PAPER – 5: ADVANCED MANAGEMENT ACCOUNTING

QUESTIONS

Total Quality Management – Quality Cost (Two Wheeler, Manufacturer)

1. Hindustan Bikes Ltd. (HBL) formerly known as HELCO is an Indian multinational company. It's headquarter is located in Bengaluru, India. It has been founded in the year 1990 as a manufacturer of locomotives. The company is presently listed locally as well as in international stock market. HBL's parent company is Hindustan Group. The management of HBL recognizes the need to establish a culture at the company so that -

   "Do the right things, right the first time, every time".

   Management has provide you following actual information for the most recent month of the current year:

   Cost Data ₹

Customer Support Centre Cost	35 per hr.
Equipment Testing Cost	18 per hr.
Warranty Repair Cost	1,560 per bike
Manufacturing Rework Cost	228 per bike

   Volume and Activity Data

Bikes Requiring Manufacturing Rework	3,200 bikes
Bikes Requiring Warranty Repair	2,600 bikes
Production Line Equipment Testing Time	1,600 hrs.
Customer Support Centre Time	2,000 hrs.

   Additional information

   HBL carried out a quality review of its existing suppliers to enhance quality levels during the month at a cost of ₹1,25,000. Due to the quality issues in the month, the bike production line experienced unproductive 'down time' which cost ₹7,70,000.

   Required:

   Prepare a statement showing 'Total Quality Cost'.

Life Cycle Analysis

2. P & G International Ltd. (PGIL) has developed a new product "K" which is about to be launched into the market and anticipates to sell 80,000 of these units at a sales price of ₹300 over the product's life cycle of four years. Data pertaining to product "K" are as follows:

Costs of Design and Development of Molds, Dies, and Other Tools	₹8,25,000
Manufacturing Costs	₹125 per unit
Selling Costs	₹12,500 per year + ₹100 per unit
Administration Costs	₹50,000 per year
Warranty Expenses	5 Replacement Parts per 25 units at ₹10 per part ; 1 Visit per 500 units (Cost ₹ 500 per visit)

Required:

(i) Compute the product "K"'s 'Life Cycle Cost'.

(ii) Suppose PGIL can increase sales volume by 25% through 10% reduction in selling price. Should PGIL choose the lower price?

Decision Making using BEP Analysis

3. You have been approached by a friend who is seeking your advice as to whether he should give up his job as an engineer, with a current salary of ₹14,800 per month and go into business on his own assembling and selling a component which he has invented. He can procure the parts required to manufacture the component from a supplier.

It is very difficult to forecast the sales potential of the component, but after some research, your friend has estimated the sales as follows:

(i) Between 600 to 900 components per month at a selling price of ₹250 per component.

(ii) Between 901 to 1,250 components per month at a selling price of ₹ 220 per component for the entire lot.

The costs of the parts required would be ₹ 140 for each completed component. However if more than 1,000 components are produced in each month, a discount of 5% would be received from the supplier of parts on all purchases.

Assembly costs would be ₹ 60,000 per month up to 750 components. Beyond this level of activity assembly costs would increases to ₹ 70,000 per month.

Your friend has already spent ₹ 30,000 on development, which he would write – off over the first five years of the venture.

Required:

(i) Calculate for each of the possible sales levels at which your friend could expect to benefit by going into the venture on his own.

(ii) Calculate the 'Break – Even Point' of the venture for each of the selling price.

(iii) Advice your friend as to the viability of the venture.

Minimum Price – Relevant Cost Concept

4. XL Polymers, located in Sahibabad Industrial Area, manufactures high quality industrial products. AT Industries has asked XL Polymers for a special job that must be completed within one week.

   Raw material R_1 (highly toxic) will be needed to complete the AT Industries' special job. XL Polymers purchased the R_1 two weeks ago for ₹7,500 for a job 'A' that recently was completed. The R_1 currently in stock is the excess from that job and XL Polymers had been planning to dispose of it. XL Polymers estimates that it would cost them ₹1,250 to dispose of the R_1. Current replacement cost of R_1 is ₹6,000.

   Special job will require 250 hours of labour G_1 and 100 hours of labour G_2. XL Polymers pays their G_1 and G_2 employees ₹630 and ₹336 respectively for 42 hours of work per week. XL Polymers anticipates having excess capacity of 150 [G_1] and 200 [G_2] labour hours in the coming week. XL Polymers can also hire additional G_1 and G_2 labour on an hourly basis; these part-time employees are paid an hourly wage based on the wages paid to current employees.

   Suppose that material and labour comprise XL Polymers's only costs for completing the special job.

   Required:

   Calculate the 'Minimum Price' that XL Polymers should bid on this job?

Flexible Budget – Basic Concepts

5. The PLN Co. presents the following static budgets for 4,000 units and 6,000 units activity levels for October 2014:

	Activity Level	
	4,000 units	**6,000 units**
Overhead A ₹ 12/hr. x 2 hr. / unit	96,000	1,44,000
Overhead B	1,40,000	1,90,000

   Overhead C was omitted to be listed out. It is a fixed plant overhead, estimated at ₹ 12.5/hr. at 4,000 units activity level. This has to also feature in the flexible budget. The actual production was 5,000 units and 9,600 hours were needed for production.

   Required:

   Prepare a statement showing the 'Flexible Budget' amount of each overhead to enable appropriate comparison with the actual figures.

Application of Sales Variances (Marketing Company)

6. Universal LTD. is engaged in marketing of wide range of consumer goods. M, N, O and P are the zonal sales officers for your zones. The company fixes annual sales target for them individually.

You are furnished with the following:

(a) The standard costs of sales target in respect of M, N, O and P are ₹ 5,00,000, ₹ 3,75,000, ₹ 4,00,000 and ₹ 4,25,000 respectively.

(b) M, N, O and P respectively earned ₹ 29,900, ₹ 23,500, ₹ 24,500 and ₹ 25,800 as commission at 5% on actual sales effected by them during the previous year.

(c) The relevant variances as computed by a qualified accountant are as follows:

Particulars	M (₹)	N (₹)	O (₹)	P (₹)
Sales Price Variance	4,000 (F)	6,000 (A)	5,000 (A)	2,000 (A)
Sales Volume Variance	6,000 (A)	26,000 (F)	15,000 (F)	8,000 (F)
Sales Margin Mix Variance	14,000 (A)	8,000 (F)	17,000 (F)	3,000 (A)

Note: (A) = Adverse variance and (F) = Favorable variance

Required:

(i) Compute the amount of 'Sales Target Fixed' and the 'Actual Margin Earned' in case of each of the zonal sales officer.

(ii) Evaluate the overall performance of these zonal sales officers taking three relevant base factors and then recommend whose performance is the best.

Interpretation of Variances and CSFs (Spices Manufacturer)

7. Natural Spices manufactures and distributes high-quality spices to gourmet food shops and top quality restaurants. Gourmet and high-end restaurants pride themselves on using the freshest, highest-quality ingredients.

Natural Spices has set up five state of the art plants for meeting the ever growing demand. The firm procures raw material directly from the centers of produce to maintain uniform taste and quality. The raw material is first cleaned, dried and tested with the help of special machines. It is then carefully grounded into the finished product passing through various stages and packaged at the firm's ultraclean factory before being dispatched to customers.

The following variances pertain to last week of operations, arose as a consequence of management's decision to lower prices to increase volume.

Sales Volume Variance	18,000 (F)
Sales Price Variance	14,000 (A)
Purchase Price Variance	10,000 (F)
Labour Efficiency Variance	11,200 (F)
Fixed Cost Expenditure Variance	4,400 (F)

Required:

(i) Identify the 'Critical Success Factors' for Natural Spices.

(ii) Evaluate the management's decision with the 'Overall Corporate Strategy' and 'Critical Success Factors'.

Transfer Pricing Based on Opportunity Cost

8. Division Z is a profit center which produces four products A, B, C and D. Each product is sold in the external market also. Data for the period is:

	A	B	C	D
Market Price *per unit* (₹)	150	146	140	130
Variable Cost of Production *per unit* (₹)	130	100	90	85
Labour Hours Required *per unit*	3	4	2	3

Product D can be transferred to Division Y, but the maximum quantity that may be required for transfer is 2,500 units of D.

The maximum sales in the external market are:

A 2,800 units

B 2,500 units

C 2,300 units

D 1,600 units

Division Y can purchase the same product at a price of ₹125 per unit from outside instead of receiving transfer of product D from Division Z.

Required:

Calculate the 'Transfer Price' for each unit for 2,500 units of D, if the total labour hours available in Division Z are 20,000 hours?

Balance Score Card (Banking Company)

9. Your Bank Ltd., was established on the 30th September, 1940 under the provisions of Co-operative Societies Act by the eminent professionals to encourage self-help, thrift, cooperation among members. Bank was issued Banking License under Banking

Regulation Act, 1949 on October 25, 1986 to carry out the Banking Business within the national capital and since then the Bank has been growing continuously. At present, Bank has large number of membership of individuals from different sections. The Bank has 12 branches in the NCT of Delhi. Bank offers 'traditional counter service'. Opening hours are designed to coincide with local market days.

Board of Directors were worried from growing popularity of new style banks. These banks offer *diverse range* of services such as direct access to executive management, a single point of contact to coordinate all banking needs, appointment banking to save time, free online banking services 24/7, free unlimited ATM access etc.

It has now been decided that the bank will focus on "What Customers Want" and will use a balanced scorecard to achieve this goal.

Required:

Produce, for each of the three non-financial perspectives of a 'Balanced Scorecard', an *objective* and a *performance measure* that the bank could use with *appropriate reason*.

Customer Profitability Analysis (Pharmaceutical Firm)

10. Oxford Medical Care Co. (OMCC) is a pharmaceutical firm, operating its entire business through its four customers Ox_1, Ox_2, Ox_3, and Ox_4. Ox_1 and Ox_2 are small pharmaceutical stores while Ox_3 and Ox_4 are large discount stores with attached pharmacies. OMCC uses discount pricing strategy and prices its products at variable cost plus 25%.

Item	Small Pharmaceuticals		Large Pharmaceuticals		Activity Rate
	Ox_1	Ox_2	Ox_3	Ox_4	
Number of Orders	4	9	6	3	₹750
Order Size	₹40,000	₹20,000	₹4,25,000	₹4,00,000	n/a
Average Discount	4.50%	9.50%	17.50%	11.50%	n/a
Regular Deliveries	4	9	6	3	₹375
Expedited Deliveries	2	0	2	0	₹1,250
General Administration Cost	₹20,250		₹48,375		

Required:

(i) Prepare a 'Customer Profitability Statement' that shows the profit from each customer and each customer channel.

(ii) Recommend some points to improve OMCC's profit.

Balance Score Card (Fitness Centre)

11. Fitness Solution is a family owned fitness club, founded in 2010 by Peter and Albert with traditional style equipment. Club commenced operations in February 2011 within a

shopping mall so that members after working out, can conveniently shop, dine, pick up their children from enrichment classes or go to the cinema.

Peter and Albert, the owners, pride themselves for providing a customized / tailored program by taking into account a person's medical history, present fitness level, fitness goals, fitness interests and offer many other small amenities that might be difficult to get in a larger Fitness Centre. They believe –

"Each individual is unique and requires a specialized program plan which should be customized and tailored to his/her needs."

They have a number of loyal members even though they offer the traditional style equipment.

Peter and Albert take care of most of the routine operations, along with a small permanent staff, and temporary staff.

Required:

(i) Identify at least three 'Critical Success Factors' for Fitness Solution.

(ii) Construct a 'Balance Scorecard' for Fitness Solution. *(2 measures for each of the 4 perspectives are sufficient).*

Linear Programming – Simplex Method

12. Given below is an iteration in a simplex table for a maximization objective linear programming product mix problem for products x, y and z. Each of these products is processed in three machines KA-07, KB-27 & KC-49 and each machine has limited available hours.

$C_j \rightarrow$			30	40	20	0	0	0
C_B	Basic Variable (B)	Value of Basic Variables b ($=X_B$)	x	y	z	s_1	s_2	s_3
30	x	250	1	0	-26/16	10/16	-12/16	0
40	y	625	0	1	31/16	-7/16	10/16	0
0	s_3	125	0	0	11/16	-3/16	1/8	1

s_1, s_2 and s_3 are slack variables for machine KA-07, KB-27 and KC-49 respectively. Answer the following questions, giving reasons in brief:

(i) Does the table above give an 'Optimal Solution'?

(ii) Are there more than one 'Optimal Solution' / 'Alternate Optimal Solution'?

(iii) Is this solution 'Feasible'?

(iv) Is this solution 'Degenerate'?

(v) Write down the 'Objective Function' of the problem.

(vi) Write the 'Optimal Product Mix' and 'Profit' shown by the above solution.

(vii) Which of these machines is being used to the full capacity when producing according to this solution?

(viii) How much would you be prepared to pay for another hour of capacity each on machine KA-07, machine KB-27, and machine KC-49?

(ix) If the company wishes to expand the production capacity, which of the three resources should be given priority?

(x) What happens if 16 machine hours are lost due to some mechanical problem in machine KB-27?

(xi) A customer would like to have one unit of product z and is willing to pay higher price for z in order to get it. How much should the price be increased so that the company's profit remains unchanged?

(xii) A new product is proposed to be introduced which would require processing time of 4 hours on machine KA-07, 2 hours on machine KB-27 and 4 hours on machine KC-49. It would yield a profit of ₹12 per unit. Do you think it is advisable to introduce this product?

Transportation Problem – Change in Resource Capacities AND/ OR Destination Requirements

13. The following table shows all the necessary information on the available supply from each warehouse, the requirement of each market and the unit transportation cost in rupees from each warehouse to each market.

Warehouses	Markets				Supply
	I	II	III	IV	
A	5	2	4	3	22
B	4	8	1	6	15
C	4	6	7	5	8
Requirement	7	12	17	9	45/45

The shipping clerk has worked out the following schedule from experience:

12 units from A to II, 1 unit from A to III, 9 units from A to IV, 15 units from B to III, 7 units from C to I and I unit from C to III.

(i) Check if the clerk has made the 'Optimal Schedule'.

(ii) Find the 'Optimal Schedule' and 'Minimum Total Shipping Cost'.

(iii) Carrier of route C to II offers to transport entire supply of warehouse C at a reduced price. By how much must the rate be reduced by the Carrier before the clerk should consider giving him business?

(iv) If the supply from warehouse B reduces to 11 units and simultaneously the requirement of market III reduces to 13 units, find the 'Optimal Transportation Schedule'.

(v) Further, if supply from warehouse A also reduces to 19 units and simultaneously the requirement of III reduces further to 10 units, will the optimal solution of part (iv) change?

Assignment Problem – The Travelling Salesman Problem

14. A salesman has to visit five cities. He wishes to start from a particular city, visit each city once and then return to his starting point. Cost (in ₹ '000) of travelling from one city to another is given below:

	P	Q	R	S	T
P	-	5	14	20	2
Q	17	-	8	23	5
R	23	20	-	11	20
S	35	11	17	-	14
T	2	8	5	23	-

Required:

Find out the 'Least Cost Route'.

Application of Simulation Technique in Project Management

15. The following table gives the activities in a construction project and the time durations with associated probability of each activity:

Activity	Predecessors	Time (in Days)	Probability
A	---	6	0.50
		8	0.50
B	---	4	0.30
		5	0.20
		6	0.50
C	A	8	0.50
		16	0.50

D	A, B	8	0.30
		10	0.70
E	C, D	2	0.20
		4	0.80

To simulate the project, use the following random numbers taking the first five random numbers digits (representing the five activities) for each trial and so on:

11, 16, 23, 72, 94; 83, 83, 02, 97, 99; 83, 10, 93, 4, 33; 53, 49, 94, 37, 7

Required:

Determine the 'Critical Path' and the 'Project Duration' for each trial.

Learning Curve – Steady State

16. AUD International Co. is a multiproduct firm. It is planning to launch a new product 'X-500' in coming months. Production will be in batches of 1,000 units throughout the life of the product. It is also possible to achieve 90% learning rate but the learning would cease after 64th batch. Other relevant data of product 'X-500' is as follows:

Expected Life	2,56,000 units
Selling Price *per unit*	₹123
Direct Material per unit	₹36
Direct Labour Cost *first batch*	₹52,500
Other Variable Costs	₹24
Specific Fixed Cost	₹38,75,000

Required:

(i) Calculate the 'Expected Profit' to be earned from the product over its lifetime.

Note: The learning index for a 90% learning curve is -0.152; $(64)^{-0.152} = 0.5314$; $(63)^{-0.152} = 0.5327$

(ii) It is now thought that a learning effect will continue for all of the 256 batches that will be produced. Calculate the 'Rate of Learning' required to achieve a lifetime product profit of ₹1,00,00,000, assuming that a constant rate of learning applies throughout the product's life.

SUGGESTED ANSWERS/ HINTS

1. Statement Showing "Total Quality Cost"

Particulars of Costs	₹
Prevention Costs	
Supplier Review	1,25,000
Appraisal Costs	
Equipment Testing (₹18 × 1,600 hrs.)	28,800
Internal Failure Costs	
Down Time	7,70,000
Manufacturing Rework (₹228 × 3,200 bikes)	7,29,600
External Failure Costs	
Customer Support (₹35 × 2,000 hrs.)	70,000
Warranty Repair (₹1,560 × 2,600 bikes)	40,56,000
Total Quality Costs	**57,79,400**

2. (i) Statement Showing "K's Life Cycle Cost (80,000 units)"

Particulars	Amount (₹)
Costs of Design and Development of Molds, Dies, and Other Tools	8,25,000
Manufacturing Costs (₹125 × 80,000 units)	1,00,00,000
Selling Costs (₹100 × 80,000 units + ₹12,500 × 4)	80,50,000
Administration Costs (₹50,000 × 4)	2,00,000
Warranty (80,000 units / 25 units × 5 parts × ₹10) (80,000 units / 500 units × 1 visit × ₹500)	 1,60,000 80,000
Total Cost	1,93,15,000

(ii) Statement Showing "K's Life Cycle Cost (1,00,000 units)"

Particulars	Amount (₹)
Costs of Design and Development of Molds, Dies, and Other Tools	8,25,000
Manufacturing Costs (₹125 × 1,00,000 units)	1,25,00,000
Selling Costs (₹100 × 1,00,000 units + ₹12,500 × 4)	1,00,50,000

Administration Costs (₹50,000 × 4)	2,00,000
Warranty (1,00,000 units / 25 units × 5 parts × ₹10) (1,00,000 units / 500 units × 1 visit × ₹500)	 2,00,000 1,00,000
Total Cost	2,38,75,000

Statement Showing "K's Life Time Profit"

Particulars	Amount (₹) 80,000 units	Amount (₹) 100,000 units
Sales	2,40,00,000 (80,000 × ₹300)	2,70,00,000 (1,00,000 × ₹270)
Less: Total Cost	1,93,15,000	2,38,75,000
Profit	46,85,000	31,25,000

Decision

Reducing the price by 10% will decrease profit by 33% (₹15,60,000). Therefore, PGIL should not cut the price.

3. The salary of ₹14,800 per month is a benefit foregone by going into business. It should therefore be considered as a minimum profit which must be earned p.m. from the new venture in order to be not worse – off than before.

Sum of ₹30,000 spent on the development work of the new venture cannot be recovered irrespective of the decision and thus it should be ignored.

At a Selling Price of ₹250

Contribution *per unit* (₹250 – ₹140) ₹110

Minimum Sales (units) to recover *assembly costs* of ₹60,000 p.m. and earn a *profit* of ₹14,800 p.m. (Break – even Sales Level)

$$\frac{₹60,000 + ₹14,800}{₹110} = 680 \text{ units}$$

Note that at 600 units and up to 679 units i.e. units below the break-even level the loss would be ₹110/- per unit. From 680 units up to 750 units i.e. on additional 70 units the total profit would be ₹ 7,700 (70 units × ₹110).

Minimum Sales (units) to recover *assembly cost* of ₹70,000 p.m. and earn a *profit* of ₹14,800 p.m. (Break – even Sales Level)

$$\frac{₹70,000 + ₹14,800}{₹110} = 770.909 \text{ units}$$

If the sales units are more than 770.909 units and up to 900 units, profit would be made. The total amount of profit comes to ₹14,200 [(900 units – 770.909 units) × ₹110]

It is not worthwhile to proceed if the demand of components is less than 680 units or between 750 to 770.909 units.

At a Selling Price of ₹220

Minimum Sales (units) to recover *assembly cost* of ₹70,000 p.m. and earn a *profit* of ₹14,800 p.m. (Break even – Sales Level)

$$\frac{₹70,000 + ₹14,800}{₹220 - ₹140} = 1,060 \text{ units}$$

Minimum Sales (units) to recover *assembly cost* of ₹70,000 p.m. and earn a profit of ₹14,800 p.m.; after availing a discount of 5% on the purchases of all parts.

$$\frac{₹70,000 + ₹14,800}{₹220 - \left(₹140 - \frac{5}{100} \times ₹140\right)} = 974.712 \text{ units}$$

Or 975 units

Conclusion

It is not worthwhile to sell between 900 and 1,000 units when no discount is available. Also, it is worthwhile selling at ₹220 if sales units are in excess of 1,000 units and a discount of 5% is available on the purchase of all components–parts.

Profit on the Sale (1,250 units) ₹23,950 (1,250 units × ₹87 – ₹84,800)

Advice on the viability of the venture

At a selling price of ₹250 he will not be at a loss if the demand of the component exceeds 680 units to 750 units and 770.909 units to 900 units.

At a selling price of ₹220, it is not worthwhile to sell if the demand is less than 1,000 components without availing a discount of 5%.

4. Opportunity Cost of Labour - The G_2 labour has zero opportunity cost as there is no other use for the time already paid for and is available. However, XL Polymers needs to pay an additional amount for G_1 labour. This amount can be save if the special job were not there.

G_1 labour:	
Hours Required	250
Hours Available	150
Extra Hours Needed	100
Cost *per hour* (₹630/42hrs)	₹15
Opportunity Cost	₹1,500

Thus, the 'Opportunity Cost of Labour' for completing the special job is ₹1,500.

Opportunity Cost of Material – XL Polymers has no alternative use for the R_1, they must dispose of it at a cost of ₹1,250. Thus, XL Polymers actually *saves* ₹1,250 by using the materials for the AT Industries' special job. Consequently, the 'Opportunity Cost of Material' is - ₹1,250 (i.e., the opportunity cost of this resource is negative).

The *minimum price* is the price at which XL Polymers just recovers its 'Opportunity Cost'. XL Polymers's 'Total Opportunity Cost' is ₹250 (₹1,500 − ₹1,250). Accordingly, minimum Price for the Special Job is ₹250.

5. Statement Showing "Flexible Budget for 5,000 units Activity Level"

Particulars	Amount (₹)
Overhead A (₹12.00 *per hour* × 2 hrs. *per unit* × 5,000 units)	1,20,000
Overhead B* (₹40,000 + ₹ 25 × 5,000 units)	1,65,000
Overhead C (₹12.50 *per hour* × 2 hrs. *per unit* × 4,000 units)	1,00,000
Total	3,85,000

Working Note (*):

Overhead B

$$\text{Variable Cost (per unit)} = \frac{\text{Change in Overhead Cost}}{\text{Change in Production Units}}$$

$$= \frac{₹1,90,000 - ₹1,40,000}{6,000\text{ units} - 4,000\text{ units}}$$

$$= ₹25$$

$$\text{Fixed Cost} = ₹1,40,000 – 4,000\text{ units} \times ₹25$$

$$= ₹40,000$$

6. Statement Showing "Sales Target Fixed and Actual Margin"

Particulars	Zonal Sales Officers			
	M (₹)	N (₹)	O (₹)	P (₹)
Commissioned Earned	29,900	23,500	24,500	25,800
Actual Sales (Commission Earned/ 5%)	5,98,000	4,70,000	4,90,000	5,16,000
Sales Price Variance	4,000(F)	6,000(A)	5,000(A)	2,000(A)
Sales Volume Variance	6,000(A)	26,000(F)	15,000(F)	8,000(F)

Sales Target (Budgeted Sales)	6,00,000	4,50,000	4,80,000	5,10,000
Standard Cost of Sales Target	5,00,000	3,75,000	4,00,000	4,25,000
Budgeted Margin	1,00,000	75,000	80,000	85,000
Sales Margin Mix Variance	14,000(A)	8,000(F)	17,000(F)	3,000(A)
Sales Price Variance	4,000(F)	6,000(A)	5,000(A)	2,000(A)
Actual Margin	90,000	77,000	92,000	80,000

*Note: Since no information has been given about Sales Margin Quantity Variance, therefore for calculating actual margin the same has been assumed to be **zero**.*

Statement Showing "Evaluation of the Performance of Zonal Sales Officers"

Particulars	Zonal Sales Officers			
	M	N	O	P
Efficiency towards the Target Sales				
(a) Whether target achieved	No	Yes	Yes	Yes
(b) Actual Sales to Target Sales Ratio	99.67%	104.44%	102.08%	101.18%
(c) Rank	IV	I	II	III
Contribution Approach				
(a) Contribution Earned (₹)	90,000	77,000	92,000	80,000
(b) Rank	II	IV	I	III
Margin Vs Sales Ratio				
(a) Budgeted Margin/ Sales Target Ratio	16.67%	16.67%	16.67%	16.67%
(b) Actual Margin Vs Actual Sales Ratio	15.05%	16.38%	18.78%	15.50%
(c) Rank	IV	II	I	III

An analysis on performance of four Zonal Sales Officers based on three base factors, the performance of officer O is the best.

7. **(i)** Gourmet and high-end restaurants recognises Natural Spices on the basis of its *high quality* of spices. Therefore, quality is most critical success factor of Natural Spices. There are other factors which cannot be ignore such as price, delivery options, attractive packing etc. But all are secondary to the quality.

(ii) Deliberate action of cutting price to increase sales volume indicates that firm is intending to expand its market to retail market and street shops which is price sensitive.

Purchase Price Variance is clearly indicating that firm has purchased raw material at lower price which may be due to buying of lower quality of material. Similarly positive *Efficiency Variance* is indicating cost cutting and stretching resources.

It appears that firm is intending to expand its market to retail market and street shops by not only reducing the price but also compromising its quality which is opposing its current strategy of *high quality*.

Management should monitor the trends of variances on regular basis and take appropriate action in case of evidence of permanent decline in quality. Here, customer feedback is also very important.

8. "Ranking of Products When Availability of Time is the Key Factor"

Products	A	B	C	D
Market Price (₹)	150	146	140	130
Less: Variable Cost (₹)	130	100	90	85
Contribution *per unit* (₹)	20	46	50	45
Labour Hours *per unit*	3 hrs.	4 hrs.	2 hrs.	3 hrs.
Contribution *per Labour Hour*	6.66..	11.50	25.00	15.00
Ranking	IV	III	I	II
Maximum Demand (units)	2,800	2,500	2,300	1,600
Total No. of Hours	8,400	10,000	4,600	4,800
Allocation of 20,000 Hours on the Basis of Ranking	600*	10,000	4,600	4,800

(*) Balancing Figure

Note -Time required to meeting the demand of 2,500 units of Product D for Division Y is 7,500 hrs. This requirement of time viz. 7,500 hrs for providing 2,500 units of Product D for Division Y can be met by sacrificing 600 hours of Product A (200 units) and 6,900 hours of Product B (1,725 units).

Transfer Price = Variable Cost + Opportunity Cost

$$= ₹85 + \frac{(6{,}900 \text{ hrs.} \times ₹11.5 + 600 \text{ hrs.} \times ₹6.66...)}{2{,}500 \text{ units}}$$

$$= ₹85 + \frac{₹79{,}350 + ₹4{,}000}{2{,}500 \text{units}}$$

= ₹85 + ₹33.34

= ₹118.34

9. Internal Business Process Perspective

Objective: Cross-sell Products

Measure: Products Purchased *per customer*

Reason: Cross-selling, or encouragement customers to purchase additional products e.g. insurance, forex etc. is a *measure of customer satisfaction*. Only if a service is perceived as highly satisfactory the service would be repeated/ additional products or services would be accepted.

Learning and Growth Perspective

Objective: Increase the Number of New Products or Services Sold

Measure: Number of Customers Buying the New Products/ New Services

Reason: Long term financial success requires bank to create new products / services (e.g. internet banking, ATM access) that will meet emerging needs of current / future customers such as 24/7 banking.

Customer Perspective

Objective: Increase Customer Loyalty

Measure: Number of Accounts Closed or Closure Request Received

Reason: Customer loyalty describes the extent to which bank maintains durable relations to its customers. The share of existing customers should have a high importance as it indicates about image and reputation. Closure request is not a good sign. Bank should investigate reasons for the same and take appropriate actions to improve services offered to retain customers.

☞ Other **Objectives** and **Measures** are also possible but they must relate to the bank's **Goal**.

10. Statement Showing "Customer Profitability Analysis"

Particulars	Ox_1	Ox_2	Channel Total	Ox_3	Ox_4	Channel Total
	Small Stores			Large Stores		
Revenue	1,60,000	1,80,000	3,40,000	25,50,000	12,00,000	37,50,000
Discount	7,200	17,100	24,300	4,46,250	1,38,000	5,84,250
Net Revenue	1,52,800	1,62,900	3,15,700	21,03,750	10,62,000	31,65,750
Variable Costs	1,28,000	1,44,000	2,72,000	20,40,000	9,60,000	30,00,000
Contribution Margin	24,800	18,900	43,700	63,750	1,02,000	1,65,750
Order Processing	3,000	6,750	9,750	4,500	2,250	6,750
Regular Deliveries	1,500	3,375	4,875	2,250	1,125	3,375
Expedited Deliveries	2,500	---	2,500	2,500	---	2,500

Customer Profit	17,800	8,775	26,575	54,500	98,625	1,53,125
Channel Cost			20,250			48,375
Channel Profit			6,325			1,04,750

Recommendations

Small Pharmaceuticals

Even though Ox_1 has lower sales volume (11% lesser from Ox_2), it is contributing around 67% of small store's profit as its order is for larger quantities and discount offered is very less.

OMCC is only just at breakeven point with small pharmaceuticals. To improve profit OMCC should:

(i) Coordinate with Ox_2 to *increase order size* and try to *negotiate a smaller discount*.

(ii) Try to work with Ox_1 to *reduce expedited deliveries*.

Large Pharmaceuticals

OMCC makes substantial profit from the large pharmaceuticals. Ox_4 alone contributing around 55% of total customer's profit and its order is for larger quantities. Therefore, Ox_4 is most favorable customer and may be given *little extra attention*. For Ox_3, OMCC may have *no options* but to treat it as less profitable customer as Ox_3 accounts more than 60% of sales.

11. (i) Fitness Solution's main **Critical Success Factors** are

(a) Developing and maintaining a high level of customer satisfaction.

(b) Offering facilities that are not much below that offered by competition.

(c) Keeping a tight cap on costs as there is considerable competitive pressure in this industry and entry barriers are not high.

(ii) The following is a possible **Balance Scorecard** for Fitness Solution

Financial Perspective	Operating expenses relative to budget
	Cash flow
	Total daily operating revenue
Customer Perspective	Turnover rate among members
	Customer satisfaction rate
Internal Perspective	Number of employee complaints
	Number of equipment not available on average day (due to maintenance)
Innovation and Learning	Number of new equipment put into service
	Number of staff participating in training courses

12. (i) Yes, the given solution is optimal because all $C_j - Z_j$ are less than, or equal to, zero.

$C_j \rightarrow$			30	40	20	0	0	0
C_B	Basic Variable (B)	Value of Basic Variables b ($=X_B$)	x	y	z	s_1	s_2	s_3
30	x	250	1	0	-26/16	10/16	-12/16	0
40	y	625	0	1	31/16	-7/16	10/16	0
0	s_3	125	0	0	11/16	-3/16	1/8	1
		$Z_j = \sum C_{Bi}X_j$	30	40	115/4	5/4	5/2	0
		$C_j - Z_j$	0	0	-35/4	-5/4	-5/2	0

(ii) No, because for each of the **non - basic variables** z, s_1 and s_2, the $C_j - Z_j$ is strictly negative. Alternate optimal solution (s) exist when either of non-basic variables has a zero $C_j - Z_j$.

Non Basic Variables	z	s_1	s_2
$C_j - Z_j$	-35/4	-5/4	-5/2

(iii) Yes, because the given solution has no artificial variable in the basis.

(iv) No, solution is not degenerate as none of the basic variables has zero quantity.

Basic Variables	x	y	s_3
Quantity	250	625	125

(A solution degenerates if the Quantity of one or more basic variables is zero)

(v) Maximize Z = 30x + 40y + 20z

(vi) According to the given solution, 250 units of x and 625 units of y are being produced. The total profit is ₹32,500 (250 units × ₹30 + 625 units × ₹40).

(vii) Machine KA-07 and KB-27 are being used to the full capacity because, the slack variable s_1 and s_2 corresponding to them has a zero value in the solution.

(viii) The shadow price of hours on machine KA-07, machine KB-27 and machine KC-49 are being ₹5/4, ₹5/2 and ₹0, respectively, these are the maximum prices one would be prepared to pay for another hour of capacity for these three machines.

(ix) Machine KB-27 may be given priority as its shadow price is the highest.

(x) When 16 hours are lost, then production of x would increase by 12 units and that of y would decrease by 10 units and the total profit decrease by ₹40.

(xi) $C_j - Z_j$ for z being -35/4, production of each unit of z would cause a reduction of 35/4 rupee. Thus, the price for z should be increased by at least 35/4 rupee to ensure no reduction of profits.

(xii) Shadow prices of times on machines KA-07, KB-27 and KC-49 are ₹5/4, ₹5/2 and ₹0. Production of a unit of the proposed new product would, therefore, reduce profit by ₹10 [(4 hrs. × ₹5/4) + (2 hrs. × ₹5/2) + (4 hrs. × ₹0)]. Since the product would yield a profit of ₹12, it would result in a net increase in profit at a rate of ₹2 per unit. It is advisable, therefore to introduce it.

13. (i) The Initial basic solution worked out by the shipping clerk is as follows-

Warehouse	Market				Supply
	I	II	III	IV	
A	5	2 [12]	4 [1]	3 [9]	22
B	4	8	1 [15]	6	15
C	4 [7]	6	7 [1]	5	8
Req.	7	12	17	9	45

The initial solution is tested for optimality. The total number of independent allocations is 6 which is equal to the desired (m +n –1) allocations. We introduce u_i's (i = 1, 2, 3) and v_j's (j = 1, 2, 3, 4). Let us assume $u_1 = 0$, remaining u_i's and v_j's are calculated as below-

($u_i + v_j$) Matrix for Allocated / Unallocated Cells

					u_i
	1	2	4	3	0
	-2	-1	1	0	-3
	4	5	7	6	3
v_j	1	2	4	3	

Now we calculate $\Delta_{ij} = C_{ij} - (u_i + v_j)$ for non basic cells which are given in the table below-

Δ_{ij} Matrix

4			
6	9		6
	1		-1

Since one of the Δ_{ij}'s is negative, the schedule worked out by the clerk is not the optimal solution.

(ii) Introduce in the cell with negative Δ_{ij} [R_3C_4], an assignment. The reallocation is done as follows-

	12	1	9
		15	
7		1	

(+1 at 9, -1 at 15, -1 at 1, +1 at the empty cell)

Revised Allocation Table

	12	2	8
		15	
7			1

Now we test the above improved initial solution for optimality-

($u_i + v_j$) Matrix for Allocated / Unallocated Cells

					u_i
	2	2	4	3	0
	-1	-1	1	0	-3
	4	4	6	5	2
v_j	2	2	4	3	

Now we calculate $\Delta_{ij} = C_{ij} - (u_i + v_j)$ for non basic cells which are given in the table below-

Δ_{ij} Matrix

3			
5	9		6
	2	1	

Since all Δ_{ij} for non basic cells are positive, the solution as calculated in the above table is the optimal solution. The supply of units from each warehouse to markets, along with the transportation cost is given below-

Warehouse	Market	Units	Cost per unit (₹)	Total Cost (₹)
A	II	12	2	24
A	III	2	4	8
A	IV	8	3	24
B	III	15	1	15
C	I	7	4	28
C	IV	1	5	5
			Minimum Total Shipping Cost	104

(iii) If the clerk wants to consider the carrier of route C to II only, instead of 7 units to I and 1 unit to IV, it will involve shifting of 7 units from (A, II) to (A, I) and 1 unit to (A, IV) which results in the following table-

Warehouse	Market				Supply
	I	II	III	IV	
A	5 [7]	2 [4]	4 [2]	3 [9]	22
B	4	8	1 [15]	6	15
C	4	6 [8]	7	5	8
Req.	7	12	17	9	45

The transportation cost will become-

Warehouse	Market	Units	Cost per unit (₹)	Total Cost (₹)
A	I	7	5	35
A	II	4	2	8
A	III	2	4	8
A	IV	9	3	27
B	III	15	1	15
C	II	8	6	48
			Minimum Total Shipping Cost	141

The total shipping cost will be ₹141.

Additional Transportation Cost ₹37.

The carrier of C to II must reduce the cost by ₹4.63 (₹37/8) so that the total cost of transportation remains the same and clerk can give him business.

(iv) Revised transportation table is shown below-

Warehouse	Market				Supply
	I	II	III	IV	
A	5	2 [12]	4 [2]	3 [8]	22
B	4	8	1 [11]	6	15/11
C	4 [7]	6	7	5 [1]	8
Req.	7	12	17/13	9	45

Since the alterations are restricted to allocated cells only, the present alterations do not disturb the optimal allocation schedule.

(v) In this situation, alterations are not restricted to allocated cells since allocation in cell (A, III) is **2** units only while reduction in requirement of Market III as well as supply of Warehouse A is **3** units. Therefore, it is essential to make alterations in allocations, check solution for optimality test and iterate if required.

14. Row Operation-

	P	Q	R	S	T
P	-	3	12	18	0
Q	12	-	3	18	0
R	12	9	-	0	9
S	24	0	6	-	3
T	0	6	3	21	-

Column Operation-

	P	Q	R	S	T
P	-	3	9	18	0
Q	12	-	0	18	0
R	12	9	-	0	9
S	24	0	3	-	3
T	0	6	0	21	-

We know check if optimal assignment can be made in below table or not. Proceeding, we get following table-

	P	Q	R	S	T
P	-	3	9	18	0
Q	12	-	0	18	0
R	12	9	-	0	9
S	24	0	3	-	3
T	0	6	0	21	-

The above solution is optimum solution with two routes-

P to T to P and

Q to R to S to Q

Above table provides the optimum solution but do not satisfy travelling condition. To solve this problem we have to bring next minimum element in the matrix i.e.3. Now the possible *new assignments* are

P to Q instead of P to T,

S to R instead of S to Q and

S to T instead of S to Q.

Let us consider each of the new assignment independently.

Situation 1-

We make 'assignment' in cell (P, Q) instead of 'assignment' in cell (P, T). The resulting table is shown below-

	P	Q	R	S	T
P	-	[3]	9	18	0
Q	12	-	[0]	18	0
R	12	9	-	[0]	9
S	24	0	3	-	[3]
T	[0]	6	0	21	-

The feasible solution is P to Q to R to S to T to P and it involves a cost of ₹40,000 (₹5,000 + ₹8,000 + ₹11,000 + ₹14,000 + ₹2,000).

Situation 2-

We make 'assignment' in cell (S, R) instead of 'assignment' in cell (S, Q). The resulting table is shown below-

	P	Q	R	S	T
P	-	[3]	9	18	0
Q	12	-	0	18	[0]
R	12	9	-	[0]	9
S	24	0	[3]	-	3
T	[0]	6	0	21	-

The resulting solution is P to Q to T to P, R to S to R, which is not feasible as it does not satisfy the travelling condition.

Situation 3-

We make 'assignment' in cell (S, T) instead of 'assignment' in cell (S, Q). The resulting table is shown below-

	P	Q	R	S	T
P	-	3	9	18	0
Q	12	-	0	18	0
R	12	9	-	0	9
S	24	0	3	-	3
T	0	6	0	21	-

The resulting table is same as in Situation 1 which gives the feasible solution P to Q to R to S to T to P with cost of ₹40,000.

Hence least cost route is P to Q to R to S to T to P with cost of ₹40,000.

15. Random Numbers Allocation for *each activity*

Activity	Time (in Days)	Probability	Cumulative Probability	Allocated Random Number
A	6	0.50	0.50	00-49
	8	0.50	1.00	50-99
B	4	0.30	0.30	00-29
	5	0.20	0.50	30-49
	6	0.50	1.00	50-99
C	8	0.50	0.50	00-49
	16	0.50	1.00	50-99
D	8	0.30	0.30	00-29
	10	0.70	1.00	30-99
E	2	0.20	0.20	00-19
	4	0.80	1.00	20-99

Simulation Table

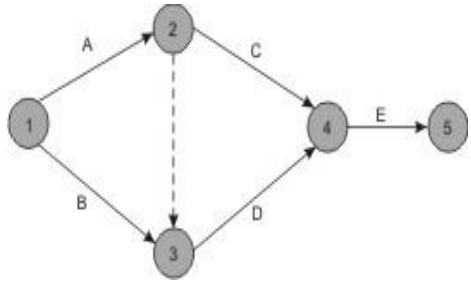
Trial	A		B		C		D		E	
	R. No.	Time	R. No.	Time	R. No.	Time	R. No.	Time	R. No.	Time
1	11	6	16	4	23	8	72	10	94	4
2	83	8	83	6	02	8	97	10	99	4
3	83	8	10	4	93	16	4	8	33	4
4	53	8	49	5	94	16	37	10	7	2

Determination of "Critical Path and Project Duration for *each trial*"

Trial	Project Duration			Critical Path
	1–2–4–5 (A–C–E)	1–2–3–4–5 (A–D–E)	1–3–4–5 (B–D–E)	
1	18 (6 + 8 + 4)	**20** (6 + 10 + 4)	18 (4 + 10 + 4)	1–2–3–4–5 (A–D–E)
2	20 (8 + 8 + 4)	**22** (8 + 10 + 4)	20 (6 + 10 + 4)	1–2–3–4–5 (A–D–E)
3	**28** (8 + 16 + 4)	20 (8 + 8 + 4)	16 (4 + 8 + 4)	1–2–4–5 (A–C–E)
4	**26** (8 + 16 + 2)	20 (8 + 10 + 2)	17 (5 + 10 + 2)	1–2–4–5 (A–C–E)

Working Note

The Network for the given problem:



16. (i) Total Direct Labour Cost for **first 64 batches** based on learning curve of 90% (when the direct labour cost for the first batch is ₹52,500)

The usual learning curve model is

$$y = ax^b$$

Where

y = Average Direct Labour Cost *per batch* for x batches

a = Direct Labour Cost for *first batch*

x = Cumulative No. of batches produced

b = Learning Coefficient /Index

$y = ₹52,500 \times (64)^{-0.152}$

= ₹52,500 × 0.5314

= ₹27,898.50

Total Direct Labour Cost for first 64 batches

= 64 batches × ₹27,898.50

= ₹17,85,504

Total Direct Labour Cost for **first 63 batches** based on learning curve of 90% (when the direct labour cost for the first batch is ₹52,500)

$y = ₹52,500 \times (63)^{-0.152}$

= ₹52,500 × 0.5327

= ₹27,966.75

Total Direct Labour Cost for first 63 batches

= 63 batches × ₹27,966.75

= ₹17,61,905

Direct Labour Cost for **64th batch** = ₹17,85,504 - ₹17,61,905

= ₹23,599

Total Labour Cost over the Product's Life

= ₹17,85,504 + (192 batches × ₹23,599)

= ₹63,16,512

Statement Showing "Life Time Expected Profit"

Particulars	Amount (₹)
Sales (₹123 × 2,56,000 units)	3,14,88,000
Less: Direct Material (₹36 × 2,56,000 units)	92,16,000
Less: Direct Labour	63,16,512
Less: Other Variable Cost (₹24 × 2,56,000 units)	61,44,000
Less: Specific Fixed Cost	38,75,000
Profit	59,36,488

(ii) In order to achieve a Profit of ₹1,00,00,000 the Total Direct Labour Cost over the Product's Lifetime would have to equal ₹22,53,000.

Statement Showing "Life Time Direct Labour Cost"

Particulars	Amount (₹)
Sales (₹123 × 2,56,000 units)	3,14,88,000

Less: Direct Material (₹36 × 2,56,000 units)	92,16,000
Less: Other Variable Cost (₹24 × 2,56,000 units)	61,44,000
Less: Specific Fixed Cost	38,75,000
Less: Profit	1,00,00,000
Direct Labour	22,53,000

Average Direct Labour Cost *per batch* for 256 batches is ₹8,800.78 (₹22,53,000 / 256 batches).

Total Direct Labour Cost for **256 batches** based on learning curve of r% (when the direct labour cost for the first batch is ₹52,500)

$$y = ₹52,500 \times (256)^{b}$$

$$₹8,800.78 = ₹52,500 \times (256)^{b}$$

$$0.1676 = (256)^{b}$$

$$\log 0.1676 = b \times \log 2^{8}$$

$$\log 0.1676 = b \times 8 \log 2$$

$$\log 0.1676 = \left(\frac{\log r}{\log 2}\right) \times 8 \log 2$$

$$\log 0.1676 = \log r^{8}$$

$$0.1676 = r^{8}$$

$$r = \sqrt[8]{0.1676}$$

$$r = 80\%$$