

MOCK TEST PAPER – 1

FINAL COURSE: GROUP – II

PAPER – 5: ADVANCED MANAGEMENT ACCOUNTING

SUGGESTED ANSWERS/HINTS

1. (a) Let K_{c1} be the Contribution per unit of Product C_1 .
Therefore Contribution per unit of Product $C_2 = K_{c2} = 4/5 K_{c1} = 0.8 K_{c1}$
Given $F_1 + F_2 = 1,50,000$,
 $F_1 = 1,800 K_{c1}$ (Break even volume $\times$ contribution per unit)
Therefore $F_2 = 1,50,000 - 1,800 K_{c1}$.
 $3,000 K_{c1} - F_1 = 3,000 \times 0.8 K_{c1} - F_2$ or $3,000 K_{c1} - F_1 = 2,400 K_{c1} - F_2$ (Indifference point)
i.e., $3,000 K_{c1} - 1,800 K_{c1} = 2,400 K_{c1} - 1,50,000 + 1,800 K_{c1}$
i.e., $3,000 K_{c1} = 1,50,000$, Therefore $K_{c1} = ₹50/-$ ($1,50,000 / 3,000$)
Therefore Contribution per unit of $C_1 = ₹50$
Fixed Cost of $C_1 = F_1 = ₹90,000$ ($1,800 \times 50$)
Therefore Contribution per unit of C_2 is $₹50 \times 0.8 = ₹40$ and
Fixed cost of $C_2 = F_2 = ₹60,000$ ($1,50,000 - 90,000$)
The value of $F_1 = ₹90,000$, $F_2 = ₹60,000$ and $C_1 = ₹50$ and $C_2 = ₹40$
- (b) Discretionary costs are those that are incurred, typically each year, in an amount that is approved as part of the normal budget process. However, there is no clear relationship between the volume of services and the amount of cost that must be incurred. Manager must decide and justify the level that is deemed to be appropriate. This justification is to be made a fresh without making reference to previous level of spending in his/her department.
- Zero based budgeting is undoubtedly most effective in terms of discretionary costs. The bottom line of a zero based budgeting is that it is important to understand what types of objectives are being accomplished by discretionary cost centers and what resources being devoted to accomplishing various objectives. This will allow a prioritization, so that organization can evaluate the likely impact of substantial increase or decrease in the resources allocated to the discretionary center.
- Accordingly, ZBB has extensive potential application to the division T, A and RD.

(c) **Efficiency Variance**

$$\begin{aligned}
 &= \text{Cost Impact of } \textit{undertaking activities} \text{ more/ less than } \textit{standard} \\
 &= (21 \text{ deliveries}^* - 19 \text{ deliveries}) \times ₹200 \\
 &= ₹400 \text{ F} \\
 &(*) \left(\frac{20 \text{ Deliveries}}{2,000 \text{ units.}} \right) \times 2,100 \text{ units}
 \end{aligned}$$

Expenditure Variance

$$\begin{aligned}
 &= \text{Cost impact of paying more/ less than standard for actual activities undertaken} \\
 &= 19 \text{ deliveries} \times ₹200 - ₹3,900 \\
 &= ₹100 \text{ (A)}
 \end{aligned}$$

- (d) The assignment problem is special case of transportation problem; it can also be solved by transportation method. But the solution obtained by applying this method would be severely degenerate. This is because the optimality test in the transportation method requires that there must be $m+n-1$ allocations/assignments. But due to the special structure of assignment problem of order $n \times n$, any solution cannot have more than n assignments. Thus, the assignment problem is naturally degenerate. In order to remove degeneracy, $n-1$ * number of dummy allocations will be required in order to proceed with the transportation method. Thus, the problem of degeneracy at each solution makes the transportation method computationally inefficient for solving an assignment problem.



$$(*) \ m+n-1 - n \Rightarrow n+n-1 - n \Rightarrow 2n-1 - n \Rightarrow n-1$$

2. **Workings**

$C_j \rightarrow$			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
$Z_j = \sum C_B X_j$			30	40	115/4	5/4	5/2	0
$C_j - Z_j$			0	0	-35/4	-5/4	-5/2	0

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

- (ii) 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)

- (iii) 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.
- (iv) 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.
- (v) Machine KB-27 may be given priority as its shadow price is the highest.
- (vi) 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.
- (vii) $C_j - Z_j$ 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.
- (viii) 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.

(b) **Statement Showing “Customer Profitability Analysis”**

Particulars	Qx ₁	Qx ₂	Channel Total	Qx ₃	Qx 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	2,500	---	2,500	2,500	---	2,500

Deliveries						
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 Qx₁ has lower sales volume (11% lesser from Qx₂), it is contributing around 67% of small store's profit as its order is for larger quantities and discount offered is very less.

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

- (i) Coordinate with Qx₂ to *increase order size* and try to *negotiate a smaller discount*.
- (ii) Try to work with Qx₁ to *reduce expedited deliveries*.

Large Pharmaceuticals

OHCC makes substantial profit from the large pharmaceuticals. Qx₄ alone contributing around 55% of total customer's profit and its order is for larger quantities. Therefore, Qx₄ is most favorable customer and may be given *little extra attention*. For Qx₃, OHCC may have *no options* but to treat it as less profitable customer as Qx₃ accounts more than 60% of sales.

3. (a) (i) Total Contribution Statement

Statement Showing "Total Contribution- for remaining two phases"

Particulars	Maturity		Decline
Weeks	31 - 50	51 - 70	71 - 110
Number of units Produced and Sold	22,000	22,000	22,000
Selling Price per unit (₹)	450	450	300
Less: Unit Variable Cost (₹)	225	188	225
Unit Contribution (₹)	225	262	75
Total Contribution (₹)	49,50,000	57,64,000	16,50,000

(ii) Pricing Strategy for Product α³

PGIL is following the skimming price strategy that's why it has planned to launch the product α³ initially with high price tag.

A skimming strategy may be recommended when a firm has incurred large sums of money on research and development for a new product.

In the problem, PGIL has incurred a huge amount on research and development. Also, it is very difficult to start with a low price and then raise the price. Raising a low price may annoy potential customers.

Price of the product α^3 is decreasing gradually stage by stage. This is happening because PGIL wants to tap the mass market by lowering the price.

(iii) Possible Reasons for the changes in cost during the life cycle of the product ' α^3 '

Product life cycle costing involves tracing of costs and revenues of each product over several calendar periods throughout their entire life cycle. Possible reasons for the changes in cost during the life cycle of the product are as follows:

PGIL is expecting reduction in unit cost of the product α^3 over the life of product as a consequence of economies of scale and learning / experience curves.

Learning effect may be the possible reason for reduction in per unit cost if the process is labour intensive. When a new product or process is started, performance of worker is not at its best and learning phenomenon takes place. As the experience is gained, the performance of worker improves, time taken per unit reduces and thus his productivity goes up. The amount of improvement or experience gained is reflected in a decrease in cost.

Till the stage of maturity, PGIL is in the expansion mode. The PGIL may be able to take advantages of quantity discount offered by suppliers or may negotiate the price with suppliers.

Product α^3 has the least variable cost ₹188 in last phase of maturity stage; this is because a product which is in the mature stage may require less marketing support than a product which is in the growth stage so, there is a saving of marketing cost per unit.

Again the cost per unit of the product α^3 jumps to ₹ 225 in decline stage. As soon as the product reaches its decline stage, the need or demand for the product disappear and quantity discount may not be available. Even PGIL may have to incur heavy marketing expenses for stock clearance.

Workings

Statement of Cumulative Sales along with Sales Price and Variable Cost

Weeks	Demand	Total	Cumulative	Selling Price	Variable Cost
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	<i>per week</i>	Sales	Sales	per unit (₹)	per unit (₹)
1 - 10	220	2,200	2,200	750	375
11 - 20	550	5,500	7,700	600	300
21 - 30	825	8,250	15,950	525	300
31 - 50	1,100	22,000	37,950	450	225
51 - 70	1,100	22,000	59,950	450	188
71 - 80	880	8,800	68,750	300	225
81 - 90	660	6,600	75,350	300	225
91 - 100	440	4,400	79,750	300	225
101 - 110	220	2,200	81,950	300	225

(b) **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

4. (a) **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

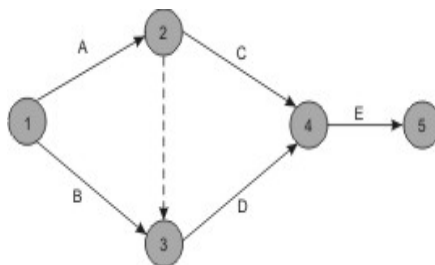
Trial	A		B		C		D		E	
	R. No.	Time	R. No.	Time	R. No.	Time	R. No.	Time	R. No.	Time
1	11	6	16	4	23	8	72	10	94	4
2	83	8	83	6	02	8	97	10	99	4
3	83	8	10	4	93	16	4	8	33	4
4	53	8	49	5	94	16	37	10	7	2

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:



- (b) (i) Variable Cost *per Room-Day* = ₹75
 (₹30 + ₹20 + ₹25)
- Total Occupancy = 12,600 Room-Days
 (50 × 30 × 8 × 0.8 + 50 × 30 × 4 × 0.5)
- Total Variable Cost = ₹9.45 lakhs
 (12,600 Room-Days × ₹75)
- Fixed Cost = ₹15.75 lakhs
- Total Cost = ₹25.20 lakhs
 (₹9.45 lakhs + ₹15.75 lakhs)
- Profit (25% of Total Cost) = ₹6.30 lakhs
 (25% of ₹25.20 lakhs)
- Tariff *per Day* = ₹250.00
 [(₹25, 20,000 + ₹6,30,000) / 12,600 Room-Days]
- (ii) Contribution *per Day* = ₹175.00
 (₹250 – ₹75)
- BEP (Room-Day) = 9,000 Room-Days
 (₹15,75,000 / ₹175)
- During Off Season for 4 months
 Rooms Occupied = 3,000 Days
 (50 × 30 × 4 × 0.5)
- For BEP,
 Occupancy During Normal Period = 6,000 Days i.e. Occupancy 50%
- (iii) If 10% Discount is allowed,
 Tariff = ₹225 *per Room-Day*
 Contribution *per Room-Day* = ₹150 (₹225 – ₹75)
 (with tariff cut)

Total Occupancy = 16,200 Room-Days
 (50 × 30 × 8) + (50 × 30 × 4 × 0.7)
 Total Contribution *for the year* = ₹24.30 lakhs
 (16,200 Room-Days × ₹150)
 Fixed Cost (unchanged) = ₹15.75 lakhs
 Profit = ₹8.55 lakhs
 As the Proposal increases the Profit, it may be accepted.

(iv) To maintain the Same Profit,
 Contribution Required = ₹22.05 lakhs
 With New Tariff,
 Contribution *per day* = ₹150
 Number of Room-Days Occupied
 = 14,700 Room-Days
 (₹22,05,000 / 150)
 Increase % in Occ. Required = 16.67 %
 [(14,700 – 12,600) / 12,600]

5. (a) **Statement Showing Evaluation of Alternatives**

	Alternative One	Alternative Two	Alternative Three
Manufacture of Containers	'WYE' Ltd	'WYE' Ltd	'EXE' Ltd
Storage of Product	'WYE' Ltd	'EXE' Ltd	'WYE' Ltd
Cash Inflows (including avoidable cost):			
Direct Materials <i>other than 'P-6'</i> (W.N.-1)	3,75,000	3,37,500	37,500
Direct Labour (W.N.-4)	3,75,000	18,750	-
Rent of a part of Warehouse (W.N.-6)	67,500	-	-
Maintenance of Machine (W.N.-7)	27,000	27,000	-
Miscellaneous Overhead (W.N.-8)	1,18,125	94,500	23,625
Total Cash Inflows p.a. ... (A)	9,62,625	4,77,750	61,125
Cash Outflows:			
Contract Fee to 'WYE' Ltd.			
For Manufacture	9,37,500	9,37,500	-
For Packing and Storage	1,87,500		1,87,500

Total Outflow p.a. ... (B)	11,25,000	9,37,500	1,87,500
Net Cash Outflow p.a. ... (C) = (A) - (B)	1,62,375	4,59,750	1,26,375
Cash Outflows for 4 years [(C) × 4]	6,49,500	18,39,000	5,05,500
One Time Income / Inflow:			
'P-6' (W.N.-3)	(4,80,000)	(4,32,000)	(48,000)
Machine (W.N.-5)	(1,87,500)	(1,87,500)	-
Net Cash Outflow	(18,000)	12,19,500	4,57,500

Therefore it is in the interest of 'EXE' Ltd. to *shut down* Division 'KXB'.

Working Note

(1) Direct Material other than 'P-6'

Direct material including 'P-6'	₹5,25,000
Use of 'P-6' 1/5 th of ₹7,50,000	<u>₹1,50,000</u>
	₹3,75,000

Alternative One:

The material will be avoidable cost if Division 'KXB' is closed down.

Alternative Two:

Savings: ₹3,37,500 (₹3,75,000 – ₹37,500) if manufacture is given to 'WYE' Ltd. and storage remains with 'EXE' Ltd.

Alternative Three:

Savings: ₹37,500 [₹3,75,000 – (90% of ₹3,75,000)] if manufacture is done by 'EXE' Ltd. and storage given to 'WYE' Ltd.

(2) 'P-6' –Stock

Stock in 2020	₹7,50,000
Used last year (1/5 th)	<u>1,50,000</u>
Balance Stock	₹6,00,000

It is given that original price is ₹3,750

Therefore, 160 tonnes (₹6,00,000 / ₹3,750) 'P-6' is there.

(3) 'P-6' –Value

Alternative One:

Manufacturing and Storage is done by 'WYE' Ltd. Therefore it will be sold at ₹3,000 per tonne.

Cash inflow will be ₹4,80,000 (₹3,000 × 160)

Alternative Two:

10% of all material will be used. It means 90% of 160 tonne will be sold.

Cash inflow will be ₹4,32,000 ($160 \times 0.90 \times ₹3,000$)

Alternative Three:

In this situation storage is done by 'WYE' Ltd. Therefore only 10% of whole quantity of 160 tonnes will be sold in market at ₹3,000 per tonne.

Cash inflow will be ₹48,000 ($16 \times ₹3,000$)

(4) Direct Labour Cost

Alternative One:

Avoidable Cost, if Deptt. KXB is closed (saving) ₹3,75,000

Alternative Two:

If manufacturing is given to 'WYE' Ltd. and 'EXE' Ltd. continues to store the product, saving on account of labour retrenchment will be only ₹18,750.

Alternative Three:

If manufacturing is done by 'EXE' Ltd. then labour force will continue. It means impact of labour cost in third alternative will be nil.

(5) Machine

Machine is used for manufacturing of containers. It is not required in alternative one and two. Therefore, it will be sold and there will be one time cash inflow of ₹1,87,500 under alternative one and two.

(6) Rent of Warehouse

The hire charge of warehouse is ₹67,500 per annum. The remaining space of the warehouse is idle. It means, when department 'KXB' is closed, cash outflow of ₹67,500 will be avoided. Therefore, cash flow for alternatives two and three will not be disturbed on this account.

(7) Maintenance of Machine

Maintenance of machine is required for manufacturing. It means ₹27,000 will be avoidable cost for alternative one and two. In third alternative this cost will continue to be there.

(8) Miscellaneous Overhead

Miscellaneous overhead of ₹1,18,125 will be avoidable cost for alternative one. For second alternative 80% of this i.e. ₹94,500 will be avoidable cost. For third alternative 20% of ₹1,18,125 i.e. ₹23,625 will be avoidable cost.

(9) Supervisory Staff

Supervisory staff will be transferred to another department in the first alternative. It means cash flow will not be affected. In the second and third alternatives, supervisory staff will be retained and it means no additional cash flow or relevant cost due to decision.

(10) Depreciation

Depreciation does not affect the cash flow. Therefore it is not relevant for these decisions.

- (b) Following acceptance by early innovators, conventional consumers start following their lead. New competitors are likely to now enter the market attracted by the opportunities for large scale production and profit. ZSL may wish to discourage competitors from entering the market by lowering the price and thereby lowering the unit profitability. The price needs to be lowered so that the product becomes attractive to different market segments thus increasing demand to achieve the growth in sales volume. Strategies at this stage may include the following:
- (i) Improving quality and adding new features such as Data Theft Protection, Parental Control, Web Protection, Improved Scan Engine, Anti Spyware, Anti Malware etc.
 - (ii) Sourcing new market segments/ distribution channels.
 - (iii) Changing marketing strategy to increase demand.
 - (iv) Lowering price to attract price-sensitive buyers.

6. (a) Working Note

(1) Statement Showing Variable Cost per 200-unit lot

	(₹)	(₹)
Cushion Material:		
- Padding	9.60	
- Vinyl	16.00	
Total Cushion Material	25.60	
Cost Increase by 20%	5.12	
Cost of Cushioned Seat		30.72
Cushion Fabrication Labour (₹30 × 0.5)		15.00
Variable Overhead (W.N.-2) (₹20 × 0.5)		10.00
Variable Cost <i>per Cushioned Seat</i>		55.72
Total Variable Cost <i>per 200-unit lot</i> (₹55.72 × 200)		11,144

(2) Statement Showing Fixed Overhead & Variable Overhead Rate per Direct Labour Hour

	Variable Amount		Fixed Amount	
	(₹)	(₹)	(₹)	(₹)
	Total	Per DLH	Total	Per DLH
Indirect Material	16,80,000	5.60	---	---
Indirect Labour	15,00,000	5.00	---	---
Supervision	---	---	10,00,000	3.33
Power	7,20,000	2.40	---	---
Heat and Light	---	---	5,60,000	1.87
Miscellaneous Overheads	---	---	8,00,000	2.67
Depreciation	---	---	68,00,000	22.67
Employee Benefits:				
- 20% Direct Labour*	18,00,000	6.00	---	---
- 20% Supervision	---	---	2,00,000	0.66
- 20% Indirect Labour	3,00,000	1.00	---	---
	60,00,000	20.00	93,60,000	31.20

Variable Overhead Rate = ₹60,00,000 ÷ 3,00,000
= ₹20.00 / DLH

Fixed Overhead Rate = ₹93,60,000 ÷ 3,00,000
= ₹31.20 / DLH

* Direct Labour Cost

0.2 (₹10,00,000 + DL + ₹15,00,000) = ₹23,00,000

0.2 DL = ₹18,00,000

DL = ₹90,00,000

(3) Statement Showing "Loss of Contribution Margin from Outside Sales"

	Stylish Stool	Normal Stool
	(₹)	(₹)
Selling Price	225.00	160.00
Less: Material	58.20	63.04
Less: Labour	45.00	24.00
	(₹30.00 × 1.5)	(₹30.00 × 0.8)
Less: Variable Overhead	30.00	16.00

	(₹20.00 × 1.5)	(₹20.00 × 0.8)
Contribution Margin <i>per unit</i>	91.80	56.96
Units Produced (units)	200	250 (W.N.- 4)
	18,360	14,240

Amount of Contribution Margin Lost as a result of shifting production to the Normal Stool ₹4,120 (₹18,360 – ₹14,240).

(4) Number of Economy Office Stools *that can be produced*

Labour Hours *to make* a 200-unit lot of Stylish Stools (1.50 × 200) 300 Hrs
 Less: Labour Hours *to make* a 200-unit lot of Cushioned Seats* 100 Hrs
 Labour Hours *available for* Normal Stool 200Hrs

* (0.50 × 200)

Labour hours *required to make* one Normal Stool 0.8 Hrs / Stool

Use of Extra Labour *devoted to* Normal Stool Production (200 / 0.8) 250 Stools

Since the 'TQR' Division is operating at Full Capacity, the Transfer Price must consider the Division's Variable Costs of Manufacturing the Seat *plus* the Lost Contribution Margin that will result from *losing outside sales*. Thus, the Transfer Price (W.N.-1 & 3) equals to ₹15,264 (₹11,144 + ₹4,120).

$$\begin{aligned}
 \text{(b) Production Volume Ratio} &= \frac{\text{StandardHoursProduced}}{\text{BudgetedHours}} \times 100 \\
 &= \frac{(200 \times 10) + (150 \times 5) + (70 \times 2)}{(200 \times 10) + (200 \times 5) + (50 \times 2)} \times 100 \\
 &= 93.23\% \\
 \text{Efficiency Ratio} &= \frac{\text{StandardHoursProduced}}{\text{ActualHours}} \times 100 \\
 &= \frac{(200 \times 10) + (150 \times 5) + (70 \times 2)}{2,800} \times 100 \\
 &= 103.21\%
 \end{aligned}$$

7. (a) Primary activities are the activities that are directly involved in transforming inputs into outputs and delivery and after-sales support to output. Following are the primary activities in the value chain of Well Fit Ltd.:-

- (i) **Inbound Logistics:** These activities are related to the material handling and warehousing. It also covers transporting raw material from the supplier to the place of processing inside the factory.
 - (ii) **Operations:** These activities are directly responsible for the transformation of raw material into final product for the delivery to the consumers.
 - (iii) **Outbound Logistics:** These activities are involved in movement of finished goods to the point of sales. Order processing and distribution are major part of these activities.
 - (iv) **Marketing and Sales:** These activities are performed for demand creation and customer solicitation. Communication, pricing and channel management are major part of these activities.
 - (v) **Service:** These activities are performed after selling the goods to the consumers. Installation, repair and parts replacement are some examples of these activities.
- (b) The Δ_{ij} matrix or $C_{ij} - (u_i + v_j)$ matrix, where C_{ij} is the cost matrix and $(u_i + v_j)$ is the cell evaluation matrix for unallocated cell.
- The Δ_{ij} matrix has one or more 'Zero' elements, indicating that, if that cell is brought into the solution, the optional cost will not change though the allocation changes.
- Thus, a 'Zero' element in the Δ_{ij} matrix reveals the possibility of an alternative solution.
- (c) As the production quantity of a given item is doubled, the cost of the item decreases at a fixed rate. This phenomenon is the basic premise on which the theory of learning curve has been formulated. As the quantity produced doubles, the absolute amount of cost increase will be successively smaller but the rate of decrease will remain fixed.

In the initial stage of a new product or a new process, the learning effect pattern is so regular that the rate of decline established at the outset can be used to predict labour cost well in advance. The effect of experience on cost is summarized in the learning curve ratio or improvement ratio.

$$\text{Learning curve ratio} = \frac{\text{Average labour cost of first } 2N \text{ units}}{\text{Average labour cost of first } N \text{ units}}$$

For example, if the average labour cost for the first 500 units is ₹25 and the average labour cost for the first 1,000 units is ₹20, the learning curve ratio is $(\text{₹}20/\text{₹}25)$ or 80%. Since the average cost per unit of 1,000 units is ₹20, the average cost per unit of first 2,000 units is likely to be 80% of ₹20 or ₹16.

- (d) Continuous improvement can be brought into the organisational culture by introducing continuously changing planned targets. One such target can be six-sigma accuracy. The sigma accuracy means the process is 99.999998% accurate. That is the process will/can produce only 0.002 defects per million. This is the structural meaning of six-sigma. In quality practice, six-sigma means 3.4 parts per million.

Six sigma is the statistical measure used to ensure quality of products and services. The six sigma academy has developed a break through strategy consisting of measure, analyze, improve and control, that allows companies to make exceptional bottom-line improvements.

In addition to the material and labour savings, which flow directly to the bottom line, a company engaged in six sigma can expect to see:

- (i) Improved customer satisfaction.
- (ii) Reduction cycle time.
- (iii) Increased productivity.
- (iv) Reduction in total defect.
- (v) Improved process flow.

Six Sigma Capability Chart

Sigma	Parts per Million
Six Sigma	3.4 Defects per Million
Five Sigma	233 Defects per Million
Four Sigma	6,120 Defects per Million
Three Sigma	66,807 Defects per Million
Two Sigma	3,08,537 Defects per Million
One Sigma	6,90,000 Defects per Million

There is an optimum level of output for a firm as a whole. This is so because there is a certain level of output beyond which its net revenue will not rise. The ideal transfer price under these circumstances will be that which will motivate these managers to produce at this level of output.

Essentially, it means that some division in a business house might have to produce its output at a level less than its full capacity and in all such cases a transfer price may be imposed centrally.

- (e) Steps in the simulation process:
- Define the problem and system you intend to simulate.

- Formulate the model you intend to use.
- Test the model, compare with behaviour of the actual problem environment.
- Identify and collect data to test the model.
- Run the simulation.
- Analyse the results of the simulation and, if desired, change the solution you are evaluating.
- Rerun the simulation to tests the new solution.
- Validate the simulation i.e., increase the chances of valid inferences.