organization. ▪ How value will be added to the different parts / business units & product lines of an organization? 3 main categories: stability, growth & retrenchment. ▪ Decisions include: investments in diversification, vertical integration, acquisitions, new ventures, allocation of resources between different businesses of the firm & divestments.
Business Strategy	▪ It is about - How to compete successfully in particular markets? ▪ It emphasizes improvement of the competitive position of organisation's products or services in the specified industry or market segment served by that business unit. ▪ Competitive & cooperative strategies are the two main categories.
Functional / Operational level Strategy	▪ How the component parts of an organisation deliver effectively the corporate & business level strategies in terms of resources, processes & people? ▪ Concerned with developing & nurturing competence to provide a business unit with a competitive advantage. ▪ Directed towards maximizing resource productivity

Q16. Explain in brief the various important issues that need to be kept in mind while setting up objectives of an organization. **[Dec 2023 - 7 Marks]**

Answer:

Specificity	▪ Specificity is related to the organisational level for which a set of objectives have been stated. ▪ Objectives may be stated at different levels of specificity. At one extreme they might be very broadly stated goals & on the other extreme it may be translated in to performance targets. ▪ This issue of specificity may be resolved by stating specificity at different levels of the organisation & prefixing terms such as corporate, general & particular so that they serve the needs of performance & its evaluation.
Multiplicity	▪ The issue of multiplicity arises from the fact that it is rare for an organisation to work on a single objective or a few objectives. ▪ Since objectives deal with a large number of functional areas, a large number of them have to be formulated to cover the diverse aspects of the organisation's functioning. ▪ It may be mentioned that neither too few nor too many objectives are considered realistic. ▪ The issue of multiplicity considers the number & types of objectives that are being set.
Periodicity	▪ Objectives may be set for different time frame. ▪ It is possible to set long term, medium term & short-term objectives. ▪ Normally organisations determine objectives for the long term & the short term. ▪ These different time frame of objectives need to be integrated with each other in order to achieve the desired result. ▪ Long term objectives tend to be general in nature as the outcomes tend to be less certain. ▪ On the other hand, short term objectives tend to be more specific & comprehensive given the certainty involved in it.

Verifiability	▪ The issue of verifiability revolves around the question of deciding whether an objective has been met or not. ▪ Moreover, linked to verifiability is the concept of quantification. A definite way to measure an objective is to quantify it. ▪ In cases where objectives cannot be quantified, qualitative objectives may be set. ▪ Qualitative objectives may require some value judgements of experts from within & outside the organisation.
Reality	▪ It is often found that organisations have two set of objectives namely, official & operative. ▪ While the official objectives are those which the organisation professes to attain, the operative objectives are those which they seek to attain in reality. ▪ **For ex:** developing human resource is the official objective of most of the organisations. However, to determine whether it is the operative objective will depend on the amount of resource allocation that has been made towards the development of human resource.
Quality	▪ The capability of an objective to provide a specific direction & a tangible basis for evaluating performance determines the quality of an objective. ▪ **For ex:** "stating that to increase revenue" is considered to be a bad objective as it lacks the element of measurability. If the same objective is rephrased as "to increase the revenue by 30% in the next 6 months & thereafter increase it by 40%, maintainable for the next two years" can be considered to be a good objective.

Q17. "Strategic Management involves a greater Scope than that of any one area of operational Management." In this Context align the objectives of Strategic Management. **[June 2024 - 7 Marks]**

Answer: The objectives of Strategic Management are as follows:

(a) To identify opportunities and adapt resources to exploit the opportunities created.

(b) To create opportunities by stretching the resources and competences of the organization and capitalize them.

(c) To help managers to understand the key relationships among actions, context and performance by providing the conceptual frameworks.

(d) To help an organization enjoy competitive advantage.

(e) To sustain and improve the competitive position by the deployment and acquisition of appropriate resources and by monitoring and responding to environmental changes.

(f) To identify the critical success factors and meet the needs and wants of the customers.

(g) To avoid failure by focusing on the building blocks of competitive advantage (superior efficiency, superior quality, superior innovation and superior responsiveness to customers), instituting continuous improvement and learning, tracking the best industrial practices and using benchmarking.

(h) To overcome inertia and accept the changes in the ever-changing environment to remain competitive and at times to survive.

(i) To develop a creative and innovative attitude and to think strategically.

CASE BASED SCENARIO

Q18. Fastfix is a small company operating in a single city. Its business is repairing laptops. It has earned a good name for its fair charges & speedy delivery. for the next five years, the environment offers the following information:

Many school students are being given laptops by the school themselves & this trend is likely to continue for another five years. College students & coaching centres provide new laptops to all the students during the admission. The fees are inclusive of these costs.

Tablets are first replacing laptops in certain market segments & models are changing every six months, if there are major repairs, richer people discard the products & go in for new products or newer versions. However, there are rural markets & certain parts of urban markets which will still be interested in the low-cost repaired & re-sold products.

Considering the above case of Fastfix it will limit its operations to only one city.

You are required to give:

(1) A vision statement;

(2) A mission statement;

(3) Does SWOT analysis exist?

(4) Some parameters that could be used in such the above situation relating to the financial & growth perspectives in a Balance Score Card - BSC. **[Dec 2013 - 8 Marks]**

Answer:

(1) Vision Statement: Our Company intends to provide the best quality of repairs to laptops in the fastest possible time anywhere in the city with the most reasonable charges to customers.

(2) Mission Statement: We deliver at customers' doorstep their fully functional laptops with minimum down times for customers while ensuring:

(a) Timely delivery as promised.

(b) Reasonable charges.

(c) Good quality of services.

(d) Replacement of parts by genuine parts based on genuine needs.

(e) Pick up of faulty laptops.

(f) Offer stand by laptops as per customer requests.

(3) SWOT Analysis:

(a) Strengths: Access to standard parts that normally fail in laptops, network of trained employees who have thorough job knowledge, available loyal customers, less time in delivery & perfect commitment.

(b) Weakness: Going beyond the scope of faults recognised by the customers, often leading to cost over runs while preventing future repairs calls.

(c) Opportunities: Branches may be opened in schools/colleges/big coaching centres. Business can be extended to sale of reworked computers in ready & going markets, preventing maintenance services, annual maintenance contracts, upgrades & compatibility addition with new peripherals, etc.

(d) Threats: Unless tablet markets also are created to, there is a threat to long term survival. Threats from one stop shops for repairing all types of mobiles/computers/laptop/tablets/iPhones/ smart phones, etc. Threats of obsolescence resulting in non-availability of spares.

(4) Balance Score Cards - BSC:

(a) Financial perspective: Revenue from repairs, average job order cost, total spares purchases, delivery costs, - revenue per jobless variable cost per job as a % of revenue per job, debtor's management - target nil, etc.

(b) Learning/innovation/growth perspectives: Number of employees trained, number of new products repaired, number of new spares used, machinery used for cleaning/servicing, new logistics management, service call tracking, repair status on-line tracking, etc.

Q19. Aashirvaad Ghee will make its debut in the January, 2016 as ITC plans to enter into the dairy segment. Extending the product range of its biggest non-cigarette brand, the company is looking to replicate the success it achieved in the unrecognized segment with the Aashirvaad brand. Being a household name, Aashirvaad has tremendous brand equity among households & housewives, so ITC has decided to launch ghee product under the Aashirvaad umbrella, which also provides spices & other food products. Aashirvaad is a ₹ 2,600 crore brand & controls 74% share of the country's packaged Atta market, which ITC entered in 2002, a year after getting into packaged food with ready-to-eat products. Dairy related product categories in India are in various stages of development. Now, ITC plans to extend its product portfolio to ICE-CREAM, BUTTER, CHEESE, CURD, MILK-BASED DRINKS & READY-TO-MIX items. India being the largest producer & consumer of dairy products is expected to see 15 to 16% growth with its expansion in the value-added products. ITC sets to launch its first dairy product 'Aashirvaad Ghee'. ITC seeks to capitalize Aashirvaad brand name, who's spices & Atta are well known in domestic market. At the root of all, strategy lies with the ability to make good choices. **[Dec 2015 - 10 Marks]**

In the above perspective:

(1) What are major subjective factors to be considered by corporate planner to take a good strategic choice decision?

(2) Does the entry of ITC in Indian dairy market fulfil the key attributes of its high-quality strategic choice?

Answer:

1. The following factors mostly regulate strategic choice decisions of selective measures & directly or indirectly influence the strategic choice:
   (a) Managerial perceptions of external dependence.
   (b) Values, preference & managerial attitude towards risk.
   (c) Managerial awareness of past strategies.
   (d) Managerial power relationship & organization structure.
   (e) Influence of lower-level managers.
   (f) Organizational policies, culture etc.
2. Good choices identify & mobilize the company towards the combination of market positioning & unique activities that represent the best scenario for where to play & how to win in a chosen market. In short, a set of good choices positions a firm for competitive advantage.

A high-quality strategic choice possesses following four key attributes:

Genuine	The company must choose where to play - i.e. which customers are to be served & what needs to target & where not to play & how to compete - i.e. How the firm will achieve advantage over competitors in chosen customer groups or segments of the market & how not compete.
Sound	▪ A sound choice flows logically from the accumulated facts, data, figures & beliefs of the choice makers. Sound choices neither ignore nor rest on intuition. ▪ They are the product of good logic applied to accurate data, data which is representative & robust.
Actionable	The choice can be easily communicated, can be broken down into series of steps to be taken immediately, & can be further broken down into long-term achievable goals & doable tasks.
Compelling	▪ The choice must be sufficiently compelling to generate management commitment to the choice-not just in an abstract it makes sense kind of way, but in an engaged & energetic way. ▪ The test of a compelling choice is: (1) Can the management team achieve sufficient commitment to make a choice to change direction? (2) Can the team maintain sufficient enthusiasm to enable its employees to implement the choices? (3) Can the management put the strategy into action for long enough to achieve success? ▪ In the light of the above, the ITC satisfied its four key attributes of high-quality strategic choice in Indian dairy market.

9 STRATEGIC ANALYSIS & STRATEGIC PLANNING

Q. Write a short note on the following concepts: [4 Marks each]

Q1	Contingency plan	**[June 2017]**
Ans	▪ A basic premise of good strategic management is that firms plan ways to deal with unfavorable & favorable events before they occur. Regardless of how carefully strategies are formulated, implemented, & evaluated, unforeseen events, such as strikes, boycotts, natural disasters, arrival of foreign competitors, & government actions, can make a strategy obsolete. ▪ To minimize the impact of potential threats, organizations should develop contingency plans as part of their strategy-evaluation process. Contingency plans can be defined as alternative plans that can be put into effect if certain key events do not occur as expected. ▪ Only high-priority areas require the insurance of contingency plans. Strategists cannot & should not try to cover all bases by planning for all possible contingencies. Contingency plans should be as simple as possible.	
Q2	Unrelated Diversification	**[Dec 2017]**
Ans	Unrelated Diversification is also termed conglomerate growth because the resulting corporation is a conglomerate, i.e. a collection of businesses without any relationship to one another. The strategic justifications advanced for this strategy are to: ▪ Take advantage of poorly managed companies which can then be turned around & either run at a gain to the shareholders or sold-on at a profit. ▪ Spread the risks of the firm across a wide range of industries. ▪ Escape a mature or declining industry by using the positive cash flows from it to develop into new & more profitable areas of business.	
Q3	Corporate Planning	**[Dec 2018]**
Ans	▪ Corporate Planning is concerned with determination of objectives treating the company as a whole. It develops means to achieve the company's overall objectives. The corporate plans may relate to achieve corporate objectives for short-run & long-run. ▪ It is an integrated systems approach considering different functions, divisions & units of the organization. Such corporate plans are framed at the corporate level by the top management.	
Q4	Stages involved in Strategic Planning	**[June 2019 & Dec 2021]**
Ans	**Stage 1: Strategic Option Generations:** At this stage, a variety of alternatives are considered, relating to the firm's product & markets, its competitors & so forth. Examples of strategies might be: (a) Increase market share' (b) Penetration into international market (c) Concentration on core competencies v (d) Acquisition or expansion etc. **Stage 2: Strategic Options Evaluation:** Each option is then examined on its merits. (a) does it increase existing strengths? (b) does it alleviate existing weaknesses? (c) is it suitable for the firm's existing position? (d) is it acceptable to stakeholders? **Stage 3: Strategic Selection:** It involves choosing between the alternative strategies. This process is strongly influenced by the values of the managers in selecting the strategies.	

Q5	What are the various approaches in Strategic Planning? [Dec 2019 & Dec 2022]
Ans	**There are three approaches that can be adopted in strategic planning:** 1. A top-down approach, in which managers are given targets to achieve which they pass on down the line. 2. A bottom-up approach, in which functional & line managers in conjunction with their staff submit plans, targets & budgets for approval by higher authority. 3. An iterative approach, which involves both the top-down & bottom-up setting of targets. There is a to-&-from movement between different levels until agreement is reached. However, this agreement will have to be consistent with the overall mission, objectives & priorities & will have to be made within the context of the financial resources available to the organization. The iterative approach, which involves the maximum number of people, is the one most likely to deliver worthwhile & acceptable strategic plans.

Q6. Distinguish between Strategic Management & Strategic Planning. **[June 2018 & 2019 - 4 Marks]**

Strategic Management	Strategic Planning
It is focused on producing strategic results; new markets new products, new technologies etc.	It is focused on making optimal strategic decisions.
It is management by results.	It is management by plans.
It is an organizational action process.	It is an analytical process.
It broadens focus to include psychological, sociological & political variables.	It is focused on business, economic & technological variables,
It is about choosing things to do & also about the people who will do them.	It is about choosing things to do.

Q7. What is 'Vertical integration'? State its pros & cons, conducted in order to ascertain the product acceptability.

[Dec 2013 - 5 arks]

Answer:

Vertical integration is the degree to which a firm's own production system handles the entire supply chain starting from procurement of raw materials to distribution of finished goods.

Pros of Vertical Integration:

- Lower costs due to eliminated market transaction costs
- Improved quality of supplies
- Critical resources can be acquired through VI
- Improved coordination in supply chain
- Greater market share
- Secured distribution channels
- Facilitates investment in specialized assets - site, physical-assets & human-assets
- New competencies

Cons of Vertical Integration

- Higher costs if the company is incapable to manage new activities efficiently.
- Ownership of supply & distribution channels may lead to lower quality products & reduced efficiency because of the lack of competition.
- Increased bureaucracy & higher investments lead to reduced flexibility.
- Higher potential for legal repercussion due to size - An organization may become a monopoly.
- New competencies may clash with old ones & lead to competitive disadvantage.

Q8. Write the benefits that can be derived from 'unrelated diversification'. What are the two ways that an unrelated diversification strategy can create value? **[Dec 2013 - 5 Marks]**

Answer: With **unrelated diversification** few benefits are derived from horizontal relationships that is the leveraging the core competencies or the sharing of activities across business units within a corporation. Unrelated diversification can create value through two ways of financial economies - cost savings.

1. **Unrelated diversified** firms can more efficiently allocate capital among the component businesses than can the external financial market. This is possible because the corporate level management has more complete information about the performance of the component businesses & it can also discipline under-performing management teams.
2. **Unrelated diversified** firms can also create value by purchasing other businesses at low prices, restructuring them & reselling them at a higher price. This practice is most successful with mature, low-technology business, rather than high technology or service businesses which are more dependent on employees who may leave.

Q9. It has been known for many years that the returns from diversification are often poor. Why do managers still persist with it as a strategy? **[June 2015 - 6 marks]**

Answer:

- The statement made is true. It is a fact that the returns from diversification are often poor, yet many managers seem to still persist with it. In diversification, an enterprise takes up new products or business which may be related or unrelated to its existing business.
- Diversification, in particular, involves a high degree of risk, as it amounts to manufacturing new products or entering into new markets, unfamiliar to the organization. One simple answer comes from the innate tendency of some entrepreneurs & entrepreneurial managers, to seize opportunities as they arise, in the belief that they can overcome the resulting challenges & hence firmly believe in diversifying.
- If every manager were to eschew diversification because the odds were against its succeeding, then many profitable openings would remain unexplored. Society & many companies would arguably be poorer if managers do not go in for diversification. The proper function of the manager, one might argue, is to take - properly assessed risks rather than to avoid them.
- 'Betting the firm' on a diversification is not necessarily a sound strategy but a trial & error approach. This approach may have something to commend it, if the errors are affordable. One final point is that the failure rate of diversification is not infact as dreadful as a Porter made it out to be. Most major organizational initiatives carry a failure rate of around 70%. The success rate for diversification is pretty well at par.
- It is better than success rates for new products, of which 9 out of 10 fail, according to most marketing folklore.
- It is also important to understand what it takes to manage a certain growth rate. Depending on where the existing business is in terms of the industry life cycle stage, a firm may need to get into other businesses for sustained future returns, as in case of companies in the tobacco business.
- Further, if the products are not doing too well in the traditional lines, managers should explore diversification. Diversification should also be resorted to in cases where the organization enjoy considerable resource strength & would like to expand its operation by looking at new businesses.
- To conclude, we can say that diversification is a high-risk strategy. Yet we should go for it, in tune with the adage "No risk, no gain."

Q10. Write the essential conditions in which the 'cost leadership business strategy' & 'differentiation business strategy' of Porter's Generic Business Level Strategy are used in business. **[Dec 2015 - 6 Marks]**

Answer: Conditions under which cost leadership business strategy is used:

(a) The markets for the product operate in such a way that price-based competition is an important factor.

(b) The product is standardized & its consumption takes place in such a manner that differentiation is not required.

(c) The bargaining power of buyer to negotiate a price reduction is high from the supplying firm.

(d) There is lesser customer loyalty & the cost of switching from one seller to another is low.

Conditions under which differentiation business strategy is used:

(a) The firm knows who are its competitors & knows all the marketing-mix.

(b) The market is too large & a few firms offering a standardized product.

(c) The customers' needs & preferences are too diversified.

(d) It is possible for the firm to charge a premium price for differentiation that is valued by the customers.

(e) The nature of the product is such that brand loyalty is possible to generate & sustain.

Q11. Mention four possible areas where 'differentiation business strategy' is applicable. **[Dec 2015 - 2 marks]**

Answer: Differentiation business strategy is possible in the following areas:

(a) Product design.
(b) Quality of product.
(c) Technology development.
(d) Distribution system.
(e) Customer services etc.

Q12. "In the maturity stage of Product Life Cycle - PLC, the market becomes saturated, price competition is intensified, & the rate of sales growth slows down." Suggest strategic choices in such a stage of the PLC. **[Dec 2015 - 5 Marks]**

Answer: In order to face the situations characterized by the maturity stage of PLC - Product Life Cycle, alternative marketing & distribution strategies listed below are suggested:

Intensive promotion by means of	▪ Brand-stressing advertising, ▪ Attractive design & functional packaging, ▪ Effective after-sales services, ▪ Given importance in customer loyalty.
Trading down through	▪ Introduction of low-priced models of existing products or services, ▪ Price-cutting of entire product line.
Trading up through	▪ Improvement of quality & appearances etc. ▪ Use of prestigious packages, ▪ Price increase to cream market levels.
Proliferation, exclusive or radical by	▪ More design or varieties, ▪ More exclusive & innovative features, ▪ Creating radical & distinct package designs, ▪ More options.
Increase of product availability & point-of-sale service through	▪ More distribution outlets, ▪ More dealers, ▪ More service centers.

Q13. What do you understand by 'Strategic Portfolio Analysis'? State the main objective of this analysis.

[June 2016 - 6 Marks]

Answer:

- Strategic Portfolio Analysis, alternatively termed business portfolio planning or portfolio strategy or policy-strategy profile or organizational portfolio plan, is a broad term & refers to a technique found in many different variations.
- This analytical technique helps the management to satisfy the emerging need for centralized decisions on key strategic issues in MNCs.
- It provides a means of comparing numerous business activities in relation to each other, establishing priorities & deciding between winners & losers.
- The formulation of the organizational portfolio plan is the final phase of the strategic planning process.
- It assumes that most organizations, at a particular time & in reality, are a portfolio of business.
- The primary/main objective of this analysis is to determine the optimal allocation of cash resource among the various business activities comprising of a diversified corporate portfolio. In addition, it can help the top management in the following respects:
  (a) What business activities the company should be in?
  (b) How performance of the different business SBUs should be evaluated?
  (c) Who should manage these SBUs?

Q14. State the disadvantages of 'Vertical Integration'. **[June 2016 - 2 Marks]**

Answer: Disadvantages of vertical integration are:

(a) Not attractive for low volumes.

(b) High capital investment & operating costs.

(c) Less ability to react more quickly to changes in customer demands, competitive actions & new techniques.

Q15. What types of risks are involved in 'focus business strategy'? **[Dec 2015 - 2 Marks]**

Answer: The risks involved in focus business strategy are as follows:

(a) Target segment may disappear for some reason.

(b) It is difficult to identify which segments the firms should choose.

Q16. What are the main contributions of General Electric GE & Boston Consulting Group BCG matrix in 'Strategic Portfolio Analysis'? **[June 2016 - 2 Marks]**

Answer:

- In the strategic portfolio analysis, General Electric - GE & Boston Consultancy Group - BCG matrix made pioneering contributions.
- GE introduced the-concept of dividing business activities into SBUs with like characteristics, related to the product life cycles.
- BCG consisted of a wide variety of products in different growth rates & market shares, search for investment strategies to allocate resources among them to optimize company's long-run profits.

Q17. Write the main criticisms of BCG Matrix. **[June 2016 - 3 Marks]**

Answer: BCG Matrix provides a framework for allocating the resources among different SBUs allows one to compare many business units at a glance. However, the approach has received some criticisms for the following reasons:

(a) The link between market share & profitability is questionable since increasing market share can be very expensive.

(b) The approach may over emphasize high growth, since it ignores the potential of declining markets.

(c) The model considers market growth rate to be a given. In practice the firm may be able to grow the market.

Q18. Define the term 'Vertical integration'. Give a suitable example with explanation. **[Dec 2016- 2 Marks]**

Answer:

- Vertical integration is the process in which several steps in the production &/or distribution of a product or services are controlled by a single company or entity, in order to increase that company's or entity's power in the market place.
- This integration represents an expansion or extension of the firm by integrating preceding or successive productive process.
- Simply said, every single product/service that you can think of has big life cycle. While you might recognize the product/service with a brand name printed on it, many companies are involved in developing that product/service. These companies necessarily not part of the brand you see.

  Example: The vertically integrated giants of computer industry, firms like IBM, Digital & Burroughs, were felled like young saplings when at the end of the 1970s Apple formed a network of independent specialists that produced machines for more efficiently than the do-it-all giants.

Q19. State the drawbacks of 'vertical integration'. **[Dec 2016 - 4 Marks]**

Answer: Vertical integration potentially has the following drawbacks:

(a) Capacity balancing issues.

(b) Potentially higher costs due to low efficiencies resulting from lack of supplier competition.

(c) Decreased flexibility due to previous upstream or downstream investments.

(d) Decreased ability to increase producer variety if significant in-house development is required.

(e) Development new core competencies may compromise existing competencies.

(f) Increased bureaucratic costs.

Q20. State the important issues which are to be considered in making decisions associated with vertical integration.

[Dec 2016 - 8 Marks]

Answer: In making decisions associated with vertical integration, following 4 important issues should be considered:

(a) Is the company satisfied with the quality of the value that its present suppliers & distributors are providing? If the performance of organizations in vertical chain - both suppliers & distributors - is satisfactory, it may not, in general, be appropriate for a company to perform these activities themselves.

(b) Are their activities in the industry value chain presently being outsourced or performed independently by others that are a valuable source of future profits? Even if a firm is outsourcing value chain activities to companies that are doing credible job, it may be missing out on substantial profit opportunities.

(c) Is there a high level of stability in the demand for the organization's products? High demand or sales volatility would not be conducive to a vertical integration strategy.

(d) How high is the proportion of additional production capacity actually absorbed by existing products or by the prospects on new one & similar products? The smaller the proportion of production capacity to be absorbed by existing or future products, the lower is the potential for achieving scale economies associated with the increased capacity - either in terms of backward integration - towards the supply of raw materials or forward integration - toward the end user. Alternatively, if there is excess capacity in the near term, the strategy of vertical integration may be viable if there is the anticipation of future expansion of products.

Q21. State various limitations of the BCG model. **[June 2017 & 2019 - 6 Marks]**

Answer:

The BCG model analyses products in the light of two variables: The growth in the market as a whole & the growth of the product's share of the market in relation to other products. It suggests that there is a relationship between these variables & the product's propensity to generate cash or consume it. It rests on the assumption that the firm with the highest market share can be the lowest cost producer. The model suggests that cash cows should be used to fund stars. There are a number of limitations to the model - & remember that it is only a model, & any model necessarily simplifies the real world which it tries to depict.

(a) How do you define your market? Segmentation strategies can provide a niche. A niche is inevitably a low or restricted share of the market, yet it is the heart of a focus strategy. Firms can profit servicing small low-growth niches.

(b) Market growth & market share are assumed to be reliable pointers for cash flow. This is often not true. High market share does not necessarily mean high profits, especially if a firm has high costs, or has bought market share by low pricing.

(c) Relative market share amongst competitors is not necessarily an indication of their competitive strengths at any particular time. After all, market leaders are vulnerable.

(d) The BCG model might become a self-fulfilling prophecy: Dogs which could be made profitable might simply be left to the rather than be resuscitated.

(e) It does not suggest any' response to declining markets other than withdrawal: many firms can make money in 'sunset industries'.

(f) It ignores the extent to which a firm which serves a number of markets can exploit production synergies.

(g) It ignores the threat of substitute products.

Q22. Define the term 'Portfolio Analysis'. List the factors influencing Portfolio Strategy. **[Dec 2017 - 6 Marks]**

Answer: Portfolio analysis is a term used in describing methods analyzing a product market portfolio with aims.

(a) To identify the current strengths & weaknesses of an organization's products in its markets, & the state of growth or decline in each of these markets.

(b) To identify what strategy is needed to maintain a strong position or improve a weak one.

Factors influencing Portfolio Strategy:

1. Mission/Vision
2. Value system
3. Future of Current Business
4. Position on the Portfolio Matrix/PLC
5. Government Policy
6. Competitive Environment
7. Company Resources

8. Supply/Demand Conditions
9. Competitive Moves
10. Portfolio Strategy of Parent
11. Business Environment

Q23. What is meant by a contingency plan? List its benefits. **[Dec 2017 - 6 marks]**

Answer: Contingency Plan:

- A basic premise of good strategic management is that firms plan ways to deal with unfavourable & favourable events before they occur.
- Too many organizations prepare contingency plans just for unfavourable events; this is a mistake, because both minimizing threats & capitalizing on opportunities can improve a firm's competitive position.
- Regardless of how carefully strategies are formulated, implemented, & evaluated, unforeseen events, such as strikes; boycotts, natural disasters, arrival of foreign competitors, & government actions, can make a strategy obsolete.
- To minimize the impact of potential threats, organizations should develop contingency plans as part of their strategy-evaluation process.
- Contingency plans can be defined as alternative plans that can be put into effect if certain key events do not occur as expected.
- Only high-priority areas require the insurance of contingency plans. Strategists cannot & should not try to cover all bases by planning for all possible contingencies in any case, contingency plans should be as simple as possible.

Benefits of Contingency Planning:

1. It will make the future through their proactive planning & advanced preparation.
2. It will introduce original action by removing present difficulties.
3. It enables to anticipate future problems.
4. It will change the goals to suit internal & external changes.
5. It experiments with creative ideas & take initiative.
6. It will attempt to shape the future & create a more desirable environment.
7. It permits quick response to change,
8. It prevents panic in crisis situations.
9. It makes managers more adaptable to unforeseen changes.

Q24. Discuss about the areas of attention for SWOT appraisal. State purpose of such appraisal. **[June 2018 - 8 Marks]**

Answer: SWOT appraisal should give particular attention to the following:

1. **A Study of past accounts & the use of ratios:** By looking at trends, or by comparing ratios - if possible with those of other firms in a similar industry, it might be possible to identify strengths & weaknesses in major areas of the business. The assistance of a management accountant should be of great value in this work.
2. **Product position & Product market mix.**
3. **Cash & Financial structure:** If a company intends to expand or diversify, it will need cash or sufficient financial standing in order to acquire subsidiaries by issuing shares.
4. **Cost Structure:** If a company operates with high fixed costs & relatively low variable costs, it might be in a relatively weak position with regard to production capacity. High volumes of production & sale might be required to break even. In contrast, a company with low fixed costs might be more flexible & adaptable so that it should be able to operate at a lower breakeven point.
5. **Managerial Ability:** There may be a problem in attempting to assess this & objective measurements should be sought. The danger is that a poor management might overestimate their own ability & incorrectly analyse their weakness as strength.

The purpose of such appraisal is to express, qualitatively or quantitatively, which areas of the business have strengths to exploit, & which areas have weaknesses which must be improved. Although every area of the business should be investigated, only the areas of significant strength or weakness should warrant further attention.

While finalizing the corporate plan together with corporate objectives, growth strategies, it would be necessary to make a review of the corporate strengths & weaknesses in connection with its mission & objectives. This is an important managerial task linked with corporate planning process.

Q25. What is meant by SWOT analysis? **[Dec 2018 - 4 Marks]**

Answer:

- Gathering data about the general, operating, & internal environments provides the raw material from which to develop a picture of the organizational environment.
- Refines this body of information by applying a general framework for understanding & managing the environment in which an organization operates. The acronym SWOT stands for Strengths, Weaknesses, Opportunities, & Threats. In many respects, the sophisticated analytical techniques discussed throughout the text are further refinements of basic SWOT analysis. In addition, SWOT is an excellent way to begin a case analysis.
- SWOT analysis attempts to assess the internal strengths & weaknesses of an organization & the opportunities & threats that its external environment presents. SWOT seeks to isolate the major issues facing an organization through careful analysis of each of these four elements. Managers can then formulate strategies to address key issues.
- The purpose of such appraisal is to express, qualitatively or quantitatively, which areas of the business have strengths to exploit, & which areas have weaknesses which must be improved. Although every area of the business should be investigated, only the areas of significant strength or weakness should warrant further attention.

Q26. State the different approaches in Strategic Planning. **[June 2018 - 4 Marks]**

Answer: Fundamentally, there are four different approaches to do formal strategic planning. The Approaches are:

1. **Top-Down Approach:**

   In a centralized company, such planning is done at the top of the corporation & the departments & outlying activities are advised straightway what to do.

   In a decentralized company, the CEO or the President may give the divisions guidelines & ask for plans. The plans after review at the head office are sent back to the divisions for modifications or with a note of acceptance.

2. **Bottom - Up Approach:** The Top management gives the divisions no guidelines but asks them to submit plans.

   Such Plans may contain information on:

   (a) Major opportunities & threats.

   (b) Major objectives.

   (c) Strategies to achieve the objectives.

   (d) Specific data on sales/profits/market share sought.

   (e) Capital requirements, etc.

   These plans are reviewed at top management levels & same process, as in the top-down approach, is then followed.

3. **Mixture of the Top-Down & Bottom-Up Approaches:**

   This is practiced in most large decentralized companies. In this approach, the guidelines given by the top management to the divisions are broad enough to permit the divisions a good amount of flexibility in developing their own plans. Sometimes, the top management may decide basic objectives by dialogue with divisional managers in respect of sales & return on investments especially when divisional performance is measured upon those criteria.

4. **Team Approach:** The chief executive, in a small centralized company, often use his line managers to develop formal plans. The same approach is used even by the president of a large company. In many other companies, the president meets & interacts with his group of executives on a regular basis to deal with all the problems facing the company so that the group can develop written strategic plans.

Q27. Categories 7 steps process of Contingency Planning. **[Dec 2018 - 6 Marks]**

Answer:

Step 1: Identify the beneficial & unfavorable events that could possibly derail the strategy or strategies.

Step 2: Specify trigger points. Calculate about when contingent events are likely to occur.

Step 3: Assess the impact of each contingent event. Estimate the potential benefit or harm, of each contingent event.

Step 4: Develop contingency plans. Be sure that contingency plans are compatible with current strategy & are economically feasible.

Step 5: Assess the counter impact of each contingency plan. That is, estimate how much each contingency plan will capitalize on or cancel out its associated contingent event. Doing this will quantify the potential value of each contingency plan.

Step 6: Determine early warning signals for key contingency event. Monitor the early warning signals.

Step 7: For contingent event with reliable early warning signals, develop advance action plans to take advantage of the available lead time.

Q28. What do you understand by Product Development Strategy? **[Dec 2019 - 4 Marks]**

Answer: Product Development Strategy involves extending the product range available to the firm's existing markets.

These products may be obtained by:

(a) Investment in the research & development of additional products.

(b) Acquisition of rights to produce someone else's product.

(c) Buying-in the product & 'badging' it.

(d) Joint development with owners of another product who need access to the firm's distribution channels or brands.

The critical factor for the success of this strategy is the profitability of the customer group for which the products are being developed. Also, the firm's present competitive advantages in serving the market must confer on to the new good.

These may include:

1. Customer information that allows accurate targeting.
2. Established distribution channels.
3. A brand which can be credibly applied to the new product.

Q29. What do you mean by Contingency Plans? Illustrate some contingency plans commonly established by firms. **[Dec 2019 - 6 Marks]**

Answer:

Contingency Plans:

Contingency plans are alternative plans that can be put into effect if certain key events do not occur as expected.

Some contingency plans commonly established by firms are:

1. If a major competitor withdraws from particular markets as intelligence reports indicate, what actions should our firm take?
2. If our sales objectives are not reached, what actions should our firm take to avoid profit losses?
3. If demand for our new product exceeds plans, what actions should our firm take to meet the higher demand?
4. If certain disasters occur-such as loss of computer capabilities; a hostile takeover attempt; loss of patent protection; or destruction of manufacturing facilities because of earthquakes, tornadoes, or hurricanes - what actions should our firm take?
5. If a new technological advancement makes our new product obsolete sooner than expected, what actions should our firm take?

Q30. State the aims of analysing the product market portfolio. How value system influences the strategy? **[Dec 2022 - 6 Marks]**

Answer:

1. Portfolio analysis is a term used in describing methods of analyzing a product -market portfolio with the following aims.
   (a) To identify the current strengths & weaknesses of an organization's products in its markets, & the state of growth or decline in each of these markets.
   (b) To identify what strategy is needed to maintain a strong position or improve a weak one.
2. Several matrices have been developed over the years to analyse market share, market growth & market position.
3. Value system: A factor very much complimentary to the mission that influences the portfolio strategy is the value system of the promoters or major stock holders. After the Murugappa group took over the EID Parry, the liquor business of the EID Parry group was sold off as the Murugappa group management felt that it was unethical to be in the liquor business.

Q31. Robert Linneman & Rajan Chandran have suggested that a seven-step process in contingency planning. In this context, describe in brief what are the said steps in contingency planning. **[Dec 2022 - 6 Marks]**

Answer: Steps in Contingency Planning

Step 1: Robert Linnemam & Rajan Chandran have suggested that a seven-step process as follows:

Step 2: Identify the beneficial & unfavorable events that could possibly derail the strategy or strategies.

Step 3: Specify trigger points. Calculate about when contingent events are likely to occur.

Step 4: Assess the impact of each contingent event. Estimate the potential benefit or harm of each contingent event.

Step 5: Develop contingency plans. Be sure that contingency plans are compatible with current strategy & are economically feasible.

Step 6: Assess the counter impact of each contingency plan. That is, estimate how much each contingency plan will capitalize on or cancel out its associated contingent event. Doing this will quantify the potential value of each contingency plan.

Step 7: Determine early warning signals for key contingency event. Monitor the early warning signals.

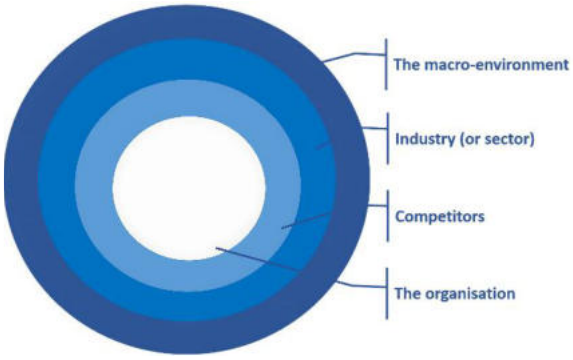
Step 8: For contingent event with reliable early warning signals, develop advance action plans to take advantage of the available lead time.

Q32. With reference to Business Environment, examine in detail.

(a) Various layers (b) Characteristics. **[June 2023 - 8 Marks]**

Answer:

(a) Layers of Business Environment:



1. The macro environment is the outermost and the highest-level layer. This consists of broad environmental factors that impact to a greater or lesser extent on almost all organizations. Here the PESTEL framework can be used to identify how future trends in the political, economic, social, technological, environmental and legal environments might impinge on organizations.
2. Industry, or sector, forms the next layer with this broad general environment. This is made up of organizations producing the same products or services. Here, the Porter's 5 forces framework is particularly useful in understanding the attractiveness of particular industries or sectors and potential threats from outside the present set of competitors.
3. Competitors and markets are the most immediate layer surrounding the organizations. Within most industries or sectors, there will be many different organizations with different characteristics and competing on different bases, some closer to a particular organization, some more remote.

(b) Characteristics of Business Environment:

1. **Environment is complex:** It comprises of a number of factors namely, events, conditions and influences arising from different sources interacting with each other to create entirely new set of influences. It is easier to understand environment in segments or compartments rather than grasp in totality.
2. **Environment is dynamic:** The changing nature of environment is constant. The dynamism of the environment is largely due to large number of factors that continuously influence its character and shape.
3. **Environment is multi-faceted:** Changes in the environment may be perceived differently by different people. It may be considered as an opportunity to one and threat to other.
4. **Environment has a far-reaching impact:** It critically underpins the growth & profitability of the organization. Any change in environment affects the organization in more than one way.

Q33. After assuming an organization of your own choice, apply the concept of Portfolio Analysis on it. Now derive.
(a) Various objectives of Portfolio Analysis (b) Advantages of Portfolio Analysis. **[June 2023- 7 Marks]**

Answer:

Objectives of Portfolio Analysis:

- To analyse the current mix of business and take investment decisions
- To develop strategies for adding new businesses in the portfolio thereby inducing growth
- To decide the business to be retained and the one to be excluded from the portfolio

Advantages of Portfolio Analysis:

- It encourages top management to evaluate each of the corporation's business individually and to set objectives and allocate resources for each.
- It stimulates the use of externally oriented data to supplement management's judgement.
- It raises the issue of cash flow availability for use in expansion and growth
- Its graphic depiction facilitates communication.

Q34. Examine Various Mechanisms that may be employed for identifying Strategic alternatives in the medium and large organizations. **[Dec 2023 - 7 Marks]**

Answer:

In medium and large organizations, the following mechanisms may be w employed for identifying strategic alternatives:

1. **Brainstorming Sessions:**

   In most organizations, strategic alternatives are identified during a brainstorming session of top management and key executives. In such meetings, participants generate a number of alternatives. At this stage, p no importance is given to the relative merits and demerits of the options. In the next stage, each alternative is reviewed and subjected to close scrutiny. The alternatives which are considered fairly appealing are further examined and analysed for final selection.

2. **Special Meetings:**

   Some large organizations may hold special meetings of top executives away from their work, in a hotel or a holiday resort. This is to ensure that the process of thinking is not disturbed by interruptions during the course of deliberations. The participants present different alternative scenarios along with their recommended courses of action. Depending on the assumptions and future trends, each course of action is discussed and attempts are made to finalize the best options for further analysis.

3. **Outside Consultants:**

   Some organizations may engage the services of an outside consultant to handle the process of generating alternative strategies. The premise is that an outsider can observe the phenomenon objectively and dispassionately, and bring in his own expertise into the process. The outside viewpoint is expected to be new and fresh, and thus can show up many new opportunities to the organization.

4. **Joint Meetings:**

   Another useful way of generating alternatives is to hire the services of a consultant and also, associate some internal members in the process. This method has the advantage of blending the new ideas contributed by the outside consultants with workable solutions from within the organization.

Q35. The value chain describes the categories of activities within and around an organization which create a product or service". In this context, demonstrate the activities involved in value chain of an organization. **[Dec 2023 - 7 Marks]**

Answer:

Primary activities are directly concerned with the creation or delivery of a product or service. For example, for a manufacturing business the primary activists are as follows:

- Inbound logistics are activities concerned with receiving; storing and distributing inputs to the product or service including materials handling, stock control, transport, etc.
- Operations transform these inputs into the final product or service. Operations include machining, packaging, assembly, testing, etc.
- Outbound logistics collect, store and distribute the product to customers, for example warehousing, materials handling, distribution, etc.
- Marketing and sales provide the means whereby consumers/users are made aware of the product or service and are able to purchase it. This includes sales administration, advertising and selling.

- Service includes those activities that enhance or maintain the value of product or service, such as installation, repair, training and spares.

Support activities help to improve the effectiveness or efficiency of primary activities. The following are the support or secondary activities:

1. **Procurement:** It refers to the processes that occur in many parts of the organisation for acquiring the various resource inputs to the primary activities.
2. **Technology development:** All value activities have a 'technology', even if it is just know-how. Technologies may be concerned directly with a product or with processes or with a particular resource.
3. **Human resource management:** This transcends all primary activities. a
4. It is concerned with those activities involved in recruiting, managing, t training, developing and rewarding people within the organisation.
5. **Infrastructure:** The formal systems of planning, finance, quality control, L information management, and the structures and routines that are part of an organisation's culture.

Q36. Identifying key drives for change helps managers to focus on the PESTEL factors that are most important & which must be addressed as the highest priority "Justify the statement with the help of PESTEL Framework.

[June 2024 - 7 Marks]

Answer:

- PESTEL framework covers six main types of environmental influences, namely, Political, Economic, Social, Technological, Environmental and Legal. All these influences create both opportunities as well as threats depending upon the situation.
- Political instability poses threats to business organizations whereas, Political stability and a favourable government creates opportune business environment.
- Economic growth leads to an increase in customer expenditures which in turn gives companies the opportunity to expand operations and earn higher profits. On the contrary Recession increases competitive pressures and decreases customer expenditures causing a threat to the companies.
- Social influences include changing cultures and demographics. Demographic forces are outcomes of changes in the characteristics of a population, such as age, gender, ethnic origin, race, sexual orientation and social class.
- Like the other forces in the general environment, demographic forces present managers with opportunities and threats and can have major implications for organizations.
- Technological influences refer to innovations such as artificial intelligence, internet, nano-technology, or the rise of new composite materials.
- Environmental stands specifically for 'green' issues, such as pollution and waste. The environmental factors have now become extremely important for organizations as countries across the globe are increasingly concerned with the environmental changes and are striving towards clean, green and renewable sources of energy.
- Legal embraces Legislative constraints or changes such as health and safety Legislation or restriction on Company mergers and acquisitions.

Q37. Analyze the Techniques that can help to improve Strategic decision Making. **[June 2024 - 7 Marks]**

Answer:

The Techniques for improving strategic decision making are enumerated below:

- **Devil's advocacy:**

  It requires the generation of a plan, and a critical analysis of that plan. One member of the decision-making group acts as the devil's advocate, emphasizing all the reasons that might make the proposal unacceptable. In this way, decision makers can become aware of the possible perils of recommended courses of action.
- **Dialectic inquiry:**

  It is more complex because it requires the generation of a plan (a thesis) and a counter-plan (an antithesis) that reflect plausible but conflicting courses of action. Strategic
- **The outside view:**

  It requires planners to identify a reference class of analogous past strategic initiatives, determine whether those initiatives succeeded or failed, and evaluate the project at hand against those prior initiatives.
- **Group Think:**

  1. Concept was given by psychologist Irvin Janis.

2. It occurs when a group of decision makers embarks upon a course of action without questioning underlying assumptions.
3. Typically, a group coalesces (unites) around a person or policy.
4. It ignores or filter out information that can be used to question the policy and develops after the fact rationalizations for its decision.
5. Commitment to the mission or goals becomes based on an emotional rather than an objective assessment of the correct course of action.
6. The consequences can be poor decisions.

Q38. A significant example of Strategic Choices in Indian Corporate in recent times is the growth for Starbucks & the Tata group. Starbucks has opted to enter into a strategic alliance with the Tata Group, as it attempts to establish a position in the Indian market. Tata Starbucks Limited is the 50-50 joint venture between Tata Global Beverages Limited & the Starbucks Coffee Company. The Company celebrated the opening of the 50m Starbuck store in India on 8th July, 2014. The company launched its first store at Phoenix Market City, Velachery, Chennai.

The Company will continue to open more & more stores & grow thoughtfully in the market with a commitment to offer the unique Starbucks experience, unrivalled service, hand-crafted beverages, extensive food offerings & with a distinct fragrance & aroma of Coffee to Coffee lovers across the country. With 50 stores now operational across 5 cities, Tata Starbucks Limited continues to grow & nurture its brand in India-in line with its promise to build a strong connect with the Indian consumers.

Perhaps somewhat unusually, the stores will be co-branded as "Starbucks Coffee: A Tata Alliance." Long known as a nation of tea drinkers- despite a rich tradition of Coffee in the south-lndia has embraced Coffee house culture with a vengeance.

"We are going to move as fast as possible in opening as many stores as we can so long as we are successful & so long as we are embraced by the Indian consumers" said John Culver, President of Starbucks China & Asia Pacific. The need to address & respect potential cultural issues seems to have been a key factor in deciding to use the joint ventures route rather than set up a separate Starbucks subsidiary in India.

"We never considered 51 %," Culver said, "When we looked at the opportunity to enter India, understanding the complexities of the market & the uniqueness that is India, we wanted to find a local business partner."

1. What is Strategic Planning? State the Strategic Planning Process. **[June 2015 - 8 Marks]**
2. What approaches to Strategic Planning are advised to Tata Starbucks Limited for the Strategic Choice phases? **[June 2015 - 5 Marks]**
3. State important key components of Strategic Planning Process for decision making in "Starbucks Coffee. **[June 2015 - 7 Marks]**

Answer:

1. **Strategic Planning:** Refers to the development of strategic plans that involve taking information from the environment & deciding upon an organizational mission & upon objectives, strategies & a portfolio plan. It involves establishing the overall identity of the company, deciding on the strategic alternatives the company will follow & choosing the tactics or weapons which the company will emphasize.

   Simply put, Strategic Planning involves identifying the long-term objectives & determining the action plans for the company. The objectives & action plans should be established only after careful assessment & prediction of the future states of relevant environmental factors.

   Strategic Planning Process: Involves the identification of alternatives, the collection of information, evaluation & selection of alternatives & finally the strategic decisions themselves. Strategic Planning Process can best be understood in terms of stages:

   Stage 1: Defining the mission.

   Stage 2: Assessing organizational resources

   Stage 3: Evaluating environmental risks & opportunities

   Stage 4: Establishing long-term objectives

   Stage 5: Formulating strategy

   Stage 6: Establishing annual objectives

   Stage 7: Establishing operational plans

   Stage 8: implementing the plans

   Stage 9: Implementing, Monitoring & Adapting.

2. Approach to Strategic Planning Process for Tata Starbucks Limited.

The following are the basic approaches to Strategic Planning process for Tata Starbucks Limited:

(a) Keep the engaging commitment.

(b) Set Long-term Strategic Objectives for improved performance of the organization,

(c) Keep on generating Strategic Options

(d) Keep evaluating & decide on strategies

(e) There is a need to track monitoring implementation of the strategies against the long-term objectives.

3. Key Components of Strategic Planning Process are:

(a) The Strategic intent/objective to improve the long-term performance of the Starbucks Coffee: A Tata Alliance.

(b) The Strategic issues distilled from the analysis of key factors relevant to the overall situation of the organization in its environment.

(c) The Strategic options generated by the planning.

- The Strategic choice space is in the area of overlap among these three components. Consideration of the other overlaps between pairs of components may stimulate discussion & possible other thoughts to clarify what are the really important elements in any decision about strategy.
- Between intent & issue analysis there may be no feasible options apparent. Before giving up it may be worth looking to see if the alignment between factors raised in the analysis which seem relevant to objectives have been misread, or are alternative forms of issues already aligned in the central strategic choice space.
- Between intent & options, it may be possible to identify early on that some options are just not feasible.
- There will of course be options thrown up that seem feasible, & to fit the issues raised to some extent, & yet do not align well with the objectives. They may be overly risky, or not align with the code of corporate conduct of the organization.
- However, it is only in the space created by all three component circles overlapping, that we find any logical candidate strategic choice for inclusion in the final corporate strategy.
- Honest & evidence-based exploration of this space enables a reasonable & possible set of strategies to emerge as if by magic. The 'magic' is that which comes with systematic hard work, & honesty in facing up to the really big challenges or strategic elephants facing the organization, in its pursuit of longer-term sustainable performance.
- When managerial ego becomes involved or a deep-rooted organizational culture is at play, it may be very difficult to follow the logic as presented.
- It will be tempting to argue for a change in strategic intent in order to get in a favored strategic option.
- A suggested but infeasible strategic choice which seems very attractive might have influential supporters, so the evidence regarding its feasibility needs to be sound & fully available to the planning team may need to be carefully argued with clear evidence in support. Choosing what not to do, is as important to agree & record as part of the planning process, as the finally agreed strategic choices.

Q39. American Apparel is a fashion retailer & manufacturer that advertises itself as a vertically integrated industrial company. The brand is based in Downtown, Los Angles, where from a single building they control the dyeing, finishing, sewing, cutting, marketing & distribution of the company's product. The shoots & distributes its own advertisements, often uses its own employees as subjects. It also owns & operates each of its retail location as opposed to franchising. According to the management, the integration strategy allows the company to design, cut, distribute & sell an item globally in the span of a month.

(a) Which type of 'integration strategy' is being followed by the company?

(b) Give reasons for adopting such strategy in support of your answer. **[Dec 2015 - 5 Marks]**

Answer: Since the company controls both production & distribution of its product, it is an example of a balanced vertically integrated strategy.

- **Vertical integration** is the process in which several steps in the production & distribution of a product or service are controlled by a single company or entity, in order to increase that company's or entity's power in the marketplace.
- **Vertical integration** represents an expansion or extension of the firm by integrating preceding or excessive productive processes. That is, the firm incorporates more processes toward the original source of raw materials - backward integration or toward the ultimate consumer - forward integration. For this reason, the given case is an example of balanced vertical integration.

10 FORMULATION & IMPLEMENTATION OF STRATEGY

Q. Write a short note on the following concepts: [4 Marks Each]

Q1	**Functional organizational structure.**	**[June 2017]**
Ans	The successful implementation of Strategy requires an effective organization structure. Organizational structure means the framework in which the organization defines how tasks are divided, resources are deployed & departments are coordinated. There are several types of organizational structure: (a) Functional Structure (b) Geographic Structure (c) Matrix Structure (d) Hybrid Structure **Functional structure:** The functional structure is characterized by the simultaneous combination of similar activities & the separation of dissimilar activities on the basis of function. All Cost Accountants are located in the Cost Accounting Department, & the HOD of Cost Accounting is responsible for all cost related activities. The same is true in marketing, research & development, & manufacturing. The functional organization form is one of the most common organizational structures found in firms pursuing strategy of concentration or very high relatedness. A functional structure is most appropriate when the organization is small to medium size & relatively stable.	
Q2	Role of marketing	**[June 2017]**
Ans	▪ The first & foremost role is that is stimulates potential aggregate demand & thus enlarges the size of the market. You might ask how it helps in the economic growth of a country. The answer is that through stimulation of demand people are motivated to work harder & earn additional money to buy the various ideas, goods & services being marketed. ▪ An additional advantage which accrues in the above context that it accelerates the process. (In India, it is believed that about one-fourth of GNP & more than one-third of agricultural output are still non-monetized). ▪ Another important role which marketing plays is that it helps in the discovery of entrepreneurial talent. Peter Drucker, a celebrated writer in the field of management, makes this point very succinctly when he observes that marketing is a multiplier of managers & entrepreneurs. ▪ Still another important contribution which marketing makes is that it helps in sustaining & improving the existing levels of employment.	
Q3	Managerial Communication	**[June 2017]**
Ans	▪ The most important & basic strategy for a manager is simply to communicate well with the organizational people. ▪ This satisfies such basic human needs as recognition, a sense of belonging, & security. For example, such a simple action as a manager's attempting to become better acquainted with subordinates can contribute substantially to the satisfaction of each of these three needs. ▪ As another example, a message from a manager to a subordinate that praises the subordinate for a job well done can help satisfy the subordinate's recognition & security needs.	
Q4	Hybrid Organization	**[Dec 2017]**
Ans	▪ A single type of structural design is not always sufficient to meet the requirements of strategy. When this occurs, one opinion is to mix & blend the basic organizations forms, matching structure to strategy, requirement by requirement, & unit by unit. ▪ Hybrid structure is a form of departmentalization that adopts parts of both functional & divisional structures at the same level of management. ▪ The major potential advantage of the hybrid structures is that the combination may allow the firm to gain the advantages offered by the primary structure while at least diminishing the impact of the disadvantages.	

Q5	Strategy	**[Dec 2017]**
Ans	▪ Strategy is all about integrating organizational activities & utilizing & allocating the scarce resources within the organizational environment so as to meet the present objectives. ▪ While planning a strategy it is essential to consider that decisions are not taken in a vacuum & that any act taken by a firm is likely to be met by a reaction from those affected, competitors, customers, employees or suppliers. ▪ Strategy can also be defined as knowledge of the goals, the uncertainty of events & the need to take into consideration the likely or actual behaviour of others. Strategy is the outline of decisions in an organization that shows its objectives & goals, reduces the key policies, & plans for achieving these goals, & defines the business the company is to carry on, the type of economic & human organization it wants to be, & the contribution it plans to make to-its shareholders, customers & society at large.	
Q6	Marketing Plan & Strategy.	**[June 2018]**
Ans	▪ Marketing Plan is a written document that specifies in detail the firms marketing objectives & how marketing management will use the controllable marketing tools such as product design, channels, promotion & pricing to achieve these objectives. ▪ Marketing Strategy means finding attractive opportunities & developing profitable ways to capture the market. A marketing strategy specifies a target market & a related marketing mix. It is a big picture of what a firm will do in some market. ▪ The job of planning strategies to guide a whole company is called strategic planning. It is the managerial process of developing & maintaining a match between an organisation's resources & its market opportunities.	
Q7	Geographic & Matrix structure for implementation of orgnisational strategy.	**[June 2018]**
Ans	The Geographic Structure is one of several organizational designs. This particular structure brings workers together in geographical divisions. Other divisional structures group according to product, service or customer. Each division operates as if it is a company in itself, complete with the personnel to carry out various business functions such as finance, marketing & production. The divisions establish themselves in the geographical area they serve, creating regional, national or international operations. **The Matrix Organization:** structure is a combination of two or more types of organizational structures, such as the projectized organization structure & the functional organization structure. These 2 types of organizational structures represent the two extreme points of a string, while the matrix organization structure is a balance of these two. This combination may help organizations achieve higher efficiency, readiness, & quick market adaptation. Moreover, they often can respond faster to market or customer demand while decreasing the lead time to produce a new product. This type of structure is most suitable for organizations operating in a dynamic environment. However, if any organization is working in a stagnant environment, producing standard products with customers rarely changing requirements, the matrix structure is not well suited for them. They should adopt the functional organization structure instead.	
Q8	Types of firms/organizations for which BPR can be applied.	**[June 2018]**
Ans	BPR could be implemented to all firms, (manufacturing firms, retailers, services, etc.) & public organizations that satisfy the following criteria: ▪ Minimum Number of Employees: 20 (at least 4 in management positions). ▪ Strong Management commitment to new ways of working & innovation. ▪ Well-formed IT infrastructure. Business Process Re-engineering could be applied to companies that confront problems such as the following: ▪ High operational costs ▪ Low quality offered to customers ▪ High level of "bottleneck" processes at pick seasons ▪ Poor performance of middle level managers ▪ Inappropriate distribution of resources & jobs in order to achieve maximum performance, etc.	
Q9	Definition of the terms 'Re-engineering' & 'Process' in Business Process Re-engineering	**[Dec 2018]**
Ans	**Re-engineering:** is the fundamental rethinking & radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance such as cost, quality, service & speed.	

Process: Is a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organization. Each process is composed of related steps or activities that use people, information, & other resources to create value for customers.

Q10 Steps involved in the formulation of production strategy. **[Dec 2018]**

Ans The following steps are involved in the formulation of production strategy:

(a) Study the overall corporate plan & define the objectives.

(b) Analyse the present production operations & the present & future environment.

(c) Review sales- forecast & marketing.

(d) Make strategic decisions for production.

Q11 Features of Human Resources Strategy. **[June 2019]**

Important features which human resource strategy may bring to bear on the organization are as follows:

(a) Orientation of the members: HRM strategy has to ensure that individuals employed in the organization have necessary orientation so that the mission & objectives of the organization are internalized by the members & they have a sense of identification with the values & culture of the organization.

(b) Facilitation of organizational changes as & when called for: The practices & procedures are required to be in conformity with the changing internal & external conditions. This is a vital role of HR strategy management.

(c) Coping with diversity of workforce: Modem organization's with highly complex nature of jobs & processes generally have a highly diversified workforce differentiated in terms of age, sex, religion, professional & technical skills & educational background. To maintain a balanced workforce with harmonious relations & providing equitable incentives & rewards are aspects of HRM functions which can sustain an effective workforce. This is a responsibility of HR strategy managers.

(d) Maintaining competent & committed workforce in a competitive environment: The intensity of market competition for enterprises has been growing fast with globalization & liberalization of economic policies. There are competitive strategies of low-cost production & differentiation of products which may enable companies to secure a competitive edge. HRM has the responsibility of managing workforce so as to make it competent in ability as well as committed to organizational success.

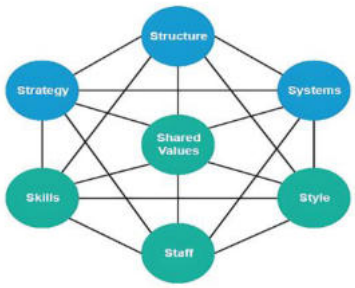
(e) Development of core competency: An enterprise succeeds in achieving its strategic objectives mainly on the basis of capabilities in the technical, marketing or human skills in areas of crucial importance. These are known as core competencies of the organization which are unique internal strengths not possessed by competitors. HRM is required to undertake building up of core competency by the organization as to secure dynamic leadership in the product market.

(f) Empowered workforce as an active resource: HR strategy is best managed when the members of an organization are individually in control of their work & are able to realise their potentials with empowerment to take relevant decisions on their own. This is likely to secure enduring performance-based achievements.

(g) Appropriate work culture & ethical norms: No organization can get the best contribution from its members unless individuals develop a liking for challenging jobs & follow the ethical norms of the organization functionally. This may require redesigning of jobs & work processes as well as developing trust & confidence among individuals & work groups, as also emphasizing intrinsic motivation for improving performance. HRM encompasses creation of an appropriate work culture on the above lines.

Q12 Mc Kinsey's 7-S Framework. **[June 2019]**

Strategy is dependent on many variables - Internal as well as external. All factors are interrelated.



Strategy: A set of decisions & actions aimed at gaining a sustainable competitive advantage.

Structure: The organization chart & associated information that shows who reports to whom & how tasks are both divided & integrated.

Systems: The flow of activities involved in the daily operation of a business, including its core processes & its support systems.

Style: How managers collectively spend their time & attention & how they use symbolic behavior. How management acts are more important than what management says.

Staff: How companies develop employees & shape basic values.

	Shared Values: Commonly held beliefs, mind sets & assumptions that shape how an organization behaves—its corporate culture. **Skills:** An organization's dominant capabilities & competencies.
Q13	Principle of BPR **[June 2019]**
Ans	▪ BPR is achieving dramatic performance improvements through radical change in organizational processes, re-architecting) of business & management processes. It involves the redrawing of organizational boundaries, the reconsideration of jobs, tasks, & skills. ▪ This occurs with the creation & the use of models. Whether those be physical models, mathematical, computer or structural models, engineers build & analyze models to predict the performance of designs or to understand the behavior of devices. More specifically, BPR is defined as the use of scientific methods, models & tools to bring about the radical restructuring of an enterprise that result in significant improvements in performance. ▪ Re-design, re-tooling & re-orchestrating form the key components of BPR that are essential for an organization to focus on the outcome that it needs to achieve. ▪ The outcome pursued should be an ambitious outcome (as for instance, are a 24-hour delivery to any customer anywhere in the world, approval of mortgage loans within 60 minutes of application, or ability to have on-line access to a patient's medical records no matter where they are in any major city in the world). ▪ These types of visionary goals require rethinking the way most organizations do business, careful redesign. They will additionally need very sophisticated supporting information systems & a transformation from a traditional organizational structure to a network type organization.
Q14	Name the steps involved in the formulation of production strategy **[Dec 2019]**
	(a) Study the overall corporate plan & define the objectives. (b) Analyse the present production operations & the present & future environment. (c) Review sales - forecast & marketing. (d) Make strategic decisions for production.
Q15	Write a brief note on 'Behavior Control' aspect of Strategic Control System. **[Dec 2019]**
	The establishment of a comprehensive system of rules & procedures to direct the actions or behavior of divisions, functions & individuals is called behavior control. The main purpose of having behavior control is not to specify goals but to standardize the way of reaching them. It is felt that if rules are standardized then outcomes are predictable. It is of utmost importance that the management reviews behavior controls over time. The rules that have been established tend to increase over time leading to inflexibility to react to the changing environment thereby adversely affecting the organization's competitive advantage.
Q16	What are the various types of firms/organizations where BPR can be applied **[Dec 2019]**
	BPR could be implemented to all firms (manufacturing firms, retailers, services, etc.) & public organizations that satisfy the following criteria: ▪ Minimum Number of employees: 20 (at least 4 in management positions). ▪ Strong management commitment to new ways of working & innovation. ▪ Well-formed IT infrastructure. **Business Process Reengineering could be applied to companies that confront problems such as:** ▪ High operational costs ▪ Low quality offered to customers ▪ High level of "bottleneck" processes at pick seasons ▪ Poor performance of middle level managers ▪ Inappropriate distribution of resources & jobs in order to achieve performance, etc.
Q17	Enumerate what are the characteristics of Core Competence. **[Dec 2022]**
	▪ Core competences are activities or processes that critically underpin an organization's competitive advantage. ▪ The core competences have the following characteristics 1. Provide distinctive advantage for the firm 2. Difficult for the competitors to imitate

(a) Competence is rare
(b) Competence is concerned with managing complex activities or processes
(c) Competitors are not clear which resource or competences have caused the success of the firm. This is known as causal ambiguity
(d) The competence is embedded in the culture

3. They make a significant contribution to customer value & the end products offered by the firm
4. They provide access to a wide variety of markets

- In order to understand this, let us take the case of Honda. Honda's core competence lies in design & manufacture of engine & its end products includes motorcycles, cars, generators, lawn-mowers, etc. Similarly, the core competences of Canon are optics, imagery & microprocessors & its end products include cameras, fax machine, image-scanners, etc.

Q18 State what are the steps involved in formulation of production strategy. **[Dec 2022]**

(a) Study the overall corporate plan & define the objectives: As in other operating areas, production planning begins with corporate objectives & planning premises. Examination of overall corporate planning not only provides overall directions for manufacturing but also answers questions about overall economic, industrial, market & company factors which will limit & otherwise affect the production planning.

(b) Analyse the present production operations & the present & future environment: The production manager should analyse the current manufacturing operations arid the present & future environmental trends to determine the company's manufacturing strengths & weaknesses & to isolate environmental factors such as the manpower supply & new process & equipment developments, which significantly affect manufacturing operations.

(c) Review sales-forecast & marketing: Since planning in other areas affects manufacturing plans, the planner should examine the plans in these areas. Sales goals are the basis upon which specific operating plans for manufacturing are built. Hopefully, the manufacturing manager will have participated in the development of these goals so that the sales goals can be reconciled with operations limitations. Once settled manufacturing plans can be developed to meet sales goals.

(d) Make strategic decisions for production: Keeping in mind the overall corporate business mix, present production operations, environmental forces, sales forecast & marketing mix, the production manager has to decide about the extent of manufacturing activity, choice of manufacturing process, capacity machines & equipment to be used, & physical facilities.

Q19 The 3-Rs of Re-Engineering **[Dec 2022]**

The 3 Rs of Re-engineering are enumerated are as shown in below Table:

Redesign	Retool	Recorchestrate
▪ Simplify ▪ Standardize ▪ Empowering ▪ Employee ship ▪ Groupware ▪ Measurements	▪ Networks ▪ Intranets ▪ Extranets ▪ Work Flow	▪ Synchronize ▪ Process ▪ IT ▪ Human Resources

Q20. Define 'Core Competency'. What tests are to be applied to identify core competence? Why core competencies are relevant? **[Dec 2013 - 6 marks]**

Answer:

Core competency is a unique skill of technology that creates distinct customer value. It not only integrates the technology but it also organises workforce & delivery of value.

Some of the ways in which a firm can effectively employ its various 'distinctive' or 'core competencies' are as follows:

To identify a core competence, Pralhad & Hamel prescribe three tests:

(a) It should be able to provide potential access to a wide variety of market;

(b) It should make a significant contribution to the perceived customers of the end product; &

(c) It should be difficult for the competitors to imitate.

Relevance of the Core Competencies: Core competencies are bundles of skills & competencies that are built over a very long period of time. Their main strength lies in the fact that such competencies are very much unique to the particular organisation & to the particular industry, in which the organisation operates. However, since the competencies are always skill-based, it is not possible for any competitor to copy the same. This gives the organisation an unbeatable competitive advantage.

Q21. List basic characteristics of Business Process Reengineering. **[Dec 2016 - 2 Marks]**

Answer: The important characteristics of BPR are given below:

- View business as a set of customers (both internal & external) oriented processes rather than a set of departmental functions.
- Processes must have clear cut ownership.
- Non-value adding activities within a process should be eliminated.
- Gather information only once at the point of origin.

Q22. Briefly discuss important features which Human Resource Strategy may bring to bear on the organization. **[June 2017 - 6 Marks]**

Answer: More important features which human resource strategy may bring to bear on organization are as follows:

(a) Orientation of the members: HRM strategy has to ensure that individuals employed in the organization have necessary orientation so that the mission & objectives of the organization are internalized by the members & they have a sense of identification with the values & culture of the organization.

(b) Facilitation of organizational changes as & when called for: The practices & procedures are required to be in conformity with the changing internal & external conditions. This is a vital role of HR strategy management.

(c) Coping with diversity of workforce: Modern organizations with highly complex nature of jobs & processes generally have a highly diversified workforce differentiated in terms of age, sex, religion, professional & technical skills & educational background. To maintain a balanced workforce with harmonious relations & providing equitable incentives & rewards are aspects of HRM functions which can sustain an effective workforce. This is a responsibility of HR strategy managers.

(d) Maintaining competent & committed workforce in a competitive environment: The intensity of market competition for enterprises has been growing fast with globalization & liberalization of economic policies. There is competitive strategy of low-cost production & differentiation of products which may enable companies to secure a competitive edge. HRM has the responsibility of managing workforce so as to make it competent in ability as well as committed to organizational success.

(e) Development of core competency: An enterprise succeeds in achieving its strategic objectives mainly on the basis of capabilities in the technical, marketing or human skills in areas of crucial importance.

These are known as core competencies of the organization which are unique internal strengths not possessed by competitors. HRM is required to undertake building up of core competency by the organization as to secure dynamic leadership in the product market.

(f) Empowered workforce as an active resource: HR strategy is best managed when the members of an organization are individually in control of their work & are able to realise their potentials with empowerment to take relevant decisions on their own. This is likely to secure enduring performance-based achievements.

(g) Appropriate work culture & ethical norms: No organization can get the best contribution from its members unless individuals develop a liking for challenging jobs & follow the ethical norms of the organization functionally. This may require redesigning of jobs & work processes as well as developing trust & confidence among individuals & work groups, as also emphasizing intrinsic motivation for improving performance. HRM encompasses creation of an appropriate work culture on the above lines.

Q23. Explain the terms: **[Dec 2017 - 6 Marks]**

(a) Marketing Plan

(b) Social Marketing

Answer:

(a) Marketing Plan: Marketing plan is a written document that specifies in detail the firms marketing objectives & how marketing management will use the controllable marketing tools such as product design, channels, promotion & pricing to achieve these objectives. Marketing strategy means finding attractive opportunities & developing profitable ways to capture the market.

A marketing strategy specifies a target market & a related marketing mix. It is a big picture of what a firm will do in some market. The job of planning strategies to guide a whole company is called strategic planning. It is the managerial process of developing & maintaining a match between an "organization's resources & its market opportunities.

(b) Social Marketing: Societal marketing concept calls for a customer, orientation backed by integrated marketing aimed at generating customer satisfaction & long-run consumer welfare as the key to attaining long-run profitable volume.

Q24. Categories major reasons of SBU approach. **[June 2018 - 8 Marks]**

Answer: Some of major reasons of using SBU approach are as follow:

- A scientific method of grouping the businesses of a multi-business corporation which helps the firm in strategic planning.
- An improvement over the geographical grouping of businesses & strategic planning based on locational units.
- An SBU is a grouping of related businesses that can be taken up for strategic planning distinct from the rest of the. businesses.
- Grouping the businesses on SBU lines helps the firm in strategic planning by removing the ambiguity & confusion generally seen in grouping businesses.
- Each SBU is a separate business from the strategic planning standpoint. In the basic factors, viz., mission, objectives, competition & strategy-one SBU will be distinct from another.
- Each SBU will have its own distinct set of competitors & its own distinct strategy.
- Each SBU will have a CEO. He will be responsible for strategic planning for the SBU.

Q25. How does Matrix Organization Structure differ from SBU Structure? Analyse related advantages & disadvantages of Matrix Organization Structure. **[Dec 2018 - 6 Marks]**

Answer: SBU Organization Structure consist of flow of authority from top to bottom i.e. vertical flow whereas Matrix Organization Structure contains both vertical & horizontal flow of communications or authority. This type of structure is frequently used in IT organization for managing different projects. Each individual project is managed by a project manager & projects manager will have his team arranged under him.

Advantages:

(a) Useful for some specific industries like Information Technology, Healthcare etc.

(b) Employee can see visible results of their efforts

(c) Remove barrier to communications

(d) Managing projects are easy

(e) Effective structures when environment is very dynamic

Disadvantages:

(a) Complex structure as this contains both vertical & horizontal flow of information

(b) High cost approach due to more management positions

(c) Dual lines of authority

(d) Conflicts arises in the allocation of resources

Q26. State the various advantages & disadvantages of SBU structure. **[June 2019 - 6 Marks]**

Answer:

Advantages:

(a) Promotes accountability since units' heads are responsible for individual SBU profitability

(b) Career development opportunities are further higher in this structure

(c) Allow better control of categories of products manufacturing, marketing & distributions

(d) Helps to expand in different related & unrelated businesses.

Disadvantages:

(a) May provide inconsistent approach to tackle customers, etc., because each unit may work in its own way to handle situations

(b) High cost approach.

Q27. What are 3 most important characteristics of SBU? List major reasons of using it. **[Dec 2019 - 6 Marks]**

Answer: 3 most important characteristics of SBU are as follows:

- It is a single business or a collection of related businesses which offer scope for independent planning & which might feasibly stand-alone from the rest of the organization.
- Has its own set of competitors.
- Has a manager who has responsibility for strategic planning & profit performance, & who has control of profit-influencing factors.

Major reasons of using SBU approach are:

- A scientific method of grouping the businesses of a multi-business corporation which helps the firm in strategic planning.
- An improvement over the geographical grouping of businesses & strategic planning based on locational units.
- An SBU is a grouping of related businesses that can be taken up for strategic planning distinct from the rest of the businesses.
- Grouping the businesses on SBU lines helps the firm in strategic planning by removing the ambiguity & confusion generally seen in grouping businesses,
- Each SBU is a separate business from the strategic planning standpoint. In the basic factors, viz., mission, objectives, competition & strategy-one SBU will be distinct from another.
- Each SBU shall have its own distinct set of competitors & its own distinct strategy.
- Each SBU shall have a CEO. He will be responsible for strategic planning for the SBU & its profit performance; he will also have control over most of the factors affecting the profit of the SBU.

Q28. What are the disadvantages of Matrix Organization Structure? **[Dec 2021 - 4 Marks]**

Answer:

(a) Complex structure as this contains both vertical & horizontal flow of information

(b) High-cost approach due to more management positions

(c) Dual lines of authority

(d) Conflicts arises in the allocation of resources

Q29. Explain with examples, why do we need the Strategic Business Unit. **[Dec 2022 - 6 Marks]**

Answer:

- A Strategic Business Unit is a relatively autonomous division of a large company that operates as an independent enterprise with responsibility for a particular range of products or activities. These strategic business units are responsible for their own profit or loss but are answerable to the top management.
- SBU or a Strategic Business unit mostly targets a particular market segment & it provides expertise in product management & operations which help the parent company manage & track the different products that are produced in the company.
- The SBU is given the authority to make its own strategic decisions within corporate guidelines as long as it meets corporate objectives A big organization like Unilever etc. has many SBUs for their different categories of products like Cosmetics, Food products, Beverages, etc., & each is managed through a separate unit head. It promotes accountability.
- Since units heads are responsible for individual SBU profitability. Career development opportunities are further higher in this structure. It allows better control of categories of products manufacturing, marketing, & distribution.

Q30. Visualize as if you are heading a Project-based firm. Justify the formation of 'Project-based structure' in your firm. Evaluate the advantages and limitation of Project-based structures. **[June 2023 - 8 Marks]**

Answer: Justify the formation of Project-based structure in your firm:

The project-based structure is one where teams are created, undertake the work and are then dissolved. This can be particularly appropriate for your organization if it deliver large and expensive goods or services (civil, engg. information systems, films) or those delivering time-limited events B (Conference, sporting events, or consulting engagements). The organization structure is a constantly changing collection of project teams created, steered and glued together loosely by a small corporate group. Many organizations use such teams in a more adhoc way to complement the main structure.

For ex. Task forces are set up to make progress on new elements of strategy or to provide momentum where the regular structure of the organization is not effective.

Advantages of Project based structures:

- The project-based structure can be highly flexible, with projects being set up and dissolved as required.
- Accountability and control are good because project teams should have clear tasks to achieve within a definite life.
- Projects can be effective at knowledge exchange as project team members will typically be drawn from different departments within the firm.
- Projects can also draw members internationally and because project life spans are typically short, project teams may be more willing to work temporarily around the world.

Disadvantages of Project based structures:

- Without strong programmed management providing overarching strategic control, organizations are prone to proliferate projects in an ill coordinated fashion.
- The constant breaking up of project teams can also hinder the accumulation of knowledge over time or within specialism

Q31. What do you understand by Business Process Re-engineering? What are the important reasons that lead an organization to undertake re-engineering? **[June 2023 - 5 marks]**

Answer:

Hammer & Champy (1993) defined BPR as "the fundamental rethinking & radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance such as cost, quality, service & speed".

Business Process Re-engineering may be considered to be radical redesign of the business processes often used by companies to cut costs & return to profitability. If is fundamental re-thinking & radical re-design of business processes to achieve dramatic improvements in critical contemporary measures of performances such as cost, quality, service & speed.

There are 3 important reasons that lead an organization to undertake re-engineering:

- An organization needs dramatic improvements to sustain itself & is already in deep trouble. High failure rate of products & repetitive customer complaints can be one of the reasons that can cause huge disruption in the functioning of the organization.
- The need for re-engineering can be felt by the management keeping in mind the imminent problems that the organization is expected to face in the future due to some dramatic changes in the environment, both internal & external.
- There can be situations when re-engineering can help organizations to be in better position than they are currently in.

Q32. "While designing a Control System, top management should remember that controls should following strategy". In this context enumerate the recommended guidelines for proper control. **[Dec 2023 -7 Marks]**

Answer: Guidelines for Proper Control:

In designing a control system, top management should remember that controls should follow strategy. Unless controls ensure the use of the proper strategy to achieve objectives, there is a strong likelihood that dysfunctional side effects will completely undermine the implementation of the objectives.

The following guidelines are recommended:

- Control should involve only the minimum amount of information needed to give a reliable picture of events: Too many controls create confusion. Focus on the strategic factors by following Pareto's 80/20 rule: Monitor those 20% of the factors determines 80% of the results.
- Control must be reasonable. Frequent reporting & rapid reporting may frustrate control.
- Controls do not work unless they are acceptable to those who apply them.
- Controls should monitor only meaningful activities & results, regardless of measurement difficulty: If cooperation between divisions is important to corporate performance, some form of qualitative or quantitative measure should be established to monitor cooperation.
- Controls must be flexible to take care of changing circumstances.
- Controls should be timely so that corrective action can be taken before it is too late: Steering controls, controls that monitor or measure the factors influencing performance, should be stressed so that advance notice of problems is given.

- Long-term & short-term controls should be used: If only short-term measures are emphasized, a short-term managerial orientation is likely.
- Controls should aim at pinpointing exceptions: Only activities or results that fall out- side a predetermined tolerance range should call for action.
- Emphasize the reward of meeting or exceeding standards rather than punishment for failing to meet standards: Heavy punishment of failure typically results in goal displacement. Managers will fudge reports & lobby for lower standard.

Q33. Demonstrate in brief some of the areas that have the ability to create goal congruence. **[Dec 2023 - 7 Marks]**

Answer: The following are some of the areas that have the ability to create goal congruence:

(a) Communication & Understanding:

Channels of communication & how goals are perceived are important to achieve goal congruence. Operational managers have a responsibility of being aware as to what actions are desirable & what goals are to be achieved. It should be understood that the communication of different goals can occur through informal channels, which involves meetings & face to face interactions, or through formal channels including budgets or other financial documents. There is an inherent risk that even if the communication is well executed, it might be perceived in different ways. Organizations, therefore, should internalize the goals in a good manner to avoid that employees feel inability to achieve them.

(b) Create direction:

One of the reasons for lack of goal congruence is the absence of direction related to employees' behavior. Performance management & goals facilitate efficient communication about what managers want their subordinates to focus on. It needs no mention that providing clear information & direction, employees can better understand what is expected from them, how to perform adequately, & how to contribute effectively to the achievement of the orgnisational goals. There is a need to increase the employees understanding of the strategic objectives as well as the organization's value drivers.

(c) Motivation:

The problem of motivation can exist even though employees have knowledge about how to perform adequately because employees can act in their own self-interest instead of in the organization's best interest. The employees can make their own performance report better by allocating resources without befitting the organization as a whole. One of the strongest reasons for demotivation among employees & managers is dislike for the work allocated. The reason for motivation varies among employees. While some employees feel motivated for some recognition & appraisals others may feel motivated because of commitment & responsibility without any required pay off. The more motivated the employees of the organization the better will be the goal congruence.

(d) Incentives:

In order to increase the likelihood of employees working to achieve their individual goals, organization's aim to influence motivation by providing incentives. Research suggests that individuals tend to perform better when they are rewarded. Rewards & compensations should create goal congruence between individual goals & organizational goals by stimulating individuals to perform by providing incentives, as rewards are related to increased effort'.

(e) Connection:

It is very important to create a connection between goals, performance measures & incentives. In order to align the employees' self-interest & overall organizational objectives it is necessary to relate incentives with performance. By linking incentives to certain goals, individuals tend to pay more attention to what is important.

Q34. "Michael Goold & Andrew Campbell provide Nine design tests against which to check specific tailor - made structural Solutions" - In this Context, Analyze any seven of these nine tests. **[June 2024 - 7 marks]**

Answer: The design tests are analyzed as follows:

1. The Market-Advantage Test:

This test of fit with market strategy is fundamental, following Alfred Chandler's classic principle that 'structure follows strategy'. For example, if coordination between two steps in a production process is important to market advantage, then they should probably be placed in the same structure unit.

2. The Parenting Advantage Test:

The structural design should fit the 'parenting' role of the corporate center.

3. The People Test:

The structural design must fit the people available. It is dangerous to switch completely from a functional structure to a multidivisional structure if, as is likely, the organization lacks managers with competence in running decentralized business units.

4. **The Feasibility Test:**

   This is a catch-all category, indicating that the structure must fit legal, stakeholder, trade union or similar constraints

5. **The Specialised Cultures Test:**

   This test reflects the value of bringing together specialists so that they can develop their expertise in close collaboration with each other. A structure fails if it breaks up important specialist cultures.

6. **The Difficult Links Test:**

   This test asks whether a proposed structure will set up links between parts of the organizations that are important but bound to be strained.

7. **The Redundant Hierarchy Test:**

   Any structural design should be checked in case it has too many layers of management, causing undue blockages and expense. Delayering in response to redundant hierarchies has been an important structural trend in recent years.

8. **The Accountability Test:**

   This test stresses the importance of clear lines of accountability, ensuring the control and commitment of managers throughout the structure.

9. **The Flexibility Test:**

   In a fast-moving world, an important test is the extent to which a design will allow for change in the future. For instance, divisional domains should be specified broadly enough to allow divisional managers to follow new opportunities as they emerge.

Q35. "Hammer & Champy (1993) point to the existence of a set of 'commonalities, recurring themes or characteristics' that can guide Business Process Re-engineering (BPR)". In accordance with this, align the said Commonalities or characteristics that guide BPR. **[June 2024 - 7 marks]**

Answer: The commonalities or characteristics that guide BPR are given below:

1. Combining several jobs into one.
2. Allowing workers to make decisions.
3. Performing the steps of a process in a natural order.
4. Recognition that processes have multiple versions and designing processes to take account of different situations.
5. Minimizing reconciliation.
6. Appointing a case manager to provide a single point of contact at the interface between processes.
7. Performing processes where it makes the most sense, e.g., if the accounting department needs pencils, it is probably cheaper for such a small order to be purchased directly from the office equipment store along the block than to be ordered via the firm's purchasing department.
8. Reconciling centralization with decentralization in process design e.g. a shared database, decentralized decisions can be made while permitting overall coordination simply through information sharing.

Q36. In a small town called Vellore in South Indian State of Tamilnadu, there is now one famous deemed university called the Vellore Institute of Technology (VIT). Its founder, Mr. Viswanathan, has adopted a unique model of building formidable Core Competencies. He has made huge investments in creating world-class infrastructure, which has attracted the best minds as students not only from various parts of India, but also from other countries of the world, including developed countries like Canada & several African nations. What has really mattered is that the quality of teaching has improved, as VIT has been able to attract high calibre teachers from all over the country. The National & International seminars that it has been able to conduct, very regularly, has opened up many vistas of knowledge, & opened up many doors, in the international arena, through very innovative tie-ups with foreign universities. In fact, VIT is just one example of a deemed university that has made India proud. Since, it supplies high quality information technology professionals to all IT companies world-wide, VIT has already made a name for itself, among such companies. The campus recruitments are one hundred percent. This has made it a very formidable learning center in India.

There are few tests useful for identifying a core competence. Does it fit to VIT? **[Dec 2013 - 4 Marks]**

Answer: There are few tests useful for identifying a core competence. A core competence should:

(a) Provide access to a wide variety of markets.

(b) Contribute significantly to the end-product benefits.

(c) Be difficult for competitors to imitate.

(d) It should be valuable.

Yes, it fits for VIT.

11 DIGITAL STRATEGY

Q1. Compare and contrast the two terms: Digitization and Digitalization. **[June 2023 - 4 Marks]**

- **Digitization:** All analogue data needs to be converted and generated by operating machinery and legacy systems, devices, physical documents etc. into digital data and records. Taking steps to ensure that all data to be used in the process of business transformation are relevant, generated from first hand sources and trustworthy is important.
- **Digitalization:** The need to use digital technologies befitting the needs for changing business, operating and revenue models with the objective to generate more turnover and achieving maximization of value creation as well as minimization of value destruction needs to be implemented. For example, brick and mortar business models is added with and / or replaced by virtual marketplace for E-Commerce

Q2. Examine various application areas of Internet of Things (loT). (any 6) **[June 2023 - 6 Marks]**

Answer:

- **Application areas of Internet of Things (loT):**

  Increasingly, organisations in a variety of industries are using loT to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business.
- **Access to low-cost, low-power sensor technology:**

  Affordable and reliable sensors are making loT technology possible for more manufacturers.
- **Connectivity:**

  A host of network protocols for the internet has made it easy to connect sensors to the cloud and to other things for efficient data transfer.
- **Machine learning and analytics:**

  With advances in machine learning and analytics, along with access to varied and vast amounts of data stored in the cloud, businesses can gather insights faster and more easily. The emergence of these allied technologies continues to push the boundaries of loT and the data produced by loT also feeds these technologies.
- **Conversational artificial intelligence (AOI):**

  Advances in neural networks have brought natural-language processing (NLP) to loT devices (such as digital personal assistants Alexa, Cortana, and Siri) and made them appealing, affordable and viable for home use.
- **Smart Lighting:**

  This is another one of the Internet of Things examples that have gradually been coming into common usage. Bulbs and battens connected to Wi-Fi can be turned on and off remotely. Schedule for usage can be set for these devices along with their brightness's controlled and their power consumption monitored. Using other loT devices, smart lighting devices can also be turned on and off by voice alone. The power consumption of these devices can also be easily monitored using loT.
- **Smart Parking:**

  It is hard to regulate the occupancy and parking coverage in large multi-story car parking facilities. Among the many Internet of Things examples is the use of loT in such facilities for counting the number of cars that have driven into the facility and the number that have driven out. Specific devices can also give you the exact location where you have parked your car so you are not lost.
- **Medical Fridges:**

  Medical fridges are a grand entry to the Internet of Things examples list and can be used for regulatory compliance and safety purposes. Vials of vaccines and medicines can often be spoiled if they are not kept at the correct temperatures. Medical refrigerators cannot be monitored throughout the day, especially in person. Having loT sensors inside medical fridges can enable them to be monitored remotely, and their temperature changed as per requirement.

Q3. "In spite of the fact that Cloud computing has huge benefits yet, it has its own causes of Concern". In this context, examine the Demerits of Cloud computing. (Any 7) **[Dec 2023 - 7 Marks]**

Answer: In spite of the fact that cloud computing has huge benefits yet, it has its own causes of concern as follows:

1. **Cloud security:** There is a clear lack of transparency regarding how and where sensitive information entrusted to the cloud provider is handled. When relying on the cloud, organisations risk data breaches, hacking of APIs and interfaces, compromised credentials and authentication issues.
2. **Costs unpredictability:** The concept pay-as-you-go subscription plans for cloud use, along with scaling resources to accommodate fluctuating workload demands, can make it tough to define and predict final costs.
3. **Lack of capability and expertise:** With cloud-supporting technologies rapidly advancing, organisations are struggling to keep up with the growing demand for tools and employees with the proper skill sets and knowledge needed to architect, deploy, and manage workloads and data in a cloud.
4. **IT Governance:** The emphasis on do-it-yourself capability in cloud computing can make IT governance difficult, as there is no control over provisioning, de provisioning and management of infrastructure operations.
5. **Compliance with industry laws:** When transferring data from on-premises local storage into cloud storage, it can be difficult to manage compliance in the industry regulations through a third party.
6. **Management of multiple clouds:** Every cloud is different, so multi-cloud deployments can dis-join efforts to address more general cloud computing challenges.
7. **Cloud performance:** Network and providers outages can interfere with productivity and disrupt business processes if organisations are not prepared with contingency plans.
8. **Building a private cloud:** Architecting, building and managing private clouds whether for its own purpose or for a hybrid cloud goal can be a daunting task for IT departments and staff.
9. **Cloud migration:** The process of moving applications and other data to a cloud infrastructure often causes complications. Migration projects frequently take longer than anticipated and go over budget.

Q4. Demonstrate the different types of Digital Marketing Strategies. (Any 7) **[June 2024 - 7 marks]**

Answer: The different types of Digital Marketing strategies are discussed below:

1. **Social Media Marketing Platforms:**

   Todays' consumers are highly reliant on social media platforms such as Instagram, Facebook, LinkedIn, and Snapchat. This is why it is essential that brands are active across accounts. Social media platforms allow marketers to reach their prospects in a myriad of ways.
2. **Influencer Marketing:**

   Another effective way to harness digital channels to reach target audiences is with influencer marketing. Brands can partner with celebrities, sites, or others that are considered experts in their field, that share similar values.
3. **Email Marketing:**

   Email marketing campaigns allow organizations to stay connected with prospects and customers, sending them customized newsletters or offers based on past shopping history or brand engagements.
4. **Content Marketing:**

   Content marketing allows marketing teams to be proactive in answering their users' questions. Marketing teams create content, videos, and other assets to answer questions or provide context to consumers throughout the three stages of the buyer's journey as (1) The Awareness Stage (ii) The Consideration stage and (iii) The Decision Stage.
5. **Search Engine Optimization (SEO) Marketing:**

   Search engine optimization often goes hand in hand with content marketing. When the customer from the above example is conducting research for which gym shoes to buy, they will probably click on one of the first three results that appear on Google.
6. **Pay-per-click (PPC):**

   Pay-per-click is a form of paid advertising that allows marketing teams to essentially purchase traffic to their website. Marketers place ads on websites or search engines such as Google and Microsoft Bing and pay a fee each time the ad is clicked on.
7. **Affiliate Marketing:**

   Affiliate marketing is similar to referral programs; it involves working with outside individuals or companies under the agreement that they promote your product in exchange for a commission from each sale that can be attributed to their efforts.
8. **Mobile Marketing:**

   Mobile marketing initiatives can include many of the digital marketing strategies mentioned above, and typically will leverage a combination of text messages, social media, email, push notifications and mobile applications.

Q5. List down the steps that an organisation should take for digital transformation.

Answer: One of the most critical tasks for saving the entity from drowning is implementation of digital transformation (DT) befitting the emerging way of living and operating in the new world order. This is a journey and not a destination to be reached just for once. Any organisation can lay the foundation of digital transformation on 4Ds, viz., Discover, Design, Deliver and De-risk as suggested by McKinsey; 2 Ps, i.e., People and Process and 1 T, i.e., Tools. Basu (2020)

The following measures can be listed for orchestrated planning and execution across hierarchical levels, length and breadth of the organisation:

- Integration of digital technologies with functional areas that will bring metamorphosis in the process of conducting business operations with the ultimate objective of improving stakeholders' relationship and experience management.
- Challenging the status quo of policies and standard operating practices for driving towards the inevitable metamorphosis.
- Training of existing human capital with different capabilities and redeployment for dealing with digital tools consciously being mindful of the requirement of cultural change and removing fear of unknown to embrace the new.
- Conducting experiments with digital technologies to assess suitability vis-a-vis the specificities of the needs of business and its stakeholders with the ultimate objective of incremental contributions for profit and profitability.
- Approaching the long-drawn task with a mindset of creative destruction of long-standing business policies and processes in favour of relatively new digitally driven practices that are still being defined, adopted, and stabilised.
- Providing the DT team, a free environment with committed assistance for innovative applications of various digital tools, if not 'inventing' new tools, and establishing collaboration with man and digitally operated machines, which are artificially intelligent.
- Ensuring data privacy, cyber security, and information safety as an integral part of the entity's policy and processes for risk-enabled performance management.
- Permitting implementation team to make mistakes and not penalising them for the same. Instead incentivise every attempt irrespective of success or failure so that the environment is congenial for innovating and delivering the best.
- Unwavering commitment of funds and other resources, as well as extending help and support to the dedicated DT team by every single functional area of the organisation

Q6. Explain the merits and demerits of Cloud Computing.

Answer: Cloud computing benefits to modern businesses including the following:

- **Cost management:** Cloud infrastructure can reduce capital costs, as organisations don't have to spend massive amounts of money buying and maintaining equipment. Moreover, companies don't need large IT teams to handle cloud data centre operations because they can rely on the expertise of their cloud providers' teams. Cloud computing also cuts costs related to downtime
- **Data and workload mobility:** Cloud computing allows users to access data from anywhere with any device with just an internet connection. That means users don't have to carry around USB drives, an external hard drive or multiple CDs to access their data. Users can access corporate data through smart phones and other mobile devices, enabling remote employees to stay up to date with co-workers and customers. End users can easily process, store, retrieve and recover resources in the cloud. In addition, cloud vendors provide all the upgrades and updates automatically, saving time and effort.
- **Business continuity and disaster recovery (BCDR):** The biggest worry for organisations in the present digital landscape is data loss. Storing data in the cloud guarantees that users can always access their data even if their devices, e.g., laptops or smart phones, are inoperable. With cloud-based services, organisations can quickly recover their data in the event of emergencies, such as natural disasters or power outages. This benefits BCDR and helps ensure that workloads and data are available even if the business suffers damage or disruption.

The demerits of cloud computing

In spite of the fact that cloud computing has huge benefits yet, it has its own causes of concern as follows:

- **Cloud security:** There is a clear lack of transparency regarding how and where sensitive information entrusted to the cloud provider is handled. When relying on the cloud, organisations risk data breaches, hacking of APIs and interfaces, compromised credentials and authentication issues.
- **Cost unpredictability:** The concept Pay-as-you-go subscription plans for cloud use, along with scaling resources to accommodate fluctuating workload demands, can make it tough to define and predict final costs.
- **Lack of capability and expertise:** With cloud-supporting technologies rapidly advancing, organisations are struggling to keep up with the growing demand for tools and employees with the proper skill sets and knowledge needed to architect, deploy, and manage workloads and data in a cloud.

- **IT governance:** The emphasis on do-it-yourself capability in cloud computing can make IT governance difficult, as there is no control over provisioning, de provisioning and management of infrastructure operations.
- **Compliance with industry laws:** When transferring data from on-premises local storage into cloud storage, it can be difficult to manage compliance with industry regulations through a third party.
- **Management of multiple clouds:** Every cloud is different, so multi-cloud deployments can disjoint efforts to address more general cloud computing challenges.
- **Cloud performance:** Network and provider outages can interfere with productivity and disrupt business processes if organisations are not prepared with contingency plans.
- **Building a private cloud:** Architecting, building and managing private clouds whether for its own purpose or for a hybrid cloud goal can be a daunting task for IT departments and staff.
- **Cloud migration:** The process of moving applications and other data to a cloud infrastructure often causes complications. Migration projects frequently take longer than anticipated and go over budget.

Q7. What are the important components of Block Chain?

Answer: The important components of a block chain include Distributed ledger technology. All network participants have access to the distributed ledger and its immutable record of transactions. With this shared ledger, transactions are recorded only once, eliminating the duplication of effort that's typical of traditional business networks.

- **Immutable records:**

  No participant can change or tamper with a transaction after it's been recorded to the shared ledger. If a transaction record includes an error, a new transaction must be added to reverse the error, and both transactions are then visible.
- **Smart contracts:**

  A smart contract is stored on the blockchain and executed automatically. A smart contract can define conditions for corporate bond transfers; include terms for travel insurance to be paid and much more. A smart contract acts a set of rules and allows fastest transactions.

Q8. What are the benefits of blockchain network?

Answer: The benefits of blockchain network Increased trust

As block chain is used by only the members who are within a defined network. This assures the members that the data being received by them is accurate and timely data. Moreover, the confidential blockchain records will be shared only with network members to whom one has specifically granted access.

- **Greater security:**

  The increase security in blockchain network arises from the fact that consensus on data accuracy is required from all network members, and all validated transactions are immutable because they are recorded permanently. No one, not even a system administrator, can delete a transaction.
- **Increased efficiencies:**

  With a distributed ledger that is shared among members of a network, time-wasting record reconciliations are eliminated. The smart contract enables automated transactions thereby saving on time.

Q9. Explain Robotic Process Automation and list the benefits of RPA.

Answer:

RPA: Robotic Process Automation (RPA) is a form of business process automation that allows anyone to define a set of instructions for a robot or 'bot' to perform. RPA boats are capable of mimicking most human-computer interactions to carry out a ton of error-free tasks, at high volume and speed.

Robotic process automation is not a physical or mechanical robot. RPA is the process by which a software bot uses a combination of automation, computer vision, and machine learning to automate repetitive, high-volume tasks that are rule-based and trigger-driven. Robotic process automation tools are best suited for processes with repeatable, predictable interactions with IT applications.

The benefits of RPA solutions not only reduce cost but also include:

- Decreased cycle times
- Flexibility and scalability
- Improved accuracy
- Improved employee morale
- Detailed data capture

MULTIPLE CHOICE QUESTIONS

SN	Question	Ans
Q1	_____ is typically found wherever a particular bottleneck machine exists in the process of manufacturing. (a) Load control (b) Block control (c) Flow control (d) Order control	A
Q2	State which of the following does not affect the Production Design. (a) Cost/Price Ratio (b) Process Capability (c) Reliability (d) Product Quality	C
Q3	The time study of a machinery operation recorded cycle times of 7.0, 9.0, 10.0 & 10.0 minutes. The analyst rated the observed worker as 90%. The firm uses a 0.15 allowance fraction. What is the standard time? (a) 8.1 (b) 10.35 (c) 9.53 (d) 9.0	C
Q4	If a firm sells 7,000 units, its loss is ₹ 40,000. But if it sells 10,000 units, its profit is ₹ 20,000. Calculate Fixed Cost: (a) 2,00,000 (b) 1,80,000 (c) 1,60,000 (d) 1,75,000	B
Q5	Given the following alternatives, Linear Programming is a technique used in: (a) Manufacturing Sequence (b) Product Mix (c) Production Programme (d) Plant Layout	B
Q6	Addition of "Broad Band" to the existing "Telephone Services" facility by BSNL an example of (a) Concentratic diversification (b) Unrelated diversification (c) Merger diversification (d) Acquisition diversification	A
Q7	'Jio' by Reliance Jio Infocomm Limited (RJIL) provides interesting example to fit in the BCG Matrix as (a) Star (b) Question Mark (c) Cash Cow (d) Dog	A
Q8	Out of the following trends in production/operations management, which one is sometimes called as agile manufacturing? (a) Re-engineering (b) Supply-Chain Management (c) Lean Production (d) Flexibility	D
Q9	Out of the following factors that are affecting Capacity Planning, which one is Less Controllable one? (a) Machine break-downs (b) Amount of labour employed (c) Facilities installed (d) Shifts of work per day	A
Q10	Which of the following stages of Product Life Cycle does attribute beginning of substantial increase in Sales & Profits? (a) Introduction (b) Growth (c) Maturity (d) Decline	B
Q11	This aims at finding the best & most efficient way of using the available resources-men, materials, money & machinery: (a) Time Study (b) Work Study (c) Method Study (d) Job Evaluation	B
Q12	Which one is NOT an index of Productivity? (a) Man-hour output (b) Productivity ratio (c) TQM (d) Use of Financial Ratios	C
Q13	The time by which an activity can be rescheduled without affecting the other activities-preceding or succeeding is called as (a) Slack (b) Independent Float (c) Free Float (d) Total Float	B
Q14	Reliability & per unit cost of which of the following spares are less? (a) Regular spares (b) Insurance spares (c) Capital spares (d) Rotatable spares	A

Q15	For a marketing manager, the sales forecast is (a) estimate of the amount of unit sales for a specified future period. (b) arranging the salesmen to different segments of the market. (c) to distribute the goods through transport to satisfy the market demand. (d) to plan the sales methods.	A
Q16	The activity of specifying when to start the job & when to end the job is known as _____. (a) Planning (b) Scheduling (c) Timing (d) Follow-up	B
Q17	The lead time is _____. (a) Time for placeholders for materials (b) Time of receiving materials (c) Time between receipt of material & using materials (d) Time between placing the order & receiving the materials	D
Q18	Benchmarking is _____. (a) the analytical tool, to identify high cost activities based on the 'Pareto Analysis'. (b) the search for industries best practices that lead to superior performance. (c) the simulation of cost reduction schemes that helps to build commitment & improvement of actions. (d) the process of marketing & redesigning the way a typical company works. (e) the framework that earmarks a linkage with suppliers & customers.	B
Q19	Successful differentiation strategy allows the company to _____. (a) gain buyer loyalty to its brands. (b) charge too high a price premium. (c) depend only on intrinsic product attributes. (d) have product quality that exceeds buyers' needs. (e) segment a market into distinct group of buyers.	A
Q20	The essential ingredients of Business Process Re-engineering (BPR) are _____. (a) continuous improvements of products, processes & technologies. (b) planning for the technologies, processes & strategic partnerships etc. (c) fundamental re-thinking & radical redesign of business process to achieve dramatic results. (d) generation, comparison & evolution of many ideas to find one worthy of development. (e) identification & selection of lay-outs most suited for products & processes.	C
Q21	Marketing Research Studies are undertaken _____. (a) to measure brand loyalty of a class of consumers. (b) to predict market potential of a product on a future date. (c) to understand product-price relationship. (d) to make out a case for revision of an existing strategy. (e) all of the above.	E
Q22	Organization culture is (a) appreciation for the arts in the organization. (b) ability of the organization to act in a responsible manner to its employees. (c) combination of (a) & (b) above (d) deeper level of basic assumptions & beliefs that are shared by the members of the firm. (e) none of the above.	D
Q23	Innovation strategy is (a) defensive strategy (b) offensive strategy (c) responding to anticipating customers & market demands (d) guerrilla strategy (e) harvesting strategy	C

Q24	The effective capacity is NOT influenced by which of the following factors: (a) Forecasts of demand (b) Plant & labour efficiency (c) Subcontracting (d) None of the above	**D**
Q25	Key aspects in process strategy does NOT include which of the following: (a) Make or buy decisions (b) Capital intensity (c) Process flexibility (d) Packaging	**D**
Q26	The example of worker involvement, as a recent trend in production/operations management is (a) SCM (b) Just-in-Time (c) Quality Circle (d) MRP	**C**
Q27	In an organization, the Production Planning & Control department comes under (a) Planning department (b) Manufacturing department (c) Personnel department (d) R & D department	**B**
Q28	JIT stands for _____. (a) Just In Time Purchase (b) Just In Time Production (c) Just In Time use of Materials (d) Just In Time Order the Material	**B**
Q29	In route sheet or operation layout, one has to show _____. (a) a list of materials to be used (b) a list of machine tools to be used (c) every work center & operation to be done at that work center (d) the cost of product	**C**
Q30	One of the important charts used in Programme control is _____. (a) Material chart (b) Gantt chart (c) Route chart (d) Inspection chart	**B**
Q31	Production planning in the intermediate range of time is termed as _____. (a) Production planning. (b) Long range production planning. (c) Scheduling. (d) Aggregate planning.	**D**
Q32	Preventive maintenance is useful in reducing (a) Inspection Cost (b) Cost of premature replacement (c) Shutdown Cost (d) Set-up Cost of machine	**C**
Q33	Which of following standards is associated with "Quality Assurance in Production & Installation"? (a) ISO 9001 (b) ISO 9002 (c) ISO 9003 (d) ISO 9004	**B**
Q34	Board of directors has certain basic tasks as follows _____. (a) To monitor plans & programs of production. (b) To design the course of strategic options & appointment of top management. (c) To control utilization of resources. (d) To monitor courses of actions for marketing management.	**B**
Q35	A Strategic Business Unit (SBU) is defined as a division of an organization: (a) That helps in the marketing operation. (b) That helps in the choice of technology. (c) That enables managers to have better control over the resources. (d) That helps in identifying talents & potentials of people.	**C**
Q36	Mc kinsey's 7-s framework consists of _____. (a) Structure, Strategy, Software, Skills, Styles, Staff & Supervision (b) Structure, Strategy, Systems, Skills, Styles, Syndication & Shared values (c) Structure, Strategy, Systems, Skills, Steering power, Styles & Shared values (d) Structure, Strategy, Staff, Skills, Systems, Shared values, Style (e) None of the above	**D**
Q37	(d) What are enduring statements of purpose that distinguish one business from other similar Firms? (a) Policies (b) Mission statements (c) Objectives (d) Rules (e) Nature of ownership	**B**

Q38	Outsourcing is the _____. (a) spinning off of a value-creating activity to create a new firm. (b) selling of a value-creating activity to other firms. (c) purchase of a value-creating activity from an external supplier. (d) use of computers to obtain value-creating data from the Internet.	**C**
Q39	For an actress in Bollywood, her pretty face would be a/an _____. (a) Asset (b) Strategic asset (c) Core competency (d) Capability (e) All of the above	**B**
Q40	The recent trend in the Production/Operations management which suggests the use of minimal amount of resources to produce a high volume of high-quality goods with some variety is referred to as: (a) SCM (b) TQM (c) Lean Production (d) Just-In-Time	**C**
Q41	Effective capacity can NOT be determined by which of the following factors? (a) Product design & product-mix (b) Quantity & quality capabilities (c) Facilities (d) None of the above	**D**
Q42	In which of the following stages the management should try to change its approach by changing its strategy from "buy my product" to "try my product"? (a) Introduction (b) Growth (c) Maturity (d) Decline	**B**
Q43	Conducting occasional check-ups of the products manufactured or assembled to ensure high quality of the production is known as: (a) Planning (b) Scheduling (c) Inspection (d) Routing	**C**
Q44	Which of following standards is associated with "Quality Assurance in Final Inspection Test"? (a) ISO 9001 (b) ISO 9002 (c) ISO 9003 (d) ISO 9004	**C**
Q45	With reference to project management, identify which of the following statement is NOT correct? (a) Gantt chart is a principal tool used in scheduling & also in some methods of loading. (b) Routing Is the first step in the production planning. (c) The cost of any activity is proportional to its time of completion. (d) The free float can be calculated by subtracting EFT from EST.	**D**
Q46	Identify which one of the following statement is NOT correct? (a) Preventing maintenance includes lubrication, cleaning, periodic overhaul, etc. (b) Two types of cost-cost of premature replacement & cost of breakdown-need to be balanced. (c) Wear & obsolescence are the two main causes of replacement of machinery in every aspect of life. (d) A machine is technically obsolete when another machine can do the same job more efficiently with reduced time & also at a lower cost.	**A**
Q47	To determine where the plant should be located for maximum operating economy & effectiveness, refers to which one of the following? (a) Plant layout (b) Facility location (c) Capacity planning (d) Capacity requirement	**B**
Q48	Which of the following models deals with the physical movement of goods from different supply origins to a number of different demand destinations? (a) Simulation (b) Transportation (c) Lean operations (d) Line balancing	**B**
Q49	One of the objectives of maintenance is _____. (a) to prevent obsolescence. (b) to ensure spare parts management (c) to satisfy customers. (d) to extend the useful life of Plant & Machinery without sacrificing the level of performance	**D**
Q50	Which one of the following does NOT seem to be an advantage of the strategic management? (a) Discharges board responsibility (b) Provides a framework for decision-making (c) Forces an objective assessment (d) It can be expensive	**D**
Q51	Which of the following analyses 'products & businesses by market share & market growth'? (a) SWOT Analysis (b) BCG Matrix (c) PEST Analysis (d) Portfolio Analysis	**B**

Q52	Which one of the following is NOT part of the McKinsey's 7-5 framework? (a) Skills (b) Staff (c) Systems (d) Supervision	D
Q53	Which one of the following statement is NOT correct? (a) Vision is the statement of the future. (b) The corporate mission is the purpose or reason for its existence. (c) Targets are formed from vision & mission statement of organizations. (d) Goals are objectives that are scheduled for attainment during planned period.	C
Q54	Which of the following can NOT be the called as a strength of an organization? (a) Good Industrial relations (b) Incentives from State Government (c) Financially very sound (d) Raw materials source at a distance	D
Q55	Strategic Business Unit (SBU) structure does NOT experience one of the following as an advantage: (a) Higher career development opportunities (b) Better control of categories of products manufacturing, marketing & distributions (c) High cost approach (d) Help in expanding in different related & unrelated businesses	C
Q56	Which one of the following recent trends in Production/Operations management involves drastic measures or break through improvements to improve the performance of a firm? (a) Corporate Downsizing (b) Re-Engineering (c) Technology (d) TQM	B
Q57	The starting point of Production cycle is (a) Product design (b) Production planning (c) Routing (d) Market research	D
Q58	Which of the following process types is used when a very highly standardized product is desired in high volumes? (a) Repetitive Process (b) Batch Process (c) Project Process (d) Continuous Process	D
Q59	Which of the following aims at finding the best & most efficient way of using the available resources-men, materials, money & machinery? (a) Method Study (b) Work Study (c) Time Study (d) Motion Study	B
Q60	(v) Generally, the size of the order for production in Job production is _____. (a) small (b) large (c) medium (d) very large	A
Q61	Which one of the following statements is NOT correct? (a) LFT is calculated from the LFT of the head event. (b) Slack can be calculated by adding EFT & LFT of any job. (c) EFT is the sum of the EST & the time of duration for any event. (d) The Total Project time is the shortest possible time required in completing the project.	B
Q62	Which one of the following is NOT the advantage of Preventive Maintenance? (a) Better product quality (b) Greater safety to workers (c) Increased breakdowns & downtime (d) Fewer large-scale repairs	C
Q63	Which one of the following establishes time sequence of operations? (a) Routing (b) Sequencing (c) Scheduling (d) Dispatching	C
Q64	MRP stands for _____. (a) Material Requirement Planning (b) Material Reordering Planning (c) Material Requisition Procedure (d) Material Recording Procedure	A
Q65	With reference to Aggregate Planning, identify which of the following statements is NOT correct? (a) It is an Intermediate-term planning. (b) It is made operational through a master schedule, that gives the manufacturing schedule.	D

	(c) Facility planning & scheduling are closely related with the aggregate planning. (d) It deals with strategic decisions, such as purchase of facilities, introduction of new products, processes, etc.	
Q66	A corporate strategy can be defined as _____. (a) A list of actions about operational planning & statement of organisation structure & control system. (b) A statement of how to compete, direction of growth & method of assessing environment. (c) Abatement of organisation's activities & allocation of resources. (d) A course of action or choice of alternatives, specifying the resources required to achieve certain stated objectives.	**D**
Q67	The existence of price-wars in the airline industry in India indicates that (a) customers are relatively weak because of the high switching costs created by frequent flyer programs. (b) the industry is moving towards differentiation of services. (c) the competitive rivalry in the industry is severe. (d) the economic segment of the external environment has shifted, but the airline strategies have not changed.	**C**
Q68	Business Process Re-engineering is _____. (a) eliminating loss-making process. (b) redesigning operational processes. (c) redesigning the product & services. (d) recruiting the process engineers.	**B**
Q69	Which one or more of the following are appropriate as a judicious mix for a Product line, which is a group of products? (a) That are closely related. (b) That are marketed through the same channel. (c) That perform a similar function for being sold to the same customers. (d) All of the above.	**D**
Q70	The Product Market matrix comprising of Strategies of Market Penetration, Market Development, Product Development, & Diversification was first formulated by _____. (a) Ansoff (b) Drucker (c) Porter (d) Pralhad	**A**
Q71	Price fixation for the first time takes place when _____. (a) a company develops or acquires a new product. (b) introducing existing product into a new geographic area or a new distribution channel. (c) a service, the company bids for a new contract work. (d) All of the above.	**D**
Q72	Inventory cost per product in intermittent production is _____. (a) Higher (b) Lowest (c) Medium (d) Abnormal	**A**
Q73	The act of assessing the future & make provisions for it is known as _____. (a) Planning (b) Forecasting (c) Assessment (d) Scheduling	**B**
Q74	One of the important charts used in Programme control is _____. (a) Material chart (b) Gantt chart (c) Route chart (d) Inspection chart	**B**
Q75	Cost reduction can be achieved through _____. (a) Work sampling (b) Value analysis (c) Quality assurance (d) Supply chain management	**B**
Q76	Linear Programming is a technique used for determining _____. (a) Production Programme (b) Plant Layout (c) Product Mix (d) Manufacturing Sequence	**C**
Q77	(Total station time/cycle time x Number of work stations) x 100 is known as _____. (a) Line efficiency (b) Line smoothness (c) Balance delay of line (d) Station efficiency	**A**

Q78	Arrangement of machines depending on sequence of operations happens in _____. (a) Process Layout (b) Product Layout (c) Hybrid Layout (d) Group Technology Layout	**B**
Q79	Line of Best fit is another name given to _____. (a) Method of Least Squares (b) Moving Average Method (c) Semi Average Method (d) Trend Line Method	**A**
Q80	In route sheet or operation layout, one has to show _____. (a) A list of materials to be used. (b) A list of machine tools to be used. (c) Every work center & the operation to be done at that work center. (d) The cost of product.	**C**
Q81	Computers are used in Production control in this area _____. (a) follow-up activity. (b) to control labour. (c) to disseminate information. (d) Loading, Scheduling & Assignment works.	**D**
Q82	Offensive strategy is a strategy (a) For small companies that consider offensive attacks in the market. (b) For those companies that search for new inventory opportunities to create competitive advantage. (c) For the market leader who should attack the competitor by introducing new products that make existing ones obsolete. (d) For those companies who are strong in the market but not leaders & might capture a market share from the leader.	**A**
Q83	The BCG growth matrix is based on the two dimensions _____. (a) Market Size & Market Share (b) Market Size & Profit Margins (c) Market Size & Competitive Intensity (d) None of the above	**D**
Q84	For an entrepreneur _____. (a) Vision is before the mission. (b) Mission is before the vision. (c) Both are developed simultaneously. (d) Vision or mission are un-important issues.	**A**
Q85	Benchmarking is _____. (a) the analytical tool to identify high cost activities based on the 'Pareto Analysis'. (b) the search for industries best practices that lead to superior performance. (c) the simulation of cost reduction schemes that help to build commitment & improvement of actions. (d) the process of marketing & redesigning the way a typical company works.	**B**
Q86	Strategic analysis is concerned with stating the position of the organization in terms of _____. (a) Mission, choice of market segments, product selection, financial targets & external appraisal. (b) Mission, goals, corporate appraisal, position audit & gap analysis. (c) Mission, goals, identification of key competitors, SWOT & environmental appraisal. (d) Mission, targeted ROI, manpower planning & position audit.	**B**
Q87	Intensity of competition is _____ in low return industries. (a) low (b) non-existent (c) high (d) not important	**C**
Q88	Conversion of inputs into outputs is known as _____. (a) Application of technology (b) Manufacturing products (c) Product (d) Operation management	**D**
Q89	Which of the following is NOT the Plant Layout Principle? (a) Principle of sequence (b) Principle of usage (c) Principle of maximum travel (d) Principle of minimum investment	**C**

Q90	Number of product varieties that can be manufactured in Mass production is _____. (a) one only. (b) few varieties in large volume. (c) two only. (d) large varieties in small volumes.	**B**
Q91	Scheduling shows _____. (a) which resource should do which job & when. (b) total cost of production. (c) total material cost. (d) the flow line of materials.	**A**
Q92	Which one of the following standards is associated with the "Quality Management & Quality System Elements-Guidelines"? (a) ISO 9001 (b) ISO 9002 (c) ISO 9003 (d) ISO 9004	**D**
Q93	In a network diagram, the activity that must be completed prior to the start of an activity is called as (a) Successor activity (b) Predecessor activity (c) Concurrent activity (d) Dummy activity	**B**
Q94	Identify which one of the following is NOT the objective of the maintenance: (a) To keep all production facilities & allied facilities in an optimum working condition. (b) To ensure specified accuracy to products & time schedule of delivery to customers. (c) To keep the down time of the machine at the maximum. (d) To keep the production cycle within the stipulated range.	**C**
Q95	One of the important charts used in programme control is _____. (a) Gantt chart (b) Material chart (c) Distribution chart (d) Maintenance chart	**A**
Q96	The act of going round the production shop to note down the progress of work & feedback the information is known as (a) Dispatching (b) Routing (c) Follow up (d) Trip card	**C**
Q97	With reference to the characteristics of a good product design, which one of the following is referred to "the case of manufacture with minimum cost"? (a) Reliability (b) Productibility (c) Specification (d) Simplification	**B**
Q98	Which of the following statements can be closely related with the Mission? (a) It includes definition of products & services the organization provides. (b) It specifies management policies towards customers & societies. (c) It provides a roadmap to company's future. (d) It indicates the kind that company management is trying to create for future.	**A**
Q99	Portfolio Analysis is a term used _____. (a) to identify what strategy is needed to maintain a strong position or improve a weak one. (b) to find out a best alternative out of various alternatives available. (c) to analyse products & business by market share & market growth. (d) to make managers more adaptable to unforeseen changes,	**A**
Q100	Which one of the following is NOT a role of Marketing? (a) It helps in sustaining & improving the existing levels of employment. (b) It helps in the economic growth of a country. (c) It helps in the discovery of entrepreneurial talent. (d) It diminishes potential aggregate demand & thus reduces the size of the market.	**D**
Q101	Which one of the following in NOT the benefit of a Vision? (a) It helps in the creation of common identity & a shared sense of purpose. (b) It fosters risk taking & experimentation. (c) It fosters short-term thinking. (d) It represents integrity.	**C**
Q102	Competitive position of a company's SBU or product line can NOT be classified as _____. (a) Dominant (b) Strong (c) Favourable (d) Volatile	**D**

Q103	The best test of a successful Strategy implementation is _____. (a) whether the strategies & procedures are observed in the strategy supportive fashion. (b) whether the structure is well-matched to strategy. (c) whether actual organizational performance matches or exceeds the targets spelt out in the strategic plan. (d) whether it is made after the strategy is formulated, so that it is supportive to the strategy.	C
Q104	The best way of improving the productivity of capital is _____. (a) Purchase automatic machines (b) Effective Labour control (c) Productivity of capital is to be increased through effective materials management (d) To use good financial management	C
Q105	Routing & Scheduling becomes relatively complicated in _____. (a) Flow production (b) Batch production (c) Mass production (d) Job	B
Q106	MRP stands for _____. (a) Material Recording Procedure (b) Material Requirement Planning (c) Material Requisition Procedure (d) Material Reordering Planning	B
Q107	One of the important charts used in Programme control is _____. (a) Material chart (b) Route chart (c) Gantt chart (d) Inspection chart	C
Q108	Number of product varieties that can be manufactured in Mass production is _____. (a) Few varieties in large volumes (b) One only (c) Large varieties in small volumes (d) Two only	A
Q109	In Production by disintegration the material undergoes _____. (a) Change in economic value only (b) Change in physical & chemical characteristics (c) Change in technology only (d) None of these	B
Q110	JIT stands for _____. (a) Just in time order the material (b) Just in time purchase (c) Just in time use of materials (d) Just in time production	D
Q111	Production control concerned with _____. (a) Good materials management (b) Good product design. (c) Strict control on labours (d) Passive assessment of plant performance	D
Q112	The time horizon selected for forecasting depends on _____. (a) Time required for production cycle. (b) The salability of the product (c) The selling capacity of Salesman (d) Purpose for which forecast is made	D
Q113	The starting point of Production cycle is _____. (a) Market research (b) Routing (c) Product design (d) Production Planning	A
Q114	To decide work load for men & machines _____. (a) Medium range forecasting is used (b) A combination of long range & medium range forecasting is used (c) Short term forecasting is used (d) Long range forecasting is used	C
Q115	Most suitable layout for Job production is _____. (a) Process layout (b) Line layout (c) Matrix layout (d) Product layout	A
Q116	In general number of product varieties that can be manufactured in Flow production is _____. (a) Five only (b) Ten to twenty varieties (c) One only (d) Large varieties	C
Q117	Most important benefit to the consumer from efficient production system is _____. (a) He can get the product on credit (b) He can save money (c) He will have product of his choice easily available (d) He gets increased use value in the product.	D

Q118	For a marketing manager, the sales forecast is _____. (a) To plan the sales methods. (b) Arranging the sales men to different segments of the market (c) Estimate of the amount of unit sales for a specified future period (d) To distribute the goods through transport to satisfy the market demand	**C**
Q119	Production planning deals with _____. (a) What should be the demand for the product in future? (b) What production facilities are required & how these facilities should be laid out in space available? (c) What to produce & when to produce & where to sell? (d) What is the life of the product?	**B**
Q120	Conversion of inputs into outputs is known as _____. (a) Operations management (b) Application of technology (c) Product (d) Manufacturing products	**A**
Q121	The first stage in production planning is _____. (a) Process Planning (b) Layout planning (c) Operation Planning (d) Factory Planning	**D**
Q122	For production planning _____. (a) Shot term forecasting is useful (b) Medium term forecasting is useful (c) Forecasting is not useful (d) Long term forecasting is useful	**A**
Q123	Scheduling deals with _____. (a) Number of machine tools used to do a job (b) Fixing up starting & finishing times of each operation in doing a job (c) Number of jobs to be done on a machine (d) Different materials used in the product	**B**
Q124	While referring to the customer service objective of Operations Management, primary consideration "Movement of a given, requested or acceptable specification" can be associated with which one of the following principal function? (a) Manufacture (b) Supply (c) Transport (d) Services	**C**
Q125	Which one of the following is not the factor influencing effective capacity of a plant? (a) Forecasts of demand (b) Plant & labour efficiency (c) Multiple shift operation (d) Proper record keeping of maintenance	**D**
Q126	Which one is the objective of product design? (a) Profit reduction in long run (b) To increase the development time to maximum (c) To increase the cost of the product (d) To achieve the desired product quality	**D**
Q127	The type of production control which is typically found where a particular bottleneck machine exists in the process of manufacturing is _____. (a) Block control (b) Load control (c) Flow control (d) Batch control	**B**
Q128	The ratio of "Value of output of goods of services" to "Capital assets employed" is: (a) Manpower Productivity (b) Materials Productivity (c) Capital Productivity (d) Energy Productivity	**C**
Q129	With reference to project planning, which one of the following signifies the “freedom for rescheduling or to start the job”? (a) Slack (b) Float (c) Free Float (d) Total Float	**A**
Q130	Which one of the following is the benefit of preventive maintenance? (a) Increased breakdowns (b) Increased downtime (c) Higher large-scale repairs (d) Less standby or reserve equipment or spares required	**D**

Q131	ZAB Ltd. a large-scale industry manufactures product-M of 24 units per shift of 8 hours. The standard time per unit is 15 minutes. What is the productivity of the per shift of 8 hours? (a) 50% (b) 60% (c) 75% (d) 80%	**C**
Q132	Which one of the following ISO standards concerns minimization of harmful effects to the environment caused by the operations of an organization? (a) ISO 9001 (b) ISO 14000 (c) IS 9002 (d) ISO 9004	**B**
Q133	The type of basic process types, which is used when a very highly standardized product is desired in high volume is _____. (a) Job shop (b) Batch (c) Project (d) Continuous	**D**
Q134	Strategic Management can be defined as _____. (a) the direction & scope of an organization over the long run. (b) A stream of decisions & actions which leads to the development of an effective strategy or strategies to help achieve objectives. (c) the statement of the future. (d) A statement of the activities or steps needed to support a strategy.	**B**
Q135	PEST analysis refers to _____. (a) Political, environmental, structural & Technical (b) Portfolio, Energy, Solar & Transformation (c) Purchase, Economics, Supply & Transportation (d) Political, Economical, Social & Technological	**D**
Q136	Business Process Reengineering could be applied to companies that confront problems such as ___. (a) low operational costs. (b) high performance of middle level managers. (c) appropriate distribution of resources & jobs in order to achieve maximum performance etc. (d) low quality offered to customers.	**D**
Q137	Vision is associated with _____. (a) Types of markets (b) Customer need or requirement (c) Road map to Company's future (d) Distinctive competencies	**C**
Q138	While performing SWOT analysis, which one of the following can be treated as a Threat? (a) Price cutting war (b) Reduction in financing cost (c) Lesser competition (d) Industrial stability	**A**
Q139	Which one of the following 'S' is not a part of McKinsey's 7s Framework? (a) Skills (b) Style (c) Synergy (d) Structure	**C**
Q140	With reference to the aspects of customer service under Operations Management, if Primary consideration focuses on "Movement of a given, requested or acceptable specification", it's corresponding Principal function will be _____. (a) Manufacture (b) Transport (c) Supply (d) Service	**B**
Q141	Which one of the following forecasting is more useful in production planning? (a) Short-term (b) Medium-term (c) Long-term (d) None of the above	**A**
Q142	In which of the following layouts, similar type of machines & services (facilities) are located together? (a) Product or Line layout (b) Process layout (c) Group layout (d) Fixed layout	**B**
Q143	Point-rating method is closely associated with _____. (a) Transportation (b) Simulation (c) Queuing system (d) Job Evaluation	**D**
Q144	The ratio of Actual Production to the Standard Production is referred to as _____. (a) Standardization (b) Simplification (c) Productivity (d) Actual Yield	**C**
Q145	Which one of the following is the project management software program? (a) MS Power Point (b) MS Excel (c) MS Project (d) MS Access	**C**

Q146	The type of spare parts which although acknowledged to have a long life or a small chance of failure, would cause a long shutdown of equipment because it would take a long time to get a replacement for them, are known as _____. (a) Insurance spares (b) Rotatable spares (c) Regular spares (d) Capital spares	**D**
Q147	Which of the following is not the method used for Operations Research problems? (a) Analytical method (b) Simulation method (c) Trail & error method (d) None of the above	**D**
Q148	Which one of the following provides the standards for performance appraisal? (a) Mission (b) Vision (c) Objectives (d) Values	**C**
Q149	Which one of the following provides the broad 'data' from which to identify key drivers of change? (a) BCG matrix (b) PESTEL analysis (c) SWOT analysis (d) Critical Success Factors	**B**
Q150	Any metric that measures whether an organization is meeting certain objectives & goals that are set to help the organization succeed is called _____. (a) Key Result Areas (b) Key Performance Areas (c) Task Control (d) Key Performance Indicators	**D**
Q151	A shared, immutable ledger that facilities the process of recording transactions & tracking assets in a business network is referred to as _____. (a) Artificial Intelligence (b) Virtual Machine (c) Machine Language (d) Blockchain	**D**
Q152	With reference to the operations of a manufacturing company, one of the important decisions "How to reach the products to the customers?" Is related to which one? (a) Quality Management (b) Inventory Management (c) Maintenance Management (d) Distribution	**D**
Q153	(b) Which one of the following is associated with the question “How much space & capacity does each economic activity center need?” (a) Facility location (b) Facility layout (c) Capacity Planning (d) MRP	**B**
Q154	The non-linear iterative process that seeks to understand users’ needs challenge assumptions, redefine problems & create innovative solutions to prototype & test, is called _____. (a) Product design (b) Product Mix (c) Design thinking (d) Product Life Cycle	**C**
Q155	Any solution that also satisfies the non-negative restrictions of the general linear programming problem is called a _____. (a) Basic Solution (b) Feasible Solution (c) Basic Feasible solution (d) Optimal feasible solution	**B**
Q156	ISO Standards are reviewed every _____. (a) Year (b) 2 Years (c) 5 Years (d) 10 Years	**C**
Q157	ABS Ltd., a manufacturing Company has a production line consisting of five work centers in series with individual capacity in units per shift as are given. The actual output of line is 270 units per shift. Work Centre: P	Q	R	S	T Capacity/Shift: 350	320	360	325	300 Identify the bottle neck center. (a) Work Centre P (b) Work Centre R (c) Work Centre T (d) Work Centre S	**C**
Q158	Under Maintenance management, two types of costs & need to be balanced-one is cost of premature replacement, other is cost of _____. (a) Purchase of Raw Materials (b) Breakdown (c) Purchase of finished goods (d) None of the above	**B**

Q159	The technique which involves developing a model of real phenomenon & then performing experiments on the model evolved, is referred to as _____. (a) Transportation (b) Assignment (c) Simulation (d) Queuing	C
Q160	Which one of-the following refers to the job-specific goals of each individual employee? (a) Performance Objectives (b) Personal Objectives (c) Professional Objectives (d) Organization Genomics	B
Q161	Which of following is related to situation when consumers prefer products of established companies? (a) Economics of Scale (b) Brand Loyalty (c) Customer switching costs (d) Absolute cost advantages	B
Q162	The fundamental rethinking & radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance such as cost, quality, service & speed is called _____. (a) Transformation (b) Reprocessing (c) Total Quality Management (d) Business Process Re-engineering (BPR)	D
Q163	A collection of data that is huge in volume & is growing exponentially with time is called _____. (a) Big data (b) Huge data (c) Block Chain (d) Cloud data	A
Q164	The expected time for an activity of project B is 7 days. If the optimistic & pessimistic time are 3 days & 15 days respectively, what will be the most likely time of the activity? (a) 10 days (b) 6 days (c) 12 days (d) None of these	B
Q165	In SWOTC Analysis, the Letter 'C' denotes _____. (a) Champions (b) Characteristics (c) Challenges (d) Core Values	C
Q166	While developing KRAs (Key Result Areas) following can be the hurdle _____. (a) Lack of clarity (b) Distractions (c) Top-Down Imposition Areas (d) All of the above	D
Q167	Let's consider an example of a product manufacturing company, who is aware that it needs to produce the products. One of the important aspects involved in the operational planning which is related to the question. "How much to produce?" is known as _____. (a) Process Selection & Layout (b) Aggregate Planning (c) Demand Forecasting (d) Quality Management	C
Q168	_____ of a plant is the maximum rate of output (goods or services) the plant can produce. (a) Production (b) Potential (c) Demand (d) Capacity	D
Q169	Which one of the following basic process types is used when a very highly standardized product is desired in high volumes? (a) Batch Process (b) Continuous Process (c) Job Shop Process (d) Project Process	B
Q170	Which one of the following production controls is typically found whenever a particular bottleneck machine exists in the process of Manufacturing? (a) Load Control (b) Batch Control (c) Block Control (d) Flow Control	A
Q171	Which one of the following ISO Standards evaluates the Management of the entire manufacturing process, from purchasing to design, to training? (a) ISO 9004 (b) ISO 9003 (c) ISO 9000 (d) ISO 9001	C
Q172	A Zinc Plant of ZOS Ltd., manufactures product Z of 30 units per shift of 8 hours. If the Standard time per unit is 12 minutes, what is the productivity per shift of 8 hours? (a) 60% (b) 75% (c) 80% (d) 90%	B
Q173	Which one of the following design Tests asks whether a proposed Structure will set up links between parts of the organizations that are important but bound to be strained? (a) People Test (b) Feasibility Test (c) Difficult Links Test (d) Flexibility Test	C

Q174	RON Ltd., a manufacturer of ball bearings provides the following items that is being managed using a fixed order Quantity Model with Safety Stock: Annual Demand (D): 24000 Units Order Quantity (OQ): 3600 Units Safety Stock (S): 400 Units What is the average Inventory Level? (a) 2500 units (b) 2400 units (c) 2200 units (d) None of (a), (b) & (c)	**C**
Q175	The Slack Time of the Tail event & Slack time of Head event of an activity M are 15 days & 2 days respectively. If the total Float of Activity M is 16 days, Free Float will be _____. (a) 13 days (b) 14 days (c) 15 days (d) 18 days	**B**
Q176	Which one of the following Digital Marketing Strategies is a form of paid Advertising that allows Marketing Teams to essentially purchase traffic to their website? (a) Email Marketing (b) Mobile Marketing (c) Pay-per Click (PPC) (d) Affiliate Marketing	**C**
Q177	Which of the following is/are true for a Blue Ocean Strategy? (a) Create & Capture new demand (b) Boat the Competition (c) Exploit existing demand (d) Compete in existing Markets	**A**
Q178	Which one of the following Sorts of Business defined by the Market growth/market share axes of BCG Matrix, is a business unit with high market share in a matured market? (a) Cash Cow (b) Dog (c) Star (d) Question Mark (or problem Child)	**A**
Q179	_____ is the science of using mathematical calculations & logic to generate time effective sequence of task considering any resource & cost constraints. (a) Scheduling (b) Plan (c) Milestone (d) Work-in-Progress	**A**
Q180	Which one of the following announces what the Company is providing to Society; either a Service or a Product? (a) Mission (b) Vision (c) Values (d) Objectives	**A**
Q181	Which one of the following types of Cloud Computing, is a distribution model that delivers software applications over the Internet, these applications are often called web services? (a) Infrastructure as a Service (las) (b) Platform as a Service (Pas) (c) Software as a Service (Sas) (d) Amazon Web Services (AWS)	**C**