Paper 15 – Strategic Cost Management and Decision Making

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

Section A

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

(i) A company has a capacity to make 4,00,000 units of a product. It has noted from market conditions that at a price of ₹ 50 per unit, it can sell 1,00,000 units but the demand would double for each ₹ 5 fall in the selling price. A minimum margin of 25% is required. The target cost for the company should be:
(a) ₹ 50 (b) ₹ 40 (c) ₹ 30 (d) ₹ 20

(ii) Division A of a company manufactures a single product and the following data are provided:

Sales = 25,000 units	Fixed Cost = ₹4,00,000
Depreciation = ₹2,00,000	Residual Income = ₹30,000
Net Assets = ₹10,00,000	

Head Office assesses divisional performance by the method of Resudual Income and uses cost of capital of 12%
(a) ₹25 (b) ₹30 (c) ₹35 (d) None of these.

(iii) ABC Ltd., has correct PBIT of ₹1920 Cr. on total assets of ₹96 Cr. The company proposes to increase assets by ₹24 Cr., which is estimated to increase operating profit before Depreciation by ₹8.4 Cr., and a net increase in Depreciation by ₹4.8 Cr. This will be result in ROI:
(a) To decrease by 1% **(b) To increase by 1%**
(c) To remain the same **(d) None of these**

(iv) A company makes components and sells internally to its subsidiary and also to external market. The external market price is ₹24 per component, which gives a contribution of 40% of sales. For external sales, variable costs include ₹1.50 per unit for distribution costs. This is, however not incurred in internal sales. There are no capacity constraints. To maximize company profit, the transfer price to subsidiary should be:

(a) ₹ 9.60 (b) ₹ 12.90 (c) ₹ 14.40 (d) None of these

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

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

The return per hour for product X is
(a) ₹210 (b) ₹300 (c) ₹180 (d) ₹90

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

	₹
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

(vii) In calculating the life cycle costs of a product, which of the following item would be included?
A) Planning and concept design costs
B) Preliminary and detailed design costs
C) Testing costs
D) Production costs
E) Distribution costs

(a) All of the above (b) D and E (c) B, D and E (d) D

(viii) A company is to market a new product. It can produce up to 1,50,000 units of this product. The following area the estimated cost data:

Probability	Fixed Cost	Variable Cost
For production up to 75,000 units	₹8,00,000	60%
Exceeding 75,000 units	₹1,20,000	50%

Sale price is expected to be ₹25 per unit. How many units must the company sell to break even?
(a) 1,00,000 units (b) 1,11,000 units (c) 1,27,000 units (d) 75,000 units

(ix) SUVAM Ltd., has the capacity of production of 80,000 units and presently sells 20,000 units at ₹100 each. The demand is sensitive to selling price and it has been observed that with every reduction of ₹10 in selling price, the demand is doubled. What should be the target cost at full capacity if profit margin on sale is taken as 25%?
(a) ₹67.50 (b) ₹60.00 (c) ₹45.00 (d) None of the above

(x) A company makes and sells a single product. The selling price and marginal revenue equations are:
Selling Price = ₹50 - ₹0.001X
Marginal Revenue = ₹50 - ₹0.002X
Where X is the product the company makes. The variable cost amount to 20 per unit and the fixed costs are ₹1,00,000.

In order to maximize the profit, the selling price should be
(a) ₹25
(b) ₹30
(c) ₹35
(d) ₹40

Answer:

1. (i) (c) 30 hrs.

Cumulative output	Average time / unit (hrs.)	Total time (hrs.)	Incremental Time (hrs.)
1	300	300	
2	270 (0.9 × 300)	540	
4	243 (0.9 × 270)	972	432 (972 – 540)

(ii) (b) ₹ 30.

Total contribution required:
12% of ₹ 10 lakhs = ₹ 1,20,000 + 30,000 + 2,00,000 + 4,00,000
(RI) (Depr.) (FC)
= ₹ 7,50,000 ÷ 25,000 = ₹ 30.

(iii) (a) to decrease by 1%

	ROI without Investment		ROI with Investment
PBIT (₹ Cr.)	19.20	(+8.4 – 4.8)	22.80
Total Assets (₹ Cr.)	96.00	(+24.00)	120.00
ROI	20%		19% (i.e. 1% decease)

(iv) (b) ₹ 12.90

Transfer Price = Marginal Cost – Opportunity Cost
= ₹ 24 × 60% - ₹ 1.50 = ₹ 12.90.

(v) (c) ₹ 180

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

(vi) (a) ₹ 3.45

Actual quantity bought × Standard Price
= 1,600 × ₹ 3.60 = ₹ 5,760
Deduct favourable price variance 240
Actual quantity × Actual Price = 5,520
Or, 1,600 × Actual Price = ₹ 5,520.
So, Actual price ₹ 5,520 / 1,600 = ₹ 3.45.

(vii) (a) All of the above

All the costs mentioned in the question are parts of the total life cycle costs.

(viii) (b) 1,11,000 units

At a production of 75,000 units or less the fixed costs amount to ₹ 8 lakh contribution is ₹ 10 per unit (₹ 25 – 60% of ₹ 25). Production will however, be more than this level. Total fixed cost is then ₹ 12 lakh.
Contribution for first 75,000 units = ₹ 7,50,000
Hence, to meet ₹ 12 lakh fixed cost, further ₹ 4,50,000 contribution is required.
Contribution beyond 75,000 units is rs. 12.5 (₹ 25 – 50% of ₹ 25).
Additional units to be sold = ₹ 4,50,000 / ₹ 12.50 = 36,000) units = 1,11,000 units.

(ix) (b) ₹ 60.

Demand	Price (₹)
20,000	100
40,000	90
80,000	80

Target Cost = ₹ 80 – (80 × 0.25) = ₹ 60.

(x) (c) ₹ 35

Selling price = ₹ 50 – ₹ 0.001x
Marginal Revenue = ₹ 50 – ₹ 0.002x
Variable cost per unit = Marginal Cost per unit = ₹ 20
Optimal output for maximum profit: 20 = 50 – 0.002x,
Hence, x = 30/0.002 = 15,000 units
SP = 50 – 0.001x = 50 – 0.001 (15000) = 50 – 15 = ₹ 35.

Section B

Answer any five questions from Question No. 2 to 8
Each question carries 16 marks. [5 x 16 = 80]

2. (a) XYZ Ltd., supports the concept of the Life Cycle Costing for new investment decisions, covering its engineering activities. XYZ Ltd., is to replace a number of its machine and the Chief engineer is to decide between the 'AB' machine, a major expensive machine, with a life of 10 years and the 'CD' machine with an estimated life of 5 years. If the 'CD' machine is chosen, it is likely that it would be replaced at the end of 5 years by another 'CD' machine.

The pattern of maintenance and running costs differs between two types of machine and the relevant data are as given below:

	AB	CD
Purchase Price	19,000	13,000
Trade-in-value	3,000	3,000
Annual repair cost	2,000	2,600
Overhaul cost (p.a.)	4,000	2,000
	(at year 8)	(at year 4)
Estimated financing cost averaged		
Over machine life (p.a.)	10%	10%

Required: Recommend, with supporting figures, which machine to be purchased, stating any assumptions made.

[Given PVIF (10,10)	=	0.39
PVIF (10,5)	=	0.62
PVIFA (10,10)	=	6.15
PVIFA (10,5)	=	3.60
PV factor @10% for 4 years	=	0.68
PV factor @10% for 8 years	=	0.47]

PVIF means present value interest factor.
PVIFA means present value interest factor for any Annuity.

(b) An Engineering Company produces product P in its Production Shop 'A'. The overhead recovery rate is 100% of direct wages based on the following budgeted figures:

Direct wages	1,60,000
Variable overheads	64,000
Fixed overheads	96,000

The Production plan for the same budget period envisages an output of 18,000 units of P, whose sales and cost data are as under:

	₹/unit
Selling price	42
Direct materials	12
Direct wages	8
Total overheads	8

The company proposes to use the balance capacity of shop A after completing the above said production plan for the manufacture of component Q, whose cost data are as under:

	₹/unit
Direct materials	8
Direct wages	16
Total overheads	16

The component Q is used by the company in the manufacture of some other product in another production department.

The company receives an export order from abroad for the purchase of 2000 units of product P at ₹30 each. This offer can be accepted by diverting the capacity from component Q. In that event, the company has to buy the component which is available from an outside supplier at a price of ₹40 each.

You are requested to evaluate the alternative courses of action and state with reasons whether the spare capacity should be utilized for the manufacture of:

(i) The component Q or;

(ii) 2000 units of product P for export and buying of the component Q from the outside supplier.

Answer:

2. (a) AB M/c – 10 years life

	Year	Cost (₹)	P/V factor	Discounted Cost (₹)
Purchase Price	0	19,000	1.00	19,000
Overhaul Costs	8	4,000	0.47	1,880
Trade-in-value	10	(3,000)	0.39	(1,170)
Annual Repair Cost	1.10	2,000	6.15	12,300
				32,010

Annualized equivalent = ₹32,110/6.15 = ₹5,221.

CD M/c – 5 years life

	Year	Cost (₹)	P/V factor	Discounted Cost (₹)
Purchase Price	0	13,000	1.00	13,000
Overhaul Costs	4	2,000	0.68	1,360
Trade-in-value	5	(3,000)	0.62	(1,860)
Annual Repair Cost	1.5	2,600	3.80	9,880
				22,380

Annualized equivalent = ₹22,380/3.80 = ₹5,890

Conclusion:

AB M/c should be purchased.

(b) First let us split the overhead recovery rate into variable and fixed.

Variable overhead recovery rate = 64,000/1,60,000 x 100 = 40%

Fixed overhead recovery rate = 90,000/1,60,000 x 100 = 60%

Fixed overhead is not relevant for decision-making

Hence the variable cost of P and Q has been worked out as below:

	P	Q
Direct Materials	12.00	8.00
Direct Wages	8.00	16.00
Variable O/H @40% of Direct Wages	3.20	6.40
Variable Cost	23.20	30.40
Selling Price (Export)	30.00	
Contribution	6.80	
Purchase Price		40.00
Loss		9.60
		₹
If the Product P is produced		13,600
Contribution for 2000 units = 2000 x 6.80		
Then the component of Q is to be bought from the outside supplied.		
In such a case the loss will be 1000 x 9.60		9,600
Net Profit on export		4,000

Spare Capacity should be utilized for export of 2000 units of P. 1000 units of Q may be bought from outside supplier. Then the net profit on export would be ₹4,000.

Direct wages	₹ / unit
P	8
Q	16

Hence for 1000 units of Q capacity, 2000 units of P can be manufactured.

3. (a) Bloom Ltd makes 3 products , A, B and C. The following information is available: (figures in ₹ Per unit)

Particulars	A	B	C
Selling Price (peak-season)	**550**	**630**	**690**
Selling Price (off-season)	**550**	**604**	**690**
Material Cost	**230**	**260**	**290**
Labour (peak-season)	**110**	**120**	**150**
Labour (off-season)	**100**	**99**	**149**
Variable Production Overhead	**100**	**120**	**130**
Variable Selling Overhead (only for peak-season)	**10**	**20**	**15**
Labour hours required for one unit of production (in hours)	**8**	**11**	**7**

Material Cost and Variable Production Overheads are the same for the peak-season and off-season. Variable Selling Overheads are not incurred in the off-season. Fixed Costs amount to ₹26,780 for each season, of which ₹2,000 is towards Salary for Special Technician, incurred only for product B, and ₹1,780 is the amount that will be incurred on after-sales warranty and free maintenance of only product C, to match competition.

Labour force can be inter-changeable used for all the products. During peak-season, there is labour shortage and the maximum labour hours available are 1,617 hours. During off-season, labour is freely available, but demand is limited to 100 units of A, 115 units of B and 135 units of C, with production facility being limited to 215 units for A, B and C put together.

You are required to:

1. **Advise the Company about the best product mix during the peak-season for maximum profit.**
2. **What will be the maximum profit for the off-season?**

(b) What is Penetrating Pricing? What are the circumstances in which this policy can be adopted?

Answer:

3. (a) **1. Product Decision and Profits during Peak Season (Figure in ₹)**

Product	A	B	C
(a) Selling Price per unit	550	630	690
(b) Variable Costs per unit:			
Direct Material	230	260	290
Direct Labour	110	120	150
Variable Overhead - Production	100	120	130
Variable Overhead - Selling	10	20	15
Sub-Total variable Cost	**450**	**520**	**585**
(c) Contribution per unit (a – b)	100	110	105
(d) Direct Labour Hours required per unit	8 hours	11 hours	7 hours
(e) Contribution per Labour hour (c ÷ d)	12.5	10	15

(f) Ranking	II	III	I
(g) Possible Production with DLH of 1,617 hours (1617 ÷ d)	**202 units**	**147 units**	**231 units**
(h) Specific Fixed Overhead (given)	Nil	2,000	4,780
(i) Other General Fixed Overhead (Total 26,780 less h)	20,000	20,000	20,000
(j) Total Fixed OH if the product is produced individually (h + i)	20,000	22,000	24,780
(k) BEQ (j ÷ c)	**200 units**	**200 units**	**236 units**

Observation: Comparing (g) and (k) above, it is observed that only Product A should be produced, since B and C will not be able to recover the Fixed Costs. Hence, the Company should produce **202 units of Product A**, resulting in a Contribution of (₹202 x 100) = ₹20.200 – Fixed Cost ₹20,000 = **₹200.**

Note Even if Product C has the maximum ranking with respect to Key Factor, it is not profitable to produce. Hence, the next best profitable product, i.e. Product A should be preferred.

2. Computation of Contribution per unit during Off-Season (Figures in ₹)

Product	A	B	C
(a) Selling Price per unit	550	604	690
(b) Variable Cost per unit:			
Direct Material	230	260	290
Direct Labour	100	99	149
Variable Overhead – Production	100	120	130
Sub – Total Variable Cost	Product	A	B
(c) Contribution per unit (a – b)	120	125	130
(d) Ranking based on Contribution per unit	III	II	I
(e) Maximum Demand	100 units	115 units	135 units

Since Overall Total Possible production is only 215 units and there are specific fixed Costs for B and C, the following options are available for analysis –

Item	Contribution p.u.	Option 1		Option 2		Option 3	
		Units	Contribution	Units	Contribution	Units	Contribution
Product A	120	Nil	Nil	100	₹12,000	80	₹9,600
Product B	125	115	₹14,375	115	₹14,375	Nil	Nil
Product C	121	100	₹12,100	Nil	Nil	135	₹16,335
Total		**215**	**₹26,475**	**215**	**₹26,375**	**215**	**₹25935**
Less: Fixed Cost			₹26,780		₹22,000		₹24780
Profit / (Loss)			**₹(305)**		**₹4,375**		**₹1,155**

Best option is to produce 100 units of Product A and 115 units of Product B during off-season. Maximum Profit = ₹4,375.

(b) 1. Penetration Pricing is a policy of using a **low price** as the principal instrument for penetrating mass markets early. This method is used for pricing a new product and to popularize it initially.
2. Profits may not be earned in the initial stages. However, Prices may be increased as and when the product is established and its demand picks up.
3. The low price policy is introduced for the purpose of long-term survival and profitability. Hence, careful analysis of the scope for market expansion and considerable amount of research and forecasting are necessary before determining the price under this strategy.
4. The circumstances in which Penetrating Pricing can be adopted are –

(a) Elastic demand: The demand of the product is high when price is low. Hence, lower prices mean large volume and so more profits.

(b) Mass Production: When there are substantial savings in large-scale production, increase in demand is sustained by the adoption of low pricing policy.

Frighten off competition: The prices fixed at a low-level act as an entry barrier to the prospective competitors. The use of this policy by existing Firms will discourage the new firms to enter the market. The pricing policy is also known as "**Stay-out-pricing**".

4. (a) The summarized results of a company for the two years ended 31st December 2014 and 2015 are given below:-

	2015	2014
	₹ lacs	₹ Lacs
Sales	**770**	**600**
Direct Materials	**324**	**300**
Direct Wages	**137**	**120**
Variable Overheads	**69**	**60**
Fixed Overheads	**150**	**80**
Profit	**90**	**40**

As a result of re-organisation of production methods and extensive advertisement campaign use, the company was able to secure an increase in the selling prices by 10% during the year 2015 as compared to the previous year.

In the year 2014, the company consumed 1,20,000 kgs. of raw materials and used 24,00,000 hours of direct labour.

In the year 2015, the corresponding figures were 1,35,000 kgs. of raw materials and 26,00,000 hours of direct labour.

You are required to:
Use information given for the year 2014 as the base year information to analyse the result of the year 2015 and to show in a form suitable to the management the amount each factor has contributed by way of price, usage and volume to the change in profit in 2015.

(b) State the limitations of Uniform Costing.

Answer:

4. (a) (ICAI Study Material Illustration 11 / P:200)
1) Sales price variance = 770 – {770 × (100/110)} = ₹70 (F)
2) Sales volume variance = {770 × (100/110)} – 600 = ₹100 (F)
% increase in volume = (100/600) × 100 = ₹16.66667%
3) Sales Value variance = 770 – 600 = ₹170 (F)
4) Material cost variance = 300 – 324 = ₹24 (F)
5) Material volume variance = 300 × (1/6) = ₹50 (A)
Material price = (30000000) / 120000 = ₹250/-
Material expected to be used = (120000 / 600) × 700 = 140000 Kgs
6) Material usage variance = 5000 × 250 = ₹12.5 (F)
7) Material price variance = 50 – 24 – 12.5 = ₹13.5 (F)
8) Labour cost variance = ₹17 (A)
9) Labour volume variance = 120 / 6 = ₹20 (A)
Labour rate = (12000000) / (2400000) = ₹5/-
Labour hours expected to be used = (2400000 / 600) × 700 = 2800000
10) Labour efficiency variance = 2 × 5 = ₹10 (F)

11) Labour rate variance = 20 – 17 – 10 = ₹7 (A)
12) VOH cost variance = ₹9 (A)
13) VOH volume variance = 60/6 = ₹10 (A)
14) VOH efficiency variance = 200000 × 2.5 = ₹5 (F)
15) VOH expenditure variance = 10 – 9 – 5= ₹4 (A)
16) FOH cost variance = ₹70 (A)

Profit reconciliation statement:

		₹ In lakhs
Profit		40
(+) sales variance:		
Price	70	
Volume	100	
Material variance:		
Usage	12.50	
Price	13.50	
Labour variance-efficiency	10	
VOH efficiency variance	5	211
		251
(–) Material volume variance	50	
Labour variance:		
Volume	20	
Rate	7	
VOH variances:		
Volume	10	
Expenditure	4	
FOH cost variance	70	161
Profit for 1988		90

(b) **Limitations of Uniform Costing:**

(i) Uniform costing presumes the application of same principles and methods of Costing in each of the member firms. But individual units generally differ in respect of certain key factors and methods.

(ii) For smaller units the cost of installation and operation of Uniform Costing System may be more than the benefits derived by them.

(iii) Uniform costing may create conditions that are likely to develop monopolistic tendencies within the industry. Prices may be raised artificially and supplies curtailed.

(iv) If complete agreement between the members is not forthcoming, the statistics presented cannot be relied upon. This weakens the Uniform Costing System and reduces its usefulness.

5. (a) A company can produce any of its 4 products, A, B, C and D. Only one product can be produced in a production period and this has to be determined at the beginning of the production run. The production Capacity is 1,000 hours. Whatever is produced has to be sold and there is no Inventory build-up to be considered beyond the production period. The following information is given:

Particulars	A	B	C	D
Selling Price (₹ Per unit)	**40**	**50**	**60**	**70**
Variable Cost (₹ Per unit)	**30**	**20**	**20**	**30**
No. of units that can be sold	**1,000**	**600**	**900**	**600**
No. of production hours required per unit of product	**1 hour**	**1 hour and 15 minutes**	**1 hour and 15 minutes**	**2 hours**

What are the Opportunity Costs of A, B, C and D?

(b) A company produces for products, viz. P, Q, R and S. The data relating to production activity are as under

Product	Quantity of Production	Material Cost / unit ₹	Direct labour hours/ unit	Machine hours / unit	Direct Labour cost / unit ₹
P	1,000	10	1	0.50	6
Q	10,000	10	1	0.50	6
R	1,200	32	4	2.00	24
S	14,000	34	3	3.00	18

Production overheads are as under:

	₹
(i) Overheads applicable to machine oriented activity	1,49,700
(ii) Overheads relating to ordering materials	7,680
(iii) Set up costs	17,400
(iv) Administration overheads for spare parts	34,380
(v) Material handling costs	30,294

The following further information have been compiled:

Product	No. of set up	No. of materials orders	No. of times materials handled	No. of spare parts
P	3	3	6	6
Q	18	12	30	15
R	5	3	9	3
S	24	12	36	12

Required:

(i) Select a suitable cost driver for each item of overhead expense and calculate the cost per unit of cost driver.

(ii) Using the concept of activity based costing, compute the factory cost per unit of each product.

Answer:

5. (a)

Particulars	A	B	C	D
1. Contribution per unit = SP pu – VC pu	40 – 30 = ₹10	50 – 20 = ₹30	60 – 20 = ₹40	70 – 30 = ₹40
2. Time Required	1 hour	1.25 hours	1.25 hours	2 hours
3. Possible Production Point Qtty = (1000 ÷ 2)	1,000 units	800 units	800 units	500 units
4. Possible Sale Quantity	1,000 units	600 units	900 units	600 units
5. Sales Quantity lost due to Production Constraint = 4 – 3, if 4>3.	Nil	NA	100 units	100 units
6. Opportunity Costs = (5 x 1)	**Nil**	**Nil**	**₹4,000**	**₹4,000**

(b) Computation of Cost Driver Rates

1) Overheads relating to Machinery oriented activity
   Cost Driver → Machine Hour Rate
   (1000 × 0.5) + (1000 × 0.5) + (1200 × 2) + (14000 × 3)
   1,49,700 / 49,900 = ₹3 per hour
2) Overheads relating to ordering materials
   Cost driver → No. of Materials orders
   7680 / 30 = ₹256 per orders
3) Set up costs
   Cost driver → No. of set ups
   17400 / 50 = ₹348 per set up

4) Administrative Overheads for spare parts
Cost driver → No. of spare parts
34380 / 36 = ₹955 per spare part.
5) Material Handling costs
Cost driver → No. of times materials handled
30294 / 81 = ₹374 per material handling

Computation of factory cost for each product

	P		Q		R		S	
Materials		10.00		10.00		32.00		34.00
Labour		6.00		6.00		24.00		18.00
Overheads								
Machine oriented activity	1.500		1.50		6.00		9.00	
Ordering of Materials	0.768		0.31		0.64		0.22	
Set up costs	1.044		0.63		1.45		0.60	
Administrative Spare Parts	5.730		1.43		2.39		0.82	
Material handling	2.244	11.29	1.12	4.99	2.81	13.29	0.96	11.60
Factory Cost (₹)		**27.29**		**20.99**		**69.29**		**63.60**

6. (a) A small retailer has studied the weekly receipts and payments over the past 200 weeks and has developed the following set of information:

Weekly Receipts	Probability	Weekly Payments	Probability
₹		₹	
3000	**0.20**	**4000**	**0.30**
5000	**0.30**	**6000**	**0.40**
7000	**0.40**	**8000**	**0.20**
12000	**0.10**	**10000**	**0.10**

Using the following set of random numbers, simulate the weekly pattern of receipts and payments for the 12 weeks of the next quarter, assuming further that the beginning bank balance is ₹8000. What is the estimated balance at the end of the 12 weekly period? What is the highest weekly balance during the quarter? What is the average weekly balance for the quarter?

Random Numbers

For Receipts	**03**	**91**	**38**	**55**	**17**	**46**	**32**	**43**	**69**	**72**	**24**	**22**
For Payments	**61**	**96**	**30**	**32**	**03**	**88**	**48**	**28**	**88**	**18**	**71**	**99**

According to the given information, the random number interval is assigned to both the receipts and the payments.

(b) A Company has 4 factories F1, F2, F3 and F4 manufacturing the same product. Production and Raw material costs differ from factory to factory and are given in the table below in the first two rows. The transportation costs from the factories to the sale depots S1, S2 and S3 are also given. The last two columns in the table below give the sales price and total requirements at each depot and the production capacity of each factory given in the last row.

	F1	F2	F3	F4	Sales Price / unit (₹)	Requirement
Production Cost/Unit (₹)	**15**	**18**	**14**	**13**		
Raw Materials Cost/Unit (₹)	**10**	**9**	**12**	**9**		
Transportation Cost/Unit (₹)						
S1	**3**	**9**	**5**	**4**	**34**	**80**
S2	**1**	**7**	**5**	**4**	**32**	**120**
S3	**5**	**8**	**3**	**6**	**31**	**150**
Production Capacity	**10**	**150**	**50**	**100**		

Determine the optimal solution and the associated profit by using the Vogel's Approximation Method (VAM).

Answer:

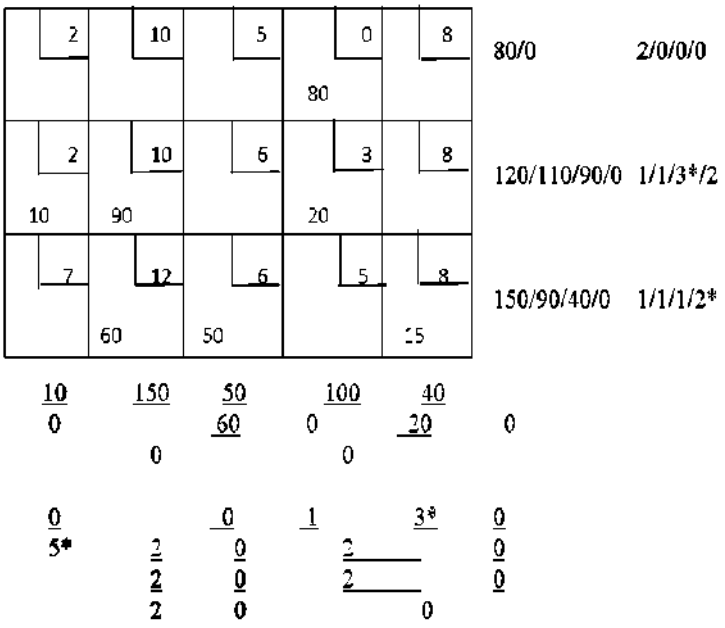
6. (a)

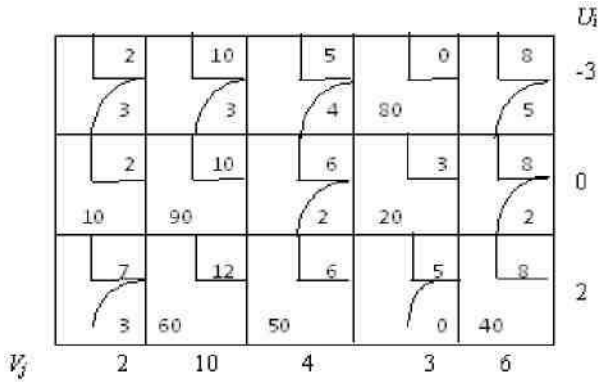
Range of random numbers							
Receipt (₹)	Probability	Cumulative probability	Range	Payments (₹)	Probability	Cumulative probability	Range
3000	0.20	0.20	0-19	4000	0.30	0.30	0-29
5000	0.30	0.50	20-49	6000	0.40	0.70	30-69
7000	0.40	0.90	50-89	8000	0.20	0.90	70-89
12000	0.10	1.00	90-99	10000	0.10	1.00	99-99

Simulation of Data for a period of 12 weeks					
Week	Random No. for receipt	Expected Receipt (₹)	Random No. for payment	Expected payment (₹)	Week end Balance
Opening Balance					8000
1	03	3000	61	6000	5000 (8000 + 3000 –6000)
2	91	12000	96	10000	7000
3	38	5000	30	6000	6000
4	55	7000	32	6000	7000
5	17	3000	03	4000	6000
6	46	5000	88	8000	3000
7	32	5000	48	6000	2000
8	43	5000	28	4000	3000
9	69	7000	88	8000	2000
10	72	7000	18	4000	5000
11	24	5000	71	8000	2000
12	22	5000	99	10000	(3000)

Estimated balance at the end of 12th week = ₹(3,000)
Highest balance = ₹ 7,000
Average balance during the quarter = 45,000 /12 = ₹3,750

(b) Loss Matrix





As Δij is ≥ 0, the solution is optimum

Qty		Maximum Profit		
S1	F4	→ 80 × 8	=	640
S2	F1	10 × 6	=	60
F2		90 × (-2) = (-)	180	
F4		20 × 5	=	100
F3	F2	60 × -4	=(-)	240
	F3	50 × 2	=	100
	Dumy	60 × 0	=	0
		350		₹ 480

7. (a) A company had planned its operations as follows:

Activity	Duration (days)
1-2	7
2-4	8
1-3	8
3-4	6
1-4	6
2-5	16
4-7	19
3-6	24
5-7	9
6-8	7
7-8	8

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

(ii) After 15 days of working, the following progress is noted:

(a) Activities 1-2, 1-3, and 1-4 completed as per original schedule.

(b) Activity 2-4 is in progress and will be completed in 4 more days.

(c) Activity 3-6 is in progress and will need 17 more days to complete.

(d) The staff at activity 3-6 are specialised. They are directed to complete 3-6 and undertake an activity 6-7, which will require 7 days. This re-arrangement arose due to a modification in a specification.

(e) Activity 6-8 will be completed in 4 days instead of the originally planned 7 days.

(f) There is no change in the other activities.

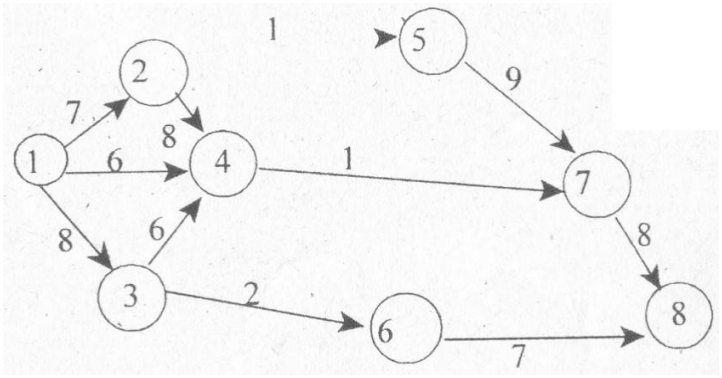
Update the network diagram after 15 days of start of work based on the assumption given above. Indicate the revised critical paths along with their duration.

(b) A company manufactures items X_1 and X_2 which are sold at a profit of ₹35 per unit of X_1 and ₹25 per unit of X_2. X_1 requires 3 kgs of materials, 4 man-hours and 2 machine-hours per unit. X_2 requires 2kgs of materials, 3 man-hours and 2 machine-hours per unit. During each production run, there are 350 kgs, of materials available, 600 man-hours and 550 machine-hours for use.

Formulate under Simplex method of linear programming:
(i) The objective function and the linear constraints, and
(ii) The equations after introducing slack variables
(iii) What are the various methods of solving a linear programming problem?

Answer:

7. (a) (i)



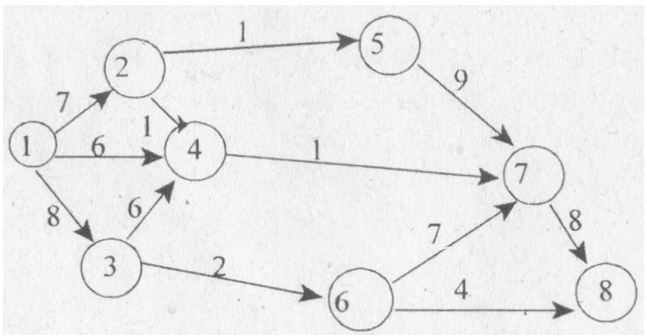
Paths	Duration
1-2-5-7-8	7+16+9+8 = 40
1-2-4-7-8	7+8+19+8 = 42
1-4-7-8	6+19+8 = 33
1-3-4-7-8	8+6+19+8 = 41
1-3-6-8	8+24+7 = 39

Critical Path 1-2-4-7-8 = 42 days

Revised duration of activities 2-4 and 3-6 after 15 days for updation.

Activity	Preceding Activity	Date of completion	Revised duration
2-4	1-2	15+4 = 19 days	19-7 = 12 days
3-6	1-3	15+17 = 32 days	32-8 = 24 days
6-7 (New-activity)	3-6		7 days
6-8	3-6		4 days

(ii)



Paths	Duration
1-2-5-7-8	7+16+9+8 = 40
1-2-4-7-8	7+12+19+8 = 46
1-4-7-8	6+19+8 = 33
1-3-4-7-8	8+6+19+8 = 41
1-3-6-7-8	8+24+7+8 = 47
1-3-6-8	8+24+4 = 36

Critical Path = 1-3-6-7-8 = 47 days

(b) (i) The objective function to be maximized is - $Z = 35X_1 + 25X_2$

Subject to constraints

$3X_1 + 2X_2 \leq 350$

$4X_1 + 3X_2 \leq 600$

$2X_1 + 2X_2 \leq 550$

$X_1, X_2 \geq 0$

(ii) By introducing slack variable the equation will be-

$3X_1 + 2X_2 + S_1 + 0S_2 + 0S_3 = 350$

$4X_1 + 3X_2 + 0S_1 + S_2 + 0S_3 = 600$

$2X_1 + 2X_2 + 0S_1 + 0S_2 + S_3 = 550$ and

$Z = 35X_1 + 25X_2 + 0S_1 + 0S_2 + 0S_3 = 550$

(iii) There are three methods of solving a linear programming problem which are as follows:

Simplex Method

Graphical Method

Transportation Method

8. (a) Socio Economic Costing.
(b) Six Sigma.
(c) Lean Accounting.
(d) Life Cycle Cost.
(e) Margin of Safety.

Answer:

8. (a) Socio Economics (also known as social economics) is the social science that studies how economic activity affects and is shaped by social processes. In general it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy.

socioeconomics is sometimes used as an umbrella term with different usages. The term 'social economics' may refer broadly to the —use of economics in the study of society.

In many cases, socioeconomics focus on the social impact of some sort of economic change. such changes might include a closing factory, market manipulation, the signing of international trade treaties, new natural gas regulation, etc. such social effects can be wide-ranging in size, anywhere from local effects on a small community to changes to an entire society. Examples of causes of socioeconomic impacts include new technologies such as cars or mobile phones, changes in laws, changes in the physical environment (such as increasing crowding within cities), and ecological changes (such as prolonged drought or declining fsh stocks). These may affect patterns of consumption, the distribution of incomes and wealth, the way in which people behave (both in terms of purchase decisions and the way in which they choose to spend their time), and the overall quality of life.

Companies are increasingly interested in measuring socio-economic impact as part of maintaining their license to operate, improving the business enabling environment, strengthening their value chains, and fuelling product and service innovation.

(b) Six Sigma has two key methodologies: DMAIC and DMADV, both inspired by W. Edwards Deming's Plan-Do-Check-Act Cycle: DMAIC is used to improve an existing business process, and DMADV is used to create new product or process designs for predictable, defect-free performance.

DMAIC

Basic methodology consists of the following five (5) steps:

- Define the process improvement goals that are consistent with customer demands and enterprise strategy.
- Measure the current process and collect relevant data for future comparison.
- Analyze to verify relationship and causality of factors. Determine what the relationship is, and attempt to ensure that all factors have been considered.
- Improve or optimize the process based upon the analysis using techniques like Design of Experiments.
- Control to ensure that any variances are corrected before they result in defects. set up pilot runs to establish process capability, transition to production and thereafter continuously measure the process and institute control mechanisms.

DMIADV

Basic methodology consists of the following five steps:

- Define the goals of the design activity that are consistent with customer demands and enterprise strategy.
- Measure and identify CTQs (critical to qualities), product capabilities, production process capability, and risk assessments.
- Analyze to develop and design alternatives, create high-level design and evaluate design capability to select the best design.
- Design details, optimize the design, and plan for design verification. This phase may require simulations.
- Verify the design, set up pilot runs, implement production process and handover to process owners.

Some people have used dmaicr (Realize). Others contend that focusing on the financial gains realized through Six Sigma is counter-productive and that said financial gains are simply byproducts of a good process improvement.

(c) Lean Accounting: What we now call lean manufacturing was developed by Toyota and other Japanese companies. Toyota executives claim that the famed Toyota Production System was inspired by what they learned during visits to the Ford Motor Company in the 1920s and developed by Toyota leaders such as Taiichi Ohno and consultant Shigeo Shingo after World War II. As pioneer American and European companies embraced lean manufacturing methods in the late 1980s, they discovered that lean thinking must be applied to every aspect of the company including the financial and management accounting processes.

Lean Accounting is the general term used for the changes required to a company's accounting, control, measurement, and management processes to support lean manufacturing and lean thinking. Most companies embarking on lean manufacturing soon find that their accounting processes and management methods are at odds with the lean changes they are making. The reason for this is that traditional accounting and management methods were designed to support traditional manufacturing; they are based upon mass production thinking. Lean manufacturing breaks the rules of mass production, and so the traditional accounting and management methods are (at best) unsuitable and usually actively hostile to the lean changes the company is making.

(d) **Meaning of Life Cycle Costing**

(i) Life Cycle Costing; aims at cost ascertainment of a product, project etc. over its projected life.

(ii) It is a system that tracts and accumulates the actual costs and revenues attributable to cost object (i.e.; product) from its inception to its abandonment.

(iii) Sometimes the terms; cradle-to-grave costing and womb-to-tomb costing convey the meaning of fully capturing all costs associated with the product from its initial to final stages.

(e) **Margin of Safety**:

It is the sales point beyond the breakeven point. Margin of safety can be obtained by subtracting break even sales from Total sales. It is useful to determine financial soundness of business enterprise. If margin of safety is high, then the financial position of the enterprise is sound.

Margin of Safety = Total Sales – Break Even Sales → (1)

Total Sales = Break Even Sales + Margin of Safety Sales → (2)

→ Margin of safety can also be computed as follows:
Margin of Safety = Profit / P/V ratio → (3)

A relative measure to the margin of safety is its ratio to total sales.

→ Margin of safety ratio is the ratio of Margin of safety sales to Total sales.
Margin of safety ratio = [Margin of safety / Total sales] x 100 → (4)

→ Margin of safety ratio and Break even sales ratios are complements of each other.