Bapatla Engineering College::Bapatla

Operations Management

14ME705/A

Scheme & Key

1. Answer all questions. 1X12=12M

(a) What are the objectives of forecasting?

The objective of forecasting is to improve organizational performance–*more revenue, more profit, increased customer satisfaction.*

(b) what are the characteristics of Job production?

- High variety of products and low volume.
- Use of general purpose machines and facilities.
- Highly skilled operators who can take up each job as a challenge because of uniqueness.
- Large inventory of materials, tools, parts.
- Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

(c) Compare between rural and urban sites for locating a plant?

Rural Sites	**Urban Sites**
land is available at cheaper rates	Land availability is costly.
Labour is stable.	Labour is not stable.
Taxes are non-existant	Heavy taxes.

(d) Write about ABC analysis?

ABC analysis divides on-hand inventory into three classifications on the basis of annual dollar volume.

- Class A items are those on which the annual monetary volume is high. Although such items may represent only about 15 per cent of the total inventory items, they represent 70 per cent to 80 per cent of the total monetary usage.
- Class B items are those inventory items of medium annual monetary volume. These items may represent about 30 per cent of inventory items and 15 per cent to 25 per cent of the total value.
- Those with low annual monetary volume are Class C items, which may represent only 5 per cent of the annual monetary volume but about 55 per cent of the total inventory items.

(e) What are the functions of inventory management?

- To decouple the firm from fluctuations in demand and provide a stock of goods.
- To take advantage of quantity discounts, because purchases in larger quantities.
- To ensure timely availability.
- Reduce the cost of goods or their delivery.
- To hedge against inflation and upward price changes.

(f) Explain about Bill of Materials.

Bill of Material (BOM) is a listing of the components, their description, and the quantity of each required to make one unit of a product.

(g) Write a short note on Aggregate planning.

1. Aggregate planning, also known as aggregate scheduling, is concerned with determining the quantity and timing of production for the intermediate future, often from 3–18 months ahead.
2. Operations managers try to determine the best way to meet forecasted demand by adjusting *production rates, labour levels, inventory levels, overtime work, subcontracting rates*, and other controllable variables.

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(h) Explain about loading.
Loading means the assignment of Jobs to work or processing centers. There are two types of loading.

infinite Loading With infinite loading jobs are assigned to work centers without regard for capacity of the work center.

Finite Loading Finite loading considers the capacity of each work center and compares the processing time so that process time does not exceed capacity.

(i) Write the objectives of scheduling.
The objective of scheduling is to allocate and prioritise demand, generated by either forecasts or customer orders, to available facilities.

(j) What is Supply Chain Management?
The supply chain management is the coordination of activities within the supply chain (from customer to end user) to maximize the supply chain's competitive advantage and profit. Which is beneficial to the end user.

(k) Write about Ordering Cost.
ordering costs include expenses for a purchase order, labor costs for the inspection of goods received, labor costs for placing the goods received in stock, labor costs for issuing a supplier's invoice and labor costs for issuing a supplier payment. These costs are irrelevant from the size of the order and are incurred every time a firm places an order.

(l) What is ERP?
ERP integrates various functions(inventory and order management, accounting, human resources, customer relationship management (CRM) etc.) into one complete system to streamline processes and information across the entire organization.

UNIT–I

2. (a) Explain different quantitative methods of Forecasting.
Quantitative Methods of Forecasting:
Quantitative forecasts use a variety of mathematical models that rely on historical data and/or causal variables to forecast demand. There are different qualitative forecasting techniques, which can be categorised into two sections: 2M

- Time Series Models
- Associative models

Time Series Models make predictions on the assumption that the future is a function of the past. A time-series is based on a sequence of evenly spaced –weekly, monthly, quarterly, and so on–data points. Analysing time series means breaking down past data into components and then projecting them forward. A time series has four components:

- Trend
- Seasonality
- Cycles
- Random Variations

Time-series models include: 4M

- Simple average
- Simple Moving Average
- Weighted Moving Average
- The Box-Jenkins Method
- Exponential Smoothing Method
- Exponential Smoothing with trend adjustment
- Trend Projection

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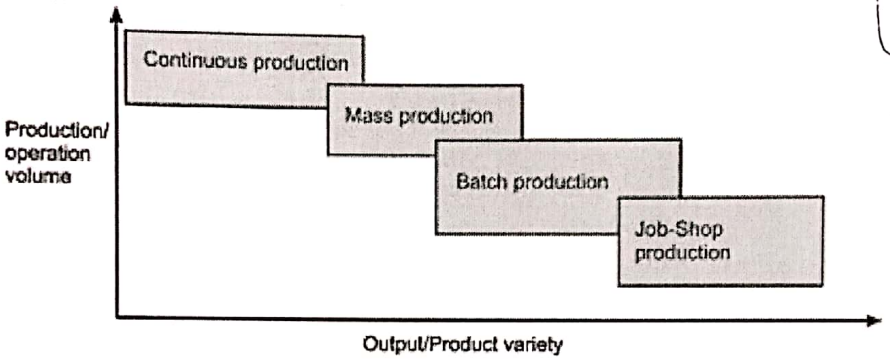
Associative models incorporate the variables or factors that might influence the quantity being forecast. Once these related variables have been found, a statistical model is built and used to forecast the item of interest. Associative models include:

- Linear Regression
- Multiple Regression

(b) Distinguish between different types of production system with examples.
Production systems can be classified as:

- Job–shop
- Batch Production
- Mass Production
- Continuous Production



2 M
1

Figure 1: Classifications of production systems

Job–Shop Production
Job-shop production are characterized by manufacturing one or few quantity of products designed and produced as per the specification of customers within prefixed time and cost. The distinguishing feature of this is low volume and high variety of products. A job-shop comprises of general-purpose machines arranged into different departments. Each job demands unique technological requirements, demands processing on machines in a certain sequence.
Job–Shop production system is characterized by:

- High variety of products and low volume.
- Use of general purpose machines and facilities.
- Highly skilled operators who can take up each job as a challenge because of uniqueness.
- Large inventory of materials, tools, parts.
- Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

1M

Batch Production
Batch Production as a form of manufacturing in which the job pass through the functional departments in lots or batches and each lot may have a different routing. It is characterized by the manufacture of limited number of products produced at regular intervals and stocked awaiting sales.
Batch Production is characterized by:

- Shorter production runs.
- Plant and machinery are flexible.
- Plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch.
- Manufacturing lead-time and cost are lower as compared to job order production.

1M

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Mass Production

Manufacture of discrete parts or assemblies using a continuous process are called Mass Production. This production system is justified by very large volume of production. The machines are arranged in a line or product layout. Product and process standardization exists and all outputs follow the same path. Mass Production is characterized by:

- Standardization of product and process sequence.
- Dedicated special purpose machines having higher production capacities and output rates.
- Large volume of products.
- Shorter cycle time of production.
- Lower in process inventory.
- Perfectly balanced production lines.
- Flow of materials, components and parts is continuous and without any back tracking.
- Production planning and control is easy.
- Material handling can be completely automatic.

1M.

Continuous Production

Production facilities are arranged as per the sequence of production operations from the first operations to the finished product. The items are made to flow through the sequence of operations through material handling devices such as conveyors, transfer devices, etc. Continuous Production is characterized by:

- Dedicated plant and equipment with zero flexibility.
- Material handling is fully automated.
- Process follows a predetermined sequence of operations.
- Component materials cannot be readily identified with final product.
- Planning and scheduling is a routine action.

1M.

(OR)

3. (a) What are the different factors to be considered in locating a plant? Explain each factor.

Labour Productivity

- Cheaper labour can't alone decide plant location.
- Differences exist in productivity in various countries. The management is interested in the combination of productivity and the wage rate.
- Employees with poor training, poor education, or poor work habits may not be a good buy even at low wages.
- Employees who cannot or will not always reach their places of work are not much good to the organization, even at low wages.

Exchange Rates and Currency Risk

Although wage rates and productivity may make a country seem economical, unfavourable exchange rates may negate any savings.

Costs

Costs can be divided into two categories, tangible and intangible.

Any 6.
6X1 = 6.M.

Tangible Costs These costs are readily identifiable and precisely measured. They include utilities, labour, material, taxes, depreciation, and other costs that the accounting department and management can identify. In addition, such costs as transportation of raw materials, transportation of finished goods, and site construction are all factored into the overall cost of a location.

Intangible Costs These costs are less easily quantified. They include quality of education, public transportation facilities, community attitudes toward the industry and the company, and quality and attitude of prospective employees. They also include quality-of-life variables, such as climate and sports teams, that may influence personnel recruiting.

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Political Risk, Values and Culture
The political risk associated with national, state, and local governments' attitudes toward private and intellectual property, zoning, pollution, and employment stability may be in flux. Governmental positions at the time a location decision is made may not be lasting ones.

Proximity to markets
For many firms, it is extremely important to locate near customers. Particularly, service organisations, like drugstores, restaurants, post offices, or barbers, find that proximity to market is the primary location factor. Manufacturing firms find it useful to be close to customers when transporting finished goods since it is expensive or difficult (perhaps because they are bulky, heavy, or fragile).

Proximity to Suppliers
Firms locate near their raw materials and suppliers because of

- Perishability of goods
- Transportation costs
- Bulk of goods

Proximity to Competitors (Clustering)
Companies also like to locate near their competitors. This tendency, called clustering, often occurs when a major resource is found in that region. Such resources include natural resources, information resources, venture capital resources, and talent resources.

(b) What are different types plant layout? Explain.
The normally used plant layouts are:

1. Product or Line Layout
2. Process or Functional Layout.
3. Fixed Position Layout.
4. Combination type of Layout.

$4 \times 1\frac{1}{2} = 6$ M.

Product or Line Layout If all the processing equipment and machines are arranged according to the sequence of operations of the product, the layout is called product type of layout. In this type of layout, only one product of one type of products is produced in an operating area. This product must be standardized and produced in large quantities in order to justify the product layout. The raw material is supplied at one end of the line and goes from one operation to the next quite rapidly with a minimum work in process, storage and material handling. **Process or Functional Layout**

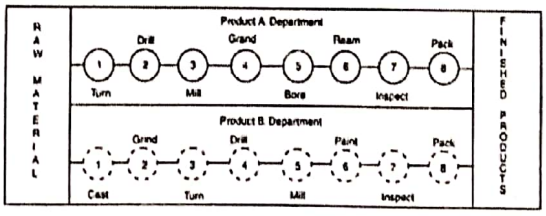

Fig. 8.3.

Figure 2: Product Layout

The process layout is particularly useful where low volume of production is needed. If the products are not standardized, the process layout is more low desirable, because it has creator process flexibility than other. In this type of layout, the machines and not arranged according to the sequence of operations but are arranged according to the nature or type of the operations. This layout is commonly suitable for non repetitive jobs.Same type of operation facilities are grouped together such as lathes will be placed at one place, all the drill machines are at another place and so on. See Fig. 8.4 for process layout. Therefore, the process carried out in that area is according to the machine available in that area.

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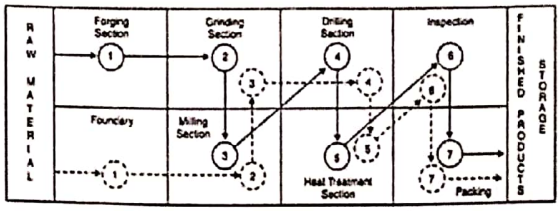

Fig. 8.4.

Figure 3: Process Layout

Fixed Position Layout

In this type of layout the major component remain in a fixed location, other materials, parts, tools, machinery, man power and other supporting equipment's are brought to this location. The major component or body of the product remain in a fixed position because it is too heavy or too big and as such it is economical and convenient to bring the necessary tools and equipment's to work place along with the man power. This type of layout is used in the manufacture of boilers, hydraulic and steam turbines and ships etc.

Combination Type of Layout

Now a days in pure state any one form of layouts discussed above is rarely found. Therefore, generally the layouts used in industries are the compromise of the above mentioned layouts. Every layout has got certain advantages and limitations. Therefore, industries would to like use any type of layout as such. Flexibility is a very important factory, so layout should be such which can be molded according to the requirements of industry, without much investment. If the good features of all types of layouts are connected, a compromise solution can be obtained which will be more economical and flexible.

UNIT–II

4. (a) Define inventory? Write the different functions of Materials Management.

Inventory, often called merchandise, refers to goods and materials that a business holds for sale to customers in the near future.

Functions of Materials Management

$4 \times 1\frac{1}{2} = 6M$.

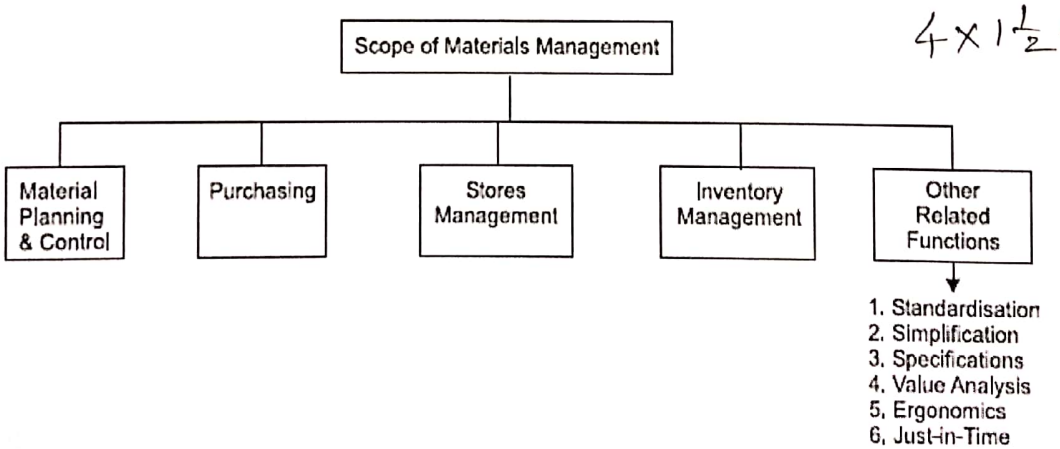

Figure 4: Functions of Materials Management

Materials planning and control Based on the sales forecast and production plans, the materials planning and control is done. This involves estimating the individual requirements of parts,

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preparing materials budget, forecasting the levels of inventories, scheduling the orders and monitoring the performance in relation to production and sales.

Purchasing This includes selection of sources of supply finalization in terms of purchase, placement of purchase orders, follow-up, maintenance of smooth relations with suppliers, approval of payments to suppliers, evaluating and rating suppliers.

Stores management or management This involves physical control of materials, preservation of stores, minimization of obsolescence and damage through timely disposal and efficient handling, maintenance of stores records, proper location and stocking. A store is also responsible for the physical verification of stocks and reconciling them with book figures. A store plays a vital role in the operations of a company.

Inventory control or management Inventory generally refers to the materials in stock. It is also called the idle resource of an enterprise. Inventories represent those items, which are either stocked for sale or they are in the process of manufacturing or they are in the form of materials, which are yet to be utilized. The interval between receiving the purchased parts and transforming them into final products varies from industries to industries depending upon the cycle time of manufacture. It is, therefore, necessary to hold inventories of various kinds to act as a buffer between supply and demand for efficient operation of the system. Thus, an effective control on inventory is a must for smooth and efficient running of the production cycle with least interruptions.

(b) Write in detail about Material Requirement Planning(MRP).

Material Requirement Planning(MRP) is a dependant demand technique that uses a bill-of-material, inventory, expected receipts, and a master production schedule to determine material requirements.

MRP Requirements

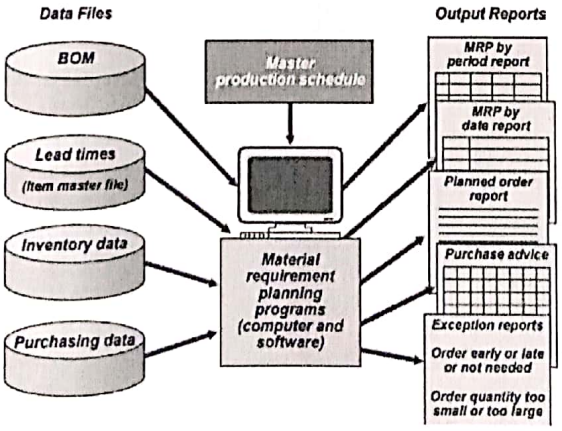
- Master Production Schedule
- Specifications or bill of materials
- Inventory availability
- Purchase orders outstanding
- Lead times

4 M.

Bill of Material (BOM) is a listing of the components, their description, and the quantity of each required to make one unit of a product.

Maser Production Schedule(MPS) A timetable that specifies what is to be made (usually finished goods) and when

Low Level Coding It is a number that identifies items at the lowest level at which they occur.



2 M.

Figure 5: MRP Structure

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(OR)

5. (a) A company has determined from its analysis of production in the fallowing way. Annual demand is 10,000 units, the ordering cost is Rs. 36 per order, and the holding cost is Rs. 2/unit/year. Determine EOQ.

$$\text{Annual Demand } D = 10,000 \text{ units.}$$
$$\text{Ordering Cost } C_o = Rs.36 \text{ /Order.}$$
$$\text{Holding Cost } C_c = Rs.2/\text{unit/year}$$
$$EOQ = \sqrt{\frac{2 \times D \times C_o}{C_c}} \qquad (6M)$$
$$EOQ = \sqrt{\frac{2 \times 10000 \times 36}{2}}$$
$$= 600 \text{ Units}$$

(b) Design an equation for basic EOQ model.
let D be Annual Demand,C_o be ordering cost, C_c be Carrying or Holding cost and Q be ordering quantity.

$$\text{Ordering Cost} = \frac{D}{Q} \times C_o$$
$$\text{Holding Cost} = \frac{Q}{2} \times C_c$$
$$\text{Total Cost (TC)} = \text{Ordering Cost} + \text{Holding Cost} \qquad (3M)$$
$$\frac{d(TC)}{dQ} = 0$$
$$\text{EOQ}(Q^*) = \sqrt{\frac{2 \times D \times C_o}{C_c}} \qquad (3M)$$

UNIT–III

6. The demand forecast for the periods 1, 2, 3 and 4 are as 100, 50, 70 and 80 units respectively. The firm is having the capacity of producing 60 units per month on regular time basis, the over time is restricted to 25% of the regular time(i.e. 15 units). The capacity of subcontracting is taken as 100 units each month. The initial inventory available is 20 units. The firm wants a final inventory of 25 units. Labour cost on regular basis is Rs. 50/- per unit. Overtime labour cost Rs. 75 per unit. Cost of subcontract is Rs.80/- per unit per period. Back ordering is not permitted. Determine the aggregate plan which mimimizes the total cost.

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Period	Source of Supply/Production	Period in which product is forecast to be sold 1	2	3	4	Unused Capacity	Total Available Capacity
	Beginning inventory	0 **20**	5 X	10 X	15 X	0 **0**	20
1	Regular time	50 **60**	55 X	60 X	65 X	0 **0**	60
1	Overtime	75 **15**	80 X	85 X	90 X	0 **0**	15
1	Subcontract	80 **5**	80	80	80	0 **95**	100
2	Regular time		50 **50**	55 **10**	60 X	0 **0**	60
2	Overtime		75	80	85	0 **15**	15
2	Subcontract		80	80	80	0 **100**	100
3	Regular time			50 **60**	55 X	0 **0**	60
3	Overtime			75	80	0 **15**	15
3	Subcontract			80	80	0 **100**	100
4	Regular time				50 **60**	0 **0**	60
4	Overtime				75 **15**	0 **0**	15
4	Subcontract				80 **30**	0 **70**	100
	Demand	100	50	70	80+25	0	

Total Cost of Production: Rs. 17,100

Cost representation - 6M

Solution - 6M.

Figure 6: Aggregate Planning Problem

(OR)

7. (a) Write differences between loading and scheduling.

Loading

A load means the quantity of work, and allocating the quantity of work to the processes necessary to manufacture each item is called loading. It is performed in the CRP (Capacity Requirements Planning) of the manufacturing planning. Each item planned in MRP is first explored to the processes necessary to manufacture it, which is usually called process explosion. Next loading is performed for the explored process. In loading, each load is usually piled up by time (hour), by which a setup time and a real operating time are determined. The real operating time may be set by manufacturing lot or by real operating time per item unit. In the former case, the time of hour is piled up as load, while in the latter case, loading is performed after calculating the real operating time per manufacturing unit by multiplying the number of manufacturing items by real operating time. In addition, the calculated load is piled up for a certain period, which is determined by selecting either the earliest start date or the last start date as a base date. This method enables loading for each process or each period. (3M)

Scheduling

Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials. (3M)

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Forward scheduling is planning the tasks from the date resources become available to determine the shipping date or the due date.

Backward scheduling is planning the tasks from the due date or required-by date to determine the start date and/or any changes in capacity required.

The benefits of production scheduling include:

- Process change-over reduction
- Inventory reduction, leveling
- Reduced scheduling effort
- Increased production efficiency
- Labor load leveling
- Accurate delivery date quotes
- Real time information

(b) Explain the scheduling techniques in detail.
The different techniques of scheduling are:

Johnson's algorithm for job sequencing Johnson's rule can be used to minimise the processing time for sequencing a group of jobs through two work centres. It also minimises total idle time on the machines.

Gantt charts Gantt charts are visual aids that are useful in loading and scheduling. The charts show the use of resources, such as work centres and labour. The Gantt load chart has a major limitation. It does not account for production variability such as unexpected breakdowns or human errors that require reworking a job.

PERT / CPM PERT and CPM are the two network-based project management techniques, which exhibit the flow and sequence of the activities and events. Program (Project) Management and Review Technique (PERT) is appropriate for the projects where the time needed to complete different activities are not known.

Project crashing Crashing is a schedule compression technique used to reduce or shorten the project schedule.

Queueing analysis Queuing theory examines every component of waiting in line to be served, including the arrival process, service process, number of servers, number of system places, and the number of customers.

Critical ratio A sequencing rule that is an index number computed by dividing the time remaining until due date by the work time remaining.

Line balancing Line-balancing strategy is to make production lines flexible enough to absorb external and internal irregularities.

UNIT–IV

8. (a) Write short notes on deterministic models.

$4 \times \frac{1}{2} = 6M.$

The Economic Order Quantity Models The concept of EOQ applies to items which are replished peridiocally into inventory in lots covering several periods needs. The EOQ concept is applicable under the following conditions.

- The item is replinished in lots or batches, either by purchasing or by manufacturing.
- Consumption of items (or Sales or usage rate) is uniform and continuous.

Economic Order Quantity Model–II In this model, stock–outs are permitted which implies that shortage cost is finite or it is not large

Economic Production Quantity Model EPQ model realistically shows that inventory is gradually built over a period of time because production and the consumption go side by side where production rate is higher than the consumption rate.

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Price Discount Model When items are purchased in bulk some discount in price is usually offered by the supplier. When discount is applicable for all the units purchased, it is know as all units discount. If discounts are offered only for items which are in excess of the specified amount, it is known as incremental discount.

(b) An organization stocks workbooks with the fallowing characteristics.
Demand = 19,500 units/year;
Ordering Cost S = Rs. 25/order;
Holding cost H = Rs. 4/unit/year

3 × 2 = 6 M.

1. Calculate EOQ.
2. What are the annual holding costs?
3. What are the annual ordering costs?

Demand = 19,500 units/year
Ordering Cost S = Rs. 25/order
Holding cost H = Rs. 4/unit/year

1.

$$EOQ = \sqrt{\frac{2 \times D \times C_o}{C_c}}$$
$$= \sqrt{\frac{2 \times 19500 \times 25}{4}}$$
$$= 494 \text{ units}$$

2.

$$\text{Annual Holding Cost} = \frac{Q}{2} \times C_c$$
$$= \frac{494}{2} \times 4$$
$$= Rs.988$$

3.

$$\text{Annual Ordering Cost} = \frac{D}{Q} \times C_o$$
$$= \frac{19500}{494} \times 25$$
$$= Rs.987$$

(OR)

9. (a) Write short notes on MRP–II.
It includes all the activities required for the manufacturing purpose. It is the method for effective planning of all the resources of the manufacturing company. Ideally, it represents operational planning in units, financial planning, and simulation capability. It is also extension of closed loop MRP.

4 M

MRP-II system is implemented in order to regulate and carry out the effective functioning of the plants and organizations as a whole. It is concerned with the integration of the aspects of manufacturing processes, including materials, finance and human relations. It gives a centralized information of all the databases and activities carried out in the organization.

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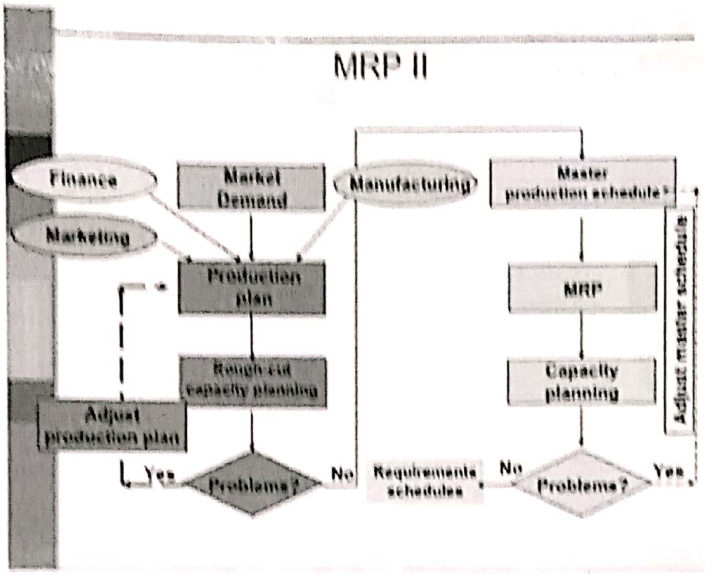
The MRP II system begins with MRP I i.e. MRP I is concerned primarily with the manufacturing materials while MRP II is concerned with the coordination of the entire manufacturing, production, including the materials, finance and human relations. The goal of MRP II is to provide consistent data to all members related to the manufacturing process as the product moves forward in the production line. It facilitates the development of a detailed production schedule known as master production schedule (MPS) that forms a backbone of the manufacturing system. It gives the specific and accurate requirements of facilities on the shop floor, the type of materials required, quantity required on the production line, the number of labor involved for that particular product, the sequence with which it will move on the line and time required for manufacturing.



(2 M)

Figure 7: MRP II

(b) Write short notes on JIT.

Just-In-Time is a Japanese manufacturing management method developed in 1970s. It was first adopted by Toyota manufacturing plants by Taiichi Ohno. The principle of Just in time (JIT) is to *eliminate sources of manufacturing waste by getting right quantity of raw materials and producing the right quantity of products in the right place at the right time.*

The goals of JIT

The ultimate goal of JIT is a balanced, smooth and rapid flow of materials through the system. This can be achieved by approaching the following supporting goals first.

- Zero defects.
- Zero inventories.
- Zero set – up time.
- Zero handling.
- Zero break – down.

(4 M)

Planning for JIT

It is impossible to establish a new JIT system that can be used successfully without modification. Since each manufacturing process is different (e.g. in terms of Goals, Product requirements, Customer requirements etc.), it is up to the individual company to determine the degree of appropriateness and the final application of JIT. However, it is very important to define the plan and objectives before setting up a JIT manufacturing system.

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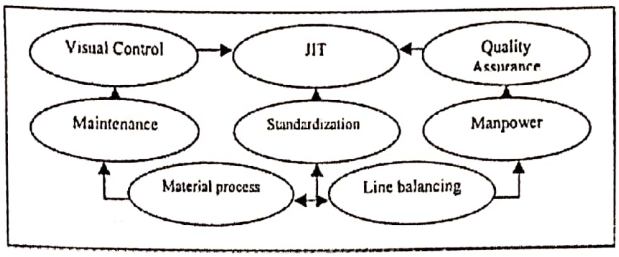

(2M)

Figure 8: Just In Time Production System (JIT)

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