PAPER – 5 : COST MANAGEMENT

Question 1

(a) A Ltd. Makes and sells a single product. The company's trading results for the year are:

	Figs. – Rs. '000 (Year 2007)	
Sales		3,000
Direct materials	900	
Direct labour	600	
Overheads	900	2,400
Profits		600

For the year 2008, the following are expected:

(i) Reduction in the selling price by 10%.

(ii) Increase in the quantity sold by 50%.

(iii) Inflation of direct material cost by 8%.

(iv) Price inflation in variable overhead by 6%.

(v) Reduction of fixed overhead expenses by 25%.

It is also known that :

(a) In 2006, overhead expenditure totalled to Rs. 8,00,000.

(b) Total overhead cost inflation for 2007 has been 5% more than 2006.

(c) Production and sales volumes have been 25% higher in 2007 than in 2006.

The high-low method is being used by the company to estimate overhead expenditure.

You are required to:

(i) Prepare a statement showing the estimated trading results for 2008.

(ii) Calculate the Break-even point for 2007 and 2008.

(iii) Comment on the BEP and profits of the years 2007 and 2008.

(b) The following information is available:

Activity		No. of days	No. of men required per day
A	1—2	4	2
B	1—3	2	3
C	1—4	8	5

D	2—6	6	3
E	3—5	4	2
F	5—6	1	3
G	4—6	1	8

(i) Draw the network and find the critical path.

(ii) What is the peak requirement of Manpower? On which day(s) will this occur?

(iii) If the maximum labour available on any day is only 10, when can the project be completed?

(c) Draw and explain the angle of incidence in a break-even chart. What is its significance to the management? (12 + 9 + 3 = 24 Marks)

Answer

(a) (i)

Trading Results

Figures Rs. '000

	2006	2007	2008	Workings
Sales:		3,000	4,050 (Refer to Note 1)	(3,000 × 1.5 × .9)
Direct Material		900	1,458	(900 × 1.5 × 1.08)
Direct Labour		600	900	(600 × 1.5 × 1)
Variable Overhead		300* (Refer Note 2)	477	(300 × 1.06 × 1.5)
Total Variable Cost		1,800	2,835	Total variable cost
Contribution		1,200	1,215	
Fixed Overhead		600 (Refer to Note 3)	450	(600 × .75)
Total Overhead	800	900	927	
Total Cost		2,400	3,285	
Profits		600	765	

(ii) P/V Ratio Contribution/ Sales 40% 30%

BEP Fixed Cost/PV Ratio $\frac{600}{40\%} = 1{,}500$ $\frac{450}{30\%} = 1{,}500$

(Note 1) $3{,}000 \times 1.5 \times 0.9$

(Note 2) Overhead Cost in 2006 = 800

Increase in price = 5%

$\therefore$ Overhead cost for same production $800 \times 5\% + 800 = 840$.

Overhead increase due to quantity = 900 – 840 = Rs. 60

Rs. 60 represents increase in variable Overhead in 2007 due to increase in quantity by 25%.

$\therefore$ Variable Overhead amount in 2007 = $1\frac{1}{4}$ times

i.e. $\frac{5}{4} = 5 \text{ times} \left(\frac{1}{4} \text{th quantity} \right) = 5 \times 60 = 300$

(Note 3)

In 2007 Total Overhead	900
Variable Overhead (Refer to Note 2)	300
Fixed Overhead	600

(iii)

	2007	2008	Difference	%
BEP	1,500	1,500	0	
Fixed Overhead	600	450	150	25%
PV Ratio	40%	30%	10%	25% $\frac{10}{40}$
Profit	600	765	165	27.5%

$$\text{BEP} = \frac{\text{Fixed Cost}}{\text{P/V ratio}}$$

Both Fixed Cost and P/V ratio have declined by 25% equally. So BEP sales remains the same.

The contribution is only Rs. 1,215 in 2008 though quantity is increased by 50%. This is due to increase in production cost and decrease in selling price. This is more than made up by decrease in fixed cost so that overall profit has increased by 27.5%.

Alternative Solution (for identifying variability and fixedness of overheads):

V_1q_1 = Variable Overhead / unit in 2007 × quantity in 2007

V_2q_2 = Variable Overhead / unit in 2008 × quantity in 2008

$V_2q_2 = V_1(1.06)\,(1.5)q_1 = 1.59\ v_1q_1$

$V_0\,q_0 + F_0 = 800$

$V_1\,q_0 + F_0 = \underline{840}$ where $q_0 \times 1.25 = q_1$

$V_1\,q_0 - V_0\,q_0 = 40$

$V_0q_0 = V_1\,q_0 - 40$

$V_1\,q_0 + F_1 - (V_0\,q_0 + F_0) = \dfrac{5}{100} \times 800 = 40$

i.e. $V_1\,q_0 + F_1 = 840$

$V_1\,q_1 + F_1 = \underline{900}$

$V_1\,(q_0 - q_1) = -60$

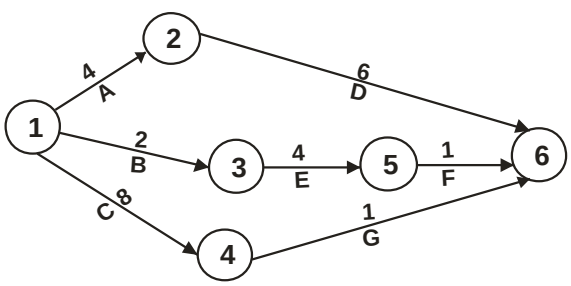
$V_1\,(q_1 - 1.25q) = -60 \times 1.25$

$V_1\,(-.25)q_1 = -75$

$V_1q_1 = \dfrac{-75}{-.25} = 300$

Year 2007	Variable Overhead	300
	Fixed Overhead	600
		900

(b)



Path	Days	
AD	10	→ CP
BEF	7	
CG	9	

Critical Path = 1– 2 – 6

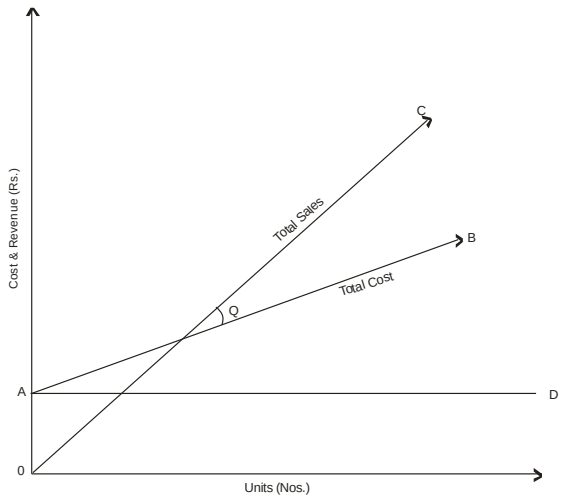
i.e. AD = 10 days.

Peak requirement is 11 men, required on days 7 and 9.

If only 10 men are available on any day, shift F,G to days 10 and 11 and the project can be completed in 11 days.

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	A_2	A_2	A_2	A_2										
					D_3	D_3	D_3	D_3	D_3	D_3				
	B_3	B_3	E_2	E_2	E_2	E_2								
							F_3							
	C_5	C_5	C_5	C_5	C_5	C_5	C_5	C_5						
									G_8					
	10	10	9	9	10	10	11	8	11	3				
If s/o shift										F_3	G_8			
New	10	10	9	9	10	10	8	8	3	6	8			

(c)



Angle of incidence (0) is the angle between the total cost line and the total sales line.

If the angle is large, the firm is said to make profits at a high rate and vice-versa.

A high angle of incidence and a high margin of safety indicate sound business conditions.

Question 2

(a) Is it justifiable to sell at a price below marginal cost at any time? Mention the circumstances in which it is justifiable.

(b) The following information has been extracted from the books of Goru Enterprises which is using standard costing system:

Actual output	=	9,000 units
Direct wages paid	=	1,10,000 hours at Rs.22 per hour, of which 5,000 hours, being idle time, were not recorded in production
Standard hours	=	10 hours per unit
Labour efficiency variance	=	Rs. 3,75,000 (A)
Standard variable Overhead	=	Rs. 150 per unit
Actual variable Overhead	=	Rs. 16,00,000

You are required to calculate:

(i) Idle time variance

(ii) Total variable overhead variance

(iii) Variable overhead expenditure variance

(iv) Variable overhead efficiency variance.

(c) M Ltd. Manufactures a special product purely carried out by manual labour. It has a capacity of 20,000 units. It estimates the following cost structure:

Direct material	30 Rs. / unit
Direct labour (1 hour / unit)	20 Rs. / unit
Variable overhead	10 Rs. / unit

Fixed overheads at maximum capacity is Rs. 1,50,000.

It is estimated that at the current level of efficiency, each unit requires one hour for the first 5,000 units. Subsequently it is possible to achieve 80% learning rate. The market can absort the first 5,000 units at Rs.100 per unit. What should be the minimum selling price acceptable for an order of 15,000 units for a prospective client?

(6 + 6 + 7 = 19 Marks)

Answer

(a) It is justifiable to sell at a price below marginal cost for a limited period.

The circumstances may be:

(i) Where materials are of perishable nature.

(ii) Where stocks have been accumulated in large quantities and the market prices have fallen. This will save the carrying cost of stocks, e.g., electronic goods – market prices fall due to quick obsolescence or advanced technological replenishment.

(iii) It is essential to reduce the prices to such an extent in order to popularize a new product.

(iv) Where such reduction enables the firm to boost the sales of other products having larger profit margin.

(b) Actual output = 9,000 units

Idle time = 5,000 hours

Production time (Actual) = 1,05,000 hours

Standard hours for actual production = 10 hours / unit × 9,000 units = 90,000 hours.

Labour efficiency variance = 3,75,000 (A)

i.e. Standard rate × (Standard Production time – Actual production time) = 3,75,000(A).

SR (90,000 – 1,05,000) = – 3,75,000

$$SR = \frac{-3,75,000}{-15,000} = Rs.\,25$$

(i) Idle time variance = 5,000 hours × 25 Rs. / hour = 1,25,000. (A)

(ii) Standard Variable Overhead = Rs. 150 / unit

Standard hours = 10 hours / unit

Standard Variable Overhead rate / hour = 150 / 10 = Rs. 15 / hour

Total Variable Overhead variance	=	Standard Variable Overhead – Actual Variable Overhead
	=	Standard Rate × Standard hours – Actual rate × Actual hours
	=	(15) × (10 × 9,000) – 16,00,000
	=	13,50,000 – 16,00,000
Total Variable Overhead Variance	=	2,50,000 (A)

(iii) Variable Overhead Expenditure Variance = (Standard Rate × Actual Hours) – (Actual Rate × Actual Hours)

= (15 × 1,05,000) – 16,00,000

= 15,75,000 – 16,00,000

= 25,000 (A)

(iv) Variable Overhead Efficiency Variance = Standard Rate × (Standard Hours for actual output – Actual hours for Actual output)

= 15 (90,000 – 1,05,000)

= 15 (–15,000)

= 2,25,000 (A)

(b) Alternative Solution

Actual Output = 9,000 Units

Idle time = 5,000 hrs

Direct Wages Paid = 1,10,000 hours @ Rs. 22 out of which 5,000 hours being idle, were not recorded in production.

Standard hours = 10 per unit.

Labour efficiency variance = Rs. 3,75,000 (A)

or

Standard Rate (Standard Time – Actual Time) = – 3,75,000

Or (90,000 – 1,05,000) = $\frac{-3,75,000}{\text{Standard Rate}}$

Or Standard Rate = Rs 25/-

(i) Idle time variance = Standard Rate × Idle time

25 × 5,000 = Rs 1,25,000 (A)

(ii) Standard Variable Overhead / unit = 150

Standard Rate = $\frac{150}{10} = \text{Rs.15/hour}$

Standard Quantity = 10 hours

Actual Variable Overhead = 16,00,000

Standard Variable Overhead = 150 × 9,000 = 13,50,000

Actual Variable Overhead = 16,00,000

Total Variable Overhead Variance = 2,50,000 (A)

(iii) Variable Overhead expenditure Variance = Standard Variable Overhead for actual hours – Actual Variable Overhead

= (150 × 1,05,000) – 16,00,000

= 15,75,000 – 16,00,000

= 25,000 (A)

(iv) Variable overhead efficiency variance = Standard Variable Overhead for actual output – Standard Variable Overhead for Actual hours)

= 15 (10 hours × 90,000 units – 1,05,000)

= 15 (90,000 – 1,05,000)

= 15 (–15,000)

= 2,25,000 (A)

(c)

	5,000 units	20,000 units
Material	1,50,000	6,00,000
Direct Labour	1,00,000	2,56,000
		Refer to W Note i
Variable Overhead	50,000	2,00,000
Total Variable Cost	3,00,000	10,56,000
Fixed Cost	1,50,000	1,50,000
Total Cost	4,50,000	12,06,000
Total cost / unit	90	60.3
Sales 100 × 5,000	5,00,000	5,00,000
15,000 × x(assumed selling price)		15,000 x
(Total Sales less Total Cost) = Profit	50,000	15,000 x – 7,06,000

Or minimum selling price = 50.4(refer to Working Note ii)

Working Note: I

Units	Hours
5,000	5,000
10,000	10,000 × 1 × .8 = 8,000 hours
20,000	20,000 × 1 × .8 × .8 = 12,800 hours

Working Note: II

15,000 x – 7,06,000 > 50,000

15,000 x > 7,56,000

or x > 50.4

Alternative Solution:

Total cost / unit of capacity 20,000 = 60.3

Weighted average selling price > 80.4

$$\text{i.e.}\ \frac{5{,}000 \times 100 + 15{,}000\,x}{20{,}000} > 60.3$$

$= 5{,}00{,}000 + 15{,}000\,x > 60.3 \times 20{,}000$

$= 15{,}000\,x > 12{,}06{,}000 - 5{,}00{,}000$

Or

$15{,}000\,x > 7{,}06{,}000$

$x > 47.06$

Minimum price to cover production Cost = 47.06

Minimum price to cover same amount of profit = 50.40 (refer to Working Note 1)

Working Note 1

$(-\ 47.06 + \ 50.04) \times 15{,}000$ units

= Rs. 50,000

Question 3

(a) X Ltd. has two divisions, A and B, which manufacture products A and B respectively. A and B are profit centres with the respective Divisional Managers being given full responsibility and credit for their performance.

The following figures are presented:

	Division A Rs. Per Unit	Division B Rs. Per Unit	
Direct material cost	50	24*	*(other than A)
Material A, if transferred from Division A	—	144	
Material A, if purchased from outside	—	160	
Direct labour	25	14	
Variable production overhead	20	2	
Variable selling overhead	13	26	
Selling price in outside market	160	300	
Selling price to B	144	—	
Selling price to S Ltd.	—	250	

Other Information:

To make one unit of B, one unit of component A is needed. If transferred from A, B presently takes product A at Rs.144 per unit, with A not incurring variable selling overheads on units transferred to B.

Product A is available in the outside market at Rs. 160 per unit from competitors.

B can sell its product B in the external market at Rs. 300 per unit, whereas, if it supplied to X Ltd.'s subsidiary, S Ltd., it supplies at Rs. 250 per unit, and need not incur variable selling overhead on units transferred to S Ltd. S Ltd. requires 6,000 units and stipulates a condition that either all 6,000 units be taken from B or none at all.

	A(units)	B(units)	
Manufacturing capacity	20,000	28,000	
Demand in external market	18,000	26,000	
S Ltd.'s demand	—	6,000	or zero

Assume that Divisions A and B will have to operate during the year.

What is the best strategy for:

(i) Department A?

(ii) Department B, given that A will use its best strategy?

(iii) For X Ltd. As a whole?

(b) What is Pareto Analysis? Name some applications. (14 + 5 = 19 Marks)

Answer

(a)

	Div A	B	B
	Rs. / unit	Rs. / unit	Rs. / unit
Direct Material (Other than A)	50	24	
Direct Labour	25	14	
Variable Overhead (Production)	20	2	
Variable Production Cost (excl. A)	95	40	40
From A		144	
From Outside			160
Variable production Cost / unit		184	200
Selling Price			
From outside	160	300	
Less: Selling Overhead	13	26	
Net Selling Price (outside)	147	274	

Net Selling Price to B	144		
Net Selling Price to S		250	
Net Selling Price (outside)	147	274	274
Variable Production Cost	− 95	− 184	−200
Contribution / unit (outside)	52	90	74
(Sale to B & S respectively)	144	250	250
Variable Production Cost	−95	−184	−200
Contribution / unit	49	66	50

Best strategy

A = Maximise Production; Sell maximum no. of units @ 52 / unit (outside)	18,000 × 52 =	9,36,000
(To B) remaining units	2,000 × 49 =	98,000
Total Contribution for A		10,34,000

Best strategy for B:

Maximise contribution / unit by selling outside and procuring from A 90 / unit

Contribution × 2,000 units

Balance units can yield contribution of either 74/ unit for outside or Rs. 50 / unit to S Ltd.

Production Capacity = 28,000.

Option I			Option II
Outside Sales	Sales to S		Outside Sales × contribution / unit
20,000 × 74 = 14,80,000	6,000 × 50	= 3,00,000	24,000 × 74 = 17,76,000
2,000 × 90 = 1,80,000			2,000 × 90 = 1,80,000
16,60,000		3,00,000	
Total Contribution	(16,60,000 + 3,00,000)	19,60,000	19,56,000

(B) Choose Option I i.e. get 2,000 units from A, sell 6,000 units to S and 20,000 to outside. Make 28,000 units @ full capacity. Total Contribution Rs19,60,000.

If A and B are allowed to act independent of the group synergy,

		Rs.
Total contribution	A –	10,34,000
	B –	19,60,000
Total contribution for X Ltd.		29,94,000

Cost from X Ltd.'s Perspective

Variable Cost of production	Div A	Rs. 95
	Div B	
Variable cost of production other than A	40	40
A supplied by Division	95	
A – Variable Cost		
A purchased	___	160
	135	200

Option I	Outside 26,000 units	Option II	
Outside 20,000 × (274 – 135)	27,80,000	20,000 (274 – 135)	27,80,000
2,000 × (274 – 200)	1,48,000	6,000 (274 – 200)	4,44,000
22,000			
S Ltd. 6,000 units (250 – 200)	3,00,000		_____
	32,28,000		32,24,000

Choose Option I

Contribution = Rs. 32,28,000 for X Ltd. as a whole

Transfer (2,000 units)

Make A transfer all output to B. Sell 6,000 units of B to S and 22,000 units to outside market. This will make X Ltd. better off by 32,28,000 – 29,94,000 = Rs 2,34,000

(i.e. 18,000 units of A sold to outside increases contribution to A by 3 Rs. / unit and decreases contribution to B by 16 Rs. / unit Net negative effect = 13 × 18,000 = Rs.2,34,000).

(b) Vilfredo Pareto, an Italian economist, observed that about 70 – 80% of value was represented by 30 – 20% of volume. This observation was found to exist in many business solutions.

Analysing and focusing on the 80% value relating to 20% volume helps business in the following areas.

(i) Pricing of a product (in a multi-product company)

(ii) Customer profitability.

(iii) Stock control.

(iv) Activity Based Costing (20% cost drivers are responsible for 80% of total cost)

(v) Quality Control.

Question 4

(a) Biscuit Ltd. Manufactures 3 types of biscuits, A, B and C, in a fully mechanised factory. The company has been following conventional method of costing and wishes to shift to Activity Based Costing System and therefore wishes to have the following data presented under both the systems for the month.

Inspection cost	Rs. p.m.	73,000
Machine – Repairs & Maintenance	Rs. p.m.	1,42,000
Dye cost	Rs. p.m.	10,250
Selling overheads	Rs. p.m.	1,62,000

	Product A	B	C
Prime cost (Rs. per unit)	12	9	8
Selling price (Rs. per unit)	18	14	12
Gross production (units/production run)	2,520	2,810	3,010
No. of defective units / production run	20	10	10
Inspection:			C
No. of hours / production run	3	4	4
Dye cost / production run (Rs.)	200	300	250
No. of machine hours / production run	20	12	30
Sales – No. of units / month	25,000	56,000	27,000

The following additional information is given:

(i) No accumulation of inventory is considered. All good units produced are sold.

(ii) All manufacturing and selling overheads are conventionally allocated on the basis of units sold.

(iii) Product A needs no advertisement. Due to its nutritive value, it is readily consumed by diabetic patients of a hospital. Advertisement costs included in the total selling overhead is Rs. 83,000.

(iv) Product B needs to be specially packed before being sold, so that it meets competition. Rs. 54,000 was the amount spent for the month in specially packing B, and this has been included in the total selling overhead cost given.

You are required to present productwise profitability of statements under the conventional system and the ABC system and accordingly rank the products.

(b) What do you mean by a dummy activity? Why is it used in networking?

(c) How would you use the Monte Carlo Simulation method in inventory control?

(11 + 4 + 4 = 19 Marks)

Answer

(a)

		A	B	C	Total
(i)	Units Rs.	25,000	56,000	27,000	1,08,000
	Selling price/unit	18	14	12	
(ii)	Sales Value (Rs.)	4,50,000	7,84,000	3,24,000	15,58,000
(iii)	Prime Cost Overhead	12	9	8	
(iv)	No. of units/run	2,520	2,810	3,010	
(v)	Prime Cost Rs.	3,02,400	5,05,800	2,16,720	
(vi)	Gross Margin (ii – v)	1,47,600	2,78,200	1,07,280	5,33,080

	Total	A	B	C
Inspection Cost $\left(\frac{7,3000}{146} \times 30/80/36 \text{ respectively}\right)$	73,000	15,000	40,000	18,000
Machine Maintenance $\left(\frac{1,42,000}{710} \times 200/240/270 \text{ respectively}\right)$	1,42,000	40,000	48,000	54,000
Dye Cost	10,250	2,000	6,000	2,250
Sub Total	2,25,250	57,000	94,000	74,250
Selling Overhead Advertisement $\left(\frac{83,000}{56,000+27,000} \times 56/27 \text{ respectively}\right)$	83,000	–	56,000	27,000
Other Overheads $\left(\frac{25,000}{108} \times 25/56/27 \text{ respectively}\right)$	25,000	5,787	12,963	6,250
Packing	———	———	54,000	———
Sub Total Selling Overhead	1,62,000	5,787	1,22,963	33,250

Workings:

	A	B	C	Total
Gross Production/unit /run (1)	2,520	2,810	3,010	
Defectives/run (2)	20	10	10	
Good units / run (3)	2,500	2,800	3,000	
Sales (Goods units)(4)	25,000	56,000	27,000	
No. of runs (5)	10	20	9	
Gross Production (6) = (1) × (5)	25,200	56,200	27,090	
Prime Cost / unit (7)	12	9	8	
Prime Cost (8) Rs.	3,02,400	5,05,800	2,16,720	10,24,920
Inspection hours/run (9)	3	4	4	
Inspection hours (10) = (9) × (5)	30	80	36	146
M/c hours / run (11)	20	12	30	
M/c hours (12) = (1) × (5)	200	240	270	710
Dye Cost/run (13)	200	300	250	
Dye cost (14) (13) × (5)	2,000	6,000	2,250	10,250

Conventional Accounting System

	Total	A	B	C
Sales – units / Production (good units)	1,08,000	25,000	56,000	27,000
Gross Margin (Rs.)	5,33,080	1,47,600	2,78,200	1,07,280
Production overheads (Rs.)	2,25,250	52,141	1,16,797	56,313
Selling Overhead (Rs.)	1,62,000	37,500	84,000	40,500
Sub-Total Overhead (Rs.)	3,87,250	89,641	2,00,797	96,813
Net profit (Rs.)	1,45,830	57,959	77,403	10,467
Ranking		II	I	III

Activity Based System

	A	B	C
Sales – units / Production (good units)	25,000	56,000	27,000
Gross Margin (Rs.)	1,47,600	2,78,200	1,07,280
Production overheads (Rs.)	57,000	94,000	74,250
Selling Overhead (Rs.)	5,787	1,22,963	33,250

Sub-Total Overhead (Rs.)	62,787	2,16,963	1,07,500
Net profit (Rs.)	84,813	61,237	(220)
Ranking	I	II	III

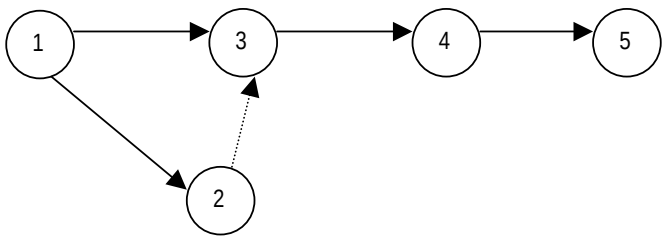
(b) Dummty activity is a hypothetical activity which consumes no resource or time. It is represented by dotted lines and is inserted in the network to clarify an activity pattern under the following situations.

(i) To make activities with common starting and finishing events distinguishable.

(ii) To identify and maintain the proper precedence relationship between activities that are not connected by events.

(iii) To bring all "loose ends" to a single initial and single terminal event.

e.g.



Dummy (2) – (3) is used to convey that can start only after events numbered (2) and (3) are over:

(c) The Monte Carlo Simulation:

It is the earliest mathematical Model of real situations in inventory control:

Steps involved in carrying out Monte Carlo simulation are:

- Define the problem and select the measure of effectiveness of the problem that might be inventory shortages per period.
- Identify the variables which influence the measure of effectiveness significantly for example, number of units in inventory.
- Determine the proper cumulative probability distribution of each variable selected with the probability on vertical axis and the values of variables on horizontal axis.
- Get a set of random numbers.
- Consider 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. Then project the point of intersection down into the vertical axis.
- Then record the value generated into the formula derived from the chosen measure

of effectiveness. Solve and record the value. This value is the measure of effectiveness for that simulated value. Repeat above steps until sample is large enough for the satisfaction of the decision maker.

Question 5

(a) Transport Ltd. Provides tourist vehicles of 3 types – 20-seater vans, 8-seater big cars and 5-seater small cars. These seating capacities are excluding the drivers. The company has 4 vehicles of the 20-seater van type, 10 vehicles of the 8-seater big car types and 20 vehicles of the 5-seater small car types. These vehicles have to be used to transport employees of their client company from their residences to their offices and back. All the residences are in the same housing colony. The offices are at two different places, one is the Head Office and the other is the Branch. Each vehicle plies only one round trip per day, if residence to office in the morning and office to residence in the evening. Each day, 180 officials need to be transported in Route I (from residence to Head Office and back) and 40 officials need to be transported in Route II (from Residence to Branch office and back). The cost per round trip for each type of vehicle along each route is given below.

You are required to formulate the information as a linear programming problem, with the objective of minimising the total cost of hiring vehicles for the client company, subject to the constraints mentioned above. (only formulation is required. Solution is not needed).

Figs. – Rs. /round trip

	20-seater vans	8-seater big cars	5-seater small cars
Route I — Residence — Head Office and Back	600	400	300
Route II — Residence — Branch Office and Back	500	300	200

(b) Explain the concept and aim of theory of constraints. What are the key measures of theory of constraints?

(c) What are the major areas of decision-making in which differential costing is used?

(8 + 7 + 4 = 19 Marks)

Answer

(a)

Type	I	II	III	Total no. of passengers
	20 – Seater vans	8 – Seater Big cars	5 – Seater Small cars	
Route I Residence H.O. Residence	600	400	300	180

Route II Residence	500	300	200	40
Br. Residence				
No. of vehicles	4	10	20	
Max. capacity	80	80	100	220
No. of passengers			260	

Let i be the ith route,

and j be the type of vehicle, so that

S_{11} = no. of vans (vehicles on Route I, Type I)

S_{12} = no. of 8 seater cars on Route I

S_{13} = no. of 5 seater cars on Route I

S_{21} = no. of vans — on Route II

S_{22} = no. of 8 seater cars on Route II

S_{23} = no. of 5 seater cars on Route II

Objective:

Minimise

$$\text{Cost } Z = 600\ S_{11} + 400\ S_{12} + 300\ S_{13} + 500\ S_{21} + 300\ S_{22} + 200 S_{23}$$

Subject to

$20\ S_{11} + 8\ S_{12} + 5\ S_{13} = 180$

$20\ S_{21} + 8\ S_{22} + 5\ S_{23} = 40$

$S_{11} + S_{21} \leq 4$

$S_{21} + S_{22} \leq 10$

$S_{31} + S_{32} \leq 20$

All sij ≥ 0

(b) The theory of constraints focuses its attention on constraints and bottlenecks within organisation which hinder speedy production. The main concept is to maximize the rate of manufacturing output is the throughput of the organisation. This requires to examine the bottlenecks and constraints. A bottleneck is an activity within the organization where the demand for that resource is more than its capacity to supply.

A constraint is a situational factor which makes the achievement of objectives / throughput more difficult than it would otherwise, for example of constraint may be lack of skilled labour, lack of customer orders, or the need to achieve high quality in product output.

For example let meeting the customers' delivery schedule be a major constraint in an organisation. The bottleneck may be a certain machine in the factory. Thus bottlenecks and constraints are closely examined to increase throughput.

Key measures of theory of constraints:

(i) Throughput contribution: It is the rate at which the system generates profits through sales. It is defined as, sales less completely variable cost, sales – direct are excluded. Labour costs tend to be partially fixed and conferred are excluded normally.

(ii) Investments: This is the sum of material costs of direct materials, inventory, WIP, finished goods inventory, R & D costs and costs of equipment and buildings.

(iii) Other operating costs: This equals all operating costs (other than direct materials) incurred to earn throughput contribution. Other operating costs include salaries and wages, rent, utilities and depreciation.

(c) Differential costing can be used for all short, medium and long term decisions. When two levels of activities are being considered, or while choosing between competing alternatives differential cost analysis is essential. The differential cost is useful for decision making in the following areas:

- Capital expenditure decisions
- Make or buy decision
- Production planning
- Sales mix decision
- Production or product decision
- Change in level or nature of an activity.

Question 6

(a) Goods manufactured at 3 plants, A, B and C are required to be transported to sales outlets X, Y and Z. The unit costs of transporting the goods from the plants to the outlets are given below:

Plants / Sales outlets	A	B	C	Total Demand
X	3	9	6	20
Y	4	4	6	40
Z	8	3	5	60
Total supply	40	50	30	120

You are required to:

(i) Compute the initial allocation by North-West Corner Rule.

(ii) Compute the initial allocation by Vogel's approximation method and check whether it is optional.

(iii) State your analysis on the optionality of allocation under North-West corner Rule and Vogel's Approximation method.

(b) Kangan Resorts operates a lodging house with attached facilities of a shopping arcade and restaurant on a National Highway. The following details are available:

(i) The lodging house has 40 twin-bedded rooms, which are to be rented for Rs. 200 per night on double occupancy basis. The occupancy ratio is expected at 85% and always both the beds in the room will be occupied. The lodging facilities are operated, for 200 days in the year during foreign tourists season time only.

(ii) As per past record the spending pattern of each tourist staying in the lodge will be as under:

Rs. 50 per day in the shopping arcade and Rs. 80 per day in the restaurant.

(iii) Ratios of variable cost to respective sales volume are:

Shops	Restaurant
50%	60%

(iv) For the lodging house the variable cost on house-keeping and electricity will amount Rs. 30 per day per occupied room.

(v) Annual fixed overhead for the entire complex is estimated at Rs. 10,00,000.

Required:

(i) Prepare an income statement for the next year.

(ii) The Lodging House Manager suggests a proposal of reducing room rent to Rs. 150 per day on double occupancy basis, which will increase occupancy level to 95%. Should the proposal be accepted or not?

What do you mean by a flexible budget? Give an example of an industry where this type of budget is typically needed? (10 + 7 + 2 = 19 Marks)

Answer

(a)

3	9	6	20
4	4	6	40
8	3	5	60
40	50	30	120

20	–	–	
20	20	–	
–	30	30	

(i) Initial allocation under NW corner rule is as above.

Initial cost : $20 \times 3 = 60$

$20 \times 4 = 80$

$20 \times 4 = 80$

$30 \times 3 = 90$

$30 \times 5 = 150$

460

(ii) Initial solution by VAM:

3 [20]	9 –	6 –	20	3		
4 [20]	4 –	6 [20]	40	0	0	2
8	3 [50]	5 [10]	60	2	2	2
40	50	30				
1	1	1				
4	1	1				
	1	1				

Initial solution: $20 \times 3 = 60$

$20 \times 4 = 80$

$50 \times 3 = 150$

$20 \times 6 = 120$

$10 \times 5 = 100$

460

Checking for optimality

3			$u_1 = 0$
4		6	$u_2 = 1$
	3	5	$u_3 = 0$
$v_1 = 3$	$v_2 = 3$	$v_3 = 5$	

$u_i + v_j$

	3	5	0
	4		1
3			0
3	3	5	

$\Delta_{ij} = c_{ij} - (u_i + v_j)$

	6	1
	0	
5		

$\Delta_{ij} \geq 0$ $\therefore$ Solution is optimal

Conclusion:

The solution under VAM is optimal with a zero in R_2C_2 which means that the cell C_2R_2 which means that the cell C_2R_2 can come into solution, which will be another optimal solution. Under NWC rule the initial allocation had C_2R_2 and the total cost was the same Rs. 460 as the total cost under optimal VAM solution. Thus, in this problem, both methods have yielded the optimal solution under the 1st allocation. If we do an optimality test for the solution, we will get a zero for Δ_{ij} in C_3R_2 indicating the other optimal solution which was obtained under VAM.

(b) (i) Income Statement of Kangan Resort for the next year

	Rs.
Sales Revenue	
Lodging house room receipts (40 Rooms × 200 days × Rs. 200 × 85%)	13,60,000
Shopping Arcade (40 Rooms × 2 persons × 200 days × Rs. 50 × 85%)	6,80,000
Restaurant (40 Rooms × 2 persons × 200 days) × Rs. 80 × 85%)	10,88,000
Total Sales Revenue	31,28,000
Variable Cost	
Lodging house rooms (40 Rooms × 200 days × Rs. 30 × 85%)	2,04,000
Shopping Arcade (50% of Rs. 6,80,000)	3,40,000
Restaurant (60% of Rs. 10,88,000)	6,52,800
Total Variable Cost	11,96,800

Contribution (Total Sales Revenue – Total Variable Cost)	19,31,200
Less: Fixed Cost	10,00,000
Profit (Estimated)	9,31,200

(ii) Income Statement on the basis of reduced room rent

	Rs.
Sales Revenue	
Lodging house room receipts (40 Rooms × 200 days × Rs. 150 × 95%)	11,40,000
Shopping Arcade (40 Rooms × 2 persons × 200 days × Rs. 50 × 95%)	7,60,000
Restaurant (40 Rooms × 2 persons × 200 days × Rs. 80 × 95%)	12,16,000
Total Revenue	31,16,000
Less: Variable Cost	
Lodging house rooms (40 Rooms × 200 days × Rs. 300 × 95%)	2,28,000
Shopping Arcade (50% of Rs. 7,60,000)	3,80,000
Restaurant (60% of Rs. 12,16,000)	7,29,600
Total Variable Cost	13,37,600
Contribution	17,78,400
Less: Fixed Cost	10,00,000
Profit	7,78,400

The profitability decreases by 9,31,200 – 7,78,400 = Rs. 1,52,800.

Hence reducing room rent proposal may not be accepted.

(c) A flexible budget is a budget which, by recognizing the difference between fixed, semi-variable and variable costs, is designed to change in relation to the level of activity attained.

E.g. seasonal products – e.g. soft drink industry

industries in make to order business like ship building

industries influenced by change in fashion.

Industries which keep on introducing new products / new designs.

Alternative Solution (6b):

Occupancy ratio 85%

Lodging facilities for 200 days

40 twin bedded rooms – Rs. 200 per night

Shopping Arcade = Rs. 50 per day.

Restaurant = Rs. 80 per day.

Annual Fixed Overhead Rs. 10,00,000.

	Lodging House	Shopping Arcade	Restaurant	
	30/days/ occupied/room	Variable Cost 50%	60%	
Revenue 40 rooms × 200 days × 85% × 200 Rs. / person × 2 persons / room				
Days:	170	170	170	
No. of persons: 2 × 170 × 40:	13,600			
Revenue / person	100	50	80	
Revenue	1,360	680	1,088	in '000
Variable Cost 30 × 170 × 40	204	340	652.80	
Contribution	1,156	340	435.20	
Contribution	19,31,200			
Fixed Cost	10,00,000			
Profit	9,31,200			
Room Days: 95% × 40 × 200 =7,600				
Person days	15,200			
Rev. 150/2 × 15,200	1,140	760	1,216	
Cost: 30/days :	228	380	729.6	
	912	380	486.4	
				1,778.40

No, do not accept the proposal as there is decrease in profit by Rs 1,52,800.