

B.E.
Sixth Semester Examination, Dec.-2007
Industrial Engineering (ME312E)

Note : Attempt any five questions.

Q. 1. (a) Discuss the importance by standardization, simplification and specialisation for new product design.

Ans. Importance of Standardization :

- (i) Fewer specifications, drawings and part lists have to be prepared and issued.
- (ii) Thus, more time is available to develop new designs or to improve established designs.
- (iii) Better resources utilisation.
- (iv) Allocation of work to suit available talent.
- (v) Lesser design mistakes and design alterations.
- (vi) Less qualified personnel can handle routines design work.

Importance of Simplification :

- (i) Simplification involves fewer, parts, varieties and changes in products; this reduces manufacturing operations and risk of obsolescence.
- (ii) Since simplification reduces variety, volume of remaining products may be increased.
- (iii) Simplification provides quick delivery and better after-sales service.
- (iv) Simplification reduces inventory and thus results in better inventory control.
- (v) Generally speaking, simplification implies fewer parts and fewer the parts, the lower the production costs.
- (vi) Thus, simplification reduces price of a product.
- (vii) Simplification improves product quality.

Importance of Specification :

- (i) Workers achieve a high state of skill and proficiency.
- (ii) They take smaller times to complete the activity in which they are specialised.
- (iii) Thus, they raise their salaries and their standard of living.
- (iv) Specialization is universal in application; it is a rule rather than exception in today's industry.
- (v) Specialisation has been applied to :
 - (a) Products
 - (b) Processes
 - (c) Individuals
 - (d) Companies
 - (e) Jobs
 - (f) Equipments, etc.

Q. 1. (b) Explain Product Life Cycle. Discuss the various approaches for Product Design.

Ans. Product Life Cycle : Life-cycle of a production system has different phases, which are same as that of human beings. We can identify eight distinct phases :

- (i) Birth of the production system
- (ii) Product design and process selection
- (iii) Design of the system
- (iv) Manning of the system
- (v) Start-up of the system
- (vi) System in the steady state
- (vii) Revision of the system
- (viii) Termination of the system

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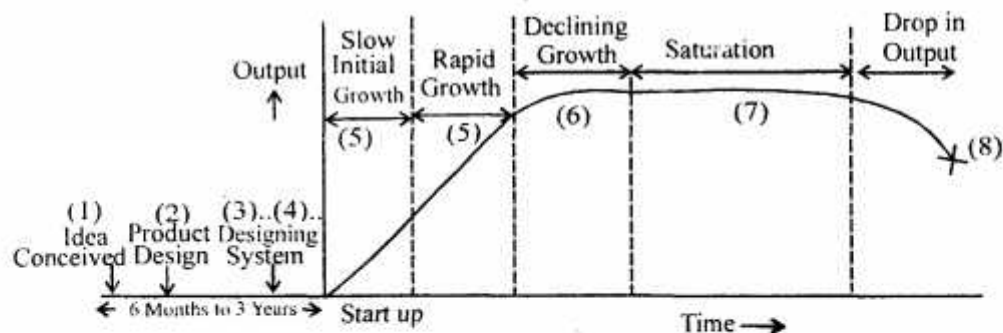


Fig. Stages in Product Life Cycle

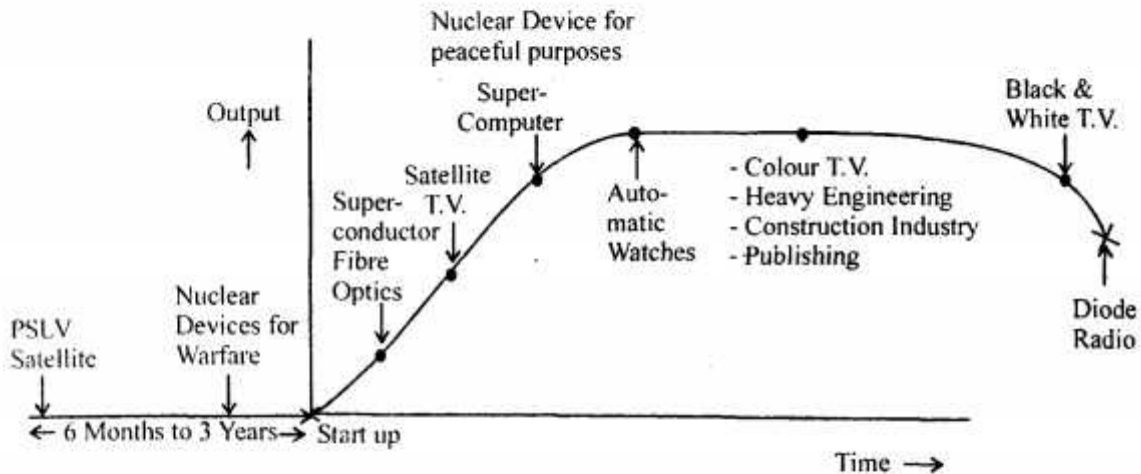


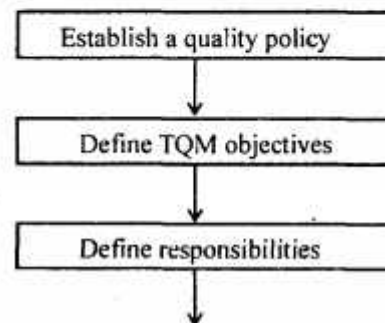
Fig. Typical products at various levels of Product Life-Cycle in Indian Industry

Following approaches are followed in the area of product design :

- (i) **Imitation** : This is an approach of using features, which some other product of similar or dissimilar type already possesses.
- (ii) **Adoption** : This is an area of developing a product for which the market is already existing.
- (iii) **Invention** : This is an area of innovation and doing something new which others have not done so far.

Q. 2. (a) Elaborate your understanding about TOTAL QUALITY MANAGEMENT.

Ans. Total Quality Management (TQM) is a system approach to quality management. It refers to complete commitment to quality in all spheres of the organisation. A plan for quality system is shown in fig. Total in TQM stands for an overall integrated approach to all aspects of quality, all domains of system, including, organisation, people, resources, time, hardware/software and even management commitments. TQM is a management approach of organisation, centred on quality,



based on the participation of all its members and aiming at long term success through customer satisfaction and benefits to the members of organisation and society.

Written quality policy issued by the chief executive.

Total quality management should be detailed.

Quality is the direct operational responsibility of the management.

Prepare job description towards TQM.

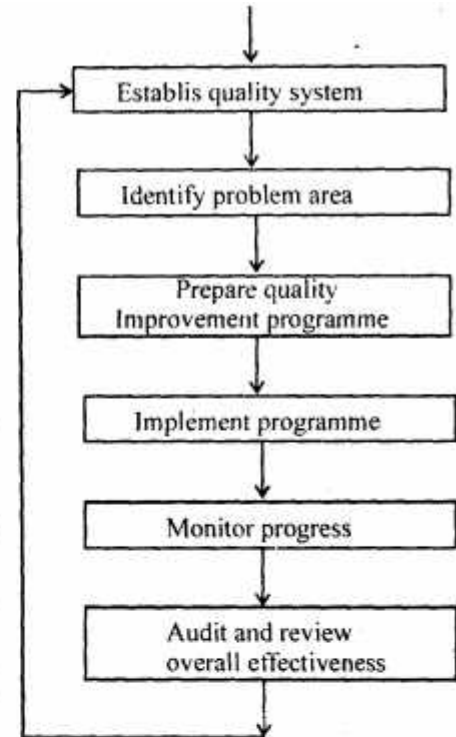
The requirements of the customer and of the company must be met and the system, in the terms of specific procedures, methods and instructions, profitability and growth profile clearly defined widely disseminated, understood and enjoyed by all.

Regular audits of the operations areas by self-assessment and team work will lead to continual updating of solutions to potential problem.

Programme designed to achieve established objectives must start.

Implementation must involve the commitment and involvement of all employees.

Quality improvement programme must defined the agreed time table. Practical implementation and usefulness of the quality system should be continually compared with the objectives. A method for changes in the plan should be identified and documented.



Q. 2. (b) The following numbers of Non-conforming items are observed in 25 subgroups of 200 items each :

16, 9, 3, 0, 23, 8, 7, 14, 11, 8, 12, 1, 21, 27, 33, 22, 10, 5, 8, 6, 13, 18, 9, 12, 5

(i) Calculate the control limits for appropriate control chart.

(ii) Is the process under control?

Ans. Control limit, $= \bar{P} \pm \frac{3\sqrt{\bar{P}(1-\bar{P})}}{\sqrt{n}}$

Where,

$$\bar{P} = \frac{\sum nP}{\sum n} = \frac{16+9+3+0+23+8+7+14+11+8+12+1+21+27+33+22+10+5+8+6+13+18+9+12+5}{25 \times 200} = 0.0602$$

$$\text{Upper Control Limit} = UCL = 0.0602 + 3\sqrt{\frac{0.0602(1-0.0602)}{25}} = 0.2029$$

$$\text{Lower Control Limit} = 0.0602 - \frac{3\sqrt{0.0602(1-0.0602)}}{\sqrt{25}} = -0.0825$$

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Lower control limit comes out negative which is unacceptable, hence

$$LCL = 0$$

Q. 3. (a) Discuss the various strategies for improving the productivity.

Ans. Human Resources : The general level of education is an important factor in national productivity. The use of computers other sophisticated equipment and systems requires better educated employees. Government can help by sponsoring more education, especially in fields that directly affect productivity. Employees need to be motivated to be productive.

Technology & Capital Investment : The major factor in long range continuing productivity improvement is technology and new technology depends on Research & Development.

The government can do the following :

- (i) Promote R & D in Industries and Universities.
- (ii) Encourage personal savings and reduce taxes on profits so that people invest in new facilities.
- (iii) Allow depreciation rates that will provide cash flow for new investment.
- (iv) Directly encourage new investment through increased investment tax credits.

Government Regulation : An excessive amount of government regulation may have a detrimental effect on productivity.

Product (or System) Design : In through better product design, a product can be simplified by eliminating some of its parts, it is obvious that the material these pieces are made of will no longer be needed. Nor will the equipment, tooling and labour to make them be required. Value analysis can bring out many product design changes that improve productivity.

Machinery and Equipment : Once the product is designed, then how it is made offers the next opportunity for productivity improvement. The equipment used-machines, tools, conveyors, robots, the way the factory is laid out- all are important.

Skill and Effectiveness of the Worker : The trained and experienced worker can do the same job in a much shorter time and with far greater effectiveness than a new one.

Production Volume : Assume that the volume of output is to be doubled. The number of direct workers would have to be doubled and a few indirect workers might also be needed.

Q. 3. (b) Discuss the various methods for Job evaluation & Merit Rating.

Ans. The various commonly used methods or systems of job evaluation are :

- (a) Ranking method
- (b) Classification method
- (c) Factor comparison method
- (d) Point method

(a) Ranking Method : The different jobs, depending upon their requirements, responsibilities involved and their importance to the organisation, are ranked, graded or placed from top to bottom.

(b) Classification or Grading Method : Jobs are classified or graded in groups or levels of equal skill difficulty, responsibility, importance and other requirements. It may be a production job, a sales job or an office job; each job family can be broken into a number of grades.

(c) Factor Comparison Method : The method employs a five factor scale for analysis, comparing and evaluating different jobs. The five factors are skill, mental effort, physical efforts, responsibility and working conditions.

The different methods of merit rating plans or merit rating systems are discussed below :

(a) Rating Scale Method : The steps involved in Rating Scale Method are :

- (i) Define the merit factors (i.e., standards) to rate the employees. The number of factors employed for rating an employee may vary from six to ten.

(ii) Divide each factor into three to five different grades or degrees like Excellent, Very good, Good, Fair and Unsatisfactory.

(iii) Impart certain points (marks) to each grade.

(iv) The worth of an employee can be determined from the total points he gets for all his merit factors.

(b) Check List Method : The method employs a list of questions and several statements which are concerned with the employee performance on various aspects of the job and which are considered important for evaluating the merit of an employee for that job.

Q. 4. (a) Discuss briefly the various methods of Work Measurement.

Ans. Comparison of Work Measurement Techniques :

Criteria	Work Sampling	Predetermined Time Standards	Stop Watch Timing	Employee Reporting	Historical
1. Speed : Time required to measure and establish standards.	Average to fast	Slow to average	Average	Average	Fast
2. Training and skill required; Technicians, supervisors.	Low to moderate	High	Moderate to high	Low	Low
3. Cost : Technician employee time, equipment, etc.	Average	Fairly high	Average	Low	Minimal
4. Assistance in methods improvement.	Low to moderate	High	Good	Very little	No
5. Hierarchy : Subjective vs objective, degree of distortion.	Fair to good	Very high	Good to high	Fair	Low
6. Acceptability : Employee supervisor.	Fair	Good	Fair to good	Fair to good	Fair to good
7. Interruption of work operation.	Moderate	Low	Fairly high	Fairly high	None
8. Applicability : For physical, clerical, professional work.	Very good	Average	Average	Very good	Good
9. Savings : How quickly; how much.	Average to high	High	Average to high	Fair to good	Fair
10. Usability : In scheduling production, evaluating performance.	Average to high	High	High	Fair to good	Fair
11. Reporting Requirements : Difficulty of furnishing data.	Average	Average	Average	Fair	Simple

Q. 4. (b) During a time study following times are observed :

53, 57, 62, 59, 55, 61, 49, 53, 52 and 55 seconds.

Using a rating factor of 95% and an allowance of 25%, establish a time standard for the job.

Ans. The average observed time are

$$= \frac{53 + 57 + 62 + 59 + 55 + 61 + 49 + 53 + 52 + 55}{10}$$

$$= 55.6 \text{ s}$$

$$\text{Basic time} = \text{Observed time} \times \text{Rating factor}$$

$$= 55.6 \times 0.95 = 52.82 \text{ s}$$

$$\text{Allowance} = 0.25 \times 52.82 = 13.205 \text{ s}$$

$$\text{Standard time} = \text{Basic time} + \text{Allowance}$$

$$= 52.82 + 13.205$$

$$= 66.025 \text{ s}$$

Q. 5. (a) Define Management Information Systems (MIS). Discuss the evolution of MIS concept during the last 50 years.

Ans. Evaluation of MIS : Organisations have always had some kind of management information system, even if it was not recognised as such. In the past, these systems were of a highly informal nature in their setup and utilisation. Not until the advent of computers, with their ability to process and condense large quantities of data, did the design of MIS become a formal process and field of study. When computers were first introduced into organisations, they were used mainly to process data for a few organisational functions—usually accounting and billing. As the speed and ease of processing data grew, other data processing and information management tasks were computerized. The growth of FDP departments spurred managers to plan their organisation information systems more nationally. These efforts led to the emergence of the concept of computer-based information systems (CBIS), which became better known as computer-based MIS or simply MIS.

Q. 5. (b) Define System Analysis & Design. Briefly discuss the process of developing MIS in any organisation with the help of block diagram.

Ans. System design is to construct a new, useful system under a specified evaluation criterion by the use of scientific disciplines and empirical laws concerning systems. Basically there are two approaches to system design :

(a) Inductive Design : It is an analytical approach to derive a general solution for an actual system by identifying and investigating the cases of existing systems reality.

(b) Deductive Design : It is an axiomatic approach to deduce a feasible or an optimal solution theoretically by first setting an ideal system based on universal disciplines and principles.

When the system is complex, the development strategy is Prototyping of the System. Prototyping is a process of progressively ascertaining the information needs, developing methodology, trying it out on a smaller scale with respect to the data and the complexity, ensuring that it satisfies the needs of the users, and assess the problems of development and implementation.

This process, therefore, identifies the problem areas, inadequacies in the prototype vis-a-vis fulfillment of the information needs. The designer then takes steps to remove the inadequacies. This may call upon changing the prototype of the system, questioning the information needs, streamlining the operational systems and procedures and more user interaction. A typical process of the system development through prototyping is given in fig.

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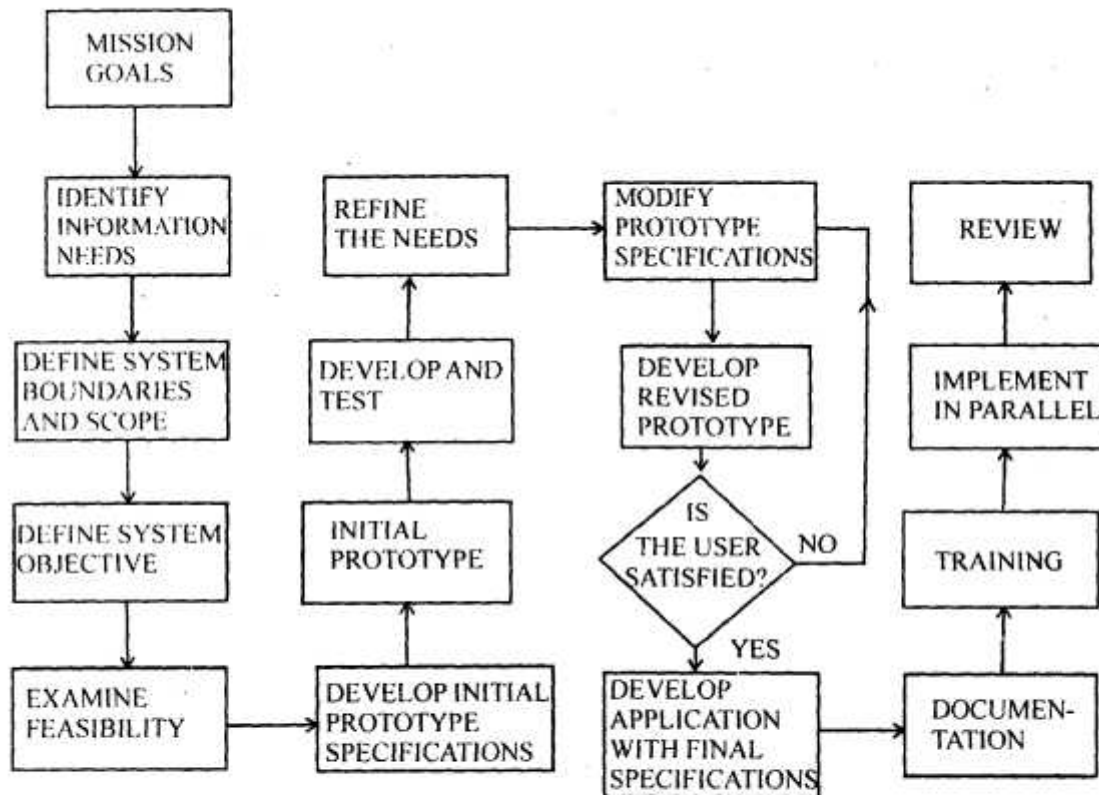
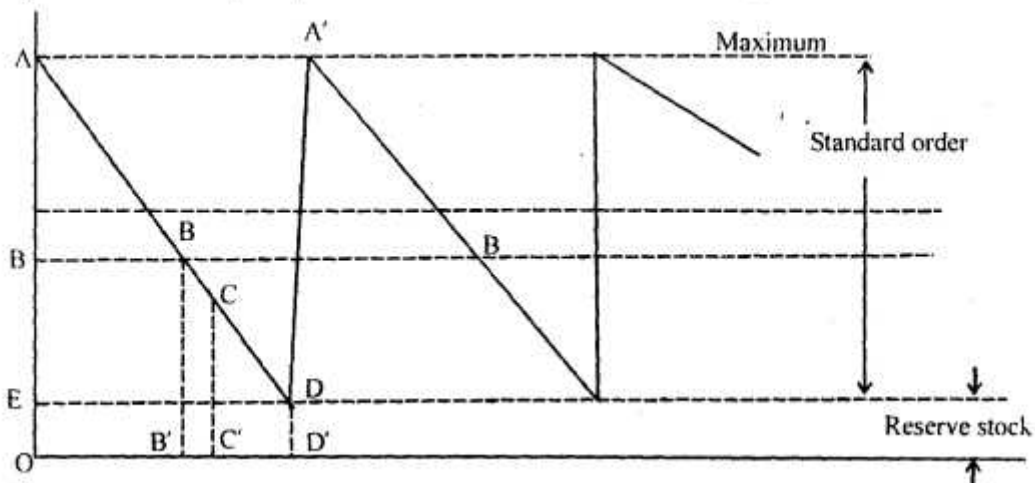


Fig. Information System Development Model : Prototyping Approach

Q. 6. (a) Describe the various order launching inventory control systems.

Ans. A problem which always remains is that how much material may be ordered at a time. An economic order quantity is one which permits lowest cost per unit and is most advantageous.

Fig. shows different quantity standards



Starting from an instant which inventory OA is in the stores, it (Inventory) consumes gradually in quantity from A along AD at a uniform rate. It is preknown that it takes L number of days between initiating order and receiving the required inventory. Therefore, as the quantity reaches point B, purchase requisition is initiated which takes from B to C, that is time R. From C to D is the inventory procurement time P. At the point D when only reserve stock is left, the ordered material is supposed to reach and again the total quantity shoots to its maximum value i.e., the point A' (A = A').

Maximum Quantity OA is the upper or maximum limit to which the inventory can be kept in the stores at any time.

Minimum Quantity OE is the lower or minimum limit of the inventory which must be kept in the stores at any time.

Standard Order (A'D) is the difference between maximum and minimum quantity and it is known as economical purchase inventory size.

Reorder Point (B) indicates that it is high time to initiate a purchase order and if not done so the inventory may exhaust and even reserve stock utilized before the new material arrives.

From B' to D' it is a lead time (L) and it may be calculated on the basis of past experience.

Q. 6. (b) An icecream manufacturing firm produces icecream bars have annual demand of 72000 bars. The company has the capacity to produce 400 bars per day. The set up cost per production run is Rs. 7.50. The inventory carrying cost is Rs. 1.50 per bar-year. The firm works for 360 days of the year.

(i) What is the economic batch size for every production run?

(ii) What is the optimal production run length in days?

$$\text{Ans. Economic batch size} = Q = \sqrt{\frac{2 \times D \times C_0}{C_c}}$$

Where D = annual demand = 72000 bars

C_0 = Set up cost = 7.5 Rs.

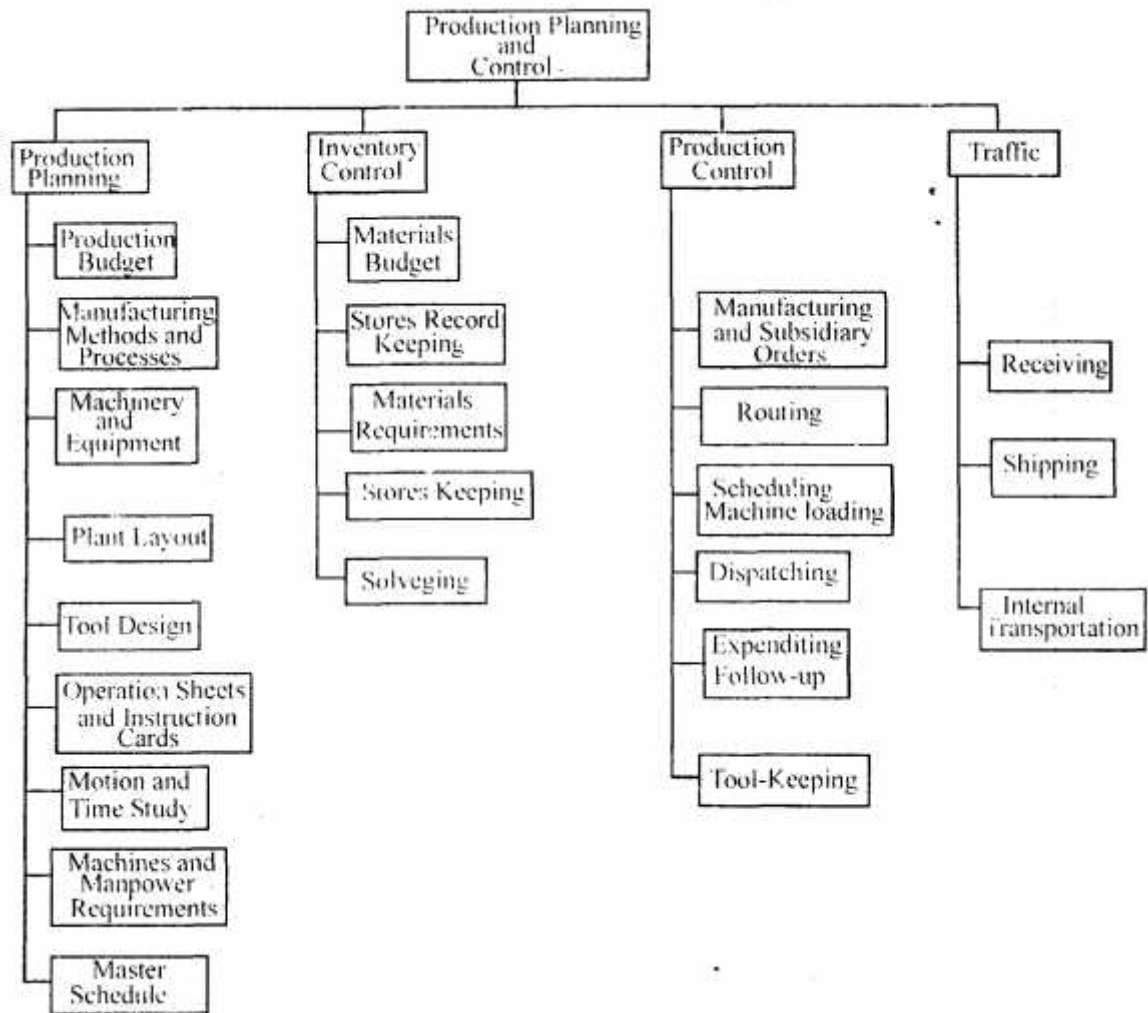
C_c = Inventory carrying cost = Rs. 1.5

$$\Rightarrow Q = \sqrt{\frac{2 \times 72000 \times 7.5}{1.5}} = 848.5 \text{ bars per production run. Ans.}$$

$$\begin{aligned} \text{Length of each production run} = t_p &= \frac{Q}{P} \\ &= \frac{848.5}{400} \\ &= 2.12 \text{ days Ans.} \end{aligned}$$

Q. 7. (a) Explain the process of production planning & control for any manufacturing organization with the help of block diagram.

Ans. Products are manufactured by the transformation of raw material (into finished goods). This is how production is achieved. Planning looks ahead, anticipates possible difficulties and decides in advance as to how the production, best be carried out. The control phase makes sure that the programmed production is constantly maintained.



Block Diagram of "Functional Organisation of Production Planning & Control"

Q. 7. (b) The data of yearly demand for 7 years are as follows :

PERIOD:	1	2	3	4	5	6	7
DEMAND:	115	110	105	112	106	108	102

(in thousands)

Forecast the demand for 8th period by 3-period weighted moving average method. Assume weights = 0.5, 0.3 and 0.2.

Ans.

Period	Demand	3-period moving average
1	115	
2	110	
3	105	$\div 3 \text{ --- } 110$

4	112	109	
5	106	107.67	108.89
6	108	108.67	108.44
7	102	107.22	107.22

The weighted moving average forecast for 8th period is,

$$F_8 = 108.89 \times 0.5 + 108.44 \times 0.3 + 107.22 \times 0.2$$

$$= 108.421 \text{ Ans.}$$

Q. 8. Write short notes on any three of the following :

- (i) Acceptance Sampling
- (ii) Work Sampling
- (iii) Aggregate Planning
- (iv) Selective Inventory Control
- (v) Incentive Payment Systems
- (vi) Manufacturing Cost Analysis & Control.

Ans. (i) Acceptance Sampling : Attribute (Yes or No) inspection is used to differentiate between a defective and a non-defective part and the part is rejected or accepted without using quantitative measures. The parts can be inspected at an isolated calm place away from the production floor. Firstly, attribute inspection is used where components are obviously defective and non-defective. Secondly, where it is very difficult and costly to measure the quality characteristics of a product, e.g., measuring the quality of point on a refrigerator. Thirdly, attribute inspection finds applications where the manufacture does not see any need to measure the exact job dimensions and he feels that go and no go type of inspection can serve his purpose—as in shafts, spindles or rings. The greatest amount of sampling inspection is done using attributes.

(ii) Work Sampling : It is a method of finding the percentage occurrence of certain activity by statistical sampling and random observations. In this approach, a large number of instantaneous observations are made over a randomly selected period of time for a group of workers, machines or process. Each observation records what is happening at that instant. The percentage of observation recorded for a particular activity or delay is a measure of the percentage of time during which that activity or delay occurs.

Work Sampling is useful for :

- (i) Intermitent work
- (ii) Work with long cycle times
- (iii) A starting point like preliminary investigation.

(iii) Aggregate Planning : Since available resources for production, such as raw materials, machines, labour forces, funds etc. are limited, it is desirable to allocate effectively and utilise those productions resources to determine optimal kinds and quantities of products to manufacture. This is aggregate planning in specified time period.

If the time range is short, usually less than a year, this is short term production planning, the time factor is not considered in this case. If time range is large, such as several years, we need inclusion of time factor in the analysis. This is long term production planning.

(iv) Selective Inventory Control : In common industry, large varieties of inventories are present. Each variety may have different cost and volume. Some inventories are critical items while other may be non-critical ones. A Prudent strategy in inventory control would be to pay more attention on vital or costly items. This requires a classification scheme for the inventory on the basis of their value. The purpose of selective control

of high value items is :

- (i) Evaluate the trade off between cost of inventory and control.
- (ii) Take more precise decision regarding order frequency.
- (iii) Reduce effort in getting precise demand forecast for trivial items.
- (iv) Take decision regarding periodic time interval between successive reviews of inventory status and demand.

(v) Incentive Payment System : There are two approaches in wage incentive system :

(a) Time Based Approach :

Hasley Plan : In this plan incentive given to worker, who is fast and completes work before standard time to complete a job. However minimum base-wage is guaranteed to worker, who complete the job upto standard time, fixed for this job.

Rowan Plan : It is similar to Hasley plan except incentive for completing job in time lesser than standard time paid to worker.

Emerson Efficiency Plan : In this, a minimum time wage is guaranteed. Working condition and standard output are fixed on the basis of time-study.

(b) Productivity Based Approach :

Taylor's Plan : In this scheme upto a certain production level, which may be standard output, a piece rate say R₁ is given. For anybody, who achieves more than this output will get payment for over achievement at higher rate.

Merrick Plan : It is modification over Taylor's plan. In this minimum base wage is not guaranteed. Efficient workers are rewarded handsomely.

Gantt Task and Bonus Wage Plan : In this, minimum wage is guaranteed. Minimum wage is given to anybody who completes the job in standard time. If the job is completed in less time, then there is hike in wage rate.

(vi) Manufacturing Cost Analysis & Control : Manufacturing costs are generally classified as :

(I) Morphological Classification :

- (a) Material Cost :** It occurs by consuming materials.
- (b) Labour Cost :** It occurs by utilising human labour force.
- (c) Overhead Cost :** It occurs by consuming cost elements other than above two.

(II) Economical Classification :

- (a) Direct Cost :** It is incurred directly for producing a piece of product.
- (b) Indirect Cost :** It is not directly associated with a particular product.

Cost control is a function to establish above variances quantitatively, investigate the causes and take action in reducing the variances, thereby resulting in reduction of manufacturing cost.