

PAPER – 5 : COST MANAGEMENT

Question No. 1 is compulsory. Answer any four questions from the rest.

Working notes should form part of the answer.

Question 1

- (a) State the general guidelines to be used in adopting a pricing policy in a manufacturing organization.
- (b) A company which has developed a new machine has observed that the time taken to manufacture the first machine is 600 hours. Calculate the time which the company will take to manufacture the second machine if the actual learning curve rate is (i) 80% and (ii) 90%. Explain which of the two learning rates will show faster learning.
- (c) A company manufactures three types of products namely P, Q and R. The data relating to a period are as under:

	P	Q	R
Machine hours per unit	10	18	14
Direct labour hours per unit @ Rs. 20	4	12	8
Direct Material per unit (Rs.)	90	80	120
Production (units)	3,000	5,000	20,000

Currently the company uses traditional costing method and absorbs all production overheads on the basis of machine hours. The machine hour rate of overheads is Rs. 6 per hour.

The company proposes to use activity based costing system and the activity analysis is as under:

	P	Q	R
Batch size (units)	150	500	1,000
Number of purchase orders per batch	3	10	8
Number of inspections per batch	5	4	3

The total production overheads are analysed as under:

Machine set up costs	20%
Machine operation costs	30%
Inspection costs	40%
Material procurement related costs	10%

Required:

- (i) Calculate the cost per unit of each product using traditional method of absorbing all production overheads on the basis of machine hours.
 - (ii) Calculate the cost per unit of each product using activity based costing principles.
- (d) A single product manufacturing company has an installed capacity of 3,00,000 units per annum. The normal capacity utilization of the company is 90%. The company has prepared the following budget for a year:

Variable costs:

Factory costs	Rs. 33 per unit
Selling and Administration costs	Rs. 9 per unit

Fixed costs:

Factory costs	Rs. 21,60,000
Selling and Administration costs	Rs. 7,56,000

Selling Price

Selling price per unit	Rs. 60
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The actual production, sales, price and cost data relating to the year under review are as given below:

Production	2,40,000 units
Sales	2,25,000 units
Finished goods stock in the beginning of the year:	15,000 units
Actual factory variable costs exceeded the budget by	Rs. 1,20,000

Required:

- (i) Calculate the budgeted profit and break-even point in units.
- (ii) What increase in selling price was necessary during the year under review to maintain the budgeted profit?
- (iii) Prepare statements showing the actual profit during the year under review by using (1) absorption costing method and (2) marginal costing method.

(3 + 3 + 7 + 11 = 24 Marks)

Answer

- (a) The general guidelines to be used in adopting a pricing policy are as under:

- (i) The pricing policy should encourage optimum utilization of resources.
- (ii) The pricing policy should work towards a better balance between demand and supply.

- (iii) The pricing policy should promote exports.
- (iv) The pricing policy should serve as an incentive to the manufacturers to maximize production by adopting improved technology.
- (v) The pricing policy should avoid adverse effects on the rest of the economy.
- (b) (i) Actual learning curve rate is 80%.

Time taken to produce the first machine = 600 hours
 Average time taken to produce two machines = $600 \times 80\%$ hours
 = 480 hours.
 Cumulative time taken to produce two machines = 480×2 hours
 = 960 hours.
 Time taken to produce the second machine = $(960 - 600)$ hours
 = 360 hours.

- (ii) Actual learning curve rate is 90%.

Time taken to produce the first machine = 600 hours
 Average time taken to produce two machines = $600 \times 90\%$ hours
 = 540 hours.
 Cumulative time taken to produce two machines = 540×2 hours
 = 1080 hours.
 Time taken to produce the second machine = $(1080 - 600)$ hours
 = 480 hours.

The time taken to produce the second machine is lower at 80% learning rate and hence 80% learning rate shows faster learning rate.

- (c) (i) Cost per unit using traditional method of absorbing all production overheads on the basis of machine hours:

Products	P	Q	R
	Rs.	Rs.	Rs.
Direct materials	90	80	120
Direct labour (4:12:8 hours) $\times$ Rs. 20	80	240	160
Production Overheads (10:18:14 hours) $\times$ Rs. 6	<u>60</u>	<u>108</u>	<u>84</u>
Cost per unit	<u>230</u>	<u>428</u>	<u>364</u>

- (ii) 1. Cost per unit of each product using activity based costing:

Products	P	Q	R	Total
A. Production (units)	3,000	5,000	20,000	
B. Batch size (units)	150	500	1000	
C. Number of batches $[A \div B]$	20	10	20	50
D. Number of purchase order per batch	3	10	8	
E. Total purchase orders $[C \times D]$	60	100	160	320
F. Number of inspections per batch	5	4	3	
G. Total inspections $[C \times F]$	100	40	60	200

2. Total Production overhead

A. Machine hours per unit	10	18	14
B. Production units	3,000	5,000	20,000
C. Total machine hours $[A \times B]$	30,000	90,000	2,80,000

Total machine hours = 4,00,000

Total production overheads = 4,00,000 $\times$ Rs. 6 = Rs. 24,00,000.

3. Cost driver rates:

Cost Pool	%	Overheads Rs.	Cost Driver Units	Cost Driver Rate Rs.
Set up	20%	4,80,000	50	9,600 per set up
Inspection	40%	9,60,000	200	4,800 per inspection
Purchases	10%	2,40,000	320	750 per purchase
Machine hours	30%	7,20,000	4,00,000	1.80 per Machine Hour

4. Cost per unit of P, Q and R:

Products	P	Q	R
Production (units)	3,000	5,000	20,000
	Rs.	Rs.	Rs.
Direct Materials (90:80:120)	2,70,000	4,00,000	24,00,000
Direct Labour (80:240:160)	2,40,000	12,00,000	32,00,000

Overheads:

Machine related costs @ Rs. 1.80/hour (30,000:90,000:2,80,000)	54,000	1,62,000	5,04,000
Set-up costs @ Rs. 9600 / set up (20 : 10 : 20)	1,92,000	96,000	1,92,000
Inspection costs @ Rs. 4800 / inspection (100 :40 : 60)	4,80,000	1,92,000	2,88,000
Purchase related costs @ Rs. 750 / purchase (60 : 100 : 160)	45,000	75,000	1,20,000
Total costs	12,81,000	21,25,000	67,04,000
Cost per unit (Total cost ÷ units)	427.00	425.00	335.20

(d) (i) Contribution per unit:

	Rs.	Rs.
Selling price per unit		60
Variable costs per unit:		
Factory	33	
Selling & Administration	<u>9</u>	<u>42</u>
Contribution per unit		<u>18</u>
(Selling price – Variable cost)		

Budgeted Profit:

	Units	Rs.	Rs.
Installed capacity	3,00,000		
Normal capacity utilization (3,00,000 × 90%)	2,70,000		
Total contribution (A)			
(Contribution per unit × Normal capacity utilization) (2,70,000 × 18)			48,60,000
Fixed Costs (B)			
Factory Costs		21,60,000	
Selling and Administration costs		<u>7,56,000</u>	<u>29,16,000</u>
Profit (A – B)			<u>19,44,000</u>

$$\begin{aligned}\text{Break - even point (in units)} &= \frac{\text{Fixed costs}}{\text{Contribution per unit}} \\ &= \frac{29,16,000}{18} = 1,62,000.\end{aligned}$$

(ii)	1.	Actual variable costs per unit	Rs.	Rs.
		Budgeted factory costs	33	
		Increase in Factory costs per unit		
		$\left(\frac{1,20,000}{2,40,000} \right)$	<u>0.50</u>	33.50
		Selling and Administration costs		<u>9.00</u>
				<u>42.50</u>
	2.	Selling price required to maintain the budgeted profit:		
	A.	Total contribution required (Rs.)		48,60,000
	B.	Actual production (units)		2,40,000
	C.	Contribution desired per unit (A ÷ B) (Rs.)		20.25
	D.	Variable cost per unit (Rs.)		42.50
	E.	Selling price required to maintain budgeted profit (C + D) (Rs.)		62.75
	F.	Increase in selling price necessary Rs. (62.75 – 60)		2.75
(iii)	Fixed overhead recovery rate:			
		Fixed factory overheads		Rs. 21,60,000
		Normal Production		2,70,000 units
		Absorption Rate per unit : 21,60,000 / 2,70,000 = Rs. 8		
		Stock analysis:		
			Units	
		Opening stocks	15,000	
		Add: Production	2,40,000	
		Total	2,55,000	
		Less: Sales	2,25,000	
		Closing stocks	30,000	

1. Profitability based on Absorption Costing Method:

	Rs.	Rs.
A. Sales (2,25,000 units @ Rs. 60)		<u>1,35,00,000</u>
B. Production costs:		
Variable factory cost:(2,40,000 units × Rs. 33)	79,20,000	
Increase in cost	1,20,000	
Fixed factory costs (2,40,000 units × Rs. 8)	<u>19,20,000</u>	
Total production costs	99,60,000	
Less: Closing stock		
(30,000 units × 99,60,000) / 2,40,000	<u>12,45,000</u>	
	87,15,000	
Add: Opening stock 15,000 units × Rs. 41*	<u>6,15,000</u>	
Production cost of goods sold		93,30,000
C. Selling and Administration Costs:		
Variable costs: 2,25,000 units × Rs. 9	20,25,000	
Fixed Costs	<u>7,56,000</u>	<u>27,81,000</u>
D. Less: Total cost of goods sold (B + C)		<u>1,21,11,000</u>
		13,89,000
Less: Under absorption of factory fixed overheads		
(2,40,000 – 2,70,000 units) × Rs. 8		<u>2,40,000</u>
Profit		<u>11,49,000</u>
*Cost of opening stock (per unit) = Variable Factory cost + Fixed overhead recovery rate		
= Rs. 33 per unit + Rs. 8 per unit		
= Rs. 41 per unit.		

Profitability based on Marginal Costing Method:

	Rs.	Rs.
A Sales (2,25,000 units @ Rs. 60)		<u>1,35,00,000</u>
Production variable costs:		
Variable cost (2,40,000 units × Rs. 33)	79,20,000	
Increase in cost	<u>1,20,000</u>	
Total	80,40,000	

Less: Closing stock:		
	(30,000 × 80,40,000) / 2,40,000	<u>10,05,000</u>
		70,35,000
Add: Opening Stock (15,000 units × Rs. 33)		<u>4,95,000</u>
B	Production variable cost of goods sold	75,30,000
C	Variable Selling & Administrative Expenses (2,25,000 × Rs. 9)	20,25,000
D	Total variable costs (B + C)	<u>95,55,000</u>
E	Contribution (A – D)	39,45,000
F	Less: Fixed overheads: Factory	21,60,000
	Selling & Administration	<u>7,56,000</u>
		<u>29,16,000</u>
G	Profit (E – F)	<u>10,29,000</u>

Question 2

- (a) Discuss the benefits accruing from the implementation of a Total Quality Management programme in an organization.
- (b) Explain the concept of relevancy of cost by citing three examples each of relevant costs and non-relevant costs.
- (c) A manufacturing company has furnished the following financial data relating to the actual output of 9,600 units produced in the last quarter:

		Rs.
Sales		4,45,500
Costs:		
Direct Materials	59,400	
Direct Wages	89,400	
Variable Overheads	1,45,500	
Fixed Overheads	<u>78,000</u>	<u>3,72,300</u>
Profit		<u>73,200</u>

The standard wage rate is Rs. 4.50 per hour and the standard variable overhead rate is Rs. 7.50 per hour. The company uses a JIT system and the budgeted production and sales quantity is 10,000 units.

The following are the variances from standard costs recorded during the last quarter:

		Rs.
Direct materials	Price V	600 A
	Usage V	1,200 A
Direct Wages	Rate V	1,500 F
	Efficiency V	4,500 A
Variable Overheads	Expense V	6,000 F
	Efficiency V	7,500 A
Fixed Overheads	Expense V	3,000 A
Sales	Price V	13,500 F

You are required to:

- (i) Prepare the Original budget and Standard cost sheet per unit of output;
- (ii) Produce a statement reconciling the budgeted profit with actual profit.

(4 + 4 + 11 = 19 Marks)

Answer

- (a) The benefits accruing from the implementation of a Total Quality Management programme in an organisation are:
 - (i) There will be increased awareness of quality culture in the organization.
 - (ii) It will lead to commitment to continuous improvement.
 - (iii) It will focus on customer satisfaction.
 - (iv) A greater emphasis on team work will be achieved.
- (b) Relevant costs are those costs which are pertinent to a decision. In other words, these are the costs which are influenced by a decision. Those costs which are not affected by the decision are not relevant costs.

Examples of relevant costs are:

- (1) All variable costs are relevant costs.
- (2) Fixed Costs which vary with the decision are relevant costs.
- (3) Incremental costs are relevant costs.

Examples of non-relevant costs:

- (1) All fixed costs are generally non-relevant.
- (2) Variable costs which do not vary with the decision are not relevant costs.
- (3) Book value of the asset is not relevant.

SQ	AQ	SP	SQ × SP	AQ × SP	AP	AQ × AP
			└──────────┘		└──────────────────────────┘	
			Usage variance		Price variance	
			1200 A		600 A	
						59,400

$$AQ \times SP = 58,800^1$$

$$SQ \times SP = 57,600^2$$

Standard cost of materials for actual output of 9,600 units = Rs. 57,600.

Hence, standard cost per unit is $57,600 / 9,600 = \text{Rs. } 6.$

SH	AH	SR	SH × SR	AH × SR	AR	AH × AR
			└──────────┘ └──────────────────────────┘			89,400
			Efficiency variance		Rate variance	
			4500 A		1500 F	

$$AH \times SR = 90,900^3$$

$$SH \times SR = 86,400^4$$

Standard wage cost per unit is $86,400 / 9,600 = \text{Rs. } 9$.

Standard wage rate is Rs. 4.50.

Standard time per unit is $9/4.5 = 2$ hours.

Standard rate is Rs. 7.50 per hour

Standard cost per unit is 2 hours $\times$ Rs. 7.50 = Rs. 15.

Actual units	9,600
Standard time / unit 2 hours	
Standard hours produced	$9,600 \times 2 = 19,200$ hours
Actual overheads	78,000
Expense variance	3,000 A
Budgeted overheads	75,000

Cost variances:

		F	A	
Materials:	Price		600	
	Usage		1,200	
Direct Labour:	Rate	1,500		
	Efficiency		4,500	
Variable Overhead:	Efficiency		7,500	
	Expense	6,000		
Fixed Overhead:	Volume		3,000	
	Expense	<u> </u>	<u>3,000</u>	
Total variances		<u>7,500</u>	<u>19,800</u>	12,300 A
Actual profit				73,200

Working Notes:

- (1) Price Variance = $[SP - AP] AQ$
 $600 (A) = [SP \times AQ - 59,400]$
 $SP \times AQ = 58,800.$
- (2) Usage Variance = $[SQ \times SP] - [AQ \times SP]$
 $1200 (A) = SQ \times SP - 58,800$
 $SQ \times SP = 57,600.$
- (3) Rate Variance = $[SR - AR] AH$
 $1500 (F) = SR \times AH - 89,400$
 $SR \times AH = 90,900.$
- (4) Efficiency Variance = $[SH - AH] \times SR$
 $4500 (A) = SH \times SR - 90,900$
 $SH \times SR = 86,400.$
- (5) Price Variance = $(AP - SP) \times AQ$
 $13500 (F) = SP \times AQ - 4,45,500$
 $SP \times AQ = 4,59,000.$

Question 3

- (a) Describe the four types of bench marking of critical success factors.
- (b) Explain, how the implementation of JIT approach to manufacturing can be a major source of competitive advantage.
- (c) A project consists of seven activities and the time estimates of the activities are furnished as under:

Activity	Optimistic Days	Most likely Days	Pessimistic Days
1–2	4	10	16
1–3	3	6	9
1–4	4	7	16
2–5	5	5	5
3–5	8	11	32
4–6	4	10	16
5–6	2	5	8

Required:

- (i) Draw the network diagram.
- (ii) Identify the critical path and its duration.
- (iii) What is the probability that the project will be completed in 5 days earlier than the critical path duration?
- (iv) What project duration will provide 95% confidence level of completion ($Z_{0.95} = 1.65$) ?

Given

Z	1.00	1.09	1.18	1.25	1.33
Probability	0.1587	0.1379	0.1190	0.1056	0.0918

(4 + 4 + 11 = 19 Marks)

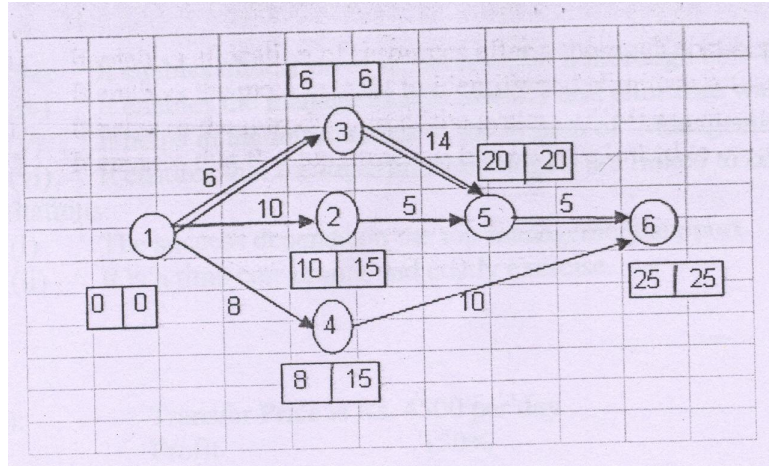
Answer

- (a) The Benchmarking is of following types:
- (i) Competitive benchmarking: It involves the comparison of competitors products, processes and business results with own.
- (ii) Strategic benchmarking: It is similar to the process benchmarking in nature but differs in its scope and depth.

- (iii) Global benchmarking: It is a benchmarking through which distinction in international culture, business processes and trade practices across companies are bridged and their ramification for business process improvement are understood and utilized.
 - (iv) Process benchmarking: It involves the comparison of an organisation critical business processes and operations against best practice organization that performs similar work or deliver similar services.
 - (v) Functional Benchmarking or Generic Benchmarking: This type of benchmarking is used when organisations look to benchmark with partners drawn from different business sectors or areas of activity to find ways of improving similar functions or work processes.
 - (vi) Internal Benchmarking: It involves seeking partners from within the same organization, for example, from business units located in different areas.
 - (vii) External Benchmarking: It involves seeking help of outside organisations that are known to be best in class. External benchmarking provides opportunities of learning from those who are at the leading edge, although it must be remembered that not every best practice solution can be transferred to others.
- (b) JIT provides competitive advantage in the following ways:
- (i) Stocks of raw materials and finished goods are eliminated, stock holding costs are avoided.
 - (ii) JIT aims at elimination of non-value added activities and elimination of cost in this direction will improve competitive advantage.
 - (iii) It affords flexibility to customer requirements where the company can manufacture customized products and the competitive advantage is thereby improved.
 - (iv) It focuses the direction of performance based production of high quality product.
 - (v) It minimize waiting times and transportation costs.
- (c) Calculation of expected time and variance of each activity:

Activity	Optimistic Days	Most likely Days	Pessimistic Days	Expected Duration	Variance
1–2	4	10	16	10	4
1–3	3	6	9	6	1
1–4	4	7	16	8	4
2–5	5	5	5	5	0
3–5	8	11	32	14	16
4–6	4	10	16	10	4
5–6	2	5	8	5	1

The network diagram is as under:



Critical Path:	1–3	3–5	5–6
Duration (days)	6	14	5 = 25 days
Standard deviation:	1 + 16 + 1 = 18		
	$\sqrt{18} = 4.24$		

Probability that the project will be completed five days earlier:

$$Z = \frac{20 - 25}{4.24} = -1.18.$$

According to probability values given in the question probability is 11.9%

To obtain 95% confidence level:

$$1.65 = \frac{X - 25}{4.24}$$

$$X - 25 = 6.996$$

$$X = 32 \text{ days}$$

Question 4

- State the methods in which initial feasible solution can be arrived at in a transportation problem.
- State the advantages and limitations of Zero Based Budgeting.
- A large business consultancy firm is organized in to several divisions. One of the divisions is the Information Technology (IT) division which provides consultancy services

to its clients as well as to the other divisions of the firm. The consultants in the IT divisions always work in a team of three professional consultants on each day of consulting assignment. The external clients are charged a fee at the rate of Rs. 4,500 for each consulting day. The fee represents the cost plus 150% profit mark up. The break up of cost involved in the consultancy fee is estimated at 80% as being variable and the balance is fixed.

The textiles division of the consultancy firm which has undertaken a big assignment requires the services of two teams of IT consultants to work five days in a week for a period of 48 weeks. While the director of the textiles division intends to negotiate the transfer price for the consultancy work, the director of IT division proposes to charge the textiles division at Rs. 4,500 per consulting day.

In respect of the consulting work of the textiles division, IT division will be able to reduce the variable costs by Rs. 200 per consulting day. This is possible in all cases of internal consultations because of the use of specialized equipment.

You are required to explain the implications and set transfer prices per consulting day at which the IT division can provide consultancy services to the textiles division such that the profit of the business consultancy firm as a whole is maximized in each of the following scenarios:

- (i) Every team of the IT division is fully engaged during the 48 week period in providing consultancy services to external clients and that the IT division has no spare capacity of consultancy teams to take up the textiles division assignment.
- (ii) IT division will be able to spare only one team of consultants to provide services to the textiles division during the 48 week period and all other teams are fully engaged in providing services to external clients.
- (iii) A new external client has come forward to pay IT division a total fee of Rs. 15,84,000 for engaging the services of two teams of consultants during the aforesaid period of 48 weeks. (3 + 5 + 11 = 19 Marks)

Answer

- (a) The methods by which initial feasible solution can be arrived at in a transportation model are as under:
 - (i) North West Corner Method.
 - (ii) Least Cost Method
 - (iii) Vogel's Approximation Method (VAM)
- (b) Advantages of zero based budgeting:
 - (i) It provides a systematic approach to the evaluation of different activities for ranking them for resource allocation.

- (ii) It ensures that the activities undertaken for achievement of the company's objectives are performed in the best possible way.
- (iii) It enables allocation of resources after a thorough cost-benefit analysis.
- (iv) It enables the management to identify and eliminate wasteful expenditure.
- (v) It helps in the introduction of the system of 'Management by Objectives'.
- (vi) It ensures that the departmental budgets are linked to corporate objectives.

Limitations:

- (i) The success of zero based budgeting depends on the top management support.
 - (ii) It is a time consuming and costly exercise.
- (c) Transfer Price is Rs. 4,500 for each consulting day.

Profit mark-up = 150%

Let cost = x

$$\begin{aligned}\text{Profit} &= x \times \frac{150}{100} \\ &= 1.5x\end{aligned}$$

Cost + profit = Transfer price

$$\Rightarrow x + 1.5x = 4,500$$

$$\Rightarrow 2.5x = 4,500$$

$$\Rightarrow x = \frac{4,500}{2.5} = 1,800$$

$\therefore$ Cost = Rs. 1,800

and profit = $1.5x = 1.5 \times 1,800$
= Rs. 2,700

Variable cost (80%) = Rs. 1,800 $\times$ 80%
= Rs. 1,440

Fixed cost (20%) = Rs. 1,800 $\times$ 20%
= Rs. 360.

Scenario (i):

Every consultancy team is fully engaged. There is no idle time or spare capacity.

Hence, transfer price = Marginal cost plus opportunity cost

Marginal cost = Rs. 1,440

Saving for internal work = Rs. 200

Net Marginal Cost = Rs. 1,240

Opportunity cost is the lost contribution.

Lost contribution = Contribution from external client

= Fee charged from external client – Variable cost

= Rs. (4,500 – 1,440)

= Rs. 3,060.

∴ Transfer price = Rs. 1,240 + 3,060

= Rs. 4,300 per consulting day per team.

Scenario (ii):

One team is idle. Idle time has no opportunity cost. Variable cost for internal work is Rs. 1,240 per consulting day. Second team is busy. Hence opportunity cost is relevant in case of second team. Hence charge of second team is Rs. 4,300 per consulting day per team.

Average of charge of two teams = Rs. (1,240 + 4,300) / 2

= Rs. 2,770 per consulting day per team.

Scenario (iii):

New client offers a fee of Rs. 15,84,000

Duration: 5 days of 48 weeks × 2 teams = 480 days

Fee per day 15,84,000 / 480 = Rs. 3,300

Variable cost = Rs. 1,440

Contribution Rs. (3,300 – 1,440) = Rs. 1,860

Fee for consulting day for internal work:

Variable cost = Rs. 1,240

Contribution lost = Rs. 1,860

Fee to be charged = Rs. 3,100 per consulting day per team.

Question 5

- State the characteristic features of a database created for operational control and decision making.
- Discuss, how target costing may assist a company in controlling costs and pricing of products.
- The costs and selling prices per unit of two products manufacturing by a company are as under:

Product	A (Rs.)	B (Rs.)
Selling Price	500	450
Variable costs:		

Direct Materials @ Rs. 25 per kg.	100	100
Direct Labour @ Rs. 20 per hour	80	40
Painting @ Rs. 30 per hour	30	60
Variable overheads	190	175
Fixed costs @ Rs. 17.50/D.L.Hr.	70	35
Total costs	470	410
Profit	30	40

In any month the maximum availability of inputs is limited to the following:

Direct Materials	480 kg.
Direct Labour hours	400 hours
Painting hours	200 hours

Required:

- (i) Formulate a linear programme to determine the production plan which maximizes the profits by using graphical approach.
- (ii) State the optimal product mix and the monthly profit derived from your solution in (i) above.
- (iii) If the company can sell the painting time at Rs. 40 per hour as a separate service, show what modification will be required in the formulation of the linear programming problem. You are required to re-formulate the problem but not to solve.

(4 + 4 + 11 = 19 Marks)

Answer

- (a) The characteristic features of a data-base created for operational control and decision making are as under:
 - (i) There should be a file structure that facilitates the association of one internal record with other internal records.
 - (ii) There should be cross functional integration of files.
 - (iii) Independence of program / data file for ease of updating and maintenance of data base.
 - (iv) There must be common standards throughout with respect to data definitions, record formats and other data descriptions.
 - (v) A data dictionary should be available.
- (b) Target costing may assist control of costs and pricing of product as under:
 - (i) Target costing considers the price that ought to be charged by a company to achieve a given market share.

- (ii) Target costing should take life cycle costs in to consideration.
- (iii) If there is a gap between the target cost and expected cost, ways and means of reducing or eliminating it can be explored.
- (iv) The target cost may be used for controlling costs by comparison.

(c) Contribution analysis:

Products	A	B
	(Rs.)	(Rs.)
Selling price (A)	<u>500</u>	<u>450</u>
Variable costs:		
Direct Materials	100	100
Direct Labour	80	40
Painting	30	60
Variable Overheads	<u>190</u>	<u>175</u>
Total variable costs (B)	<u>400</u>	<u>375</u>
Contribution (A – B)	<u>100</u>	<u>75</u>
Direct Material per unit	100/25 = 4 kg.	100/25 = 4 kg.
Direct Labour hour per unit	80/20 = 4 hours	40/20 = 2 hours
Painting hour per unit	30/30 = 1 hour	60/30 = 2 hours

Let A be the units to be produced of product A and B be the units to be produced of product B.

LP Problem formulation:

Z Max 100A + 75B Maximisation of contribution

Subject to:

$4A + 4B \leq 480$	Raw material constraint
$4A + 2B \leq 400$	Direct Labour hour constraint
$A + 2B \leq 200$	Painting hour constraint
$A, B \geq 0$	Non negativity constraint

Raw Material Constraint : Put B = 0, A = 120

Put A = 0, B = 120

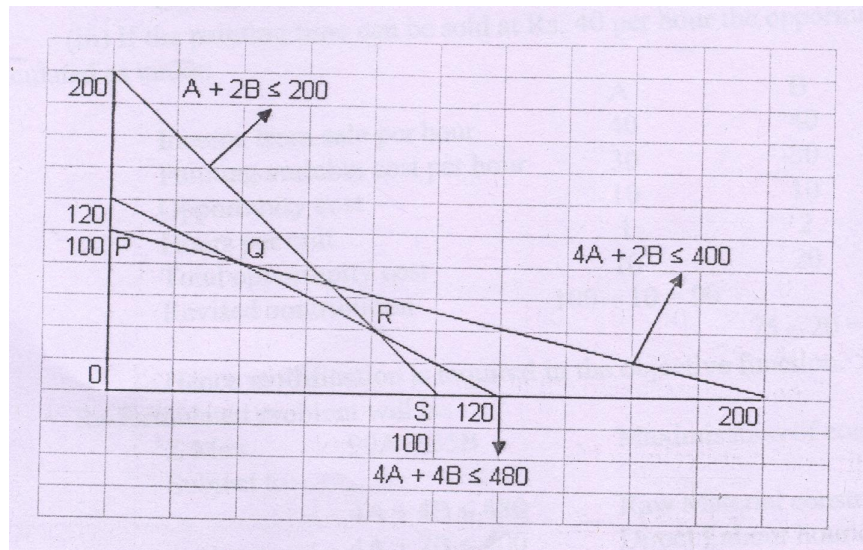
Direct Labour Constraint : Put B = 0, A = 100

Put A = 0, B = 200

Painting Constraint : Put $B = 0$, $A = 200$

Put $A = 0$, $B = 100$

The graphical representation will be as under:



Q Intersects $4A + 2B = 400$ (1)

and $4A + 4B = 480$ (2)

Subtracting (2) from (1), we get $-2B = -80$

$$\Rightarrow B = 80/2 = 40$$

Putting value of B in (1), we get $4A + 2 \times 40 = 400$

$$\Rightarrow A = \frac{400 - 80}{4} = 80$$

R Intersects $4A + 4B = 480$ (3)

and $A + 2B = 200$ (4)

Multiplying (4) by (2) and then subtracting from (3), we get

$$2A = 80$$

$$\Rightarrow A = 40$$

Putting the value of A in (4), we get $2B = 200 - 40$

$$\Rightarrow B = 80.$$

Evaluation of corner points:

Point	Products		Contribution		Total Contribution
	A	B	A (Rs.)	B (Rs.)	Rs.
			100 per unit	75 per unit	
P	0	100	0	7,500	7,500
Q	80	40	8,000	3,000	11,000
R	40	80	4,000	6,000	10,000
S	100	0	10,000	0	10,000

Optimal product mix is Q

Product	Units	Contribution
		Rs.
A	80	8,000
B	40	3,000
Total contribution		11,000
Less: Fixed costs 400 D.L. Hrs. × Rs. 17.50		7,000
Optimal Profit		4,000

- (iii) If the painting time can be sold at Rs. 40 per hour the opportunity cost is calculated as under:

	A	B
	(Rs.)	(Rs.)
Income from sale per hour	40	40
Painting variable cost per hour	30	30
Opportunity cost	10	10
Painting hours per unit	1	2
Opportunity cost	10	20
Revised contribution	$100 - 10 = 90$	$75 - 20 = 55$

Hence, modification is required in the objective function.

Re-formulated problem will be:

Z Max.	$90A + 55B$	Maximisation of contribution
Subject to:		
	$4A + 4B \leq 480$	Raw Material constraint
	$4A + 2B \leq 400$	Direct Labour hour constraint
	$A + 2B \leq 200$	Painting hour constraint
	$A, B \geq 0$	Non-negativity constraint

Question 6

- (a) Enumerate the uses of Pareto Analysis.
- (b) A single counter ticket booking centre employs one booking clerk. A passenger on arrival immediately goes to the booking counter for being served if the counter is free. If, on the other hand, the counter is engaged, the passenger will have to wait. The passengers are served on first come first served basis. The time of arrival and the time of service varies from one minute to six minutes. The distribution of arrival and service time is as under:

Arrival / Service Time (Minutes)	Arrival (Probability)	Service (Probability)
1	0.05	0.10
2	0.20	0.20
3	0.35	0.40
4	0.25	0.20
5	0.10	0.10
6	0.05	—

Required:

- (i) Simulate the arrival and service of 10 passengers starting from 9 A.M. by using the following random numbers in pairs respectively for arrival and service. Random numbers 60 09 16 12 08 18 36 65 38 25 07 11 08 79 59 61 53 77 03 10.
- (ii) Determine the total duration of
- (1) Idle time of booking clerk and
 - (2) Waiting time of passengers.
- (c) A city health centre provides health and other related services to the citizens who are covered under insurance plan. The health centre receives a payment from the insurance company each time any patient attends the centre for consultation as under:

Consultations involving	Payment from Insurance company
	Rs.
No treatment	60
Minor treatment	250
Major treatment	500

In addition, the adult patients will have to make a co-payment which is equivalent to the amount of payment for the respective category of treatment made by the insurance company. However, children and senior citizens are not required to make any such co-payment.

The health centre will remain open for 6 days in a week for 52 weeks in a year. Each physician treated 20 patients per day although the maximum number of patients that could have been treated by a physician on any working day is 24 patients.

The health centre received a fixed income of Rs. 2,25,280 per annum for promotion of health products from the manufacturers.

The annual expenditure of the health centre is estimated as under:

Materials and consumable (100% variable)	Rs. 22,32,000
Staff salaries per annum per employee (fixed):	
Physician	Rs. 4,50,000
Assistants	Rs. 1,50,000
Administrative staff	Rs. 90,000
Establishment and other operating costs (fixed)	Rs. 16,00,000

The non-financial information is as under:

(i) Staff:

Number of physicians employed	6
Assistants	7
Administrative staff	2

(ii) Patient Mix:

Adults	50%
Children	40%
Senior Citizens	10%

(iii) Mix of patient appointments (%)

Consultation requiring no treatment	70%
Minor treatment	20%
Major treatment	10%

Required:

- (i) Calculate the Net income of the city health centre for the next year;
- (ii) Determine the percentage of maximum capacity required to be utilized next year in order to break even. (3 + 8 + 8 = 19 Marks)

Answer

(a) Pareto analysis is useful to:

- (i) Prioritize problems, goals and objectives.
- (ii) Identify the root causes.
- (iii) Select and define the key quality improvement programs, key employee relations improvement programs etc.
- (iv) Verify the operating procedures and manufacturing processes.
- (v) Allocate physical, financial and human resources effectively.
- (vi) Maximise research and product development time.

(b) Random allocation tables are as under:

Time (Mts)	Arrival (Probability)	Arrivals Cumulative Probability	Random No. allocated	Time (Mts)	Service (Probability)	Service Cumulative (Probability)	Random No. allocated
1	0.05	0.05	00-04	1	0.10	0.10	00-09
2	0.20	0.25	05-24	2	0.20	0.30	10-29
3	0.35	0.60	25-59	3	0.40	0.70	30-69
4	0.25	0.85	60-84	4	0.20	0.90	70-89
5	0.10	0.95	85-94	5	0.10	1.00	90-99
6	0.05	1.00	95-99				

Simulation of ten trails:

R. No.	Arrival Mts.	Time	Start	R. No.	Time Mts.	Finish Time	Waiting Time	
							Clerk	Passanger
60	4	9.04	9.04	09	1	9.05	4	
16	2	9.06	9.06	12	2	9.08	1	
08	2	9.08	9.08	18	2	9.10	—	
36	3	9.11	9.11	65	3	9.14	1	
38	3	9.14	9.14	25	2	9.16	—	
07	2	9.16	9.16	11	2	9.18	—	
08	2	9.18	9.18	79	4	9.22	—	
59	3	9.21	9.22	61	3	9.25	—	1
53	3	9.24	9.25	77	4	9.29		1
03	1	9.25	9.29	10	2	9.31	—	<u>4</u>
Total							<u>6</u>	<u>6</u>

In half an hour trial, the clerk was idle for 6 minutes and the passengers had to wait for 6 minutes.

(c) (1) Total number of patients attended

Number of patients attended per day by a physician: 20

Number of physicians employed 6

Number of days in week 6

Number of weeks in a year 52

Total number of patients attended = $20 \times 6 \times 6 \times 52 = 37,440$.

(2) Patient Mix:

Adults (50%) $37,440 \times 50/100 = 18,720$

Children (40%) $37,440 \times 40/100 = 14,976$

Senior Citizens (10%) $37,440 \times 10/100 = \underline{3,744}$

37,440

(3) Patient Appointments:

No treatment required (70%) $37,440 \times 70/100 = 26,208$

Minor treatment (20%) $37,440 \times 20/100 = 7,488$

Major treatment (10%) $37,440 \times 10/100 = \underline{3,744}$

37,440

(4) Income from Insurance Companies:

	Number of patients	Rs.	Rs.
	(A)	(B)	(A × B)
No treatment patients	26,208	60	15,72,480
Minor treatment patients	7,488	250	18,72,000
Major treatment patients	3,744	500	<u>18,72,000</u>
Total			<u>53,16,480</u>

(5) Co-payment from adult patients:

	Number of patients	Payment (Rs.)	Total payment (Rs.)
Total number of adult patients	18,720		
No treatment patients (70%)	13,104	60	7,86,240
Minor treatment (20%)	3,744	250	9,36,000
Major treatment (10%)	1,872	500	<u>9,36,000</u>
Total			<u>26,58,240</u>

(6) Net income:

	Rs.	Rs.
Payment from Insurance companies	53,16,480	
Co-payment from adult patients	<u>26,58,240</u>	
Total	79,74,720	
Other Income (fixed)	<u>2,25,280</u>	
Total Income (A)		82,00,000
Less: Expenditure		
Variable expenses:		
Material and consumables	22,32,000	
Fixed expenses:		
Physician's salary (6 × 4,50,000)	27,00,000	
Assistants salary (7 × 1,50,000)	10,50,000	

Administrative staff's salary ($2 \times 90,000$)	1,80,000	
Establishment and other operating costs	16,00,000	<u>55,30,000</u>
Total Expenditure (B)		<u>77,62,000</u>
Net Income (A – B)		<u>4,38,000</u>

(ii) 1. Contribution Analysis:

	(Rs.)
Total Fees from Insurance Companies and adult patients	79,74,720
Less: Variable costs	22,32,000
Contribution	57,42,720
Average contribution per patient	$\frac{57,42,720}{37,440} = 153.38$

2. Break-even patients:

	(Rs.)
Fixed costs	55,30,000
Less: Fixed income	2,25,280
Net Fixed costs	53,04,720
Break-even patients = $\frac{\text{Net fixed costs}}{\text{Contribution per patient}}$	$\frac{53,04,720}{153.38} = 34,585$

3. Percentage of maximum capacity required to be utilized in order to break-even

$$\text{Present utilization} = \frac{20 \text{ patients}}{24 \text{ patients}} = 83.33\% = 37,440$$

$$100\% \text{ patient capacity is } \frac{37,440}{0.8333} = 44,930 \text{ patients}$$

Percentage of maximum capacity required to be utilized in order to break-even

$$= \frac{\text{Break - even patients}}{100\% \text{ patient capacity}} \times 100$$

$$= \frac{34,585}{44,930} \times 100 = 76.98\% \text{ say } 77\%.$$

Assumption: Patient mix and mix of patient appointments will be same in the next year.