

PAPER – 5 : ADVANCED MANAGEMENT ACCOUNTING

Question No. 1 is compulsory.

Answer any Five questions from the remaining six questions.

Working notes should form part of the answer.

Question 1

- (a) A potato chips manufacturing company decided that the mean net weight per pack of its product must be 90 grams. A random sample of 16 packets yields a mean weight of 80 grams with standard deviation of 17.10 grams. Test the hypothesis that the mean of the whole universe is less than 90, use level of significance of (a) 0.05 (b) 0.01. (5 Marks)

- (b) What are the steps involved in Zero-base budgeting? (5 Marks)

- (c) G Ltd. produces and sells 95,000 units of 'X' in a year at its 80% production capacity. The selling price of product is ₹ 8 per unit. The variable cost is 75% of sales price per unit. The fixed cost is ₹ 3,50,000. The company is continuously incurring losses and management plans to shut-down the plant. The fixed cost is expected to be reduced to ₹1,30,000. Additional costs of plant shut-down are expected at ₹15,000.

Should the plant be shut-down? What is the capacity level of production of shut-down point? (5 Marks)

- (d) H. Ltd. manufactures three products. The material cost, selling price and bottleneck resource details per unit are as follows:

	Product X	Product Y	Product Z
Selling price (₹)	66	75	90
Material and other variable cost (₹)	24	30	40
Bottleneck resource time (minutes)	15	15	20

Budgeted factory costs for the period are ₹ 2,21,600. The bottleneck resources time available is 75120 minutes per period.

Required:

- (i) Company adopted throughput accounting and products are ranked according to 'product return per minute'. Select the highest rank product.
- (ii) Calculate throughput accounting ratio and comment on it. (5 Marks)

Answer

- (a) Test of Hypothesis

$$H_0: \mu_0 = 90$$

$$H_1: \mu_0 < 90 \text{ (Left tail test)}$$

As n is small, <30, we use the t Statistic

$$t = (\bar{X} - \mu_0) / \sigma$$

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$$\sigma = S / \sqrt{n} = 17.10 / \sqrt{16} = 4.275$$

$$t = (80 - 90) / 4.275 = -2.339 \approx -2.4$$

Calculated $t = -2.339$, < table value of $t_{0.05}$ (15 degrees of freedom) which is -1.753 Hence, reject the null hypothesis at 5% level of significance

Calculated $t = -2.339$, >table value of $t_{0.01}$ (15 dof) which is -2.602. Hence, accept the null hypothesis at 1% level of significance.

(b) Steps involved in the process of Zero Based Budgeting:

1. Determination of a set of objects is the pre-requisite and essential step in the direction of ZBB technique.
2. Deciding about the extent to which the technique of ZBB is to be applied whether in all areas of organization activities or only in few selected areas on trial basis.
3. Identify the areas where decisions are required to be taken.
4. Developing decision packages and ranking them in order of performance.
5. Preparation of budget that is translating decision packages into practicable units/items and allocating financial resources.

ZBB is simply an extension of the cost, benefit analysis method to the area of corporate planning and budgeting.

(c)

	If plant is continued	If plant is shutdown
Sales	7,60,000	-
Less: Variable Cost	<u>5,70,000</u>	-
Contribution	1,90,000	
Less: Fixed Cost	3,50,000	1,30,000
Additional Cost		<u>15,000</u>
Operating Loss	<u>1,60,000</u>	<u>1,45,000</u>

A comparison of loss figures indicated as above points out that loss is reduced by (16,000-14,500) Rs. 15,000 if plant is shut down.

$$\text{Shut down point} = \frac{3,50,000 - 14,5000}{8 - 6} = \frac{20,500}{2} = 1,02,500 \text{ units}$$

Capacity level of shut down point:

$$\text{At 100\% level production is } \frac{95,000}{0.80} = 1,18,750$$

$$\text{Capacity level at shut down} = \frac{1,02,500}{1,18,750} = 86.31\%$$

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Alternative Solution

					Rs.
If the plant is shut down, the sunk cost or fixed expenses					1,45,000
If it is working at 80% capacity, the fixed cost					3,50,000
Additional fixed expenses					2,05,000
Contribution (95000*2)					1,90,000
Incremental Loss on Continuing					15,000
Decision - better to shut down					
Production at shut-down point					
2 x – 350000	=	1,45,000			
2x	=	2,05,000			
x	=	1,02,500 Units			
Capacity %	=	1,02,500/(95,000/0.8) = 86.31%			
(d) (i) Calculation of Rank according to product return per minute					
Particulars		X	Y	Z	
Selling Price		66	75	90	
Variable Cost		24	30	40	
Throughput Contribution		42	45	50	
Minutes per unit		15	15	20	
Contribution per minute		2.8	3	2.5	
Ranking		II	I	III	
(ii)					
Factory Cost per minute(221600/75120)		2.95	2.95	2.95	
TA Ratio = Contrb per min / cost per minute		0.95	1.02	0.85	
Ranking based on TA Ratio		II	I	III	
Comment : P roduct Y yields more contribution compared to a verage factory contribution per minute, whereas X and Z yield less.					

Question 2

- (a) E Ltd. manufactures and sells four types of products under the brand names A, B, C and D. On a turnover of ₹ 30 crores in 2009, company earned a profit of 10% before interest and depreciation which are fixed. The details of product mix and other information are as follows:

Products	Mix% to total sales	PV Ratio (5)	Raw material as % on sales value
A	30	20	35

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B	10	30	40
C	20	40	50
D	40	10	60

Interest and depreciation amounted to ₹225 lakhs and ₹115.50 lakhs respectively. Due to increase in prices in the international market, the company anticipates that the cost of raw materials which are imported will increase by 10% during 2010. The company has been able to secure a license for the import of raw materials of a value of ₹1,535 lakhs at 2010 prices. In order to counteract the increase in costs of raw materials, the company is contemplating to revise its product mix. The market survey report indicates that the sales potential of each of the products: 'A', 'B' and 'C' can be increased upto 30% of total sales value of 2009. There was no inventory of finished goods or work in progress in both the year.

You are required to :

Set an optimal product mix for 2010 and find the profitability. (12 Marks)

- (b) List out the remedies available for difficulties experienced during implementation of PRAISE. (4 Marks)

Answer

- (a) Revised P/V ratio and ranking of products:

Product	Existing P/V ratio %	Increase in Raw material cost as % of sales value	Revised P/V Ratio	Revised raw material as % of sale value	Contribution per Rs. 100 of raw material %	Rank
A	20	3.5	16.5	38.50	42.86%	III
B	30	4	26	44.00	59.09%	II
C	40	5	35	55.00	63.64%	I
D	10	6	4	66.00	6.06%	IV

Maximum Sales potential

A	30 % Rs. 3000	900
B	30 % Rs. 3000	900
C	30 % Rs. 3000	900
D	40 % of 3000	1200

Allocation of raw material whose supply is restricted to Rs. 1535 lacs in order of raw material profitability.

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Product	Rank	Sales Rs . In lacs	Raw Material per Rs. 100 Lacs Sales	Raw Material Equired	Balance Raw Material
C	I	900	55	495	1040
B	II	900	44	396	644
A	III	900	38.5	346.5	297.5
D	IV	451**	66	297.5*	0

* Balancing figure, hence sales will be restricted to 451** lakhs (297.5/66%)

Profitability Statement				Rs. In Lakhs		
Product	Existing (2009)			Proposed(2010)		
	Sales	P/V Ratio	Contribution	Sales	P/V Ratio	Contribution
A	900	20	180	900	16.5	148.5
B	300	30	90	900	26	234
C	600	40	240	900	35	315
D	1200	10	120	451	4	18.04
Total	3000		630	3151		715.54
Less : Fixed Costs*			330	330		
Profit before Dep and Int.			300	385.54		
Less :Depreciation			225	225.00		
Less :Interest			115.5	115.50		
Profit before tax			(40.5)	45.04		

* Balancing figure(Contribution - Profit before Depreciation & Interest)

The increase of contribution of Rs 85.54 in 2010 will set off loss of Rs 40.50 lakhs and result in profit of Rs 45.04 lakhs.

- (b) Remedies available for difficulties experienced in each step available during implementation of praise:

Sl. No.	Activities	Remedies
1.	Problem Identification	Participate in programs like brain storming, multi voting, GD etc Precise definition of a problem and quantification.
2.	Ranking	- Participative approach - Sub ordination of individual to group approach.
3.	Analysis	Lateral thinking/Brain storming.
4.	Innovation	Systematic evaluation of all aspects of each strategy.

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5.	Solution	- Effective internal communication. - Training of personnel/managers
6.	Evaluation	- Participative approach - Effective control system to track actual feedback system

Question 3

- (a) A company is engaged in manufacturing of several products. The following data have been obtained from the record of a machine shop for an average month:

Budgeted

No. of working days	24
Working hours per day	8
No. of direct workers	150
Efficiency	One standard hour per clock hour
Down time	10%
Overheads	
Fixed	₹ 75,400
Variable	₹ 90,720

The actual data for the month of August 2010 are as follows:

Overheads	
Fixed	₹ 78,800
Variable	₹ 70,870
Net operator hours worked	20,500
Standard hours produced	22,550

There was a special holiday in August 2010.

Required :

- Calculate efficiency, activity, calendar and standard capacity usages ratio.
 - Calculate all the relevant fixed overhead variances.
 - Calculate variable overheads expenditure and efficiency variance. (10 Marks)
- (b) A firm makes two products X and Y, and has a total production capacity of 16 tonnes per day. X and Y are requiring the same production capacity. The firm has a permanent contract to supply at least 3 tonnes of X and 6 tonnes of Y per day to another company. Each tonne of X require 14 machine hours of production time and each tonne of Y requires 20 machine hours of production time. the daily maximum possible number of

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machine hours is 280. All the firm's output can be sold, and the profit made is ₹ 20 per tonne of X and ₹ 25 per tonne of Y.

Required:

Formulate a linear programme to determine the production schedule for maximum profit by using graphical approach and calculate the optimal product mix and profit. (6 Marks)

Answer

(a)

Ratio	Working	Result
Efficiency Ratio	$\frac{\text{Output expressed in Standard Hours}}{\text{Actual Hours Worked}}$	$(22550/20500)*100 = 110\%$
Activity Ratio	$\frac{\text{Output expressed in Standard Hours}}{\text{Budgeted output in standard hours}}$	$(22550/25920)*100 = 87\%$ or 86.99 %
Calendar Ratio	$\frac{\text{Actual Working days in a period}}{\text{No. of working days in related budget period}}$	$(23/24)*100 = 96\%$
Standard Capacity usage ratio	$\frac{\text{Budget Hours}}{\text{Maximum No. of hours in related period}}$	$(25920/28800)*100 = 90\%$

Workings

Maximum Hours	= 24 * 8 * 150	28,800
Budgeted Hours	= 28800 less 10%	25,920
Actual Hours (given)		20,500
Standard Hours (produced)		22,550
Budgeted Working days		24
Actual Working days		23

Standard Rate X Standard Hours	Standard Rate X Standard Hours	Actual Hours X Actual Rate
(1)	(2)	(3)
$(90720/25920)*22550$	$(90720/25920)*20500$	Given
Rs. 78925	Rs. 71750	Rs. 70870

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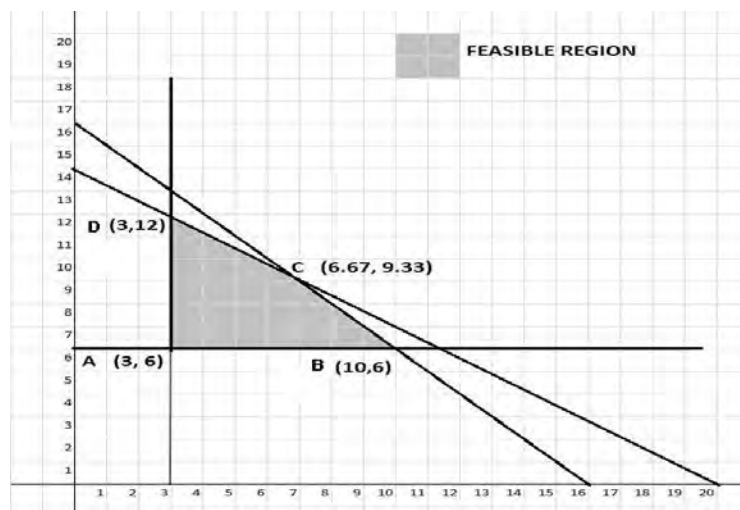
Variable Overhead Efficiency Variance	(1) - (2)	Rs. 7175 (F)
Variable Overhead Expenditure Variance	(2) - (3)	Rs. 880 (F)
Variable Overhead Variance	(1) - (3)	Rs. 8055 (F)

Budgeted Fixed Overheads

Standard Rate X Standard Hours (1)	Standard Rate X Actual Hours (2)	Standard Rate X Revised Budgeted Hours (3)	Standard Rate X Budgeted Hours (4)	Actual Overheads (5)
2.91 X 22550 = 65621	2.91 X 20500 = 59655	2.91 X 24840 = 72284	Given = 75400	Given = 78800

Fixed Overhead Efficiency Variance	(1) - (2)	Rs. 5,966(F)
Fixed Overhead Capacity Variance	(2) - (3)	Rs.12,629(A)
Fixed Overhead Calender Variance	(3) - (4)	Rs. 3,116(A)
Fixed Overhead Volume Variance	(1) - (4)	Rs. 9,779(A)
Fixed Overhead Expenditure Variance	(4) - (5)	Rs. 3,400(A)
Fixed Overhead Variance	(1) - (5)	Rs.13,179(A)

- (b) Maximise Z $20x + 25y$
 Subject to $x + y \leq 16$
 $x \geq 3$
 $y \geq 6$
 $14x + 20y \leq 280$
 $x, y > 0$



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Z =	20 x +	25y	Total Contribution
Point	X	Y	
A	3	6	210
B	10	6	350
C	6.67	9.33	367- Optimal
D	3	12	360

The maximum value of objective function $Z = 370$ occurs at extreme point C (6.67, 9.33).

Hence company should produce $x_1 = 6.67$ tonnes of product X and $x_2 = 9.33$ tonnes of product Y in order to yield a maximum profit of Rs. 367.

Question 4

Attempt any four

(a) The following information is given by Z Ltd.:

Margin of safety	₹ 1,87,500
Total cost	₹ 1,93,750
Margin of safety	7500 units
Break-even sales	2500 units

Required:

Calculate Profit, P/V Ratio, BEP Sales (in ₹) and Fixed Cost. (4 Marks)

(b) Explain the major components of balanced score card. (4 Marks)

(c) List the 5 steps involved in the methodology of critical path analysis. (4 Marks)

(d) Calculate the selling price per unit to earn a return of 12% net on capital employed (net of tax @40%). The cost of production and sales of 80,000 units are:

Variable cost including material cost	₹ 9,60,000
Fixed overheads	₹ 5,00,000

The fixed portion of capital employed is ₹ 12 lakhs and the varying portion is 50% of sales turnover. (4 Marks)

(e) What are the steps involved in carrying out Monte Carlo simulation model? (4 Marks)

Answer

(a) Margin of Safety(%) = MoS Units/Actual Sales Units

$$= 7500 / (7500 + 2500) = 75\%$$

$$\text{Total Sales} = 187500 / 0.75 = \text{Rs. } 2,50,000/-$$

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$$\begin{aligned}
 \text{Profit} &= \text{Total sales} - \text{Total Cost} \\
 &= 250000 - 193750 = \text{Rs. } 56250 \\
 \text{P/V Ratio} &= \text{Profit/MoS (Rs.)} \times 100 \\
 &= 56250/187500 \times 100 = 30\% \\
 \text{BEP Sales} &= \text{Total Sales} / (100 - \text{MS}) \\
 &= 2,50,000 \times 0.25 = \text{Rs. } 62,500 \\
 \text{Fixed Cost} &= \text{Sales} \times \text{P/V Ratio} \\
 &= 250000 \times 0.30 - 56250 = 18750
 \end{aligned}$$

Alternate Answer 1

$$\begin{aligned}
 \text{Margin of Safety} &= \text{Selling Price per unit} \times (7500 \text{ units}) \\
 \text{Rs. } 187500 &= \text{Selling Price per unit} \times (7500 \text{ units})
 \end{aligned}$$

Therefore ,

$$\text{Selling Price per unit} = \frac{187500}{7500} = \text{Rs. } 25$$

Profit		Rs.
Sales	10000×25	2,50,000
Less: Total Cost		1,93,750
Profit		56,250
P/V Ratio	$\frac{\text{Profit/Margin of Safety}}{56250/187500} =$	30%
BEP Sales	2500×25	Rs. 62,500
Fixed Cost	$62500 \times 30\% =$	Rs. 18,750

Alternative Answer 2

$$\text{Selling price} = \text{Rs } 187500 / 7500 = \text{Rs. } 25$$

$$\text{Total Cost at Break Even point} = \text{Rs. } 25 \times 2500 = 62500 = \text{Break Even Sales}$$

$$(\text{Total Cost} - \text{Total Cost of BE}) / (\text{Total Units} - \text{Break Even Units}) = \text{Variable Cost per Unit}$$

$$(93,750 - 62,500) / (10,000 - 2,500) = 1,31,250 / 7,500 = \text{Rs. } 17.50 \text{ per unit}$$

$$\text{Selling Price} = 25.00$$

$$\text{Variable Cost} = \underline{17.50}$$

$$\text{Contribution} = 7.50$$

$$\text{P/V Ratio} = 7.50/25 = 30\%$$

$$\text{Fixed Cost} = 7.50 \times 2500 \text{ units} = \text{Rs. } 18750.$$

$$\text{Profit} = 7.50 \times 7500 = \text{Rs. } 56,250$$

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- (b) Well designed balanced score card combines financial measures of past performance with measures of the firm's drivers of future performance. Generally the Balanced Score Card has the following perspectives from which a company's activity can be evaluate

1. Customer perspective i.e how customers see us?
2. Internal perspective ie. In what processes must the firm excel?
3. Innovation & learning perspective i.e,can we continue to improve and create value?
4. Financial perspective i.e., how we look to our share holders?

- (c) Working Methodology of PERT:

The working methodology of PERT which includes both CPM and PERT, consists of following five steps:

1. Analyze and break down the project in terms of specific activities and/or events.
2. Determine the interdependence and sequence of specific activities and prepare a net-work.
3. Assign estimates of time, cost or both to all the activities of the network.
4. Identify the longest or critical path through the network.
5. Monitor, evaluate and control the progress of the project by re-planning, rescheduling and reassignment of resources.

- (d) Let 'x' be the selling price per unit, Therefore, Turnover = 80000 x

$$\text{Capital Employed} = 1200000 + 40000 x$$

$$\text{Return on capital employed after tax} = 12\%$$

Therefore,

$$\text{Return on capital employed before tax} = 12/0.6 = 20\%$$

Therefore,

$$\text{Return on capital employed before tax} = 20\% \text{ of } (1200000 + 40000x) = 240000 + 8000x$$

$$\text{Sales} = 80000 x$$

$$\text{Variable Cost} = 960000$$

$$\text{Fixed Cost} = 500000$$

$$\text{Profit} = 80000x - 1460000$$

Therefore

$$80000x - 1460000 = 240000 + 8000x$$

$$72000x = 1700000$$

$$X = \text{Rs. } 23.61$$

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Alternative Answer

Selling price per unit should cover Variable cost unit, Fixed Cost per unit and ROCE per unit

Fixed Capital Employed = Rs.12 lacs

Required Return (net of tax) = 12% = Rs.1,44,000

Pre tax return = 1,44,000 / 0.6 = Rs.2,40,000

Let Selling Price per unit = X

$$\begin{aligned} X &= (14,60,000 + 2,40,000) / 20,000 + (12\% \text{ of } 50\% \text{ of } X) / 0.6 \\ &= 17,00,000 / 20,000 + 6 / 100 \times 1 / 0.6 \times X \end{aligned}$$

$$X(1 - 0.1) = 21.25$$

$$X = 21.25 / 0.9 = \text{Rs.}23.61 \text{ per unit}$$

Required Selling price = Rs.23.61

If a student has arrived at Rs.23.61, full 4 marks may be given even if the intermediary steps are not adequately shown.

(e) Steps involved in Monte Carlo simulation are:

- (i) To select the measure of effectiveness of the problem, that is, what element is used to measure success in improving the system modeled. This is the element one wants to maximize or minimize.
- (ii) Identifying the variables which influence the measure of effectiveness significantly.
- (iii) Determining the proper cumulative probability distribution.
- (iv) To get a set of random numbers.
- (v) Consideration of each random number as a decimal value of the cumulative probability distribution. With the decimal, enter the cumulative distribution plot from the vertical axis, Project this point horizontally, until it intersects cumulative probability distribution curve.
- (vi) Recording the value generated in step(v) into the formula derived from the chosen measures of effectiveness. Solve and record the value.
- (vii) Repeating steps (V) and (VI) until sample is large enough for the satisfaction of the decision maker.

Question 5

- (a) Fruitolay had decided to increase the size of the store. It wants the information about the probability of the individual product lines : Lemon, grapes and papaya. It provides the following data for the 2009 for each product line:

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	<i>Lemon</i>	<i>Grapes</i>	<i>Papaya</i>
<i>Revenues</i>	₹ 79,350.00	₹ 2,10,060.00	₹ 1,20,990.00
<i>Cost of goods sold</i>	₹ 60,000.00	₹ 1,50,000.00	₹ 90,000.00
<i>Cost of bottles returned</i>	₹ 1,200.00	₹ 0	₹ 0
<i>Number of purchase orders placed</i>	36	84	36
<i>Number of deliveries received</i>	30	219	66
<i>Hours of shelf stocking time</i>	54	540	270
<i>Items sold</i>	12,600	1,10,400	30,600

Fruitolay also provides the following information for the year 2009:

<i>Sr.No.</i>	<i>Activity</i>	<i>Description of Activity</i>	<i>Total costs (₹)</i>	<i>Cost allocation basis</i>
1.	Bottle returns	Returning of empty bottles to the store	1,200.00	Direct tracing to product line
2.	Ordering	Placing of orders of purchases	15,600.00	156 purchase orders
3.	Delivery	Physical delivery and the receipts of merchandise	25,200.00	315 deliveries
4.	Self stocking	Stocking of merchandise on store shelves and ongoing restocking	17,280.00	864 hours of time
5.	Customer support	Assistance provided to customers including bagging and checkout	30,720.00	153600 items sold

Required:

- (i) Fruitolay currently allocates store support costs (all costs other than the cost of goods sold) to the product line on the basis of the cost of goods sold of each product line. Calculate the operating income and operating income as the percentage of revenue of each product line.
 - (ii) If Fruitolay allocates store support costs (all costs other than the cost of goods sold) to the product lines on the basis of ABC system, calculate the operating income and operating income as the percentage of revenue of each product line.
 - (iii) compare both the systems. (11 Marks)
- (b) Discuss various forecasting methods using time series. (5 Marks)

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Answer

(a)

(i) <i>Particulars</i>	<i>Lemon</i>	<i>Grapes</i>	<i>Papaya</i>	<i>Total</i>
Revenue	79,350	2,10,060	1,20,990	4,10,400
Less: Cost of goods sold (COGS)	60,000	1,50,000	90,000	3,00,000
Less: Store Support Cost	18,000	45,000	27,000	90,000
Operating income	1,350	15,060	3,990	20,400
Operating Income %	1.70%	7.17%	3.30%	4.97%

(ii) ABC System

Activity	Cost Hierarchy Level	Total Costs (Rs)	Quantity Of Cost Allocation Base	Overhead Allocation Rate
Ordering	Batch	15600.00	156 Purchase orders	Rs. 100
Delivery	Batch	25200.00	315 delivering orders	Rs. 80
Shelf stocking	Output unit	17280.00	864 self stocking hours	Rs. 20
Customer support	Output unit	30,720.00	153600 items sold	Rs. 0.20

<i>Particulars</i>	Cost Driver	<i>Lemon</i>	<i>Grapes</i>	<i>Papaya</i>	<i>Total</i>
Bottle Returns	Direct	1,200	0	0	1,200
Ordering	Purchase orders	3,600	8,400	3,600	15,600
Delivery	Deliveries	2,400	17,520	5,280	25,200
Self Stocking	Hours of time	1,080	10,800	5,400	17,280
Customer Support	Items Sold	2,520	22,080	6,120	30,720
Grand Total		10,800	58,800	20,400	90,000

<i>Particulars</i>	<i>Lemon</i>	<i>Grapes</i>	<i>Papaya</i>	<i>Total</i>
Revenue	79,350	2,10,060	1,20,990	410,400
Less: Cost of goods sold	60,000	1,50,000	90,000	300,000
Less: Store Support Cost	10,800	58,800	20,400	90,000
Operating income	8,550	1,260	10,590	20,400
Operating Income %	10.78%	0.60%	8.75%	4.97%

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Summary

	<i>Lemon</i>	<i>Grapes</i>	<i>Papaya</i>	<i>Total</i>
Under Traditional Costing System	1.70%	7.17%	3.30%	4.97%
Under ABC System	10.78%	0.60%	8.75%	4.97%

The grapes line drops sizeably when ABC is used. Although it constitutes 50 % COGS, it uses a higher percentage of total resources in each activity area., especially the high cost of customer support area. In contrast, lemon line draws a much lower percentage of total resources used in each activity area than its percentage of total COGS. Hence under ABC, Lemon is most profitable. Fruitolay can explore ways to increase sales of lemons and also explore price increases on grapes.

Operating Income Ranking is highest for Grapes under Traditional System because other products bear its overhead cost, whereas under ABC a more accurate picture shows Grapes as the lowest ranking product.

(b) Forecasting methods using Time series.

- (i) Mean forecast: In this method we calculate mean of the series for the time period t and take this value as representative of the future time series. $Y_t = Y$
- (ii) Naïve forecast:-This method is based on the assumption that the future will exactly resemble the past. We forecast the value, for the time period t , to be equal to the actual value observed in the previous period t that is, time period $(t-1)$ $Y_t = Y_{t-1}$
- (iii) Linear trend forecast: A linear relationship is established between the time and the variable under study, which may be represented by $Y_t = a + bX$

Where X will be found from the value of t and a and b are constants.

- (iv) Non –linear trend forecast: In this method, a non-linear relationship between the time and the response value has been found again by least squares method. Then the value, for the time period t , will be calculated from the non-linear equation;

$$Y_t = a + bX + cX^2$$

- (v) Forecasting by exponential smoothing: In this method, the forecast value for the time period t is found using exponential smoothing of time series

$$Y_t = Y_{t-1} + a (Y_t - Y_{t-1}) \text{ where } Y_{t-1} = \text{the forecasted value for time period } t$$

$$Y_t = \text{the observed value for time period } t.$$

Question 6

- (a) A company has three plants located at A, B and C. The production of these plants is absorbed by four distribution centres located at X, Y, W and Z. the transportation cost per unit has been shown in small cells in the following table:

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<i>Distribution Centres</i> <i>Factories</i>	X	Y	W	Z	Supply (Units)
A	6	9	13	7	6000
B	6	10	11	5	6000
C	4	7	14	8	6000
Demand (Units)	4000	4000	4500	5000	18000 17500

Find the optimum solution of the transportation problem by applying Vogel's Approximation Method. (8 Marks)

- (b) Mention the data required to operate the material requirement planning system. (4 Marks)
- (c) "Customer profile is important in charging cost." Explain this statement in the light of customer costing in service sector. (4 Marks)

Answer

- (a) Step 1 : Initial Allocation based on Least cost cells corresponding to highest differences

	X	Y	W	Z	Dummy	Total
A		2,000	3,500		500	6,000
B			1,000	5,000		6,000
C	4,000	2,000				6,000
TOTAL	4,000	4,000	4,500	5,000	500	18,000

Step 2 : Δ_{ij} Matrix values for Unallocated cells

	X	Y	W	Z	Dummy
A	0			0	
B	2	3			2
C			3	3	2

All Δ_{ij} values ≥ 0 . Therefore initial allocation is optimal.

Step 3 : Optimal Transportation Cost

	Units	Costs involved	Total
A to Y	2,000	9	18,000
A to W	3,500	13	45,500
B to W	1,000	11	11,000
B to Z	5,000	5	25,000
C to X	4,000	4	16,000

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C to Y	2,000	7	14,000
Total minimum cost			1,29,500

Note : Since there are zeroes in the Δ_{ij} Matrix alternate solutions exist.

(b) Data requirements to operate material requirement planning system:

1. The master Production schedule: This schedule specifies the quantity of each finished unit of products to be produced and the time at which each unit will be required.
2. The Bill of material file: The bill of material file specifies the sub-assemblies, components and materials required for each of the finished goods.
3. The inventory file: This file maintains details of items in hand for each sub-assembly, components and materials required for each of the finished goods.
4. The routing file: This file specifies the sequence of operations required to manufacture sub-assemblies, components and finished goods.
5. The master parts file: This file contains information on the production time of sub-assemblies; components produced internally and lead times for externally acquired items.

(c) Customer costing in the service sector:

The customer costing is a new approach to management. The central theme of this approach is customer satisfaction. In some service industries, such as public relations, the specific output of industry may be difficult to identify and even more difficult to quantify. Further there are multiple customers, identifying support activities i.e. common costs with particular customer may be more problematic. In such cases it is important to cost customer. An ABC analysis of customers profitability provides valuable information to help management in pricing customer. Consider a banking sector. A bank's activities for customer will include the following types of activities. These are:

- i. Stopping a cheque
- ii. Withdrawal of cash
- iii. Updation of pass book
- iv. Issue of duplicate pass book
- v. Returning a cheque because of insufficient funds
- vi. Clearing of a customer cheque.

Different customers or categories of customers use different amount of these activities and so customer profiles can be built up and customer can be charged according to the cost to serve them.

Customer profile is important in analyzing cost under the following categories

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1. Customer specific costs: These are the direct and indirect cost of providing service to customer plus customer related cost assigned to each customer.
For example: cost of express courier service to a client who requests over-night delivery of some agreement.
2. Customer – line categories: These are the costs which are broken into broad categories of customers and not individual customers.

Question 7

- (a) A company has two divisions : Division a and Division B. Both divisions of the company manufacture the same product but located at two different places. The annual output of division A is 6000 tons (at 80% capacity) and that of division B is 7500 tons (at 60% capacity). The basic raw material required for production is available locally at both the places, but at division A, it is limited to 4000 tons per annum at the rate of ₹100 per ton, at division B, it is limited to 8000 tons per annum at the rate of ₹110 per ton. Any additional requirement of material will have to be purchased at a rate of ₹125 per ton from other markets at either of division. Variable costs per ton at each division remain constant. For every 1000 tons of output, 800 tons raw material is required. The details of other costs of the divisions are as follows:

	Division A	Division B
Other variable costs of output (₹)	122 per ton	120 per ton
Fixed cost per annum(₹)	3,80,000	6,00,000

Required:

- (i) Calculate variable cost per ton for each division's product and decide ranking in order to preference.
 - (ii) The company desires to fully utilize the available local supplies of raw material to save the overall variable cost of production; keeping the total production of both the divisions putting together is the same as at present level. Calculate the quantity of production (output) that could be transferred between the two divisions and overall saving in variable cost.
 - (iii) After considering the option (ii), how the balance capacity should be utilized if company is working at 100% capacity, and also calculate selling price per ton if company mark up 10% on full cost of each division's product. (12 Marks)
- (b) Explain distinctive features of learning curve theory in manufacturing environment. (4 Marks)

Answer

- (a) variable cost per ton in different alternatives

Particulars	Division A		Division B	
	Local	Outside	Local	Outside

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Material per ton	0.8	0.8	0.8	0.8
Rate per ton	100	125	110	125
Cost of material	80	100	88	100
Other Variable cost per ton	122	122	120	120
Total Variable Cost	202	222	208	220
Ranking	I	IV	II	III

Maximum production at both divisions $6000+7500 = 13500$ tons

Rank	Division	Market	Material	Output	Total	Balance
						13,500
I	A	Local	4,000	5,000	5,000	8,500
II	B	Local	6,800	8,500	13,500	0
	Total		10,800	13,500		

Statement showing saving in overall variable cost of proposed mix

Production (Current Mix)	Production (tons)	Variable cost per ton	Amount (Rs.)
Division A from local Market	5,000	202	10,10,000
Division A from outside Market	1,000	222	2,22,000
Division B from local Market	7,500	208	15,60,000
Total Variable Cost of Production	13,500		27,92,000
Production (Proposed Mix)			
Division A from local Market	5,000	202	10,10,000
Transfer from Division A to B as variable cost in Division B is less than other market cost $(6000-5000)=1000$ output required 800 tons input.	8,500	208	17,68,000
Total Variable Cost of Production	13,500		27,78,000
Transfer from Division A to Division B 1000 tons output will save in variable cost $Rs. 2792000 - 2778000 = 14000$.			

At 100% capacity the production is

	Div A	Div B	Total
Output (in tons)	$6000/0.80 = 7,500$	$7500/0.6 = 12,500$	20,000
Output already used	5,000	8,500	13,500
Balance capacity (tons)	2,500	4,000	6,500

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Input required (tons)	6,000	10,000	
Input locally available	4,000	8,000	
Input locally used	4,000	6,800	
Balance available (input local)	NIL	1,200	

Rank	Div	Market	Material	Output	Total	Balance Output
						6500
2nd	B	Local	1200	1500	1500	5000
3rd	B	Outside	2000	2500	4000	2500
4th	A	Outside	2000	2500	2500	NIL

Total cost of production and Selling price per tone

	Division A	Amount (Rs.)	Division B	Amount (Rs.)
Variable Cost	Output x VC		Output x VC	
Local Material	5000 × 202	10,10,000	8500+1500=10000 × 208	20,80,000
Outside Material	2500 × 222	5,55,000	2500×220	5,50,000
Fixed Cost		3,80,000		6,00,000
TOTAL COST (full cost)		19,45,000		32,30,000
Profit		1,94,500		3,23,000
Selling Price		21,39,500		35,53,000
Selling Price per tonne		285.27		284.24

Alternative Answer

	Division A		Division B	
	Output	Raw Material	Output	Raw Material
Current production	6,000	4,800	7,500	6,000
Maximum Production	7,500		12,500	
Maximum production from Local Raw material	5,000	4,000	10,000	8,000

	Division A	Division B
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	Local Raw Material	Outside Raw Material	Local Raw Material	Outside Raw Material
Raw material cost per ton of output	80	100	88	100
Variable Overhead per ton of output	122	122	120	120
Total Variable Cost	202	222	208	220
Rank	I	IV	II	III
Current Mix (Output) M	5,000	1,000	7,500	-
Divisional subtotal of output	6,000		7,500	
Maximum Possible Output	5,000	2,500	10,000	2,500
Divisional subtotal of max. output	7,500		12,500	
Proposed optimal mix current output N	5,000	-	8,500	0

Savings in Variable Cost = 1000 x (222-208) = 14,000

(Difference between rows M and N)

	Division A		Division B	
	Local Raw Material	Outside Raw Material	Local Raw Material	Outside Raw Material
Maximum Prodn Capacity (Output)	5,000	2,500	10,000	2,500
Weighted average Variable Cost per tonne	$\frac{202 \times 2 + 222 \times 1}{3} = 208.67$		$\frac{208 \times 4 + 220 \times 1}{5} = 210.10$	

	Division A	Division B
Variable Cost per unit	208.67	210.40
Fixed Cost per unit	50.67 380000/7500	48.00 600000/12500
Total Cost per ton	259.34	258.40
Markup @ 10%	25.93	25.84
Total Selling price per ton	285.27	284.24

- (b) The production quantity of a given item doubled the cost of that item decrease at a fixed rate. This phenomenon is the basic premise on which the theory of learning curve has been formulated.

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The distinctive features of a learning curve are:

1. Better tooling methods are developed and used
2. More productive equipments are designed and used to make the product.
3. Design bugs are detected and corrected.
4. Better design engineering reduces material and labour costs.
5. Early teething problems are overcome. As production progresses management is prompted to achieve better planning and better management.
6. Rejections and rework tend to diminish over time.
7. As quantity produced increases the Cost per unit decreases, since each unit entails:
(i) Lesser labour (ii) Greater productivity of material and labour (iii) Fewer delays and lesser time losses.

