Paper 15 – Strategic Cost Management and Decision Making

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Full Marks : 100 **Time allowed: 3 hours**

Section - A

1. Answer the following and each question carries 2 marks. [10×2=20]

(i) If the direct labour cost is reduced by 20% with every doubling of output, what will be the cost of labour for the sixteenth unit produced as an approximate percentage of the cost of the first unit produced?
(A) 51.2%
(B) 40.96%
(C) 62%
(D) None of these

(ii) A company has 2,000 units of an obsolete item which are carried in inventory at the original purchase price of ₹ 30,000. If these items are reworked for ₹ 10,000, they can be sold for ₹ 18,000. Alternatively, they can be sold as scrap for ₹ 3,000 in the market. In a decision model used to analyze the reworking proposal, the opportunity cost should be taken as:
(A) ₹ 8,000
(B) ₹ 12,000
(C) ₹ 3,000
(D) ₹ 10,000

(iii) By making and selling 9,000 units of a product, a company makes a profit of ₹ 10,000, whereas in the case of 7,000 units, it would lose ₹ 10,000 instead. The number of units to break-even is
(a) 7,500 units
(b) 8,000 units
(c) 7,750 units
(d) 8,200 units

(iv) 1200 units of microchips are required to be sold to earn a profit of ₹1,06,000 in a monopoly market. The fixed cost for the period is ₹74,000. The contribution in the monopoly market is as high as 3/4th of its variable cost. Determine the target selling price per unit.
(a) 450
(b) 325
(c) 400
(d) 350

(v) A company has the capacity of production of 80000 units and presently it sells 20000 units at ₹ 100 each. The demand is sensitive to selling price and it has been observed that every reduction of ₹ 10 in selling price the demand is doubled. What should be the target cost at full capacity if profit margin on sales is taken at 25%?

(a) ₹ 58 lakhs
(b) ₹ 52 lakhs
(c) ₹ 48 lakhs
(d) ₹ 50 lakhs

(vi) A company makes a single product which it sells at ₹10 per unit. Fixed costs are ₹ 48,000 per month and the product has a contribution to sales ratio of 40%. In a period when actual sales were ₹1,40,000, the company's margin of safety in units was:
(a) 2000
(b) 3000
(c) 3500
(d) 4000

(vii)Which of the following would take place if a company is able to reduce its variable cost?

Contribution Margin	Break-Even Point
(a) Increase	Increase
(b) Decrease	Decrease
(c) Increase	Decrease
(d) Decrease	Increase

(viii) The information relating to the direct material cost of a company is as under:

Particulars	₹
Standard price per unit	3.60
Actual quantity purchased in units	1,600
Standard quantity allowed for actual production in units	1.450
Material price variance on purchase (favourable)	240

What is the actual purchase price per unit?
(A) ₹ 3.45
(B) ₹ 3.75
(C) ₹ 3.20
(D) ₹ 3.25

(ix) A company operates throughput accounting system. The details of product X per unit are as under:

Particulars	
Selling Price	₹50
Material Cost	₹20
Conversion	₹15
Time on bottleneck resources	10 minutes

The return per hour for product X is:
(A) ₹ 210
(B) ₹ 300
(C) ₹ 180
(D) ₹ 90

(x) A company manufactures two products using common material handling facility. The total budgeted material handling cost is ₹ 60,000. The other details are:

	Product X	Product Y
Number of units produced	**30**	**30**
Material moves per product line	**5**	**15**
Direct labour hour per unit	**200**	**200**

Under activity based costing system the material handling cost to be allocated to product X (per unit) would be:

(A) ₹ 1,000

(B) ₹ 500

(C) ₹ 1,500

(D) ₹ 2,500

Answer:

1. (i) (b)

1st	100%
2nd	80% × 100%
4th	80% of 2nd
8th	80% of 4th
16th	80% of 8th = 0.80 × 0.80 × 0.80 × 0.80 = 40.96%

Say, 41% of the time required for the 1st unit.

(ii) (c) Original price is not relevant

Rework income	₹ 18,000	
Deduct cost of rework	10,000	
Net inflow	₹ 8,000	It is relevant

The other alternative relevant cash flow is from sale as scrap = ₹ 3,000. Hence, the opportunity cost is ₹ 3,000.

(iii) (b) 40.96%

Contribution for 2000 units = 20,000 (difference in profits for two output levels)
Hence, contribution per unit = 10.
Substituting in equation 1,00,000 = F + 10,000. Or F = 80,000.
BEP = 80000 / 10 = 8000.

(iv) (d) Contribution = 1,06,000 + 74,000 = 1,80,000
Contribution/Unit = 180000/1200 = 150
Variable cost/unit = 150 ÷ ¾ = ₹ 200
Selling price = 350

(v) (c)

Maximum Capacity	80,000 Units
Present Sale	20,000 Units @ ₹ 100/-per Unit
Selling Price/Unit	Demand
100	20,000
90	40,000

80 80,000
Target Price ₹ 80
Target Cost/Unit 80 - 25% of Sales = 80 - 20 = ₹ 60/- per unit
Total Target Cost 80,000 Units × ₹60/- per unit = ₹ 48 lakhs.

(vi) (a) BEP = FC ÷ C/S Ratio = ₹ 48,000 ÷ 0.4 = ₹ 1,20,000 or 12,000 units.
When sells are ₹ 1,40,000, the volume is ₹ 1,40,000 ÷ 10 = ₹ 14,000 units
∴ Margin of Safety is 14,000 – 12,000 = 2,000 units.

(vii) (c) Contribution margin = Sales Less Variable Cost
So, reduction in variable cost will increase contribution.
BEP = FC/Contribution Margin
Hence, increase in contribution will reduce BEP.

(viii) (a) Actual quantity bought x standard price = 1,600 x ₹ 3.60 = ₹ 5,760
Deduct favorable price variance 240
Actual quantity x actual price = 5,520
Or, 1,600 x actual price = ₹ 5,520
So, Actual price ₹ 5,520/1,600 = ₹ 3.45

(ix) (c) (Selling Price - Material Cost)/ Time of bottleneck resource
= [(₹ 50 - ₹ 20)/10 minutes] x 60 = ₹180 per hour.

(x) (b) Total moves in material handling = 5+15 = 20
Percentage move for Product A = 5/20 = 25%
Material handling cost to be allocated to Product A = ₹60,000/25% = ₹15,000
i.e., ₹ 15,000/30 = ₹500 per unit.

Section - B

Answer any five questions from question nos. 2 to 8. Each question carries 16 marks.

2. (a) Relevant data relating to Trident Industries Limited are:

	Products			
	P	**Q**	**R**	**Total**
Production and Sales (Units)	**60,000**	**40,000**	**16,000**	
Raw Material Usage (in Units)	**10**	**10**	**22**	
Raw Material Costs (₹)	**50**	**40**	**22**	**24,76,000**
Direct Labour Hours	**2.5**	**4**	**2**	**3,42,000**
Machine Hours	**2.5**	**2**	**4**	**2,94,000**
Direct Labour Costs (₹)	**16**	**24**	**12**	
No. of Production Runs	**6**	**14**	**40**	**60**
No. of Deliveries	**18**	**6**	**40**	**64**
No. of Receipts	**60**	**140**	**880**	**1080**
No. of Production Orders	**30**	**20**	**50**	**100**

Overheads:	₹
Set-up	**60,000**
Machines	**15,20,000**
Receiving	**8,70,000**
Packing	**5,00,000**
Engineering	**7,46,000**

The Company operates a JIT inventory policy and receives each component once per production run.

Required:

(i) Compute the product cost based on direct labour hour recovery rate of overheads.

(ii) Compute the product cost using Activity Based Costing. [4+8=12]

(b) What is Target Cost? How would you determine it? [2+2=4]

Answer:

2. (a) (i) Computation of overhead rate based on direct labour hour hours:

P	60,000	2.5	150000
Q	40,000	4	160000
R	16,000	2	32000
Total			342000

Total Overheads = 60,000 + 15,20,000 + 8,70,000 + 5,00,000 + 7,46,000 = 36,96,000

Overhead rate per direct labour hour = 36,96,000/3,42,000 = 10.807 = 10.81

Product Cost based on direct labour recovery rate:

	P	Q	R
Raw Material	50	40	22
Direct Labour	16	24	12
Overheads @ ₹ 10.81 per hour			
a. × 10.81	27.03		
4 × 10.81		43.24	
2 × 10.81			21.62
Total Cost	93.03	107.24	55.62

Or,

Based on the whole production figures,

	P	Q	R
Production units	60,000	40,000	16,000
Raw Material	30,00,000	16,00,000	3,52,000
Direct Labour	9,60,000	9,60,000	1,92,000
Overheads @ 10.81 per hour			
2.5 × 10.81 × 60000	16,21,800		
4 × 10.81 × 40,000		17,29,600	
2 × 10.81 × 16,000			3,45,920
Total Cost	52,21,800	42,89,600	8,89,920

(ii) Cost Driver Rates:

Nature of Overhead	Overhead cost (₹)	Total Quantity of activity Driver	Activity Driver	Cost Driver Rate ₹/ unit of Cost driver
Set-up	60,000	60	Production Runs	1000
Machines	15,20,000	294000	Machine Hours	5.17
Receiving	8,70,000	1080	No. of Receipts	805.56
Packing	5,00,000	64	No. of Deliveries	7812.5
Engineering	7,46,000	100	No. of Production Orders	7460
Total				

Overhead allocation to products based on Activity Based Costing: (Total Value for Production units Basis)

Based on the whole production figures,

	P	Q	R
Production units	60,000	40,000	16,000
Raw Material	30,00,000	16,00,000	3,52,000
Direct Labour	9,60,000	9,60,000	1,92,000
Overheads Set-up @ ₹ 1000 per hour production run			
1000x6	6000		
1000x14		14,000	
1000x40			40,000
Machines @ ₹ 5.17 per machine hour			
2.5x60,000x5.17	7,75,500		
2x40,000x5.17		4,13,600	
4x16,000x5.17			3,30,880
Receiving @ 805.56 per receipt			
60x805.56	48,333.60		
140x805.56		1,12,778.40	
880x805.56			7,08,892.80
Packing @ 7812.5 per delivery			
18x7812.5	1,40,625		
6x7812.5		46,875	
40x7812.5			3,12,500
Engineering @ 7460 per production order			
30 x 7460	2,23,800		
20 x 7460		1,49,200	
50x7460			3,73,000
Total Overhead Cost	11,94,258.60	7,36,453.40	17,65,272.80
Total Cost	51,54,258.60	32,96,453.40	23,09,272.80

On a per unit cost basis,

	P	Q	R
Production Units	60,000	40,000	16,000
Raw material	50	40	22
Direct Labour	16	24	12
Overheads			
Set-up @ ₹ 1000 per production run 1000x6/60000 1000x14/40,000 1000x40	0.10	0.35	2.50
Machines @ ₹ 5.17 per machine hour 2.5x60,000x5.17/60000 2x40,000x5.17/40,000 4x16,000x5.17/16000	12.93	10.34	20.68
Receiving @ 805.56 per receipt 60x805.56/60000 140x805.56/40,000 880x805.56/16,000	0.81	2.82	44.31
Packing @ 7812.5 per delivery. 18x7812.5/60000 6x7812.5/40,000 40x7812.5/16000	2.34	1.17	19.53
Engineering @ 7460 per production order 30 x 7460 / 60000 20 x 7460 / 40,000 50x7460/16000	3.73	3.73	23.31
Total Overhead Cost	19.91	18.41	110.33
Total Cost	85.91	82.41	144.33

Note: Figures could vary slightly due to different decimal approximations considered by students for cost driver rates or in other calculations.

The question contains the raw material cost totaling to 24,76,000. But on multiplying the per unit raw material cost, we get 49,52,000. This is given wrongly in the question.

(b) Target Cost is the cost at which a proposed product with specified functionality and quality must be produced to generate a desired level of profitability at its anticipated selling price.
Or
Target cost is Target selling price less the required profit margin

The target selling price is the price that is dictated by competition in case there are comparable products, or the perceived value that a customer will pay for the product in case there is no competition.

The desired profit level is fixed by the seller. The difference between the selling price and the profit margin represents the target cost to be achieved by design or cost reduction or by economies of scale or by other means.

How to determine target cost:
The market requirement is identified regarding design, utility, need for the product.
Target selling price is determined based on customer expectation and sales forecast.
Target production volume is set based on price volume relationship

Target profit margin is established based on the company's long term profit objectives, projected volumes, course of action, etc.

The target cost or allowable cost is determined as the target selling price minus the target profit margin.

3. (a) Excel Electronics manufacturing electronic equipments is currently procuring component A from a local supplier at a cost of ₹60 each. The company is presently considering the proposal for installing a machine for the manufacture of the component. It has two alternative proposals as under:

(A) Installation of semi-automatic machine involving an annual fixed expenditure of ₹36 lakhs and a variable cost of ₹24 per component manufactured.

(B) Installing an automatic machine involving an annual fixed expenditure of ₹ 60 lakhs and a variable cost of ₹ 20 per component manufactured.

You are required to:

(i) Find the annual requirement of components to justify a switch-over from procurement of components to manufacture of the same by installing (I) semiautomatic machine and (II) automatic machine.

(ii) Advise the company on the machine to be installed if the annual requirement of the components is 5,00,000 units.

(iii) Advise the company at what annual volume it should select automatic machine instead of semi-automatic machine. [3+3+2=8]

(b) Write eight steps of Business process re-engineering suggested by Vakola et al. (1998). [8]

Answer:

3. (a) (i)

	Semi-Automatic machine (₹)	Automatic Machine (₹)
Purchase price of the component		
Variable Cost	60	60
Saving	24	20
	36	40
Fixed Cost	36,00,000	60,00,000
Components required to be produced to justify the installation of the machine	36,00,000/36 = 1,00,000	60,00,000/40 = 1,50,000

(ii) If the annual requirement is 5,00,000 units:

Variable Cost	1,20,00,000	1,00,00,000
Fixed Cost	36,00,000	60,00,000
Total cost	1,56,00,000	1,60,00,000

Recommendation: Install semi-automatic machine.

(iii)

Fixed costs for Automatic machine	₹ 60,00,000
(-) Fixed costs for semi – Automatic machine	₹ 36,00,000
Difference	₹ 24,00,000

Volume required to justify Automatic machine = 24,00,000 / 4 = 6,00,000 components.

(b) Business process re-engineering (BPR)

Business process re-engineering (BPR) is a business management strategy, originally pioneered in the early 1990s, focusing on the analysis and design of workflows and processes within an organization. BPR seeks to help companies radically restructure their organizations by focusing on the ground-up design of their business processes. Business process re-engineering is also known as business process redesign, business transformation, or business process change management. The globalization of the economy and the liberalization of the trade markets have formulated new conditions in the market place which are characterized by instability and intensive competition in the business environment. Competition is continuously increasing with respect to price, quality and selection, service and promptness of delivery. Removal of barriers, international cooperation, technological innovations cause competition to intensify. All these changes impose the need for organizational transformation, where the entire processes, organization climate and organization structure are changed.

The eight proposed stages, as SUGGESTED BY Vakola et al. (1998) are as follows:

- Develop Vision and Objectives
- Understand existing processes
- Identify Process for Re-design
- Identify Change Levers
- Implement the new process
- Make new process operational
- Evaluate the new process
- Monitor ongoing continuous improvement.

4. (a) ANRO use traditional standard costing system. The inspection and setup costs are actually ₹ 1,760 against a budget of ₹ 2,000.

ABC system is being implemented and accordingly, the number of batches is identified as the cost driver for inspection and setup costs. The budgeted production is 10,000 units in batches of 1,000 units, whereas actually, 8,800 units were produced in 11 batches.

(i) Find the volume and total fixed overhead variance under the traditional standard costing system.

(ii) Find total fixed overhead cost variance under the ABC system. [10]

(b) One kilogram of product 'kit' requires two chemicals A and B. The following were the details of product 'Kit' for the month of June, 2017:

(a) Standard mix Chemical 'A' 50% and Chemical 'B' 50%

(b) Standard price per kilogram of Chemical 'A' ₹ 12 and Chemical 'B' ₹ 15

(c) Actual input of Chemical 'B' 70 kilograms

(d) Actual price per kilogram of Chemical 'A' ₹ 15

(e) Standard normal loss 10% of total input.

(f) Materials cost variance total ₹ 650 adverse

(g) Materials Yield variance total ₹ 135 adverse.

You are required to calculate:

1. **Materials mix variance total**
2. **Materials usage variance total**
3. **Materials price variance total**
4. **Actual loss of actual input**
5. **Actual input of chemical 'A'**
6. **Actual price per kilogram of Chemical 'B'** **[6]**

Answer:

4. (a) (i) Calculation of volume and total fixed overhead under Traditional Standard Costing System:

Budgeted overhead cost per unit = ₹ 2,000/10,000 units = ₹ 0.20

Actual overhead cost per unit = ₹ 1,760/8,800 units = ₹ 0.20

Total fixed overhead variance = Absorbed budgeted overhead - Actual overhead

= (₹ 0.20 x 8,800 units) - ₹ 1,760 = Nil

Fixed overhead expenditure variance = Budgeted overhead - Actual overhead

= 2,000- 1,760 = ₹240 (F)

Standard absorption rate = ₹ 2,000/10,000 units = ₹ 0.20 per unit

Fixed overhead volume variance =Standard absorption rate × (Budgeted units-Actual units) = ₹ 0.20 (10,000 units - 8,800 units) = ₹ 240 (A)

Verification:

Total fixed overhead variance = Expenditure variance + Volume variance = 240 (F) + 240 ((A) = Nil

(ii) Calculation of fixed overhead cost variance under ABC System

Particulars	Budget	Actual	ABC Standard
Total Cost (₹)	2,000	1,760	1,800
Production (units)	10,000	8,800	8,800
No. of batches	10	11	9
Batch size (units/batch)	1,000	800	1,000
Cost per batch	200	160	200

Under ABC 8,800 units should have been produced in standard batch size of 1,000 units/batch.

No. of batches = 8,800/1,000 = 9 approx.

Standard cost under ABC = Budgeted cost per batch × ABC standard number of batches = ₹ 200 x 9 = 1,800

Under ABC, variability is with respect to batches and not units Absorbed overheads
= 9 batches × Standard rate per batch
= 9 × ₹ 200
= ₹ 1,800

Actual overheads = ₹ 1,760
Total overheads cost variance = ₹ 40 (F)

(b) Let, actual output of chemical A be 'a' kgs
Actual price per Kg of chemical B be ₹ b
Standard input be 100Kgs
Actual output be 90Kgs

	Standard			Actual		
	Q	P	V	Q	P	V
A	50	12	600	A	15	15a
B	50	15	750	70	B	70b
	100		1350	70+a		15a+70b
(-) Normal Loss	10	--	--	a-20	--	--
	90		1350	90		15a+70b

	(1)	(2)	(3)	(4)
	SQSP	RSQSP	AQSP	AQAP
A		12×(70+a/100)×50	12 × a	
B		15×(70+a/100)×50	15 × 70	
	1350	945 + 13.5a	1050 + 12a	15a + 70b

Given material cost variance = (1) – (4) = - 650
= 15a + 70b
= ₹ 2000

Material yield variance = (1) – (2) = - 135
⇒ a = 40 ⇒ b = 20

1) SQSP = ₹ 1350
2) RSQSP = 945 + (13.5 x 40) = ₹ 1485
3) AQSP = 1050 + (12 x 40) = ₹ 1530
4) AQAP = (15 x 40) + (70 x 20) = ₹ 2000
   (a) Material mix variance = ₹ 45(A)
   (b) Material usage variance = ₹ 180(A)
   (c) Material price variance = ₹ 470(A)
   (d) Actual loss of actual input = ₹ 20
   (e) Actual input of chemical A = 40Kgs
   (f) Actual price per Kgs of chemical B = ₹ 20

5. (a) What is Bench trending and how does it differ from Bench Marking? [8]

(b) You are given, in respect of a manufacturing company, the following activity centres and their costs for a period:

	₹
1. Material handling	**8,000**
2. Machining	**5,000**
3. Assembly	**4,800**
4. inspection	**1,400**

The other particulars are:

	₹
Number of materials parts	**80,000**
Machine hours	**150**
Numbers of assembly parts	**8,000**
Number of finished units	**1,000**

(i) Calculate overhead allocation rates using ABC.

(ii) What will be the cost of a product which uses the following?

8 units of materials

One-fourth of the machine hour

8 assembly parts (₹100)

Power etc. (₹10)

Given direct material cost for one unit ₹200. [4+4=8]

Answer:

5. (a) Continuous monitoring of specific process performance with a selected group of benchmarking is a systematic and continuous measurement process of comparing through measuring an organization business processes against business leaders (role models) anywhere in the world, to gain information that will help organization take action to improve its performance. The continuous process of enlisting the best practices in the world for the processes, goals and objectives leading to world class levels of achievement.

Benchmarking is the process of comparing the cost, time or quality of what one organization does against what another organization does. The result is often a business case for making changes in order to make improvements.

Benchmarking is a powerful management tool because it overcomes "paradigm blindness". Paradigm Blindness can be summed up as the mode of thinking, "the way we do it is the best because this is the way we've always done it". Bench Marking opens organizations to new methods, ideas and tools to improve their effectiveness. It helps crack through resistance to change by demonstrating other methods of solving problems than the one currently employed and demonstrating that they work, because they are being used by others.

(b) (i) Allocation rates:

	Per unit of application base (₹)
Material handling (₹ 8,000 ÷ 80,000)	0.10
Machining (₹ 5,000 ÷ 150)	33.33
Assembly (₹ 4,800 ÷ 8,000)	0.60
Inspection (₹ 1,400 ÷ 1,000)	1.40

(ii) Cost Statement:

		Per unit (₹)
Direct Material		200
Power etc.		10
Variable Costs		210
Other Costs:		
Material handling (8 parts × 0.10)	0.80	
Machining (1/4 × ₹ 33.33)	8.33	
Assembly (8 parts × 0.60)	4.80	
Inspection (1 unit × 1.40)	1.40	15.33
Total		₹ 225.33

6. (a) An automobile production line turns out about 100 cars a day, but deviations occur owing to many causes. The production is more accurately described by the probability distribution given below:

Production /Day	Probability	Production /Day	Probability
95	**0.03**	**101**	**0.15**
96	**0.05**	**102**	**0.10**
97	**0.07**	**103**	**0.07**
98	**0.10**	**104**	**0.05**
99	**0.15**	**105**	**0.03**
100	**0.20**		
		Total	**1.00**

Finished cars are transported across the bay, at the end of each day, by ferry. If the ferry has space for only 101 cars, what will be the average number of cars waiting to be shipped, and what will be the average number of empty space on the boat? [8]

(b) A company has four zones open and four salesmen available for assignment. The zones are not equal rich in their sales potentials. It is estimated that a typical salesman operating in each zone would bring in the following annual sales:
Zone: A: 1,26,000; Zone: B: 1,05,000; Zone: C: 84,000; Zone: D: 63,000.

The four sales men are also considered to differ in ability. It is estimated that working under the same condition their yearly sales would be proportionately as follows:
Salesman P: 7; Salesman Q: 5; Salesman R: 5; Salesman S: 4.

If the criterion is maximum expected total sales, the intuitive answer is to assign the best salesman to the richest zone, the next best to the second richest zone and so on. Verify this by the method of assignment. [8]

Answer:

6. (a)

Simulation of data of an Automobile Production line			
Production/day	Probability	Cumulative Probability	Random No. Range
95	0.03	0.03	0-2
96	0.05	0.08	3-7
97	0.07	0.15	8-14
98	0.10	0.25	15-24
99	0.15	0.40	25-39
100	0.20	0.60	40-59
101	0.15	0.75	60-74
102	0.10	0.85	75-84
103	0.07	0.92	85-91
104	0.05	0.97	92-96
105	0.03	1.00	97-99
	1.00		

Stimulated Data				
Day	Random No.	Production	No. of cars waiting to be shipped	No. of empty space on the boat
1	20	98	--	3
2	63	101	--	--
3	46	100	--	1
4	16	98	--	3
5	45	100	--	1
6	41	100	--	1
7	44	100	--	1
8	66	101	--	--
9	87	103	2	--
10	26	99	--	2
11	78	102	1	--
12	40	100	--	1
13	29	99	--	2
14	92	104	3	--
15	21	98	--	3
Total			6	18

Average no. of cars waiting to be shipped = 6/15 = 0.40

Average no. of empty space on the boat = 18/15 = 1.2

(b)

Sales Man	A	B	C	D
P	42	35	28	21
Q	30	25	20	15
R	30	25	20	15
S	24	20	16	12

Loss Matrix

0	7	14	21
12	17	22	27
12	17	22	27

Row Operation

0	7	14	21
0	5	10	15
0	5	10	15
1	4	8	12

Column Operation

[0]	3	6	9
0	1	2	3
0	1	2	3
0	[0]	0	0

Row Operation

[0]	2	5	8
0	[0]	1	2
0	0	1	2
1	0	[0]	0

Column Operation

[0]	2	4	7
0	[0]	0	1
0	0	[0]	1
2	1	0	[0]

P → A - 42
Q → B - 25
R → C - 20
S → D - 12
99 × 3000 = ₹ 2,97,000 Maximum Sales

7. (a) XYZ Auto-manufacturing company has to prepare a design of its latest model of motorcycle. The various activities to be performed to prepare a design are as follows:

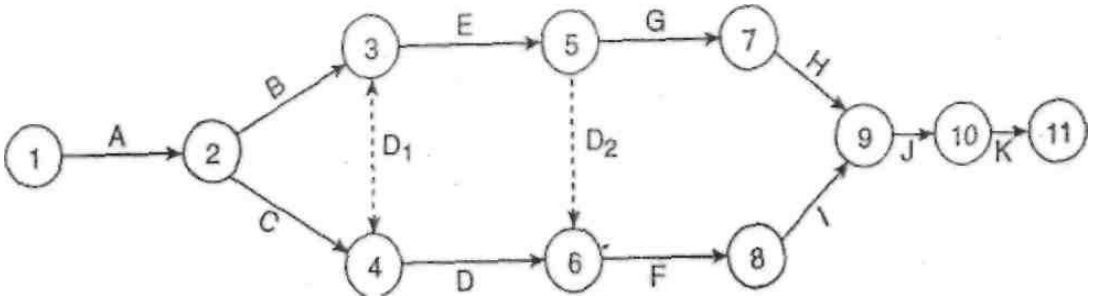
Activity	Description of activity	Preceding activity
A	Prepare drawing	---
B	Carry out cost analysis	A
C	Carry out financial analysis	A
D	Manufacture tools	C
E	Prepare bill of material	B, C
F	Receive material	D, E
G	Order sub-accessories	E
H	Receive sub-accessories	G
I	Manufacture components	F
J	Final assembly	I, H
K	Testing and shipment	J

Prepare an appropriate network diagram. [8]

(b) A Company produces the products P, Q and R from three raw materials A, B and C. One unit of product P requires 2 units of A and 3 units of B. A unit of product Q requires 2 units of B and 5 units of C and one unit of product R requires 3 units of A, 2 unit of B and 4 units of C. The company has 8 units of material A, 10 units of B and 15 units of C available to it. Profits/ unit of products P, Q and R are ₹ 3, ₹ 5 and ₹ 4 respectively.
(a) Formulate the problem mathematically,
(b) Write the Dual problem. [8]

Answer:

7. (a) The network diagram will be as follows:



(b)

Raw Materials	P	Q	R	Available units
A	2	-	3	8
B	3	2	2	10
C	-	5	4	15

Profits 3/- 5/- 4/-
Let x_1 be the no. of units of P
Let x_2 be the no. of units of Q
Let x_3 be the no. of units of R
Objective function: Max. $Z = 3x_1 + 5x_2 + 4x_3$

Subject to constraints:
$2x_1+3x_2 \leq 8$
$3x_1+2x_2+2x_3 \leq 10$
$5x_2+4x_3 \leq 15$
And $x_1, x_2, x_3 \geq 0$.

Primal
Max.$Z = 3x_1+5x_2+4x_3$
Subject to
$2x_1+3x_2 \leq 8$
$3x_1+2x_2+2x_3 \leq 10$
$5x_2+4x_3 \leq 15$
And $x_1, x_2, x_3 \geq 0$

Dual
Min. $Z = 8y_1+10y_2+15y_3$
Subject to
$2y_1+3y_2 \geq 3$
$3y_1+2y_2+5y_3 \geq 5$
$2y_2+4y_3 \geq 4$
And $y_1, y_2, y_3 \geq 0$

$2x_1+3x_2 + S1 = 8$
$3x_1+2x_2+2x_3 + S_2 = 10$
$5x_2+4x_3 + S_3 = 15$

Max $Z = 3x_1 + 5x_2+4x_3+0.S_1+0.S_2+0.S_3$
$\therefore x_1 = 23/20 \quad x_2 = 19/10 \quad x_3 = 11/8$
$Z = 18.45$

8. Answer any 4 questions out of 5 **[4*4=16]**

(a) Simulation Technique

(b) Kaizen Costing

(c) The Variants of Backflush Accounting

(d) Principles of Total Quality Management (TQM)

(e) Uses of Learning Curve

Answer:

8. (a) Simulation:

Simulation is a modelling and analysis tool that is widely used for the purpose of designing, planning and control of manufacturing systems. Simulation in general is to pretend that one deals with a real thing while really working with an imitation. In Operations Research, the imitation is a computer model of the simulated reality. The task of executing simulations provides insight and a deep understanding of physical processes that are being modelled.

Simulation is generally referred to as computer simulation, which simulates the operation of a manufacturing system. A computer simulation or a computer model is a computer program, which attempts to simulate an abstract model of a particular system.

A simple example of a simulation involves the tossing of a ball into the air. The ball can be said to "simulate" a missile, for instance. That is, by experimenting with throwing balls starting at different initial heights and initial velocity vectors, it can be said that we are simulating the trajectory of a missile.

Monte Carlo method of simulation is the most popular method of simulation. In Linear Programming, Simulation is called as the 'technique of last resort'. It means, when all other methods fails, we resort to Simulation as the last resort.

(b) Kaizen Costing:

The initial VE review may not be complete and perfect in all cost aspects. There may be further chances of waste reduction, cost and time reduction and product improvement. Such continuous cost reduction technique is called as Kaizen Costing.

Kaizen Costing refers to the ongoing continuous improvement program that focuses on the reduction of waste in the production process, thereby further lowering costs below the initial targets specified during the design phase. It is a Japanese term for a number of cost reduction steps that can be used subsequent to issuing a new product design to the factory floor.

Toyota's Experience of Kaizen Costing: Toyota aggressively pursued Kaizen Costing to reduce costs in the manufacturing phase. Methods for achieving these kaizen goals include cutting material costs per unit and improvement in standard operating procedures. These are pursued based on employee's suggestions. About two million suggestion were received from Toyota employees in t\one recent year alone roughly thirty-five per employee. Ninety-seven percent of them were adopted. This is really a prime example of concept of employee empowerment in which workers are encouraged to take their own initiatives to improve operations, reduce costs, and improve product quality and customer service.

(c) **The Variants of Backflush Accounting**

There are a number of variants of the Backflush system, each differing as to the 'trigger points' at which costs are recognized within the cost accounts and thus associated with products. All variants, however, have the following common features:

- the focus is on output – costs are first associated with output (measured as either sales or completed production) and then allocated between stocks and costs of goods sold by working back.

- Conversion costs (labour and overheads) are never attached to products until they are complete (or even sold) – thus the traditional WIP account doesn't exist.

  Two variants of the Backflush system are summarized below. Note that in each as conversion costs (labour and overheads) are incurred they will be recorded in a conversion cost (CC) account.

  Variant 1
  This has two trigger points (TP):
  TP 1 - purchase of raw materials / components. A 'raw and in process (RIP)' account will be debited with the actual cost of materials purchased, and creditors credited.

  TP 2 - completion of good units. The finished goods (FG) account will be debited with the standard cost of unit produced and the RIP and CC account will be credited with the standard cost.

  Under this variant, then, there will be two stock accounts:
  - raw materials (which may, in fact, be incorporated into WIP)
  - finished goods

  Variant 2
  This has only one trigger point – the completion of good units. The FG account is debited with the standard cost of units produced, with corresponding credits to the CC account and the creditors account.

  Thus the cost records exclude:
  - raw materials purchased but not yet used for complete production
  - the creditors for these materials (and any price variance)

  and there is only stock account, carrying the standard cost of finished goods stock.

  Other variants include those using the sale of complete goods units as a trigger point for the attachment of conversion cost to unit - thus there is no finished goods account, just a raw materials stock account, carrying the materials cost of raw materials, WIP and finished goods.

(d) Principles of Total Quality Management (TQM):

The philosophy of TQM rest on the following principles, which are enlisted below:
(i) Clear exposition of the benefits of a project.
(ii) Total Employee Involvement (TEI).
(iii) Process measurement.
(iv) Involvement of all customers and contributors.
(v) Elimination of irrelevant data.
(vi) Understanding the needs of the whole process.
(vii) Use of errors to prompt continuous improvement.
(viii) Use of statistics to tell people how well they are doing.

(e) **Uses of Learning curve**

Learning curve is now being widely issued in business. Some of the uses are as follows:

1. Where applicable the learning curve suggests great opportunities for cost reduction to be achieved by improving learning.
2. The learning curve concept suggests a basis for correct staffing in continuously expanding production. The curve shows that the work force need not be increased at the same rate as the prospective output. This also helps in proper production planning through proper scheduling of work; providing manpower at the right moment permitting more accurate forecast of delivery dates.
3. Learning curve concept provides a means of evaluating the effectiveness of training programs.
4. Learning curve is frequently used in conjunction with establishing bid price for contracts. Usually, the bid price is based on the cumulative average unit cost for all the units to be produced for a given contract. If production is not interrupted. Additional units beyond this quantity should be costed at the increment costs incurred, and not at the previous cumulative average. If the contract agreement so provides, a contract may be cancelled and production stopped before the expected efficiency is reached. 5. The use of learning curve, where applicable, is important in the working capital required. If the requirement is based on average cumulative unit cost, the revenues from the first few units may not cover the actual expenditures.
6. As employees become more efficient, the rate of production increases and so more materials are needed, the work-in-progress inventory turns over faster, and finished goods inventory grows at an accelerated rate.
7. Learning curve techniques are useful in exercising control, Variable norms can be established for each situation, and a comparison between these norms and actual expenses can be made. Specific or average incremental unit cost should be used for this purpose.
8. The learning curve may be used for make-or- buy decisions especially if the outside manufacturer has reached the maximum on the learning curve. Help to calculate the sensitive rates in wage bargaining.