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TEST PAPER – 01

(Chapters Covered – Operations Management – Introduction and Operations Planning)

OPERATIONS MANAGEMENT AND STRATEGIC MANAGEMENT

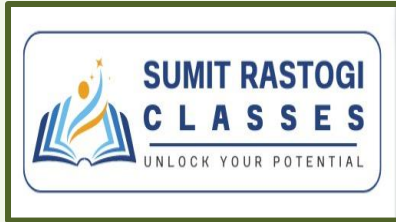
Time Allowed: 3 Hours

Full Marks: 100

**Section A contains Question Number 1. All parts of this question are compulsory.
Working notes should form part of the relevant answer.**

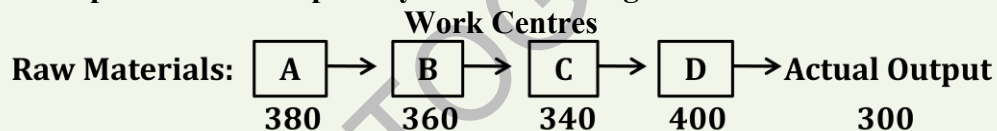
SECTION-A

- 1. Choose the correct answer from the given alternatives (you may write only the Roman number and the alphabet chosen for your answer) (2×15 = 30 Marks)**
- (i) 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
- (ii) Application of technology or process to the raw material to add use value is known as:
- (a) Product
 - (b) Production
 - (c) Application of Technology
 - (d) Combination of Technology and Process
- (iii) With reference to the operations of RN Ltd., a manufacturing company, one of the important decisions is “How to reach the products to the Customers”? Which one of the following is related to this?
- (a) Delivery Planning
 - (b) Process Section & Layout
 - (c) MRP
 - (d) Aggregate Planning



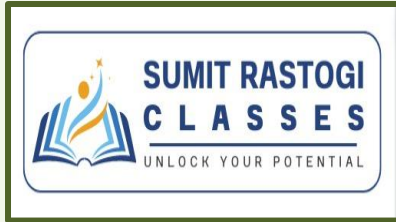
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- (iv) Which one of the following is associated with the configuration of departments, work centres and equipment and machinery, with focus on the flow of materials or work through the production system?
- (a) Facility Location
 - (b) Facility Layout
 - (c) Capacity Planning
 - (d) Process Design
- (v) The Annual Carrying Cost of Material ZB is ₹3.60 per unit and its Total Carrying Cost is ₹9,000 per annum. If there is no Safety Stock of Material ZB, what will be the Economic Order Quantity (EOQ) for Material ZB?
- (a) 5000 units
 - (b) 6000 units
 - (c) 6500 units
 - (d) 4000 units
- (vi) ZOOS Ltd., a manufacturing firm, has four Work Centres A, B, C & D in series with individual capacities in units per day shown in the figure below:



What is the System Efficiency?

- (a) 75.25%
 - (b) 80.33%
 - (c) 99%
 - (d) 88.23%
- (vii) Which one of the following is associated with the question “Where should each centre be located”?
- (a) Process Layout
 - (b) Facility Layout
 - (c) Product Layout
 - (d) Plant Layout
- (viii) The over capacity is preferred when:
- (a) The cost of creating the capacity is prohibitively high
 - (b) Fixed cost of the capacity is not very high
 - (c) Shortage of products does not affect the company
 - (d) The technology changes fast



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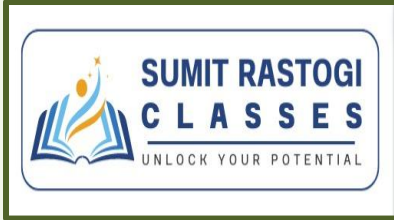
- (ix) A steel plant has a design capacity of 50000 tons of steel per day, effective capacity of 40000 tons of steel per day and actual output of 36000 tons of steel per day. Compute the efficiency of the plant.
- (a) 90%
 - (b) 72%
 - (c) 80%
 - (d) 110%

- (x) The following item is being managed using a fixed time period model with safety stock:

Weekly demand (D)	50 units
Review Cycle (T)	3 weeks
Safety Stock (SS)	30 units

What is the average inventory turn(s) for the item? (1 year = 52 weeks)

- (a) 84.20 turns per year
 - (b) 24.76 turns per year
 - (c) 80.50 turns per year
 - (d) None of the above
- (xi) Let's consider an example of a product manufacturing company, who is aware that it needs to produce the products. One of 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
- (xii) _____ of plant is the maximum rate of output (goods or services) the plant can produce.
- (a) Production
 - (b) Potential
 - (c) Demand
 - (d) Capacity
- (xiii) Which one of the following is associated with the question "How much space and capacity does each economic activity centre need?"
- (a) Facility Location
 - (b) Facility Layout
 - (c) Capacity Planning
 - (d) MRP



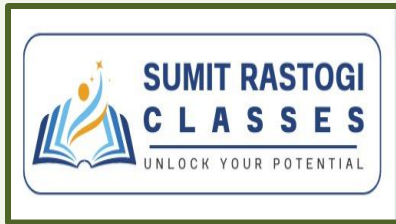
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- (xiv) RON Ltd., a manufacturing of ball bearings provides the following items that is being managed using a fixed order Quantity Model with Safety Stock:

Annual demand (D)	24000 units
Order Quantity (QO)	3600 weeks
Safety Stock (SS)	400 units

What is the average Inventory Level?

- (a) 2500 units
 - (b) 2400 units
 - (c) 2200 units
 - (d) None of these
- (xv) Arrangements of machines depending on sequence of operations happens in
- (a) Process Layout
 - (b) Product Layout
 - (c) Hybrid Layout
 - (d) Group Technology Layout



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SECTION-B

2. (a) Operations Management is responsible for producing goods and/or services. In this context, define 'Operating System' and state the principal functions of an operating system. (7 Marks)
2. (b) List recent trends in Production/Operations Management as a result of global competition and the Impact on manufacturing firms. Explain in one or two sentences the implication of any four of such trends as listed. (7 Marks)
3. (a) Enumerate the characteristics of a modern operations function. (7 marks)
3. (b) List down various activities lying under Production and Operations Management function. (7 marks)

4. (a) The annual sales of truck tyres manufactured by a company are as follows:

Year	2008	2009	2010	2011	2012
Sales ('000 units) (Y)	25	34	45	38	53

(7 marks)

4. (b) The following table gives the age of cars of SKODA Make and its Annual Maintenance Cost.

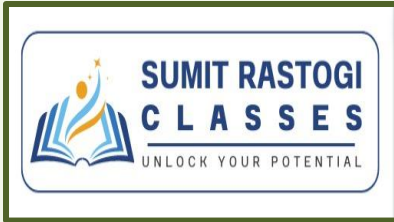
Age of Cars in Years (X)	2	4	6	8
Maintenance Cost (in thousand of ₹) (Y)	10	20	25	30

Required:

- (a) Fit a Linear Regression of Y on X.
- (b) Estimate:
- (i) Maintenance Cost for Age of Cars 10 years.
- (ii) Age of car in years of Maintenance Cost of ₹50,000. (7 marks)
5. (a) A manufacturing company has a product line consisting of five work stations in series. The individual workstation capacities are given. The actual output of the line is 440 units per shift.

Workstation No.	1	2	3	4	5
Capacity/Shift	550	650	700	650	600

Calculate (i) System capacity (ii) Efficiency of the production line. (7 marks)



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5. (b) A manager has to decide about the number of machines to be purchased. He has three options i.e., purchasing one or two or three machines. The data are given below:

Number of machine	Annual Fixed Cost	Corresponding range of output
One	₹14,000	0-350
Two	₹17,000	351-550
Three	₹23,000	551-900

Variable cost is ₹30 per unit and revenue is ₹70 per unit. (i) Determine the break-even point for each range. (ii) If projected demand is between 540 and 570 units, how many machines should the manager purchase? **(7 marks)**

6. (a) M/s. HMT Bearings Ltd. is committed to supply 24,000 bearings per annum to M/s. Lokesh Machines on a steady daily basis. It is estimated that it costs ₹1.00 as inventory holding cost per bearing per month and that the setup cost per run of bearing manufacture is ₹3240.

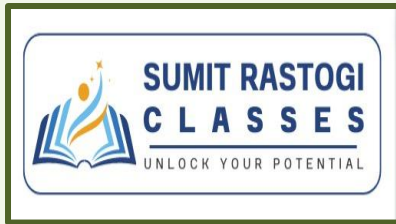
- (i) What is the optimum run size for bearing, manufacture?
(ii) What should be the interval between the consecutive optimum runs?
(iii) What is the minimum inventory holding cost? **(7 Marks)**

6. (b) FRESHWEAR Clothing Co. shifted its marketing strategy to focus heavily on digital outreach. The management wants to examine how their monthly sales are influenced by the number of social media ad impressions (in Crore). They collected the following data over the last six months:

Month	Ad. Impressions (in Crore) (₹)	Sales (₹ in Crores) (Y)
January	1	18
February	2	23
March	4	32
April	3	28
May	10	38
June	4	29

Required:

- (i) Fit a linear regression of Sales (Y) on Ad. Impressions (X)
(ii) If FRESHWEAR plans to run a campaign that reaches 5 Crore (Nos.) impressions, forecast their expected monthly sales using simple linear regression. **(7 marks)**
7. (a) What are the principles for a plant layout? **(7 marks)**



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7. (b) A defence contractor is evaluating its machine shops current process layout. The figure below shows the current layout and the table shows the trip matrix for the facility. Health and safety regulations require departments E and F to remain at their current positions.

E B F
A C D

Current Layout

From/To	A	B	C	D	E	F
A		8	3	9	5	
B		-	3			
C			-	8	9	
D				-	3	
E						3
F						

Can Layout be improved? Also evaluate using Load Distance (LD) score. **(7 marks)**

8. (a) RONP Ltd. manufactures two colour televisions "Model 2M3" and "Model 3SP4" in a variety of sizes, colours and component combinations. Identical colour TVs are produced in lots of 100. The projected demand, lot size and time standard are shown in the following table:

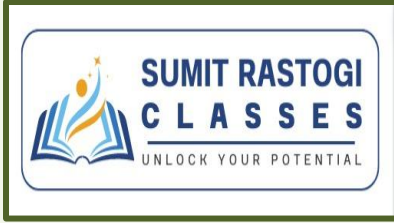
Particular	Model 2M3	Model 3SP4
Demand Forecast (D)	6000 Units/Year	12000 Units/Year
Lot Size (Q)	100 Units	100 Units
Standard Processing time (P)	20 Hours/Unit	40 Hours/Unit
Standard Setup time (s)	2 Hours/Lot	3 Hours/Lot

The factory currently works 3 shifts, 8 hours a day, 5 days a week, 50 weeks a year. It operates 100 workstations, each producing one colour TV in the time shown in the above Table. The factory maintains a 19% Capacity cushion (C).

(Ignore use of overtime works).

Required:

- (i) Analyze and Assess how many workstations will be required next year to meet the expected demand without decreasing the Company's Current capacity cushion.
- (ii) Assess the number of additional workstations to be required to meet expected demand. [Present calculation (NOs) upto nearest integer] **(7 marks)**



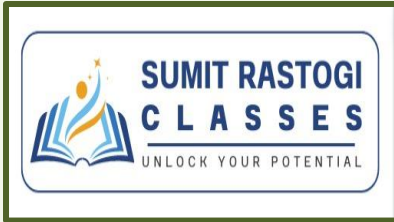
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8. (b) METRO-WALLS Ice Cream Parlour observed that during summer months the daily sales of its ice cream depends on the average day temperature as shown in the following Table:

Average Day Temperature in Centigrade (X)	20	25	30	35	40
Daily Sale of Ice Cream (in Thousand ₹) (Y)	10	20	30	40	50

Required:

- Fit a linear regression of Y on X.
 - Estimate the trend values of daily sales of ice cream for average day temperature of 32 and 42 centigrade.
 - Estimate the Average Day Temperature (in Centigrade) for the daily sale of ice cream of ₹60 thousands.
- (7 marks)**



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ANSWERS OF TEST PAPER – 01

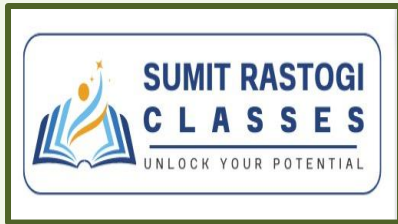
(Chapters Covered – Operations Management – Introduction & Operations Planning)

OPERATIONS MANAGEMENT AND STRATEGIC MANAGEMENT

SECTION-A

ANS.1

- (i) (c) Maintenance Management**
- (ii) (b) Production**
- (iii) (a) Delivery Planning**
- (iv) (b) Facility Layout**
- (v) (a) 5000 units**
- (vi) (d) 88.23%**
- (vii) (b) Facility Layout**
- (viii) (b) Fixed Cost of the capacity is not very high**
- (ix) (a) 90%**
- (x) (b) 24.76 turns per year**
- (xi) (c) Demand Forecasting**
- (xii) (d) Capacity**
- (xiii) (b) Facility Layout**
- (xiv) (c) 2200 units**
- (xv) (b) Product Layout**



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SECTION-B

ANS. 2 (a)

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

The function of an operating system is a reflection of the purpose it serves for its customers.

The following four principal functions is also relate to the basic four operations done in any organization:

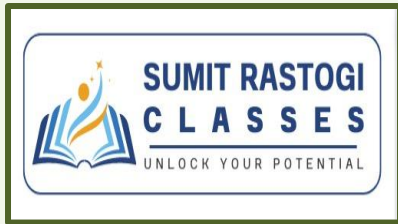
- 1. Manufacture:** Manufacturing function is the one which involves some physical transformation or a change in the form utility of the resources. Something is physically created and the output consists of goods which differ physically (e.g., in terms of form, content etc.) from those materials input 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 and 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 is 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.

ANS. 2 (b)

Recent Trends in Production/Operations Management: Recent trends in production / operations management relate to global competition and the impact it has on manufacturing firms. **Some of the recent trends are:**

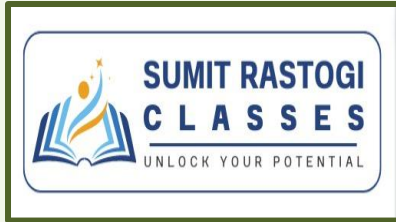
- (i) Global Market Place,
- (ii) Production/Operations Strategy,
- (iii) Total Quality Management (TQM),
- (iv) Flexibility,
- (v) Time Reduction,
- (vi) Technology.
- (vii) Worker Involvement,
- (viii) Re-engineering,
- (ix) Environmental Issues,
- (x) Corporate Downsizing (or Right Sizing),
- (xi) Supply-Chain Management,
- (xii) Lean Production.



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Various aspects of recent trends as follows:

- (i) **Global Market Place:** Globalisation 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.
- (ii) **Production/Operations Strategy:** More and more firms are recognising the importance of production/operations strategy for the overall success of the business and the necessity for relating it to their overall business strategy.
- (iii) **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 and services.
- (iv) **Flexibility:** The ability to adapt quickly to changes in volume of demand, in the product mix demanded, and in product design or in delivery schedules, has become a major competitive strategy and a competitive advantage to the firms. This is sometimes called as agile manufacturing.
- (v) **Time Reduction:** Reduction of manufacturing cycle time and speed to market for a new product provides competitive edge to a firm over other firms. When companies can provide products at the same price and quality, quicker delivery (short lead times) provide one firm competitive edge over the other.
- (vi) **Technology:** Advances in technology have led to a vast array of new products, new processes and new materials and components. Automation computerization, information and communication technologies have revolutionized the way companies operate. Technological changes in products and processes can have great impact on competitiveness and quality, if the advanced technology is carefully integrated into the existing system.
- (vii) **Worker Involvement:** The recent trend is to assign responsibility for decision making and problem solving to the lower levels in the organisation. This is known as employee involvement and empowerment. Examples of worker involvement are quality circles and use of work teams or quality improvement teams.
- (viii) **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.
- (ix) **Environmental Issues:** Today's production managers are concerned more and more with pollution control and waste disposal which are key issues in protection of environment and social responsibility. There is increasing emphasis on reducing waste, recycling waste, using less-toxic chemicals and using biodegradable materials for packaging.
- (x) **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 and for higher dividend payment to shareholders.
- (xi) **Supply-Chain Management:** Management of supply-chain, from suppliers to final customers reduces the cost of transportation, warehousing and distribution throughout the supply chain.



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(xii) **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 and multi-skilled workforce to have advantages of both mass production and job production (or craft production).

ANS. 3 (a)

1. Manufacturing as Competitive Advantage:

Unlike the past, today plants have excess capacities, competition is mounting and firms look and competitive edge and 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) and 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 needs to be geared to serve (a) intangible and perishable nature of the services, (b) constant interaction with clients or customers, (c) small volumes of production to serve local markets, and (d) need to locate facilities to serve local markets.

3. Disappearance of Smokestacks:

Protective labour legislation, environmental movement and gradual emergence of knowledge based organizations have brought total transformation in the production system. Today's factories are aesthetically designed and 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.

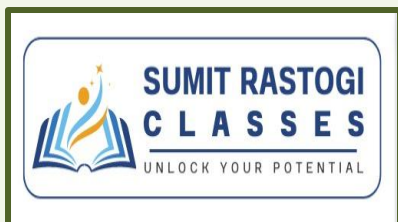
4. Small has Become Beautiful:

E.F. Schumacher, in his famous book Small is Beautiful, opposed giant organizations and increased specialization. He advocated, instead, intermediate technology based on smaller working units, community ownership, and regional workplaces utilizing local labor and 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 and mass production systems.

ANS. 3 (b)

Various activities lying under Production and Operations Management functions:

- (i) Location of facilities.
- (ii) Plant layouts and Material Handling.
- (iii) Product Design.
- (iv) Process Design.
- (v) Production Planning and Control.
- (vi) Quality Control.



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- (vii) Materials Management.
 (viii) Maintenance Management

ANS. 4 (a)

Years T	X	Sales in ('000 units) Y	X ²	XY
2008	- 2	25	4	- 50
2009	- 1	34	1	- 34
2010	0	45	0	0
2011	+ 1	38	1	+ 38
2012	+ 2	53	4	+ 106
n = 5	$\sum X = 0$	$\sum Y = 195$	$\sum X^2 = 10$	$\sum XY = + 60$

Let Linear trend be:

$$Y = a + bX$$

- (1) where X is time deviation, $X = (T - 2010)$
 ORIGIN YEAR – 2010

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

(2)

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

(3)

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

(4)

Put $\sum X = 0$, $\sum Y = 195$, $\sum X^2 = 10$, $\sum XY = 60$ and $n = 5$ in Equation (2), (3) and (4)

Then equation (3) becomes

$$195 = 5a, a = 39$$

From Equation (4)

$$60 = 10b, b = 6$$

Put value of a and b in equation (1)

So, linear trend by, $y = 39 + 6x$

Estimation of Sales for 2013

$$Y_{2013} = 39 + 6(3) = 39 + 18 = 57$$

The estimated sales for 2013 will be 57,000 units.

ANS. 4 (b)

Age of car (X)	Maintenance Cost (₹) Y	XY	X ²	Y ²
2	10	20	4	100
4	20	80	16	400
6	25	150	36	625
8	30	240	64	900
$\sum X = 20$	$\sum Y = 85$	$\sum XY = 490$	$\sum X^2 = 120$	$\sum Y^2 = 2025$

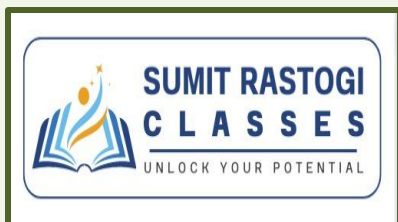
(a) Let linear Regression of y on x be:

$$y = a + bx$$

(1)

$$\sum y = na + b\sum x$$

(2)



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$$\sum xy = a\sum x + b\sum x^2 \quad (3)$$

From Equation 2 and Equation 3

$$85 = 4a + 20b \quad (4)$$

$$490 = 20a + 120b \quad (5)$$

Equation 2 $\times$ 5 - Equation 5

$$\begin{array}{rcl} 425 & = & 20a + 100b \\ - 490 & = & - 20a + 120b \\ \hline - 75 & = & - 20b \end{array}$$

$$b = 75/20 = 3.75$$

put $b = 3.75$ in equation (4)

$$85 = 4a + 20b$$

$$85 = 4a + 75$$

$$4a = 10$$

$$a = 10/4 = 2.5$$

Now put value of $a = 2.5$ and $b = 3.75$ in equation (1)

$$y = 2.5 + 3.75x \quad (6)$$

This is required Linear Regression y on x .

(b) (i) Estimation of Maintenance cost

When Age of car 10 years

Put $x = 10$ in equation (6)

$$y = 2.5 + 3.75 \times 10$$

$$= 2.5 + 37.5$$

$$y = 40$$

Maintenance cost is ₹40,000

(ii) let Regression Equation x and y be:

$$x = a + by \quad (1)$$

$$\sum x = na + b\sum y \quad (2)$$

$$\sum xy = a\sum y + b\sum y^2 \quad (3)$$

$$20 = 4a + 85b \quad (4)$$

$$490 = 85a + 2025b \quad (5)$$

Equation (4) $\times$ 85 - Equation (5) $\times$ 4

$$\begin{array}{rcl} 1700 & = & 340a + 7225b \\ - 1960 & = & - 340a + 8100b \\ \hline - 260 & = & - 1075b \end{array}$$

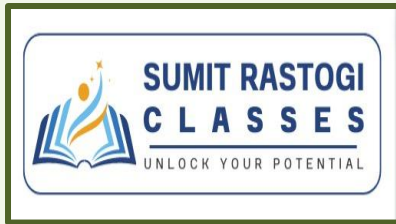
$$b = 260/1075 = 0.242$$

Put $b = 0.242$ in equation (4)

$$20 = 4a + 85 \times 0.242$$

$$20 = 4a + 20.57$$

$$4a = - 0.57; a = - 0.57/4 = - 0.1425$$



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Linear Regression x on y be; put value of $a = -0.1425$ and $b = 0.242$ in equation (1)

$X = -0.1425 + 0.242y$ (6)

Estimation of Age When Maintenance Cost ₹50,000

Put $Y = 50$ in equation (6)

$X = -0.1425 + 0.242 \times 50$

$X = 11.9575 = 12$ yrs. (Approx.)

ANS. 5 (a)

- (i) Workstation decides the capacity of the system with minimum capacity/shift, i.e., the bottleneck. In the given question, the work station '1' is having a capacity of 550 units/shift which is minimum. Therefore, the system capacity = 550 units/shift.
- (ii) The actual output of the production line = 440 units/shift
Therefore, the system efficiency = $\text{Actual output} / \text{System Capacity} \times 100$
 $= 440/550 \times 100 = 80\%$

ANS. 5 (b)

(I) Break-even point Let QBEP be the break-even point. FC = Fixed Cost.

R = Revenue per unit, VC = Variable Cost

Then $BEP (\text{Quantity}) = FC / (R - VC)$

Let Q_1 be the break-even point for one machine option Then,

$Q_1 = 14000 / (70 - 30) = 14000 / 40 = 375$ units (Not within the range of 0 to 300)

Let Q_2 be the break-even point for two machines option.

Then, $Q_2 = 17000 / (70 - 30) = 17000 / 40 = 425$ units (within the range of 351 to 550)

Let Q_3 be the break-even point for three machines option.

Then, $Q_3 = 23000 / (70 - 30) = 23000 / 40 = 575$ units (within the range of 551 to 900)

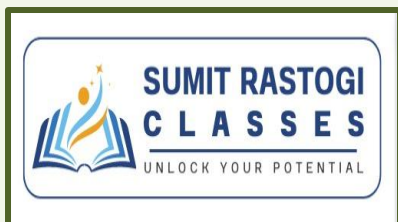
(II) The projected demand is between 540 to 570 units. The break-even point for single machine option (i.e., 375 units) is not feasible because it exceeds the range of volume that can be produced with one machine (i.e., 0 to 350).

Also, the break-even point for 3 machines is 575 units which is more than the upper limit of projected demand of 540 to 570 units and hence not feasible.

For 2 machines option the break even volume is 425 units and volume range is 351 to 550. Hence, the demand of 540 can be met with 2 machines and profit is earned because the production volume of 550 is more than the break even volume of 425.

If the manager wants to produce 570 units with 3 machines, there will be loss because the break even volume with three machines is 575 units.

Hence, the manager would choose two machines and produce 540 units and meet demand upto 550 units.



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ANS. 6 (a)

(i) Optimum run size or Economic Batch Quantity (EBQ)

$$= \sqrt{\frac{2 \times \text{Annual Output} \times \text{Setup Cost per run}}{\text{Annual Cost of carrying per unit}}}$$

$$= \sqrt{\frac{2 \times 24,000 \times 3240}{1 \times 12}} = 3600 \text{ unit}$$

(ii) Interval Between two consecutive optimum runs

$$\text{Annual no. of run} = 24000/3600$$

$$\text{Time interval in two consecutive run} = (12/\text{no. of run}) \times 30$$

$$= [(12 \times 3600)/24000] \times 30 = 54 \text{ days}$$

(iii) Minimum Inventory holding = Avg. inventory $\times$ Annual carrying cost of one unit inventory

$$= 3600/2 \times 12 = ₹21,600$$

ANS. 6 (b)

x	y	xy	x ²
1	18	18	1
2	23	46	4
4	32	128	16
3	28	84	9
10	38	380	100
4	29	116	16
$\Sigma x = 24$	$\Sigma y = 168$	$\Sigma xy = 772$	$\Sigma x^2 = 146$

(i) Let Linear Regression y on x be

$$y = a + bx \quad (1)$$

$$\Sigma y = na + b \Sigma x \quad (2)$$

$$\Sigma xy = a \Sigma x + b \Sigma x^2 \quad (3)$$

From Equation (2)

$$168 = 6a + 24b \quad (4)$$

From Equation (3)

$$772 = 24a + 146b \quad (5)$$

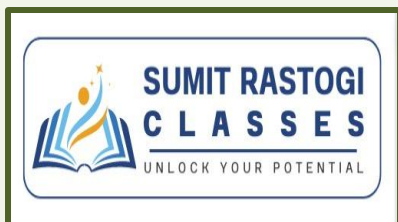
Equation (4) $\times$ 4 – Equation (5)

$$672 = 24a + 96b$$

$$-772 = -24a + 146b$$

$$-100 = -50b$$

$$b = 2$$



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Put $b = 2$ in equation 4

$$168 = 6a + 48$$

$$6a = 120$$

$$a = 20$$

Put value of a and b in equation 1

$$y = 20 + 2x$$

(6)

This is linear Regression y on x .

(ii) Estimation of Monthly sales if Ad impression campaign is 5 crores

Put $x = 5$ in Equation 6

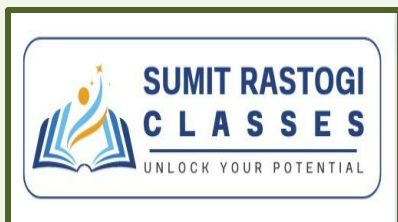
$$y = 20 + 5 \times 2 = 30$$

Expected Sales = ₹30 crores.

ANS. 7 (a)

Principle for Plant Layout as follows:

1. Principle of Minimum Travel	Men and materials should travel the shortest distance between operations so as to avoid waste of labour and time and minimize the cost of material handling.
2. Principle of Sequence	Machinery and operations should be arranged in a sequential order. The principle is best achieved in product layout, and efforts should be made to have it adopted in the process layout.
3. Principle of Usage	Every unit of available space should be effectively utilised. This principle should receive top consideration in town and cities where, land is costly.
4. Principle of Compactness	There should be a harmonious fusion of all relevant factors so that the final layout looks well integrated and compact.
5. Principle of safety and satisfaction	The layout should be built in provision for safety of the workmen. It should also be planned on the basis of the faction comfort and convenience of the workmen so that they feel satisfied.
6. Principle of Flexibility	The layout should permit revisions with the least difficulty and at minimum costs.
7. Principle of Minimum Investment	The layout should result in savings in fixed capital investment not by avoiding installation of the necessary facilities but by an intensive use of available facilities.



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ANS. 7 (b)

Do not change the department E and F from the current location. Because C should be as close as possible to E and F, put C between them. Place E directly above A and F directly above D, all the heavy traffic concerns have been accommodated. Department C is located in the remaining place. The proposed layout will be as follows:

E
C
F
A
B
D

The load distance scores for the existing and proposed layout

Dept pair	No. of trips (1)	Existing plan		Proposed Plan	
		Distance (2)	Load × Distance [(1) × (2)]	Distance (3)	Load × Distance [(d) × (3)]
A – B	8	2	16	1	8
A – C	3	1	3	2	6
A – E	9	1	9	1	9
A – F	5	3	15	3	15
B – D	3	2	6	1	3
C – E	8	2	16	1	8
C – F	9	2	18	1	9
D – F	3	1	3	1	3
E – F	3	2	6	2	6
Total			92		67

From the proposed layout we can conclude that load distance score for proposed layout is less. Hence proposed layout indicates improvement over existing layout.

ANS. 8 (a)

Total Time = Setup time + Processing time

Total Time Required Model 2M3 = $6000/100 \times 2 + 20 \times 600 = 120 + 120000$
 = 120120 Hrs.

Total Time Required Model 3SP4 = $1200/100 \times 3 + 40 \times 12000 = 360 + 480000$
 = 480360 Hrs.

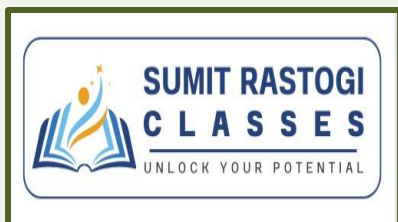
Total Time Required for both Models = 600480 Hrs.

Total Working Hrs. = $3 \times 8 \times 5 \times 50 = 6000$ Hrs.

Actual working Hrs. = $6000 \times 81\% = 4860$ Hrs.

(i) No. of Work stations Required = $600480/4860 = 124$ (Approx.)

(ii) Additional no. of work stations Required to meet expected demand = $124 - 100 = 24$



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ANS. 8 (b)

Temperature X	Sales Y	XY	X ²	Y ²
20	10	200	400	100
25	20	500	625	400
30	30	900	900	900
35	40	1400	1225	1600
40	50	2000	1600	2500
$\Sigma x = 150$	$\Sigma y = 150$	$\Sigma xy = 5000$	$\Sigma x^2 = 4750$	$\Sigma y^2 = 5500$

(i) Let Linear Regression Equation of y on x

$$y = a + bx \quad (A)$$

$$\Sigma y = na + b\Sigma x \quad (1)$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad (2)$$

Put value of Σx , Σy , Σxy , Σx^2 and n in equation (1) & (2)

$$150 = 5a + 150b \quad (3)$$

$$5000 = 150a + 4750b \quad (4)$$

Equation (3) $\times$ 30 – Equation (4)

$$4500 = 150a + 4500b$$

$$5000 = 150a + 4750b$$

$$\underline{\quad\quad\quad}$$

$$- 500 = - 250b$$

$$250b = 500$$

$$b = 2$$

Put $b = 2$ in equation (3)

$$150 = 5a + 300$$

$$5a = - 150$$

$$a = - 30$$

Put value of $a = - 30$ and $b = 2$ in equation (A)

$$y = - 30 + 2x \quad (B) \text{ which will be required Regression y on x}$$

(ii) Put $x = 32$ in Equation (B)

$$y = - 30 + 2 \times 32$$

$$= - 30 + 64 = 34$$

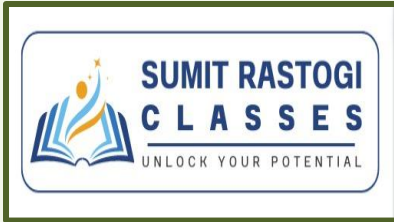
$$\text{Sales} = ₹34,000$$

Put $x = 42$ in equation (B)

$$y = - 30 + 2 \times 42$$

$$= - 30 + 84 = 54$$

$$\text{Sales} = ₹54,000$$



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(iii) Let Regression Equation x on y be

$$x = a + by \quad (C)$$

$$\sum x = na + b\sum y \quad (5)$$

$$\sum xy = a\sum y + b\sum y^2 \quad (6)$$

Put value of $\sum x$, $\sum y$, $\sum xy$, $\sum y^2$ and n in equation (5) and (6)

$$150 = 5a + 150b \quad (7)$$

$$5000 = 150a + 5500b \quad (8)$$

Equation (7) $\times$ 30 – Equation (8)

$$4500 = 150a + 4500b$$

$$5000 = 150a + 5500b$$

$$\begin{array}{r} - \\ - \\ - \end{array}$$

$$-500 = -1000b$$

$$b = 500/100 = 1/2$$

Put $b = 1/2$ in Equation (7)

$$150 = 5a + 75$$

$$5a = 75$$

$$a = 15$$

Put $a = 15$ and $b = 1/2$ in Equation (C)

$$x = 15 + 1/2y \quad (D) \text{ which will be required Equation}$$

Estimation of temperature when sales = ₹60,000

Put $y = 60$ in Equation (D)

$$x = 15 + 30 = 45, \text{ Temperature} = 45 \text{ Centigrade}$$