FINAL EXAMINATION

GROUP - III
(SYLLABUS 2016)

SUGGESTED ANSWERS TO QUESTIONS

DECEMBER - 2019

Paper-15 : STRATEGIC COST MANAGEMENT – DECISION MAKING

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

The figures in the margin on the right side indicate full marks.

Section – A

1. Choose the most appropriate answer to the following questions giving justification/ reasonable workings: 2x10=20

(i) The break-even point of a manufacturing company is ₹ 1,60,000. Fixed cost is ₹ 48,000. Variable cost is ₹ 12 per unit. The PV ratio will be:
(A) 20%
(B) 40%
(C) 30%
(D) 25%

(ii) A factory has a key resource (bottleneck) of Facility A which is available for 31,300 minutes per week. The time taken by per unit of Product X and Y in Facility A are 5 minutes and 10 minutes respectively. Last week's actual output was 4750 units of product X and 650 units of Product Y. Actual factory cost was ₹ 78,250. The throughput cost for the week would be:
(A) ₹ 75,625
(B) ₹ 76,225
(C) ₹ 77,875
(D) ₹ 79,375

(iii) In a PERT network, the optimistic time for a particular activity is 9 weeks and the pessimistic time is 21 weeks. Which one of the following is the best estimate of the standard deviation for the activity?
(A) 12
(B) 9
(C) 6
(D) 2

(iv) The higher the actual hours worked,

(A) The lower the capacity usage ratio.

(B) The higher the capacity usage ratio.

(C) The lower the capacity utilization ratio.

(D) The higher the capacity utilization ratio.

(v) X is a factory making a certain product where learning curve ratio of 80% and 90% apply respectively for two equally paid workers, A and B

(A) The labour cost of manufacturing the 4th product will be more for A.

(B) The labour cost of manufacturing the 4th product will be more for B.

(C) The labour cost is the same for the fourth product.

(D) Nothing can be said about the specific product since learning applies ratio to the average quantity of the product.

(vi) What is the opportunity cost of making a component part in a factory given no alternative use of the capacity?

(A) The variable manufacturing cost of the component

(B) The total manufacturing cost of the component

(C) The total variable cost of the component

(D) Zero

(vii) The product of XYZ company is sold at a fixed price of ₹ 1,500 per unit. As per company's estimate, 500 units of the product is expected to be sold in the coming year. If the value of investments of the company is ₹ 15 lakh and it has a target ROI of 15%, the target cost would be:

(A) ₹ 930

(B) ₹ 950

(C) ₹ 1050

(D) ₹ 1130

(viii) Max Ltd. fixes the inter divisional transfer prices for its products on the basis of cost plus a return on investment in the division. The budget for division X for 2019 – 20 appears as under –

	₹
Fixed assets	5,00,000
Current assets	3,00,000
Debtors	2,00,000
Annual fixed cost of the division	8,00,000
Variable cost per unit of the product	10
Budgeted volume	4,00,000 units per year
Desired ROI	28%

Transfer price for division X is

(A) ₹ 12.70

(B) ₹ 10.70

(C) ₹ 8.70

(D) ₹ 14.70

(ix) Which of the following is not a correct match?

Activity	Cost Drivers
(A) Production scheduling	**Number of production runs**
(B) Despatching	**No. of Despatch orders**
(C) Goods receiving	**Goods received order**
(D) Inspection	**Machine hours**

(x) A manufacturing company uses two types of materials. X and Y, for manufacture of a standard product. The following information is given:

	Standard mix				Actual mix		
Materials X	**120**	**Kg. @ ₹ 5 =**	**₹ 600**		**112**	**Kg. @ ₹ 5 =**	**₹ 560**
Y	**80**	**Kg. @ ₹ 10 =**	**₹ 800**		**88**	**Kg. @ ₹ 10 =**	**₹ 880**
	200		**₹ 1,400**		**200**		**₹ 1,440**
30% loss	**60**			**25% loss**	**50**		
	140		**₹ 1,400**		**150**		**₹ 1,440**

Direct Materials Mix Variance is:

(A) ₹ 40 (fav.)

(B) ₹ 40 (unfav.)

(C) ₹ 80 (fav.)

(D) ₹ 80 (unfav.)

Answer:

1. (i) (C)

Explanation: $\text{BEP} = \frac{\text{FC}}{\text{P/V ratio}} = \text{P/V Ratio} = \frac{\text{FC}}{\text{BEP}} = \frac{\text{Rs. 48,000}}{\text{1,60,000}} = 30\%$

(ii) (A)

Explanation: Cost per Factory Minute = Total Factory Cost / Minutes Available = ₹ 78,250/31,300 = ₹ 2.50

Standard Minutes of throughput for the week = (4750 × 5) + (650 × 10) = 30,250 minutes

Therefore, throughput Cost for the week = 30,250 × ₹ 2.50 = ₹ 75,625

(iii) (D)

Explanation: Standard Deviation equals (pessimistic time minus optimistic Time)/6 that is 21-9/6 = 2

(iv) (D)

Explanation: Capacity utilization ratio = $\frac{\text{Actual Hours}}{\text{Budgeted Hours}}$

So, the capacity utilization ratio would be higher.

(v) (B)

Explanation: The labour cost of manufacturing the 4th product will be more for B since B will take more time per unit of product.

(vi) (D)

Explanation: Opportunity cost is not an out of pocket cost. It is the benefit given up by not selecting the next best alternative. Therefore, answers A, B and C are incorrect and D is correct.

(vii) (C)

Explanation: ROI at 15% of total investment ₹ 15 lakhs = ₹ 15,00,000 × 0.15 = ₹ 2,25,000.
Profit per unit of future output = ₹ 2,25,000/500 = ₹ 450 per unit.
Therefore, target cost per unit = Selling Price – Profit per unit = ₹ 1,500 – ₹ 450 = ₹ 1,050 per unit.

(viii) (A)

Explanation:

	Per unit (₹)
VC	10
FC (₹ 8,00,000 ÷ 4,00,000)	2
Investment : (FA + CA + Debtors) = ₹ 10,00,000	
Return = $\frac{Rs.10,00,000 \times 0.28}{4,00,000}$	0.70
TP for Div. X	12.70

(ix) (D)

Explanation: Inspection hours, and not machine hours, drive the cost of inspection.

(x) (B)

Explanation: A manufacturing company uses two type of Materials, X and Y, for manufacture of a standard product:

	Standard mix				Actual mix		
Materials X	120	Kg. @ ₹ 5 =	₹ 600		112	Kg. @ ₹ 5 =	₹ 560
Y	80	Kg. @ ₹ 10 =	₹ 800		88	Kg. @ ₹ 10 =	₹ 880
	200		₹ 1,400		200		₹ 1,440
30% loss	60			25% loss	50		
	140		₹ 1,400		150		₹ 1,440

Direct Materials Mix Variance is: ₹ 40 (unfav.)

	SP (SQ – AQ)		
X	₹ 5 (120 – 112)	=	₹ 40 (fav.)
Y	₹ 10 (80 – 88)	=	₹ 80 (unfav.)
			₹ 40 (unfav.)

Section – B

Answer any five questions.

Each Question carries 16 Marks.

16×5=80

2. (a) State with brief reason whether you would recommend an Activity Based Costing system is each of the following independent situations:

(i) A consultancy firm consisting of Lawyers. Accountants and Computer Engineers provides management consultancy services to clients.

(ii) Company X produces one product. The overhead costs mainly consist of Depreciation.

(iii) Company Z produces two different labour intensive products. The contribution per unit in both products is very high. The BEP is very low. All the work is carried on efficiently to meet target costs.

(iv) Company Y produces 4 different products using different production facilities.

1½×4=6

(b) Following is the operating results of Premier hospital for the year ended 31st march 2019:

Particulars	₹
Revenue	1,13,88,000
Cost: Variable	26,28,000
Bed capacity cost (fixed) but varies with number of beds	45,30,000
Staff cost	35,10,000
Profit	7,20,000

The hospital charged each patient and average of ₹ 650 per day, had a capacity of 60 beds operated 24 hours per day for 365 days. The hospital has minimum departmental personnel requirements based on totals annual patient days and following table gives the Salary to be paid.

Annual patient days	Salary (₹ in 000s)
10,000 – 14,000	32,00
14,001 – 17,000	33,80
17,001 – 23,725	35,10

Required:

(i) Compute the Break even patient days for the year ended 31st March, 2019.

(ii) Compute the Break even patient days for the year ended 31st March, 2020 if the hospital capacity is raised to 80 beds. Patient demand is unknown but assume that revenue per patient and cost per patient day, cost per bed, and employee salary will remain the same as for the year ended 31st March, 2019. 6+4=10

Answer:

2. (a) (i) ABC system uses the cost of activities as the basis for assigning cost of services to jobs which provides more accurate cost information for services. Hence ABC can be used for the consultancy firm.

(ii) ABC is needed by organizations for product costing where there is a great diversity in product range. Since company X produces only one product, ABC is not necessary. Moreover overhead consists of mainly depreciation. ABC is not required.

(iii) Company Z is highly labour intensive and does not have a great diversity of products. All work is carried out efficiently, hence ABC is not required. Moreover Target costs are achieved, NVA activities have already been identified and eliminated.

(iv) There is diversity in product range which use different amounts of OH resources as different production facilities are involved. ABC improves product costing by avoiding over or under costing of products. ABC system is recommended.

(b) (i)

No of patient days operated	1,13,88,000/650	17,520
Variable Cost per patient day	26,28,000/17520	150
Contribution per patient day	650 – 150	500
Fixed Cost		
Bed Capacity cost	45,30,000	
Staff Cost – Salary	35,10,000	80,40,000
Break Even Patient days	80,40,000 / 500	16,080
Since it falls in the previous range revised fixed cost will be		
Fixed Cost		
Bed Capacity cost	45,30,000	
Staff Cost – Salary	33,80,000	79,10,000
Break Even Patient days	79,10,000/500	15,820

(ii)

Expected patient demand with 80 beds	80×365×17,520/365×60	23,360
Existing Staff salary will return unchanged		
Fixed Cost		
Bed Capacity cost (80/60 × 45,30,000)	60,40,000	
Staff Cost – Salary	35,10,000	95,50,000
Break Even Patient days	9550000/500	19,100

Since it is in the same range there is no change in the breakeven.

3. (a) Zenith Ltd. manufacturers tablet batteries. The company is preparing a product life cycle budget for a new type of battery. Development on the new battery is to start shortly. Estimates for the new battery are as follows:

Life cycle units manufactured and sold	**2,00,000**
Selling price per battery	**₹ 55**
Life cycle costs:	
R&D and design cost	**₹ 8,00,000**
Manufacturing:	
Variable cost per battery	**₹ 25**
Variable cost per batch	**₹ 300**
Battery per batch	**250**
Fixed costs	**₹ 12,00,000**
Marketing	
Variable cost per battery	**₹ 3.50**
Fixed costs	**₹ 8,00,000**
Distribution:	
Variable cost per battery	**₹ 140**
Battery per batch	**100**
Fixed costs	**₹ 4,60,000**
Customer service cost per battery (Variable)	**₹ 1.70**

Ignore the time value of money.

Required:

(i) Calculate the budgeted life cycle operating income for the new battery.

(ii) What percentage of the budget total product life cycle costs will be incurred by the end of the R&D and design stages?

(iii) Company's market research department estimates that reducing price by ₹ 2.50 will increase life cycle unit sales by 8%. If unit sale increases by 8%, the company plans to increase manufacturing and distribution batch sizes by 8% as well. Assume that all variable costs per battery, per batch and fixed costs will remain the same. Should the company reduce battery price by ₹ 2.50? Show your calculations. 5+2+5=12

(b) What do you mean by Incremental cost? Is it always variable? 3+1=4

Answer:

3. (a) (i) Statement of Budgeted Life Cycle revenue and cost
Revenue (200000 × 55 = 11000000

Costs:

Pre-manufacturing cost	₹
Research and design	8,00,000
Manufacturing Costs:	
Variable Cost (25 × 200000)	50,00,000
Batch (300 × 200000/250)	2,40,000
Fixed cost	12,00,000
Marketing Costs:	
Variable Costs (3.5 × 200000)	7,00,000
Fixed cost	8,00,000
Distribution costs	
Batch (140 × 200000/100)	2,80,000
Fixed Cost	4,60,000
Customer Service (Variable) 1.7 × 200000	3,40,000
Total cost	98,20,000
Operating Income	11,80,000

(ii)

Budgeted product life cycle costs for R&D and design ₹ 8,00,000

Total budgeted life cycle product costs ₹ 98,20,000

Percentage of budgeted product life cycle cost incurred

Till the R&D and design ₹ 8,00,000/98,20,000 = 8.14%

(iii) Statement of Revised Budgeted Life Cycle revenue and cost

Revenue (2,16,000 × 52.50) = 1,13,40,000

Costs:

Pre-manufacturing cost	₹
Research and design	8,00,000
Manufacturing Costs:	
Variable Cost (25 × 216000)	54,00,000
Batch (300 × 800)	2,40,000
Fixed cost	12,00,000
Marketing Costs:	
Variable Costs (3.5 × 216000)	7,56,000
Fixed cost	8,00,000
Distribution costs	
Batch (140 × 2000)	2,80,000
Fixed Cost	4,60,000
Customer Service (Variable) 1.7 × 216000	3,67,200
Total cost	1,03,03,200
Operating Income	10,36,800

Since profit is lower, price should not be reduced.

(b) Incremental costs are costs that are incurred for the additional cost object with reference to the base. It could be for any additional resource or for any decision that is over and above the current scenario. It includes all costs that are incurred in addition to the existing base level. It could be fixed or variable or both.

4. XY Co. has Profit Centre Divisions X and Y, making products X and Y respectively. Each unit of Y requires one unit of X and Y can sell a maximum of 50,000 units in the external market at a selling price of ₹ 150 per unit. X has the capacity to produce 1,00,000 units of X. The variable cost per unit is 12. Fixed costs are ₹ 7,20,000. X can sell the following quantities in the external market:

Price per unit (₹)	Demand Units
18	84,000
20	76,000
22	70,000
24	64,000
26	54,000 or less

Assume no stock to build up for X or Y.

Y can purchase its requirement from the external market at ₹ 22 per unit, but has to incur a bulk transportation cost of ₹1,50,000 for any quantity, which will not be incurred on transfers from X.

Required:

(i) Assuming no demand from Y, what will be the best strategy for X?

(ii) What will be the minimum transfer price that X will agree to if X has to supply 50,000 units to Y? What price will Y offer as the maximum?

(iii) If Y is acceptable to partial supplies, what will be X's best strategy under no compulsion to transfer, but with the option to transfer as many units that it wants to? What will be the quantity that X will agree to transfer and the corresponding price, assuming both divisions agree to share the benefits of transfer equally?

(iv) What is the best strategy of the company? Will the company's overall strategy differ from the individual divisions' strategy? Compute the benefits/disadvantages/indifference between the divisional best and company best strategies.

Present relevant calculations to substantiate all your answers. 2+4+3+3+4=16

Answer:

4. Variable cost is constant at ₹ 12. Hence the value that will give the maximum contribution will be relevant.

Price per unit	Demand Units	Contbn ₹/u	Contbn Value
18	84,000	6	5,04,000
20	76,000	8	6,08,000
22	70,000	10	7,00,000
24	64,000	12	7,68,000
26	54,000	14	7,56,000

(i) The optimal strategy for X would be to manufacture 64000 units for external demand in the absence of demand from Y.

(ii) If X has to supply 50,000 units to Y, then, it can supply only 50,000 units for external sales at ₹ 26. Contribution from external sales will be ₹ 14 × 50,000 = 7,00,000
Minimum contribution from Y will be 56,000 for 50,000 units. Hence, X will transfer at a minimum price of ₹ 12 + (56,000/50,000) = 13.12 or ₹ 13 so that it is able to maintain the contribution from its optimal strategy.
However, if X is strong enough, it can demand a price of ₹ 22 which Y will be paying to outside suppliers.
Y will not pay anything more than 22 + 1,50,000/50,000, i.e., 25 ₹ /unit.

(iii) If X can choose, X will supply 64000 units for external demand and supply 36000 units to Y. Y will have to incur transport even for the 14000 units it purchases from outside. Hence it will not pay anything above ₹ 22. X will not accept anything below ₹ 13. Benefits to be shared equally between X and Y = 22 – 13 = 9 per unit. Hence Transfer price per unit will be ₹ 13 + 4.5 = ₹ 17.5, so that Y benefits by ₹ 4.5 and X also gets additional ₹ 4.5 contribution per unit transferred. Quantity transferred will be 36,000 units.

(iv) For the company as a whole, it is incurring a variable cost of ₹ 22 plus transport of ₹ 3 = ₹ 25 for every unit of Y purchased. Contribution of X as per best strategy = ₹ 13. Hence, for the company, best strategy will be to transfer 50,000 units to Y and sell 50,000 units to external sales.

Contribution lost by sub optimal strategy in Div X will be 68,000 =[768000 - (50000 ×14)]

Gain by transfer
= transport of 1,50,000 + savings in purchase cost (22 – 13) × 50,000
= ₹ 1,50,000 + 450,000. = ₹ 600,000.

Net gain = - 68,000 + 6,00,000 = 5,32,000.

5. (a) (i) Discuss briefly on the significance of Margin of Safety in the context of a business.

(ii) The following are the data for two business units, P and Q. You are required to find out which of the two units has a better Margin of Safety.

	Unit P (₹)	Unit Q (₹)
Sales Price per unit	**100.00**	**250.00**
Variable Cost per unit	**80.00**	**150.00**
Total Fixed Cost	**1,75,000**	**2,25,000**
Budget Sales	**1,00,000**	**2,50,000**

4+4=8

(b) Company XYZ produces two components (M and N) and is planning the allocation of its available resources for the next period.

75 units of component M and 60 units of component N are required to be produced but machine hour capacity is restricted to a total of 300 hours. Any deficit of components produced in-house can be made up by the purchase of any quantity of either component from an outside supplier.

The objective of company XYZ is to satisfy the requirement for components at minim um total cost. The following information is available concerning each component.

Cost (₹ per unit)	M	N
Direct materials	6.20	8.70
Direct Labour	5.10	7.50
Variable production overheads	1.20	1.30
Fixed production overheads	4.80	6.40
Total	17.30	23.90
Machine hours (per unit)	2.00	3.00
Price from outside supplier (₹ per unit)	18.50	25.90

Required:
For the next period:
(i) Calculate the variable costs of producing each component in – house.
(ii) Calculate the extra costs of buying-in each component
(iii) Determine which component should have production priority. Show workings clearly and justify your conclusion.
(iv) Calculate the number of units of each component that should be manufactured by company XYZ. 2+2+2+2=8

Answer:

5. (a) (i) The expression Margin of Safety (MOS) signifies the difference between actual sales and break even sales. In other words, all sales revenue above the break-even point represents the margin of safety. For example, if actual sales for the month of December 2015 are ₹ 50,00,000 and the break-even sales are ₹ 37,00,000, the difference of ₹ 12,50,000 is margin of safety. It can be expressed in percentage also.

Margin of safety is an important figure for any business because it tells management how much reduction in revenue will result in break-even. A higher MOS reduces the risk of business losses. Generally, the higher the margin of safety, the better the strength of business.

The formula or equation for arriving at MOS is stated as under:
Margin of safety = Actual or budgeted sales – Sales required to break-even

Margin of safety is also expressed in the form of ratio or percentage that is calculated by using the following formulae:

M/S = $\frac{\text{Profit}}{\text{Contribution}}$ or Sales over BEP / Total Sales.

MOS ratio = MOS/Actual or budgeted sales

MOS percentage = (MOS/Actual or budgeted sales) × 100

(ii) The following table shows calculation of margin of safety in units and rupees and the margin of safety ratio:

Particulars	Unit P	Unit Q
Sales Price p.u. (₹) (1)	100	250*
Variable Cost p.u. (₹)(2)	80	150
Contribution p.u. (₹)(3)=(1-2)	20	100
Fixed Cost (₹)(4)	175000	225000
Budgeted Sales (₹)(5)	100000	250000
Budgeted Sales in units (6) = (5/1)	1000	1000
B.E.P in units (7) = 4/3	8750	2250
Margin of Safety in units (8) = (6-7)	-7750	-1250
Margin of Safety Ratio (9) = 8/6×100	-775%	-125%

*This figure was stated as 225 in the suggested solution given, hence, the calculation stated was wrong.

(b) (i) Calculation for variable cost of producing in-house

Products	M (₹)	N (₹)
Variable Cost:		
Direct material	6.20	8.70
Direct labour	5.10	7.50
Variable production cost in-house	1.20	1.30
Total	12.50	17.50

(ii) Calculation of Extra Cost of Buying–in each component

Products	M	N
Price to be charged by outside Supplier	18.50	25.90
Variable cost of producing in-house [as per (a)]	12.50	17.50
Extra cost of buying – in	6.00	8.40

(iii) Machine hour cost per unit

Products	M	N
Machine Hours per unit	2.00	3.00
Extra cost of buying – in per unit (₹)	6.00	8.40
Extra cost of buying (per machine hour) (₹)	3.00	2.80

Priority should be given to the In-house production of component M in order to minimize the extra cost of buying-in.

(iv) Components to be manufactured by XYZ

M = 75 units (75 units × 2 hours) = 150 machine hours

N = 50 units [(300 – 150 machine hours)/3]

6. (a) An agro-based farm is planning its production for next year. The following is relating to the current year:

Products/Crops	M	N	O	P
Area occupied (acres)	125	100	150	125
Yield per acre (ton)	50	40	45	60
Selling price per ton (₹)	100	125	150	135
Variable cost per acre (₹):				
Seeds	150	125	225	200
Pesticides	75	100	150	125
Fertilizers	62.50	37.50	50	62.50
Cultivations	62.50	37.50	50	62.50
Direct wages	2,000	2,250	2,500	2,850

Fixed overhead per annum ₹ 13,44,000.

The land that is being used for the production of O and P can be used for either crop. But not for M and N. the land that is being used for the production of M and N can be used for either crop, but not for O and P. In order to provide adequate market service, the company must produce each ear at least 1,000 tons of each of M and N and 900 tons each of O and P.

Required:

(i) Determine the profit for the production mix fulfilling market commitment.

(ii) Assuming the land could be cultivated to produce any of the four products and there was no market commitment, calculate the profit amount of most profitable crop and break-even point of most profitable crop in terms of acres and sales value. **5+3=8**

(b) Nava Bharat Industries Ltd. manufactures four products (1,2,3,4) on two machines (X and Y). The time (in minutes) to process one unit of each product on each machine is shown below:

		Machine	
		X	Y
Product	1	12	26
	2	15	19
	3	18	30
	4	10	25

The profit per unit for each product (1,2,3,4) is ₹ 120, ₹ 150, ₹ 190 and ₹ 100 respectively. Product 1 must be produced on both machines X and Y but products 2, 3 and 4 can be produced on either machine.

Due to acute space constraints in the company's works, only one week's production is stored in 4,000 square feet for floor space where the floor space taken up by each product is 1.0, 1.5, 5.0 and 0.50 (square ft.) for products 1,2,3 and 4 respectively.

As per customer requirements the output of Product 2 is related with that of Product 3 and over a week approximately twice as many units of product 2 should be produced as product 3.

Machine X is out of action (for maintenance/because of breakdown) 8% of the time and machine Y 10% of the time.

Required:

Assuming a working week 42 hours, formulate the problem of how to manufacture these products as a linear programme. 8

Answer:

6. (a) (i) Profit Statement of Recommended mix:

Product	M	N	O	P
Yield per acre (tons)	50	40	45	60
Selling price per ton	100	125	150	135
Sales revenue per acre	5000	5000	6750	8100
Variable cost per acre	2350	2550	2975	3300
Contribution per acre	2650	2450	3775	4800

Rank	1	2	2	1
Minimum sales requirement in acre		25 (1000/40)	20 (900/45)	

Recommended mix in acre	200	25	20	255	
Total Contribution	530000	61250	75500	1224000	1890750
Less – Fixed cost					1344000
Profit					546750

(ii) Most profitable crop. Production should be concentrated on P which gives highest contribution per acre of ₹ 4800.

Overall contribution if complete land is used for P = (500 × 4800) = ₹ 24,00,000
Less: Fixed cost = ₹ 13,44,000
Profit = ₹ 10,56,000

Break-even point in acres for P = 1344000/48000 = 280 acres

Break-even point in sales value = 280 × 135 × 60 = ₹ 22,68,000

(b) Variables:
Essentially the company is interested in the amount produced on each machine. Hence let:

x_i = amount of product i (i = 2,3,4) produced on machine X per week
y_i = amount of product i (i = 2,3,4) produced on machine Y per week
where x_i >=0 i = 1,2,3,4 and y_i>=0 i=2,3,4

it may be stated here that as product 1 must be processed on both machines X and Y ,y_i has not been defined here.
Then objective function will be
Maximize $120x_1 + 150(x_2 + y_2)+190(x_3 + y_3)+100(x_4 + y_4)$ subject to constraints

- Floor space
  $1x_1 + 1.5(x_2 + y_2) + 5(x_3 + y_3) + 0.5(x_4 + y_4) <=4000$

- Customer requirements
  $x_2 + y_2 = 2(x_3 + y_3)$

- Available time
  $12x_1 + 15x_2 + 18x_3 + 10x_4<= 0.92(42)(60)$ (machine X)
  $26y_1 + 19y_2 + 30y_3 + 25y_4<= 0.90(42)(60)$ (machine Y)
  With non negative constraints to be inserted: X1, X2, X3, X4 and Y1, Y2, Y3, Y4 >_ 0.

7. The Following table gives data on normal time & cost and crash time & cost for a project.

Activity	Normal		Crash	
	Time (days)	Cost (₹)	Time (days)	Cost (₹)
1-2	6	600	4	1,000
1-3	4	600	2	2,000
2-4	5	500	3	1,500
2-5	3	450	1	650
3-4	6	900	4	2,000
4-6	8	800	4	3,000
5-6	4	400	2	1,000
6-7	3	450	2	800

The indirect cost per day is ₹ 100.

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

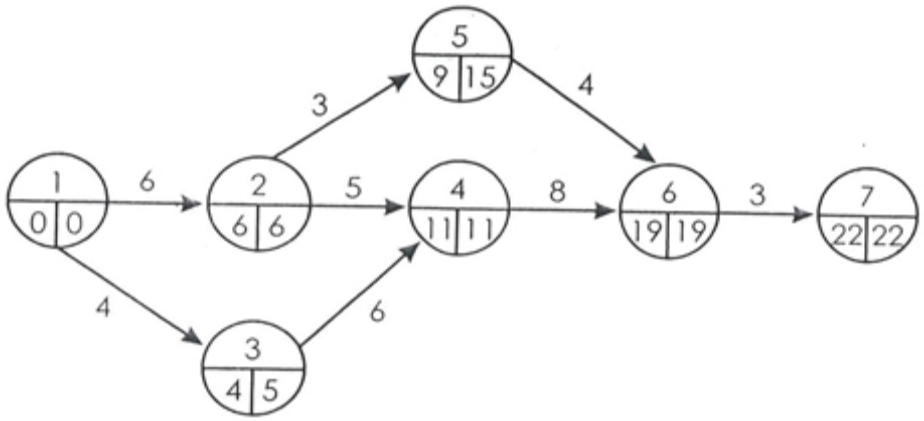
(ii) What are the normal project duration and associated cost?

(iii) Crash the relevant activities systematically and determine the optimum project completion time and cost. 4+2+10=16

Answer:

7. (i) The network for normal activity times indicates a project time of 22 weeks with the

critical path 1-2-4-6-7.



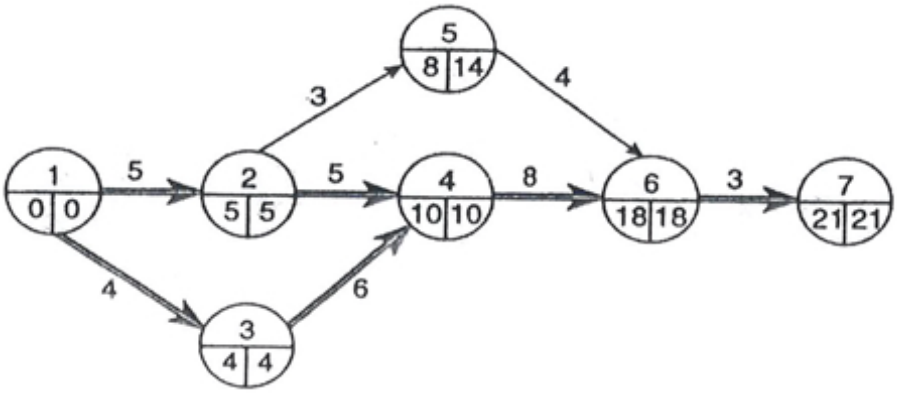
(ii) Normal project duration is 22 weeks and the associated cost is as follows: Total cost = Direct normal cost + indirect cost for 22 weeks.
= 4,700 + 100 × 22 = ₹ 6,900.

(iii) For critical activities, crash cost – slope is given below:

Critical activity	Crash cost-slop
1-2	$\frac{1000-600}{6-4} = 200$
2-4	$\frac{1500-500}{5-3} = 500$
4-6	$\frac{3000-800}{8-4} = 550$
6-7	$\frac{800-450}{3-2} = 350$

Of the activities lying on the critical path, activity 1-2 has lowest cost slope. Therefore, we shall first crash this activity by just one day.

Duration = 21 days, and cost = 4700 + 1 × 200 + 100 × 21 = ₹ 7,000.



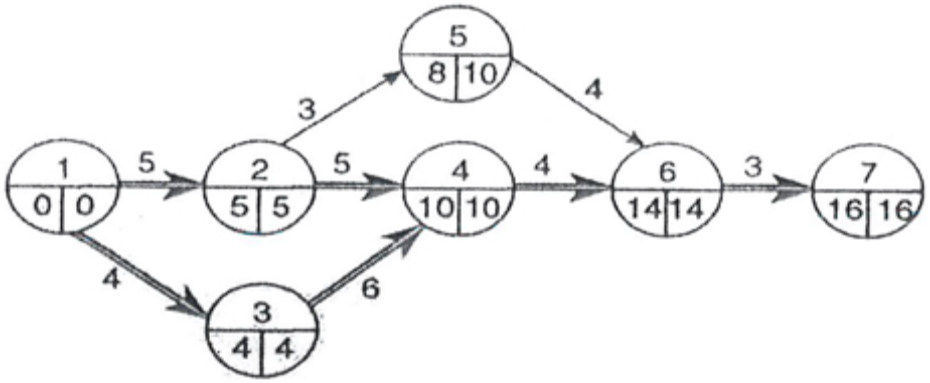
Other activities too have become critical. Now we have 2 critical paths:
1→2→4→6→7 and 1→3→4→6→7.

To reduce duration of the activity further, we shall have to reduce duration of both the paths. We have following alternatives:

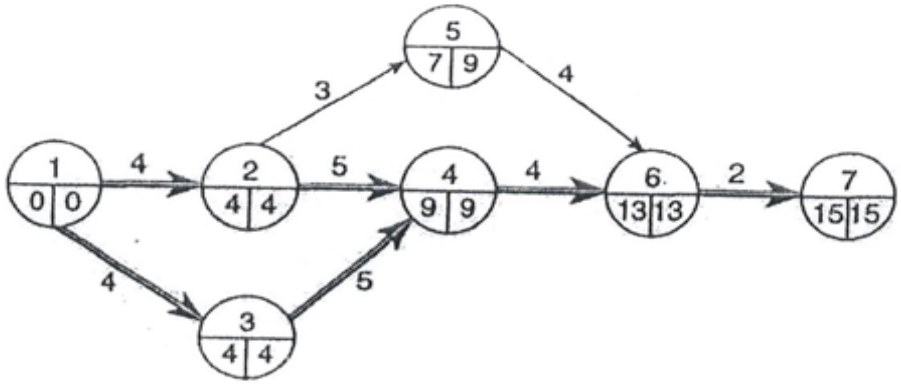
Crash activity 6 - 7 by 1 day at a cost of ₹ 350.
Crash activity 4 – 6 by 4 days at the cost of ₹ 550 per day.
Crash activities 1-2 and 1-3 by 1 day each at a cost of ₹ (200 + 700) = ₹ 900.
Crash activities 2-4 and 3-4 by 2 day each at a cost of ₹ (500+550) = ₹ 1,050/day.

Thus, we shall first crash activities 6-7 by 1 day and then activity 4-6 by 4 days.
On crashing activity 6-7 by 1 day, cost = 4900 + 350 × 1 + 100 × 20 = ₹ 7,250, and duration = 20 days. Next we crash 4-6 by 4 days.

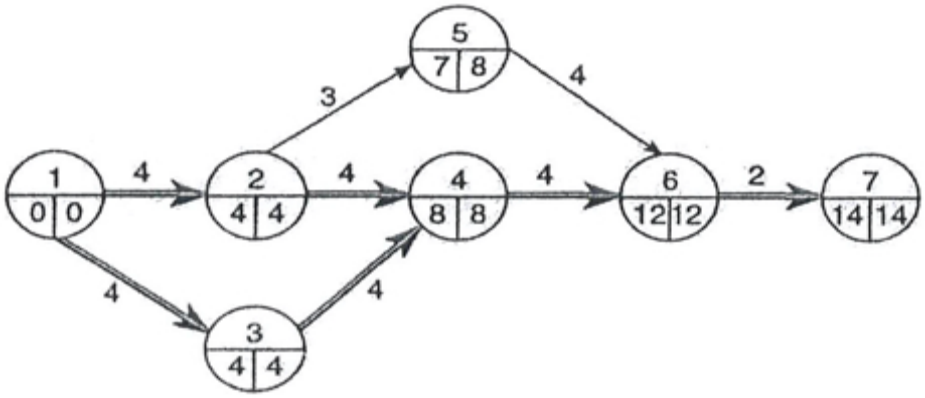
Cost = 5250 + 550 × 4 + 100 × 16 = ₹ 9,050. Duration = 16 days.



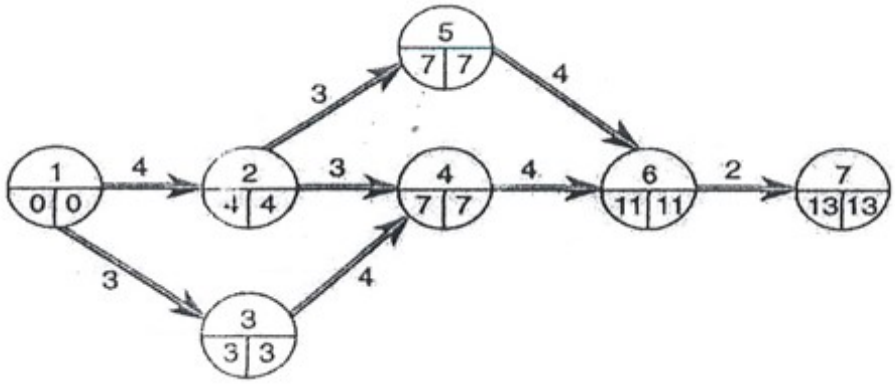
Next we crash activities 1-2 and 3-4 by 1 day each,
Cost = 7450 + 200 × 1 + 550 × 1 + 100 ×15 = ₹ 9,700.



Next we crash activities 2→4 and 3→4 by 1 day each.
Cost = 8200 + 500 × 1 + 550 × 1 + 100 × 14 = ₹ 10,650. Duration = 14 days.



We crash activities 1-3 and 2-4 by 1 day each.
Cost = 9250 + 700 × 1 + 500 × 1 + 100 × 13 = ₹ 11,750. Duration = 13 days.



Now there are three critical paths:
1-2-5-6-7, 1-2-4-6-7, 1-3-4-6-7

Also, no further crashing is possible. Hence minimum duration of the project = 13 days with cost ₹ 11,750.

8. Write short notes on any four of the following: 4x4= 16

(a) List down the situations where a product can be sold below the marginal cost.

(b) Price sensitivity

(c) Target costing

(d) Six sigma in quality control process

(e) Assignment

Answer:

8. (a) List down the situations where product can be sold below the marginal cost

1. When one has already produced and paid for the units and:
   - There is no more market for the product at any price other than the one is below the marginal cost
   - Any organization cannot keep the business open to clear the rest of the inventory because any profit you may see is not enough to cover the cost to stay open.
   - As a loss leader to attract customers that can be up sold. Works only if the customer margin - sum of contribution margins from the basket of products and services customers buy is more than other available options.

2. When one has produced each unit on demand (truly marginal):
   - Only case is as a loss leader
   - Any other reason not only generates a loss in the short term but also sets really bad reference price in the minds of customers. It is not going to be easy to improve prices when the seller gives it away at very low price.
   - The seller has to make sure that the cost is truly marginal cost and does not include overheads and COGS (Cost of Goods Sold) is not MC (Marginal Cost).

(b) Price sensitivity:

Price sensitivity is the degree to which the price of a product affects consumers'

purchasing behaviors. It may also be said that through price sensitivity analysis, any organization measure how it's demand changes with the change in the cost of it's products. Price sensitivity is commonly to measure of the change in demand based on its price change.

For example, some consumers are not willing to pay a few extra cents per gallon for gasoline, especially if a lower-priced station is nearby.

When they study and analyze price sensitivity, companies and product manufacturers can make sound decisions about products and services.

Price sensitivity can basically be defined as being the extent to which demand changes when the cost of a product or service changes. The price sensitivity of a product varies with the level of importance consumers place on price relative to other purchasing criteria. Some people may value quality over price, making them less susceptible to price sensitivity. For example, customers seeking top-quality goods are typically less price sensitive than bargain hunters, so they're willing to pay more for a high-quality product. By contrast, people who are more sensitive to price may be willing to sacrifice quality. These individuals will not spend more for something like a brand name, even if it has a higher quality over a generic store brand product.

Price sensitivity also varies from person to person, or from one consumer to the next. Some people are able and willing to pay more for goods and services than others. Companies and governments are also able to pay more compared to individuals.

Consumers are less sensitive to price when the total cost is low compared to their total income. Likewise, the total expenditure compared to the total cost of the end product affects price sensitivity.

(c) Target Costing:

Target Costing: This technique has been developed in Japan. It aims at profit planning. It is a device to continuously control costs and manage profit over a product's life cycle. In short, it is a part of a comprehensive strategic profit management system. For a decision to enter a market prices of the competitors' products are given due consideration. Target Costing initiates cost management at the earliest stages of product development and applies it throughout the product life cycle by actively involving the entire value chain. In the product concept stage selling price and required profit are set after consideration of the medium term profit plans, which links the operational strategy to the long term strategic plans.

Target Cost = Planned Selling Price - Required Profit.

From this, the necessary target cost can be arrived at. Target cost, then, becomes the residual or allowable sum. If it is thought that the product cannot generate the required profit, it will not be produced as such and aspects of the product would be redesigned until the target is met. Target profit is a commitment agreed by all the people in a firm, who have any part to play in achieving it.

(c) Six sigma in quality control process:

Six Sigma is a set of practices originally developed by Motorola to systematically improve processes by eliminating defects. A defect is defined as non-conformity of a product or service to its specifications. While the particulars of the methodology were originally formulated by Bill Smith at Motorola in 1986, Six Sigma was heavily inspired by six preceding decades of quality improvement methodologies such as quality control, TQM, and Zero Defects.

Like its predecessors, Six Sigma asserts the following:

(a) Continuous efforts to reduce variation in process outputs is key to business success
(b) Manufacturing and business processes can be measured, analyzed, improved and controlled
(c) Succeeding at achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

The term "Six Sigma" refers to the ability of highly capable processes to produce output within specification. In particular, processes that operate with six sigma quality produce at defect levels below 3.4 defects per (one) million opportunities (DPMO). Six Sigma's implicit goal is to improve all processes to that level of quality or better.

(e) Assignment:

Assignment is a special linear programming problem. There are many situations where the assignment of people or machines etc. may be called for. Assignment of workers to machines, clerks to various check-out counters, salesmen to different sales areas are typical examples of these. The Assignment is a problem because people possess varying abilities for performing different jobs and therefore the costs of performing jobs by different people are different. Thus, in an assignment problem, the question is how the assignments should be made in order that the total cost involved is minimized.

There are four methods of solving an assignment problem and they are:

(1) Complete Enumeration Method
(2) Simplex Method
(3) Transportation Method and
(4) Hungarian Method.