Paper 9 - Operations Management & Information Systems

Section –A

Question No. 1 is compulsory and any 4 from the rest

[6x2=12]

1. (a) State which is not affecting the Production Design
   (i)Product Quality; (ii) Reliability; (iii) Process Capability; (iv) Cost/Price Ratio

Ans: (ii) Reliability

(b) Which of the following is not a benefit of the Value Engineering?
 (i) Cost Reduction (ii) Robust Design (iii) Improvement in functions of the product (iv) Design for quality.
Ans: (iv) Design for quality

(c) Machines A is capable of manufacturing a product

Particulars	Machine A
Investment (₹)	50,000
Hourly Charges (wages + power) (₹)	10
No. pieces produced per hour	5
Life of the operating hours	20,000

Calculate the cost per unit
Solution: Calculation for Cost per unit:

Particulars	Calculation	Amount (₹)
Depreciation	50,000/20,000	2.50
Hourly Charges (wages + power)		10.00
		12.50

(d) If a firm sells 8,000 units, its loss is ₹ 20,000. But if it sells 10,000 units, its profit is ₹ 20,000. Calculate Fixed Cost.
(i) 1,80,000 (ii) 1,60,000 ,(iii) 1,55,000 (iv) 1,75,000

Solution: (i) 1,80,000
Change in quantity (10,000 – 8,000) units = 2,000 units
Change in profit =₹ [20,000 – (-20,000)] = ₹40,000.

∴ Unit contribution = $\dfrac{\text{Change in Profit}}{\text{Change in Output}}$ = $\dfrac{₹40,000}{2,000}$ = ₹ 20

So, when output = 10,000 units
Total contribution= (₹ 20 x 10,000) = ₹ 2,00,000

We know Contribution = Fixed Cost + Profit
2,00,000 = Fixed Cost + 20,000
or, 2,00,000 – 20,000 = Fixed Cost
or, Fixed cost = 1,80,000

(e) The time study of a machinery operation recorded cycle times of 9.0, 10.0, 11.0, 12.0 minutes. The analyst rated the observed worker as 90%. The firm uses a 0.15 allowance fraction. What is the Standard Time:
(i) 8.47 (ii) 11.12, (iii) 10.12 (iv) 9.00

Solution: (ii) 11.12

Average cycle Time = $\dfrac{9.0+10.0+11.0+12.0}{4} = 10.5$ minutes

Normal time = 10.5 x 0.9 = 9.45 minutes

Standard Time = $\dfrac{9.45}{(1-0.15)} = \dfrac{9.45}{0.85} = 11.12$ minutes

The standard time for this machinery operation would be set at 11.12 minutes, which is greater than the average cycle time observed. The average cycle time was adjusted for the rating factor (90%) and the allowance fraction (0.15).

(f) If the demand function is $X = \dfrac{20}{P+1}$, determined the price elasticity of demand if p=3

Solution:

Here, $X = \dfrac{20}{P+1}$, $\therefore \dfrac{dx}{dp} = -\dfrac{20}{(P+1)^2}$

Now, price elasticity of demand, say,

$e_p = \dfrac{p}{x} \cdot \dfrac{dx}{dp} = \dfrac{p}{20} \times (p+1) \times -\dfrac{20}{(p+1)^2}$

If p = 3, $e_p = \dfrac{3}{20} \times (3+1) \times -\dfrac{20}{(3+1)^2}$

$|e_p| = \dfrac{3}{4}$

Comment: As $|e_p| = \dfrac{3}{4} < 1$, demand is inelastic at P = 3.

(g) A workshop operates on 2 shifts of 8 hours per day. It has 10 machines. It works for 5 days in a week. Machine utilization is 90% and the efficiency of the machines is 85%. Calculate the designed/rated capacity of the workshop in standard hours.

Solution:
Rated Capacity of the workshop = No. of shifts x No. of hour's in each shift x No. of days per week x No. of machines x utilization factor x Efficiency
= 2 x 8 x 5 x 10 x 0.90 x 0.85
= 612 standard hour per week.

(h) Monthly demand for a component 1,000 units. Setting –up cost per batch ₹ 120. Cost of manufacture per unit ₹ 20. Rate of interest 10% P.a. Calculate the EBQ.
Solution:

Calculation of EBQ:

EBQ = $\sqrt{\dfrac{2 \times 12 \times 1,000 \times 120}{0.1 \times 20}}$ = 1,200 units.

(i) A departmental store has one cashier. During the rush hours, customers arrive at a rate of 20 customers per hour. The average number of customers that can be handled by the cashier is 24 per hour. Assume the conditions for use of the single – channel queuing model. Find out average time a customer spends in the system.
Solution:
The usual notations are given:
Arrival Rate $\lambda = 20$ customers / hour and service rate $\mu = 24$ customers / hour

$$L_s = \frac{\lambda}{\mu - \lambda} = \frac{20}{24 - 20} = \frac{20}{4} = 5 \text{ customers}$$

(j) Given the following alternatives, Linear Programming is a technique used in:
(i)Plant Layout (ii) Production Programme (iii) Product Mix (iv) Manufacturing Sequence
Ans: (iii) Product Mix

(k) Mentioning the Five principles of TQM.
Ans:
The Five Principle of Total Quality Management:
   (i)   Concentrate on the customer
   (ii) Do it right first time
   (iii) Communication and educate
   (iv) Measure and record
   (v)   Do it together

(l) Write down the formula of "Maintenance Cost Index" in respect of Maintenance Effectiveness.
Ans:
Maintenance Cost index (as a percentage) = $\dfrac{\text{Annual Maintenance Cost}}{\text{Cost of Production}} \times 100$

2 (a) Explain Capacity Requirement Plan.
Ans:

Capacity Requirement Plan

Forecast for demand of the product is the base for estimating the short-term workload on the facility. Companies make plans for a period of about one year and workout the expected output of different products or services based on the forecast. The plants thus generated are compared with the existing capacity. It is observed that one of the products have high demand in one season and low demand in another. For example, woolen clothes would have high demand in winter season whereas in summer it could have low or no demand. Another product could have a uniform demand throughout the year. For example, milk and some of the food items have uniform demand throughout the year.

Capacity Requirement Plans (CRP) looks into the individual operations by using the routine information. Each operation is valued in standard hours, which results in total hours required per work center per time period. Final adjustments are then made to the manufacturing plan at the operation level to obtain a balanced workload for each work center.

(b)A book store wishes to carry 'The Test of my Life' written by Yuvraj Singh, in stock. Demand is probabilistic and replenishment of stock takes 2 days (i.e. if an order is placed on March 1, it will be delivered at the end of the day on March 3). The probabilities of demand are given below:

Demand(daily)	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of ₹ 10 per order. The store also incurs a carrying cost of Re 0.05 per book per day. The inventory carrying cost is calculated on the basis of stock at the end of each day.

The manager of the book store wishes to compare two options for his inventory decision.

A. Order 5 books when the inventory at the beginning of the day plus orders outstanding is less than 8 books.
B. Order 8 books when the inventory at the beginning of the day plus orders outstanding is less than 8.
Currently (beginning of 1st day) the store has a stock of 8 books plus 6 books ordered two days ago and expected to arrive next day.

Using Monte Carlo Simulation for 10 cycles, recommend which option the manager should choose.
The two digits random numbers are given below:
89, 34, 78, 63, 61, 81, 39, 16, 13, 73.

[3+9 = 12]

Solution:

Demand	Probability	Cumulative Probability	Random Numbers
0	0.05	0.05	00-04
1	0.10	0.15	05-14
2	0.30	0.45	15-44
3	0.45	0.90	16-89
4	0.10	1.00	90-99

Stock in hand = 8 and stock on order = 6 (expected next day)
OPTION 'A'

Random number (given)	Demand	Opening stock in hand	Receipt	Closing stock on hand	Opening stock on order	Order quantity	Closing stock on order
89	3	8	-	8 – 3 = 5	6	-	6
34	2	5	6	5 + 6 – 2 = 9	-	-	-
78	3	9	-	9 – 3 = 6	-	.*5	5
63	3	6	-	6 – 3 = 3	5	-	5
61	3	3	-	3 – 3 = 0	5	*5	10
81	3	0	5	5 – 3 = 2	5	*5	10
39	2	2	-	2 – 2 = 0	10	-	10
16	2	0	5	5 – 2 = 3	5	-	5
13	1	3	5	5 + 3 – 1 = 7	0	*5	5
73	3	7	-	7 – 3 = 4	5	-	5

*5 books have been order 4 times.
∴ Order cost = ₹ (4 x 10) = ₹40.
Closing stock of 10 days = (5 + 9 + 6 + 3 + 2 + 3 + 7 + 4) = 39 books.
Closing cost @ ₹ 0.5 per book/day = 39 x 0.5 = ₹19.5

Total cost for 10 days = ₹(40 + 19.5) = ₹ 59.5.

OPTION 'B'

Random number (given)	Demand	Opening stock in hand	Receipt	Closing stock on hand	Opening stock on order	Order quantity	Closing stock on order
89	3	8	-	8 – 3 = 5	6	-	6
34	2	5	6	5 + 6 – 2 = 9	-	-	-
78	3	9	-	9 – 3 = 6	-	*8	8
63	3	6	-	6 – 3 = 3	8	-	8
61	3	3	-	3 – 3 = 0	8	-	8
81	3	0	8	8 – 3 = 5	-	-	8
39	2	5	-	5 – 0 = 5	8	*8	8
16	2	3	-	3 – 2 = 1	8	-	8
13	1	1	8	8 + 1 – 1 = 8	-	-	-
73	3	8	-	8 – 3 = 5	-	*8	8

*8 books have been order three times when the inventory at the beginning of the day plus orders outstanding is less than 8.
∴ Order cost = ₹ (3 x 10) = ₹30
Closing stock of 10 days = (5 + 9 +6 + 3 + 5 + 3 + 1 + 8 + 5) = 45 books
Carrying cost @ 0.5 per book day = ₹(45 x .5) = ₹ 22.50.
∴ Total cost = ₹ (22.50 + 30) = ₹52.50
Since 'Option B' has lower cost than 'Option A' i.e., 52.50 < 59.60, the manager should choose option 'B'.

3 (a) Describe the objectives of scheduling.
Ans:
Scheduling:
Scheduling, means organizing a production line to produce products in time efficiently with least use of time and maximum utilization of resources (especially men and machines).
Objectives of Scheduling
  (i) To prevent unbalanced use of time among departments and work centers or to evenly load   all machines in the production line.

  (ii) To utilize machines and 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 and (b) complete production in the shortest cycle time possible at minimum total cost of production.

  (iii) To reduce idle time of labour and machines, which might be caused due to waiting for materials, waiting for movement, waiting for inspection and waiting for want of work.

  (iv) To fix up delivery dates for various manufacturing activities and for the finished products.

  (v) To increase the efficiency of production or productivity.

(b) As a tool service centre the arrival rate is two per hour and the service potential is three per hour. Simple queue conditions exist.
The hourly wage paid to the attendant at the service centre is ₹1.50 per hour and the hourly cost of a machinist away from his work is ₹ 4.

Calculate:
(i) The average number of machinists being served or waiting to be served at any given time.
(ii) The average time a machinist spends waiting for service.
(iii)The total cost of operating the system for an eight – hour day.
(iv)The cost of the system if there were two attendants working together as a team, each paid ₹ 1.50 per hour and each able to service on average 2 per hour.

[2+10=12]

Solution:
Arrival rate = λ = 2 per hour
Service rate μ = 3 per hour
(i) Average number of machinists being served or waiting to be served at any given time:

$$L_n = \frac{\mu}{\mu - \lambda} = \frac{2}{3-2} = 2$$

(ii) Average Time a machinist spends waiting for the services:

$$W_q = \frac{\lambda}{\mu} \times \frac{1}{(\mu - \lambda)} = \frac{2}{3} \times \frac{1}{(3-2)} = 0.667 \text{ hours}$$

It means a machinist spends 40 minutes (ie., 60 x 0.667) in the queue.

(iii) Average time in the system

$$W_s = \frac{1}{(\mu - \lambda)} = \frac{1}{(3-2)} = 1 \text{ hours}$$

Average number of machinists in the system = 2   [As per (i) above]
Cost of two machinists being away from work = ₹ 4 x 2 = ₹8.00 per hour
Attendant cost =   1.50 per hour
                                  9.50 per hour

Cost of 8- hour day = 8 hrs x ₹9.50 = ₹76.00

(iv) It is assumed that there is still a single service point, but the average service rater is now 4 per hour

∴ Now   1= 2 per hour
              M= 4 per hour

∴ Average number in the system $L_n = \dfrac{\lambda}{\mu - \lambda} = \dfrac{2}{4-2} = 1$

Average time spent in the system $W_s = \dfrac{1}{\mu - \lambda} = \dfrac{1}{4-2} = \dfrac{1}{2}$

Machinists cost = ½ hr x ₹4 =	₹2.00
Attendant cost	3.00
Total Cost	5.00

Cost per 8 – hour day = ₹5 x 8 hrs. = ₹40.00

4 (a) **"The concept of product failure is applicable both to new products and the existing ones. There may, however, be varying periods of life spans for each product: some falling immediately, other living for a longer period." – mentioning the different stages which is describe in the statement, give the strategic consideration.**

Ans:

The concept of product failure is applicable both to new products and the existing ones. There may, however, be varying periods of life spans for each product: some failing immediately, other living for a longer period. The product, thus, has "life cycles" just as human beings have. From its birth, a product passes through various stages, until it is finally abandoned, *i. e..* discontinued from the market. These stages taken   together are referred, to as "the product life cycle". This life cycle of the product comprises four stages: Introduction, Growth, Maturity and Decline. It should be noted that it is purely a theoretical concept.

This may graphically be represented in below:

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
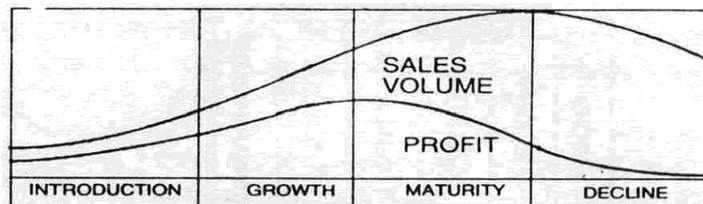
cycle would give the management an idea as to the time within which the original investment could be recouped.

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.

The above discussion concentrates only on the life cycle of a product, beginning with its introduction into the market *(i.e.,* post-marketing). But a series of processes are to be undertaken by the management prior to the introduction of a product.

Product Life cycle concept may be used as a managerial tool. Marketing strategies must change as the product goes through the life cycle. If managers understand the cycle concept they are in a better position to forecast the future sales activities and plan marketing strategies. The following points, however, may be kept in mind in using this concept.

Stages in the product life cycle concept				
Effects and Responses	Introduction	Growth	Maturity	Decline
Competition	No importance	Some	Many rivals competing for same price	Few in number
Overall strategy	Market establishment persuade early adopters to try the product	Market penetration persuasion of mass market- Brand preferences	Creation of brand loyalty, prevention of competition	Preparation for removal or renewal
Profits	Negligible- high production and marketing cost	Reach peak levels as a result of high prices and growing demand	Increasing competition cuts profits margins	Declining volume pushes costs up and eliminates profits
Retail Price	High to recover some excessive cost of launching	High to take advantage of heavy consumer demand	Avoid price war principle: "What the tariff will bear"	Low
Distribution	Selective	Intensive	Intensive	Selective
Advertising strategies	Aims at the needs of early adopters	Make the mass market aware of brand benefits	Use advertising as vehicle for differentiation among otherwise similar brands.	Emphasis low price
Advertising emphasis	High, to generate awareness and interest among early adopters	Moderate, to let sales rise- 'word of mouth' recommendations.	Moderate, since most buyers are aware of brand characteristics	Minimum expenditure
Consumer sales and promotion expenditures	Heavy, to entice target groups with samples, coupons, etc.	Moderate to create brand preferences- Advertising better suited.	Heavy to encourage brand switching	Minimum

(b) A company plans to assign 5 salesmen to 5 districts in which it operates. Estimates of sales revenue in thousands of rupees for each salesman in different districts are given the following table. In your opinion, what should be the placement of the salesmen if the objective is to maximize the expected sales revenue?

Salesman	District				
	D$_1$	D$_2$	D$_3$	D$_4$	D$_5$
S$_1$	40	46	48	36	48
S$_2$	48	32	36	29	44
S$_3$	49	35	41	38	45
S$_4$	30	46	49	44	44
S$_5$	37	41	48	43	47

Solution:

Since it is a maximization problem, we would first subtract each of the entries in the table from the largest one, which equals 49 here. The resultant data are given in Table below:

Table: Opportunity Loss Matrix

Salesman	District				
	D$_1$	D$_2$	D$_3$	D$_4$	D$_5$
S$_1$	9	3	1	13	1
S$_2$	1	17	13	10	5
S$_3$	0	14	8	11	4
S$_4$	19	3	0	5	5
S$_5$	12	8	1	6	2

Now we shall proceed as usual.

Step 1

Subtract minimum value in each row from every value in the row. The resulting values are given in Table 1.

Reduced Cost Table 1

Salesman	District				
	D$_1$	D$_2$	D$_3$	D$_4$	D$_5$
S$_1$	8	2	0	12	0
S$_2$	0	16	12	19	4
S$_3$	0	14	8	11	4
S$_4$	19	3	0	5	5
S$_5$	11	7	0	5	1

Steps 2, 3

Subtract minimum value in each column in reduced cost table 1 from each value in the column. Test for optimality by drawing lines to cover zeros. These are shown in Table 2

Reduced Cost Table 2

Salesman	District				
	D_1	D_2	D_3	D_4	D_5
S_1	8	0	0	7	0
S_2	0	14	12	14	4
S_3	0	12	8	6	4
S_4	19	1	0	0	5
S_5	11	5	0	0	1

Since the number of lines covering all zeros. We select the least uncovered cell value, which equals 4. With this, we can modify the table as given in Table 3.

Steps 4, 5, 6

Find improved solution. Test for optimality and make assignments.

Reduced Cost Table 3

Salesman	District				
	D_1	D_2	D_3	D_4	D_5
S_1	12	[0]	✗	7	✗
S_2	[0]	10	8	10	✗
S_3	✗	8	4	2	[0]
S_4	23	1	[0]	✗	5
S_5	15	5	✗	[0]	1

There are more than one optimal assignments possible in this case because of the existence of multiple zeros in different rows and columns. The assignments possible are:

Salesman	District	Sales Revenue
		(₹ in thousands)
S_1	D_2	46
S_2	D_1	48
S_3	D_5	45
S_4	D_3	49
S_5	D_4	43
		231

The assignment patterns would lead to expected aggregated sales equal to ₹ 231 thousand.

(c) Formulate the Dual of the Primal Equation:

$$\text{Max } Z = 20x_1 + 50x_2$$

$$\text{Subject to },$$

$$5x_1 + 3x_2 \leq 60$$

$$4x_1 + 2x_2 \leq 40$$

$$x_1, x_2 \geq 0$$

[5+5+2= 12]

Solution:
Dual Problem:

$$\text{Min } Z = 60y_1 + 40y_2$$
$$\text{subject to },$$
$$5y_1 + 4y_2 \geq 20$$
$$3y_1 + 2y_2 \geq 50$$
$$y_1, y_2 \geq 0$$

5. (a) An engineering company produces two products A & B. The cost data are as under:

Particulars	A (₹)	B (₹)
Selling Price	175	220
Direct Material	40	80
Direct Labour	60	40
Variable Overheads	30	20

Each product undergoes an operation in the two departments' viz., cutting and finishing, before it emerges as a finished product. The unit time taken by the products and the maximum available hours in the cutting and finishing operations are given below:

Product	Cutting Hours	Finishing Hours
A	5	10
B	20	15
Maximum Hours Available	400	450

Formulate an LP Problem by using Simplex Method.

Solution:

Contribution per unit

Particulars	A (₹)	B (₹)
Selling Price	175	220

	130	140
Less: Variable cost	130	140
contribution	45	80

Let x_1 = Product A and x_2 = Product B

Set-up the problem in standard form

Maximize $Z = 45x_1 + 80x_2$

Subject to:

$$5x_1 + 20x_2 \leq 400$$
$$10x_1 + 15x_2 \leq 450$$
$$x_1, x_2 \geq 0$$

Step 2. Initial Simplex table

C_j col.	C_j row Product mix	Qty.	₹45 X_1	₹80 X_2	0 S_1	0 S_2	
0	S_1	400	5	20	1	0	→ Pivot Row
0	S_2	450	50	15	0	1	
	Z_j	0	0	0	0	0	
	$C_j - Z_j$		45	80	0	0	

Pivot col. (↑ under X_2)

The positive number in $C_j - Z_j$ row indicates that profits can be improved.

Second simplex Table

Step 1. Divide each element in the pivot row by pivot number

$$\frac{400}{200} = 20, \ \frac{5}{20} = \frac{1}{4}, \ \frac{20}{20} = 1, \ \frac{1}{20}, \ \frac{0}{20} = 0$$

The new row X_2 will be

20	$\frac{1}{4}$	**1**	$\frac{1}{20}$	**0**

The elements in the other rows are computed by the following formula:

New values for an element in other rows

$$= \text{Old value} - \frac{\text{Corresponding value in Pivot row} \times \text{Corresponding value in Piovt column}}{\text{Pivot number}}$$

New value for S_1 rows are:

$$450 - \frac{400 \times 15}{20} = 150.10 - \frac{5 \times 15}{20} = \frac{25}{4}, \ 15 - \frac{20 \times 15}{20} = 0.$$

$$0 - \frac{1 \times 15}{20} = -\frac{3}{4}, \ 1 - \frac{0 \times 15}{20} = 1$$

Now second simplex table is:

C_j col	C_j row Product mix	Qty.	₹45 X_1	₹80 X_2	0 S_1	0 S_2	
80	X_2	20	1/4	1	1/20	0	→ **Pivot Row**
0	S_2	150	25/4	0	- 3/ 4	1	
	Z_j	1,600	20	80	4	0	
	$C_j - Z_j$		25	0	- 4	0	

$$\uparrow$$
Pivot Col.

Since there is positive number is $C_j - Z_j$ row solution can be improved.
Third tableau
Step 1. Divide each element in the pivot row by pivot number:
$150 \div (25/4)= 24, (25/4) \div (25/4) = 1, 0 \div 25/4 = 0, (-3/4) \div 25/4 = -3/25, 1 \div 25/4 = 4/25$
The new row x_1 will be:

24	1	0	-3/25	4/25

Value of other by using the above mentioned formula

$20 - \dfrac{150 \times 1/4}{25/4} = 14, \quad \dfrac{1}{4} - \dfrac{25/4 \times 1/4}{25/4} = 0, 1 - 0 = 1$

$\dfrac{1}{4} - \left(\dfrac{-3/4 \times 1/4}{25/4} \right) = \dfrac{2}{25}, \quad 0 - 1 \times \left(\dfrac{1/4}{25/4} \right) = -1/25$

∴ New value for x_2 row are:

14	0	1	$\dfrac{2}{25}$	$-\dfrac{1}{25}$

New Third Simplex tableau is

	C_j row		₹45	₹80	0	0	
C_j col	Product mix	Qty.	X_1	X_2	S_1	S_2	
80	X_2	14	0	1	2/25	- 1/25	→ Pivot Row
45	X_1	24	1	0	- 3/25	4/25	
	Z_j	2,200	45	80	+1	4	
	$C_j - Z_j$		0	0	- 1	-4	

Since all value in C_j and Z_j row is negative, it is the best mix, i.e., solution is optimal.

[Note: The question is to 'Formulate the LP problem by simplex method'. But as the marks allocated to the question is 10. So, we are providing the solution also.]

(b) Mention the characteristics of Just – in – Time system. [10+2= 12]
Ans:
Characteristics of Just-In-Time System
JIT systems focus on reducing inefficiency and unproductive time in the production process to improve continuously the process and quality of the product or service. Employee involvement and inventory reductions are essential to JIT operations. The salient characteristics of JIT are:

(i) Pull method of material flow
(ii) Constantly high quality
(iii) Small lot sizes
(iv) Uniform workstation loads

6. (a) Describe the role of factory Executives and Workers in raising productivity.
Ans:
Role of Factory Executives And Workers In -Raising -Productivity

A. Engineers: The scope of Industrial Engineers on this subject of increasing productivity is enormous. Industrial Engineers can make valuable contribution to raise productivity. The object of Industrial Engineering is to apply scientific and engineering knowledge and techniques to increase the efficiency of industrial activities. It is concerned with product design, standardization, plant layout, efficient machine operation, materials handling, tool designs, maintenance of plant, time and motion study, incentive methods and industrial relations, value analysis and value engineering etc.

B. Sales Manager: Sales managers should be interested not only in delivering the goods by due dates in proper quality but also raising the productivity of factory for increasing the sales. They may help the production people by (a) Supplying data about efficient production arrangement of other competitors, (b) Relaxing rigidity in inspection provided quality does not suffer and (c) Accepting orders enabling standardization and simplification.

C. Personnel Manager: Responsibility of personnel manager is (i) to ensure cordial labour relations (ii) to settle labour problems (iii) to look after the amenities of the workers. On behalf of the management the personnel manager looks after better human relations which will motivate all employees to work productivity and co-operatively.
He should also be responsible to recruit right persons and place them in the right jobs. A man's productivity depends to a considerable extent on his job being suited to his abilities and his attitude towards that job.
He should properly educate the workmen as to how they may contribute to increase in national wealth, and standard of living. He should check the absenteeism, lack of co-operation of some workers and tactfully eliminate bad elements causing disharmony among other-workers.

D. Finance Manager:
The finance manager can make some vital contribution towards higher productivity by setting up proper standard of costing system and by supply periodical reports to the management for visualizing the trend in the activity of their performance.
The finance manager will remain a constant companion in all activities of the management, say setting norms of standards, work study, fixing production Bonus, or piece rates of wages, job evaluation cost estimation, cost concepts in various natures of activities and so on.

E. Managers and Workers (Through KAIZEN): KAIZEN is a kanji word made up of KAI and ZEN. KAI means change and ZEN means better. Thus KAIZEN means change for the better. It implies continuous improvement done consistently. KAIZEN diagnoses the major root causes of inefficient working in the organization and offers a systematic approach to changing the attitudes 6f people for increasing productivity, improving quality and thus leading to miraculous organizational change. The essence of KAIZEN is simple and straight forward, i.e. "on going improvement involving everyone including both managers and workers". KAIZEN signifies productivity improvement made in the status-quo as a result of on-going efforts.

(b) Definition of Quality circle. Explain the objectives quality circles?   **[4+ (3+5)]**
Ans:
Quality Circles
After Second World War, most of the countries in the world had to face the problem of industrial development.
Japan was worst hit and the industrial units in Japan were going from bad to worse and it was necessary for Japan to put their shattered economy back on the rails. To do so they had to wipe out their poor image of quality. Later with the help of American quality management experts Dr.

Deming and Dr. Juran, the Japanese managers learnt the quality control techniques and different aspects of quality management.
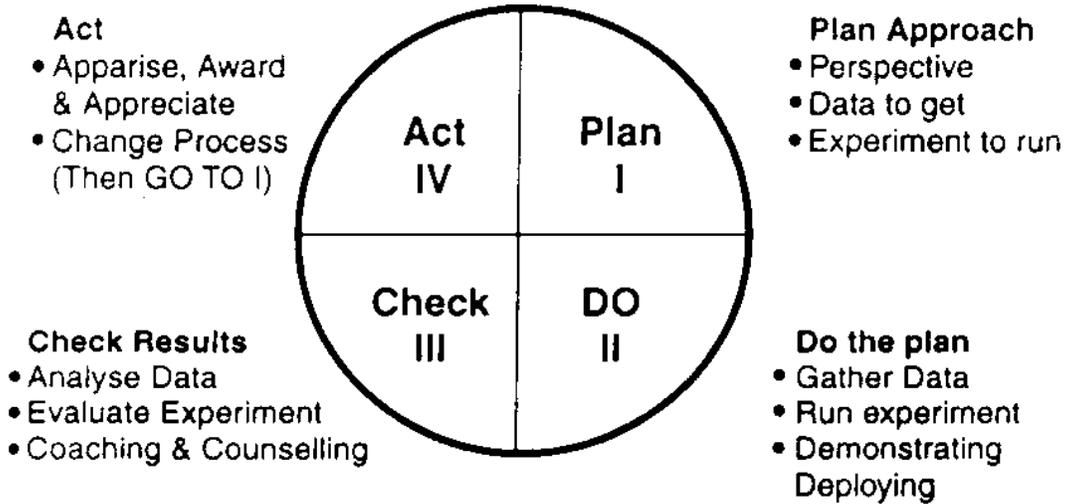
It was at this point, Dr. K. Ishikawa of Mushashi Institute of Technology, Tokyo added a new dimension to this effort by involving task performers at the grass root levels to work towards the improvement of quality. He motivated the workmen to follow quality control technique in their shop floors by forming small groups and sought their help in solving the daily problems of the company. After all the persons who are actually doing the job knows the job best. This is the basic philosophy behind forming QUALITY CIRCLES.

Definition
According to the formal definition given by Union of Japanese Scientists and Engineers (JUSE) "Quality Circle is a small group formed to perform voluntarily QC activities leading to self development within the work place".

Objectives
Quality circles adoption leads to benefits (A) Individual and (B) Organizational.

(A) Benefits for the Individual
(i) Personality Development. For doing a job, everyone needs some kind of help from others, during such help exchange of ideas are involved. This leads to the personality development of an individual as he is sure to receive good ideas of others.
(ii) Mutual Development. Quality circle is a group activity, as such in a group every individual, besides, developing self also help in the development of others, this leads to development of the whole group which in turn leads to the development of society and nation.

(iii) Job Satisfaction. It is a well-known fact that an individual or a group feels satisfied if the ideas given by them are implemented.
This is also a human tendency that once encouraged every person tries to do more and more constructive work in future. This gives job satisfaction. Moreover a stage comes when salary, allowances post, facility do not encourage an individual if his ideas are not given due importance.

(iv) Problem Solving Capability. In the absence of QC, every problem has to be solved by management. It is quite possible that top management may not completely understand the

problems of a particular work area.
QC member are well in touch with the problems of their work area and hence can find best solution of such problems earlier.

This way the management can look into other work and problem solving capability in QC member are enhanced.

(v) Togetherness. QC is a group activity and this way it creates an atmosphere where an individual starts thinking about we rather than I, this reduces and eliminates the enemity between workers and then the problems can be solved easily.

(vi) Better Human Relationship. QC leads to better relationship because if we work together, we are sure to develop better relationship with others.

(vii) Exchange of Good Thoughts. When the better human relations are established we can exchange our thoughts in a better manner and without any hesitation.

(viii) Orating Capability (Stage openings). Many times an individual may not explain his ideas due to hesitation or shyness, after working in QC, a member can get rid off such problems and can express themselves in a better manner.

(B) Benefits for An Organization
  (i) Improves Productivity.
  (ii) Improves Quality of Product.
  (iii) Reduces Wastage.
  (iv) Increases Employee Motivation.
  (v) Inspires More Effective Team Work.
  (vi) Develops Harmonious Superior-Subordinate Relationship.
  (vii) Improves Communication Within Organizations.

Section B - Information System

Question no. 7 is compulsory; answer any four from the rest

7. (a) What is Iconic scale Model? [2×4]

Answer:

Iconic scale model: It is physical replica of the system based on different scale from original. Iconic models may appear to scale in three dimensions - such as model of a production process, building, car or an aircraft.
 (b) What do you understand by Data Independence?

Answer:

Data Independence can be defined as the capacity to change the schema at one level of a database system without having to change the schema at the next higher level.
 There are two types of data independence:
  • Logical Data Independence and

- Physical Data Independence.

(c) List the Pre – requisites of a Management Information System.

Answer:

The following are pre-requisites of an effective Management Information System:
- **(i)** Database
- **(ii)** Qualified System and Management Staff
- **(iii)** Support of Top Management
- **(iv)** Control and Maintenance of Management Information System.

(d) What is "Asymmetric Crypto System"?

Answer:

"**Asymmetric Crypto System**" means a system of a secure key pair consisting of a private key for creating a digital signature and a public key to verify the digital signature.

Answer any four questions from the following

8. (a) State the objectives of The Information Technology Act,2000.   [4]

Answer:

The objectives of Information technology Act, 2000 Act are:

- To grant legal recognition to transactions carried out through electronic data interchange and other means of electronic communication commonly referred to as "electronic commerce" replacing the paper-based communication;
- To give legal recognition to Digital Signature for authentication of any information or matter which requires authentication under any law;
- To facilitate electronic filing of documents with Government Departments;
- To facilitate electronic data storage;
- To facilitate and give legal sanction to electronic funds transfers between banks and financial institutions;
- To give legal recognition for keeping of books of account by bankers in electronic form;
- To amend the Indian Penal Code, the Indian Evidence Act, 1872; the Banker's Book Evidence Act, 1891 and the Reserve Bank of India Act, 1934.

(b) What is Transaction Processing System?   [2]

Answer:

Transaction Processing System is an information system designed to process information relating to monetary transactions in the business activities like purchase, sale,   payment, receipts etc. It is a computer based processing for different functional areas to generate all required reports for day-to-day use in the organization. It seeks time - and cost-efficiency by automating repetitive operations in large volumes.

(c) List the four parts of Decision Table?   [2]

Answer:

Following are the four parts of Decision Table –
- Condition stub
- Action stub
- Condition entries
- Action entries

9. Discuss the activities involved in System Development Life Cycle.

Answer:

The System Development Life Cycle (SDLC) consists of a set of phases/activities in which each phase of the SDLC uses the results of the previous one.

The system development life cycle method consists of the following activities:

A. Preliminary investigation: Users submit a formal request for a new system to the Management Information System (MIS) department, when they come across a problem. This activity consists of three parts-
(i) Request clarification
(ii) Feasibility study
(iii) Request approval

B. Requirements analysis or systems analysis:
Several fact-finding techniques and tools such as questionnaires, interviews, observing decision-maker behaviour and office environment, etc. are used for understanding the requirements of the users. As details are gathered, the analysts study the present system to identify its problems and shortcomings and identify the features which the new system should include to satisfy the new or changed user application environment.

C. Design of the system:
The analyst designs various reports/outputs, data entry procedures, inputs, files and database. These detailed design specifications are then passed on to the programming staff for software development.

D. Acquisition and development of software:
Specific type of hardware, software and services are determined. Subsequently, choices are made regarding which products to buy or lease from which vendors. Software developers then install purchased software or they may write new custom designed programs.

E. System testing:
Special test data are input for processing, and then the results are examined. Various types of testing is made such as Unit testing, Integration testing, System testing etc.

F. Implementation and maintenance:
Implementation and Maintenance is the final stage in SDLC. When system is found to be fit, it is implemented. After implementation, the system is maintained and it is modified to adapt to changing users and business needs.

Or,

State the tangible and intangible benefits of ERP.   **[8]**

Answer:

The tangible benefits of ERP are as follows:

i. Reduced level of inventory, including raw material, work in progress and finished goods, through improved planning and control.

ii. Reduced materials cost through improved procurement and accounts payable practices, less obsolescence and wastage.

iii. Reduced labor cost through better allocation and reduction of overtime of workmen directly involved with production such as technicians and skilled workers.

iv. Improved production throughput through better scheduling of critical equipment and sub-contracting operations, thereby minimizing shortages, interruption and rework.

v. Reduction in the cost of after sales services.

In addition to the above mentioned tangible benefits, following intangible benefits also occur:

i. Integration of information resulting efficiency, transparency and effective Management Information System (MIS).

ii. Error reduction, accuracy of inventory record.

iii. Improved customer service, on time shipment, shorter order to shipment cycle.

iv. Establishment of standardized procedures.

v. Improved accounting control and shorter sales to cash cycle.

vi. Legal and regulatory compliance.

10. (a) Define Data Flow Diagram.

Answer:

Data Flow Diagram - A data flow diagram uses a few simple symbols to illustrate the flow of data among external entities. The tools help the system analysts to document the data flow among the major resources and activities of an information system.

<p align="center">Or,</p>

Define Electronic Data Interchange [2]

Answer:

Electronic Data Interchange (EDI) is the system where data is transferred electronically in machine readable or processable form. In a moment any message is sent through EDI then it would be immediately processed by receiving computer without any human intervention or interpretation or rekeying.

(b) What is Graphical User Interfaces? [3]

Answer:

Graphical User Interfaces- A graphical user interface (GUI) typically displays a schema to the user in diagrammatic form. The user can then specify a query by manipulating the diagram. In many cases, GUIs utilize both menus and forms. Most GUIs use a **pointing device**, such as a mouse, to pick certain parts of the displayed schema diagram.

(c) Mention the responsibility of a database administrator? [3]

In a database environment, the primary resource is the database itself and the secondary resource is the Database Management System and related software. Administering these resources is the responsibility of the Database Administrator (DBA).

The Database Administrator is responsible for
- Authorizing access to the database,
- coordinating and monitoring its use, and
- acquiring software and hardware resources as needed.

The Database Administrator is accountable for problems such as
- breach-of security or
- poor system response time.

11. Describe Three–Schema Architecture. [8]

Answer:

Three important characteristics of the database approach, are
(i) insulation of programs and data (program-data and program-operation independence);
(ii) support of multiple user views; and
(iii) use of a catalog to store the database description (schema).
In relation to this name of an architecture is specified for database systems, called the **three-schema architecture**, which was proposed to help achieve and visualise these characteristics.

The Three-Schema Architecture

In this architecture, schemas can be defined at the following three levels:
A. The **internal level** has an **internal schema**, which describes the physical storage structure of the database. The internal schema uses a physical data model and describes the complete details of data storage and access paths for the database.
B. The **conceptual level** has a **conceptual schema**, which describes the structure of the whole database for a community of users. The conceptual schema hides the details of physical storage structures and concentrates on describing entities, data types, relationships, user operations, and constraints. A high - level data model or an implementation data model can be used at this level.
C. The **external** or **view level** includes a number of **external schemas** or **user views**. Each external schema describes the part of the database that a particular user group is interested in and hides the rest of the database from that user group. A high-level data model or an implementation data model can be used at this level.
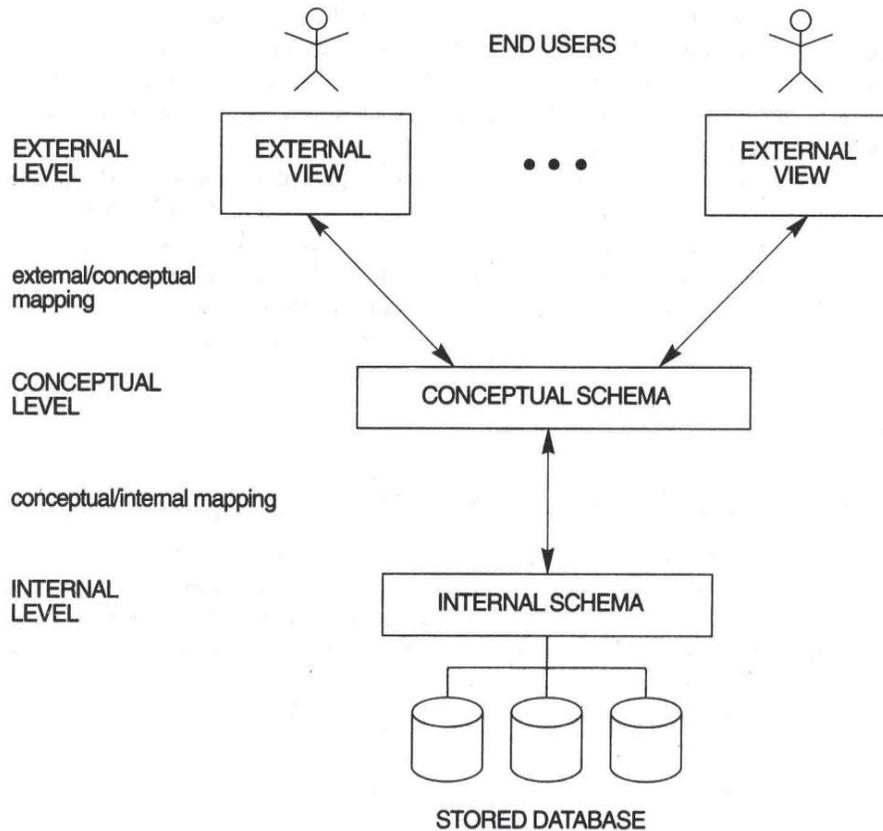
Three-Schema Architecture

The three-schema architecture is a convenient tool for the user to visualise the schema levels in a database system. Most Database Management Systems (DBMSs) do not separate the three levels completely, but support the three-schema architecture to some extent. Some DBMSs may include physical-level details in the conceptual schema. In most DBMSs that support user views, external schemas are specified in the same data model that describes the conceptual-level information. Some DBMSs allow different data models to be used at the conceptual and external levels. Three schemas are only descriptions of data.

12. (a) Write a note on Management Information System (MIS)?   **[4]**

Answer:

Management Information System (MIS) is a concept of the last decade or two.

Decisions are made on many issues that recur regularly and require a certain amount of information. So, the information systems can be developed so that the reports are prepared regularly to support these recurring decisions. MIS is designed to provide accurate, relevant and timely information to managers at different levels and in different functional areas throughout the organization for decision-making purpose.

In today's world, the MIS is a computerized business processing system generating information for the people in the organization to meet the information needs for decision-making to achieve the corporate objectives of the organization.

Management means -
(i) Determination of organizational objectives and developing plans to achieve them.

(ii) Securing and organizing the human and physical resources so that these objectives could be accomplished.
(iii) Exercising adequate controls over the functions.
(iv) Monitoring the results to ensure that accomplishments are proceeding according to plan.

Information could be defined as sets of facts, figures and symbols processed for the current decision-making situation.

A **system** is defined as a set of related components, activities, processes and human beings interacting together so as to accomplish some common objectives and thus, MIS can be defined as set of related processes, interacting together to provide processed data to managers at various levels and functional areas for decision making. State and explain any five characteristics of a good Management Information System.

(b) What is On – line Analytical Processing (OLAP)?   **[4]**

Answer:

An On-line Analytical Processing (OLAP) software does the analysis of information from data warehouse. The OLAP applications are widely scattered in divergent application areas like Finance Management, Sales Analysis. The real test of an OLAP system is inefficient use of data from databases and computational capability of data to develop model establishing the relationship of various parameters. In fact, it provides the services of 'just-in-time' information.
Though OLAP software are found in widely divergent functional areas, they have three common key features which are :

•   Multidimensional views of data
•   High analytical ability
•   'Just-in-time' information delivery

Rarely a business model limited a fewer than three dimensions. The common dimensions in business environment are organization, line item, time, product, channel, place etc. OLAP system should have the ability to respond the queries from a manager within a specified time. The OLAP software must provide a rich tool kit of powerful capability of analytical ability.