

PAPER – 5: ADVANCED MANAGEMENT ACCOUNTING

Question No.1 is compulsory.

Answer any five questions from the remaining six questions.

Working notes should form part of the answer.

No statistical or other table will be provided with this question paper.

Wherever necessary, candidates may make appropriate assumption & clearly state them.

Question 1

(a) *UK Ltd. prepared a draft budget for the next year as follows:*

<i>Quantity</i>	<i>10,000 units</i>	<i>₹</i>
<i>Selling price per unit</i>		<i>60</i>
<i>Variable cost per unit</i>		
- <i>Direct materials</i>		<i>16</i>
- <i>Direct labour (2 hours × ₹ 6)</i>		<i>12</i>
- <i>Variable overheads (2 hrs × ₹ 1)</i>		<i>2</i>
<i>Contribution per unit</i>		<i>30</i>
<i>Total budgeted contribution</i>		<i>3,00,000</i>
<i>Total budgeted fixed overheads</i>		<i>2,80,000</i>
<i>Total budgeted profit</i>		<i>20,000</i>

The board of directors are not satisfied with this draft budget and suggested the following changes for the better profit:

- (i) The budgeted profit is ₹ 50,000,*
- (ii) The company should spend ₹ 57,000 on advertisement and the target sales price up to ₹ 64 per unit.*
- (iii) It is expected that the sales volume will also rise, inspite of the price rise, to 12,000 units.*

In order to achieve the extra production capacity, however, the work force must be able to reduce the time taken to make each unit of the product. It is proposed to offer a pay and productivity deal in which the wages rate per hour is increased to ₹ 8. The hourly rate for variable overheads will be unaffected.

You are required to calculate the target labour time require to achieve the target profit.

(5 Marks)

(b) Supreme Prakashan Ltd. is in the business of publishing a leading newspaper which has a wide customer base. It measures quality of service in terms of

- (i) Print quality
- (ii) On time delivery
- (iii) Number of damaged and unsold paper

To improve its business prospects and performance, the company is considering installing a scheduling and tracking system which involve an annual additional cost of ₹ 3,00,000 beside equipments costing ₹ 4,00,000 needed for the installation of system.

To purchase the equipment, company is planning to utilise the proceeds of an investment fetching an annual income @ of 9%.

Details regarding the present and future performance are given as under-

	Present	Expected
On-time delivery	85%	97%
Variable cost per lost of newspaper damaged and unsold	₹ 40	₹ 40
Fixed cost	50,000	50,000
No. of lots of newspaper damaged and unsold	6,000	1,000

It is expected that each percentage increase in on time performance will result in revenue increase of ₹ 36,000 per annum. Required contribution margin is 40%.

Should Supreme Prakashan Ltd. install the new system? (5 Marks)

(c) A company is considering three alternative proposals for conveyance facilities for its sales personnel who have to do considerable travelling, approximately 20,000 kilometres every year. The proposals are as follows:

- (i) Purchase and maintain its own fleet of cars. The average cost of a car is ₹ 1,00,000.
- (ii) Allow the Executive to use his own car and reimburse expenses at the rate of ₹ 1.60 per kilometre and also bear insurance costs.
- (iii) Hire cars from an agency at ₹ 20,000 per year per car. The company will have to bear costs of petrol, taxes and tyres.

The following further details are available:

Petrol.....	₹ 0.60 per km
Repairs and maintenance.....	₹ 0.20 per km
Tyres.....	₹ 0.12 per km
Insurance.....	₹ 1,200 per car per annum
Taxes.....	₹ 800 per car per annum

Life of the car..... 5 years with annual mileage of 20,000 kms

Resale value..... ₹ 20,000 at the end of the fifth year

Work out the relevant costs of three proposals and rank them. (5 Marks)

- (d) The cost per unit of transporting goods from the factories X, Y and Z to destination A, B, C and D and the quantities demanded and supplied are given:

Factories	Destinations				Supply
	A	B	C	D	
X	25	50	20	25	100
Y	30	40	35	10	250
Z	20	10	25	35	200
Demand	250	100	150	50	550

Answer the following question with reasons taking u_3 as zero while calculating u_i & v_j :

- (i) Is this solution is optimum?
 (ii) If yes, can there be any alternate optimum solution? (5 Marks)

Answer

- (a) Statement Showing 'Target Cost of Direct Labour & Variable Overheads'

Particulars	Amount (₹)
Expected Sales (₹ 64 × 12,000 units)	7,68,000
Less: Direct Material (₹ 16 × 12,000 units)	1,92,000
Advertisement Expenses	57,000
Fixed Overheads	2,80,000
Target Profit	50,000
Target Cost of Direct Labour and Variable Overheads	1,89,000

Target Labour Time Required to achieve Target Profit

$$\begin{aligned}
 &= \frac{\text{Target Cost of Direct Labour and Variable Overheads}}{\text{WagesRate} + \text{Variable OverheadRate}} \\
 &= \frac{\text{₹ 1,89,000}}{\text{₹ 8} + \text{₹ 1}} \\
 &= 21,000 \text{ hrs.}
 \end{aligned}$$

(b) Should Supreme Prakashan Ltd. Install the New System?

₹	
Additional Costs of the New Scheduling & Tracking System p.a.	3,00,000
Equipment - Opportunity Cost (₹4,00,000 × 9%)	36,000
...(A)	3,36,000
Contribution from Additional Annual Revenue (40% × ₹ 4,32,000*)	1,72,800
Cost Saving in respect of Lots of Newspapers [(6,000 - 1,000) × ₹ 40]	2,00,000
...(B)	3,72,800
Net Benefits	...(B) - (A) 36,800

(*) [₹ 36,000 × 12% / 1%]

By installing the scheduling and tracking system, the company will be able to save ₹ 36,800 per annum. Hence, the company should install the new system.

(c) Statement Showing 'Evaluation of Three Proposals'

Particulars	Proposal-I Own Fleet of Cars (₹)	Proposal-II Reimbursement (₹)	Proposal- III Hire Cars (₹)
Hire Charges	---	---	1.00 $\left(\frac{₹ 20,000}{20,000\text{km}} \right)$
Reimbursement	---	1.60	---
Petrol Expenses	0.60	---	0.60
Repairs & Maintenance	0.20	---	---
Tyres	0.12	---	0.12
Insurance	0.06 $\left(\frac{₹ 1,200}{20,000\text{km}} \right)$	0.06 $\left(\frac{₹ 1,200}{20,000\text{km}} \right)$	---
Taxes	0.04 $\left(\frac{₹ 800}{20,000\text{km}} \right)$	---	0.04 $\left(\frac{₹ 800}{20,000\text{km}} \right)$
Depreciation	0.80 $\left(\frac{₹ 1,00,000 - ₹ 20,000}{5\text{yrs.} \times 20,000\text{km}} \right)$	---	---
Total Cost/ km	1.82	1.66	1.76
Rank	III	I	II



This Question can also be solved by on the basis of 'Total Cost' approach.

(d) Working

The given problem is a balanced minimization transportation problem. The objective of the company is to minimize the cost. Let us find the initial feasible solution using Vogel's Approximation method (VAM).

	A	B	C	D	Supply	Diff.
X	25	50	20	25	100/0	5 5 5 5
Y	30	40	35	10	250/200/0	20 20 5 5
Z	20	10	25	35	200/100/0	10 5 5 -
Demand	250/150/0	100/0	150/50/0	50/0	550	
Diff.	5	30	5	15		
	5	-	5	15		
	5	-	5	-		
	5	-	15	-		

Since the number of allocations $m+n-1 (= 6)$, let us test the above solution for *optimality*.

We have taken $u_3 = 0$ (as stated in question), and rest of the u_i 's, v_j 's and Δ_{ij} 's are calculated as below-

$(u_i + v_j)$ Matrix for Allocated / Unallocated Cells

					u_i
	15	5	20	-5	-5
	30	20	35	10	10
	20	10	25	0	0
v_j	20	10	25	0	

Now we calculate $\Delta_{ij} = C_{ij} - (u_i + v_j)$ for non basic/ unallocated cells which are given in the table below-

Δ_{ij} Matrix

10	45		30
	20		
		0	35

Answer to the Requirement

- (i) Since, all cells values in $\Delta_{ij} = C_{ij} - (u_i + v_j)$ matrix are non- negative, hence the solution is *optimum*.
- (ii) It may be noted that zero opportunity cost in cell (Z, C) indicates a case of *alternative optimum solution*.



This question can also be solved by using other methods of finding initial basic feasible solution.

Question 2

- (a) A company produces and sells a single product. The cost data per unit for the year 2017 is predicted as below:

	₹ per unit
Direct material	35
Direct labour	25
Variable overheads	15
Selling price	90

The company has forecast that demand for the product during the year 2017 will be 28,000 units. However to satisfy this level of demand, production quantity will be increased?

There are no opening stock and closing stock of the product.

The stock level of material remains unchanged throughout the period.

The following additional information regarding costs and revenue are given:

- 12.5% of the items delivered to customers will be rejected due to specification failure and will require free replacement. The cost of delivering the replacement item is ₹ 5 per unit.
- 20% of the items produced will be discovered faulty at the inspection stage before they are delivered to customers.
- 10% of the direct material will be scrapped due to damage while in storage.

Due to above, total quality costs for the year is expected to be ₹ 10,75,556.

The company is now considering the following proposal:

1. To introduce training programmes for the workers which, the management of the company believes, will reduce the level of faulty production to 10%. This training programme will cost ₹ 4,50,000 per annum.
2. To avail the services of quality control consultant at an annual charges of ₹ 50,000 which would reduce the percentage of faulty items delivered to customers to 9.5%.

You are required to:

- (i) Prepare a statement of expected quality costs the company would incur if it accepts the proposal. Costs are to be calculated using the four recognised quality costs heads.
- (ii) Would you recommend the proposal? Give financial and non-financial reasons.

(8 Marks)

- (b) A company manufactures a product Y in addition to other products by using the same machines in department A and department B.

The usage details are:

Per Unit of Product Y	Department A		Department B	
	Usage	Rate	Usage	Rate
Direct Material	8 kg	₹ 4	4 kg	₹ 6
Direct Labour	2 hours	₹ 14	3 hours	₹ 12

Basis of overhead recovery are given below:

	Deptt. A per rupee of direct material ₹	Deptt. B per direct labour hour ₹
Variable overheads	0.80	2.00
Fixed overheads	2.20	3.00

Other Details are:

Value of Plant & Machinery in department A is ₹ 22 Lacs and in department B is ₹ 18 Lacs.

The Working Capital requirement of Product Y based on a target volume of output of 2,000 units per month is estimated at ₹ 2,72,800 per annum which is 40% of the potential capacity.

Required:

- (i) Calculate the selling price of Product Y to ensure contribution equivalent to 25% of investment made.
- (ii) If Product Y is a new product about to be launched in the market, on what basis should the price be fixed and what would be the minimum price?
- (iii) If Product Y is a well established product, what should be the basis for price fixing and what would be the minimum price? (8 Marks)

Answer

(a) (i)

Statement Showing 'Expected Quality Costs'

Particulars	Current Situation (₹)	Proposed Situation (₹)
Prevention Costs	---	4,50,000
Appraisal Costs	---	50,000
External Failure Costs	3,20,000	2,35,120
Internal Failure Costs	7,55,556	3,91,538
Total Quality Costs	10,75,556	11,26,658

Workings

External Failure Cost

Particulars	Current Situation	Proposed Situation
Customer's Demand ... (A)	28,000 units	28,000 units
Number of units Dispatched to Customers... (B) $\left(\frac{28,000 \text{ units}}{87.5\%}\right); \left(\frac{28,000 \text{ units}}{90.5\%}\right)$	32,000 units	30,939 units
Number of units Replaced ... (B) – (A)	4,000 units	2,939 units
External Failure Cost {4,000 units × ₹ (35+25+15+5)}; {2,939 units × ₹ (35+25+15+5)}	₹ 3,20,000	₹ 2,35,120

Internal Failure Cost

Particulars	Current Situation	Proposed Situation
Number of units Dispatched to Customers ... (A)	32,000 units	30,939 units
Number of units Produced & Rejected ... (B) $\left(\frac{32,000 \text{ units}}{80\%}\right); \left(\frac{30,939 \text{ units}}{90\%}\right)$	40,000 units	34,377 units
Number of units Discovered Faulty ... (B) – (A)	8,000 units	3,438 units
Cost of Faulty Production ... (D) {8,000 units × ₹ (35+25+15)}; {3,438 units × ₹ (35+25+15)}	₹ 6,00,000	₹ 2,57,850
Material Scrapped $\left(\frac{40,000 \text{ units}}{90\%} \times 10\%\right); \left(\frac{34,377 \text{ units}}{90\%} \times 10\%\right)$	4,444.44 units	3,819.67 units
Cost of Material Scrapped ... (E) {4,444.44 units × ₹ 35}; {3,819.67 units × ₹ 35}	₹ 1,55,556	₹ 1,33,688
Internal Failure Cost ... (D)+(E)	₹ 7,55,556	₹ 3,91,538

(ii) Recommendation

On purely *financial grounds* the company should not accept the proposal because there is an increase of ₹ 51,102 in quality costs. However there may be *other factors* to consider as the company may enhance its reputation as a company that cares about quality products and this may increase the company's market share.

On balance the company should accept the proposal to improve its *long-term* performance.

(b) (i) Workings

Statement Showing 'Computation of Variable Cost'

		Dept. A	Dept. B	Total (₹)
Direct Material	Dept. A (8 kg × ₹ 4)	32.00	---	
	Dept. B (4 kg × ₹ 6)	---	24.00	56.00
Direct Labour	Dept. A (2 hrs × ₹14)	28.00	---	
	Dept. B (3 hrs × ₹12)	---	36.00	64.00
Variable Overhead	Dept. A (0.80 × ₹32)	25.60	---	
	Dept. B (3 hrs × ₹2)	---	6.00	31.60
Total Variable Cost per unit				151.60

Statement Showing 'Desired Contribution on Investment (Department A)'

(₹)

Investment in Plant & Machinery		22,00,000
Desired Contribution (25% of investment) ... (A)		5,50,000
Material Required (2,000 units × 8kg. × ₹ 4)		64,000
Material Required at 100% Capacity <i>p.m.</i> $\left(\frac{64,000}{40\%}\right)$		1,60,000
Material Required at 100% Capacity <i>p.a.</i> (₹ 1,60,000 × 12) ... (B)		19,20,000
Contribution <i>per rupee of material</i> ... (A)/(B)		0.2865

Statement Showing 'Desired Contribution on Investment (Department B)'

Investment in Plant & Machinery		₹ 18,00,000
Desired Contribution (25% of investment) ... (A)		₹ 4,50,000
Hours Required (2,000 units × 3hrs)		6,000 hrs.
Total Capacity <i>p.m.</i> $\left(\frac{6,000 \text{ hrs.}}{40\%}\right)$		15,000 hrs.
Total Capacity <i>p.a.</i> (15,000 hrs. × 12) ... (B)		1,80,000 hrs.
Contribution <i>per hour</i> ... (A)/(B)		₹ 2.50

Statement Showing 'Desired Contribution on Working Capital'

Return on Working Capital (₹ 2,72,800 × 25%) ... (A)		₹ 68,200
Target Volume of Output <i>p.a.</i> (₹ 2,000 units × 12) ... (B)		24,000 units
Contribution <i>per unit</i> ... (A)/(B)		₹ 2.8417

Statement Showing 'Desired Contribution'

Particulars	₹
Capital Investment	
Dept. A (₹ 0.2865 × ₹ 32)	9.17
Dept. B (₹ 2.50 × 3 hrs.)	7.50
Working Capital	2.84
Contribution <i>per unit</i>	19.51

Price of Product is ₹ 171.11 per unit.

[Variable Cost (₹ 151.60) + Contribution Required (₹ 19.51)]

- (ii) If the Product Y is a new product about to be launched in the market, the strategy should be to *penetrate the market* by adopting 'Penetration Pricing' which could be as below as to recover 'Variable Cost' for the product which is ₹ 151.60.
- (iii) If the Product Y is a well-established product, the company may be able to sell the product at Price which also *recover* Fixed Cost apart from Variable Cost. Hence, the minimum price would be Total Cost of the Product i.e. ₹231/-

Variable Cost ₹ 151.60
 Fixed Cost*..... ₹ 79.40
 Total Price..... ₹ 231.00

(*)

		(₹)		
		Dept. A	Dept. B	Total
Fixed Overhead	Dept. A (2.20 × ₹32)	70.40	---	79.40
	Dept. B (3 hrs × ₹3)	---	9.00	

Note

Fixed Charges Recovery is based on usage. Full Capacity is not being used by Product Y and Departments are also producing other Products using same Plant and Machinery.

Question 3

- (a) Division X and Y are two divisions of XY Ltd., which operates as profit centres. Division X makes and sells product X. The budgeted Income statement of Division X, based on a sales volume of 30,000 units, is given below:

Budgeted Income Statement of Division X

Particulars	₹ In '000
Sales Revenue	6,000
Component purchase costs	1,050
Other variable costs	1,680
Fixed costs	480
Variable marketing costs	270
Fixed marketing overheads	855
Operating profit	1,665

The manager of Division X suggests that sales can be increased by 9,600 units, if the selling price is reduced by ₹ 20 per unit from the present price of ₹ 200 per unit and that for this additional volume, no additional fixed costs will be incurred.

Division Y makes a component Y which is sold outside at a price of ₹ 50 per unit.

Division X presently uses a component which is purchased from outside at ₹ 35 per unit. This component is similar to component made by Division Y. Division Y can make this component for Division X with a minor modification in specification which would cause reduction in direct material cost for the Division Y by ₹ 1.5 per unit and would require extra labour hour of 1 per unit at the rate of ₹ 1.5 per hour.

Further the Division Y will not incur variable selling marketing cost on units transferred to the Division X. Division X's manager has offered to buy the component from Division Y at ₹ 25.00 per unit. Division Y has the capacity to produce 85,000 units.

The current budgeted information of Division Y are as follows:

Number of units sold outside 60,000 units @ ₹ 50 per unit, variable cost including material and labour ₹ 15 per unit, variable marketing cost ₹ 3 per unit, operating profit ₹ 12,00,000 and fixed overheads ₹ 7,20,000.

Advise

- (i) Should the Division X reduce the selling price by ₹ 20 per unit even if it is not able to procure the component from Division Y at ₹ 25 per unit?
- (ii) Should the Division Y be willing to supply 39,600 units to Division X at ₹ 25 per unit?

Support each of your conclusions with appropriate calculations.

(8 Marks)

- (b) A company is engaged in manufacturing two products M and N. Product M uses one unit of component P and two units of component Q. Product N uses two units of component P, one unit of component Q and two units of component R. Component R which is assembled in the factory uses one unit of component Q. Components P and Q are purchased from the market. The company has prepared the following forecast of sales and inventory for the next year:

	Product M	Product N
Sales (in units)	80,000	1,50,000
At the end of the year	10,000	20,000
At the beginning of the year	30,000	50,000

The production of both the products and the assembling of the component R will be spread out uniformly throughout the year. The company at present orders its inventory of P and Q in quantities equivalent to 3 months production. The company has compiled the following data related to two components:

	P	Q
Price per unit (₹)	20	8
Order placing cost per order (₹)	1,500	1,500
Carrying cost per annum	20%	20%

Required:

- (i) Prepare a Budget of production and requirements of components for next year.
(ii) Suggest the optimal order quantity of components P and Q. (8 Marks)

Answer

- (a) (i) Should the Division X reduce the selling price by ₹ 20 per unit...?

Statement Showing 'Impact of Selling Price Reduction'

Particulars	₹
Incremental Revenue	
Additional Sales Revenue (9,600 units × ₹ 180)	17,28,000
Loss of Revenue (30,000 units × ₹ 20)	(6,00,000)
Total (A)	11,28,000
Incremental Cost	
Component Purchase Costs (9,600 units × ₹ 35)	3,36,000
Other Variable Costs $\left(\frac{9,600 \text{ units} \times ₹ 16,80,000}{30,000 \text{ units}} \right)$	5,37,600
Variable Marketing Costs $\left(\frac{9,600 \text{ units} \times ₹ 2,70,000}{30,000 \text{ units}} \right)$	86,400
Total (B)	9,60,000
Savings/ (Loss)	...(A) – (B) 1,68,000

Advice

Above *incremental analysis* clearly indicates that the reduction of Selling Price by ₹ 20 per unit shall be accepted as it increases the Profit of the concern by ₹ 1,68,000.

- (ii) Should the Division Y be willing to supply 39,600 units to Division X...?

Statement Showing 'Minimum Average Transfer Price' per component (39,600)

Particulars	₹
Variable Cost	15.00
Loss of Contribution* [14,600 units × (₹ 50 - ₹ 15 - ₹ 3)/ 39,600 units]	11.80
Transfer Price	26.80

- (*) Division Y has surplus capacity to the extent of 25,000 units, for additional 14,600 units the Transfer Price must consider the Division Y's Variable Costs of Manufacturing the Component *plus* the Lost Contribution Margin (that will result from *losing outside sales*).

Company's Perspective

Particulars	₹
Market Price <i>per component</i>	35.00
Relevant Cost for Transfer <i>per component</i> (from above)	26.80
Saving <i>per component</i>	8.20
Units	39,600
Total Savings	3,24,720

Advice

It is not in the interest of the Division Y to transfer 39,600 units to Division X at Price below the Minimum Average Transfer Price based on Opportunity Cost. However, from the Concern's Perspective, internal transfer between Divisions is beneficial as each unit to be transferred is offering a saving of ₹ 8.20.

(b) (i) Production Budget for Products / Budgeted Requirements of Components

Production Budget for Product M & N

Particulars	'M' Units	'N' Units
Inventory at the end of the year	10,000	20,000
Sales Forecast	80,000	1,50,000
Total Requirements	90,000	1,70,000
Less: Beginning Inventory	30,000	50,000
Production	60,000	1,20,000

Budgeted Requirements of Components 'P', 'Q' and 'R'

Components	'P'	'Q'	'R'
For Product 'M': Production 60,000 units			
'P': 60,000 × 1 per unit	60,000	---	---
'Q': 60,000 × 2 per unit	---	1,20,000	---
For Product 'N': Production 1,20,000 units			
'P': 1,20,000 × 2 per unit	2,40,000	---	---
'Q': 1,20,000 × 1 per unit	---	1,20,000	---
'R': 1,20,000 × 2 per unit	---	---	2,40,000
For comp 'R': Production 2,40,000 comp			
'Q': 2,40,000 × 1 per component 'R'	---	2,40,000	---
Total Requirements	3,00,000	4,80,000	

(ii) Optimum Order Quantity

‘P’		‘Q’
$EOQ \sqrt{\frac{2 \times 3,00,000 \times 1,500}{20 \times 20\%}}$		$\sqrt{\frac{2 \times 4,80,000 \times 1,500}{8 \times 20\%}}$
= 15,000 components		= 30,000 components

Question 4

- (a) A company operates a standard cost system to control the variable works cost of its only product. The following are the details of actual production, costs and variances for November, 2015.

Production and cost (actual)

Production.....	10,000 units
Direct Materials (1,05,000 kg.).....	₹ 5,20,000
Direct Labour (19,500 hrs.).....	₹ 3,08,000
Variable Overheads.....	₹ 4,10,000

Cost variances

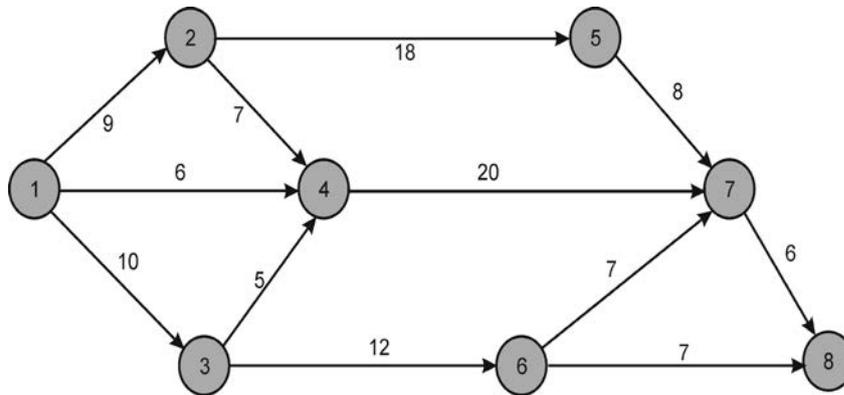
Direct materials – Price.....	₹ 5,000 (F)
Direct materials – Usages.....	₹ 25,000 (A)
Direct labour – Rate.....	₹ 15,500(A)
Direct labour – Efficiency.....	₹ 7,500 (F)
Variable overheads.....	₹ 10,000 (A)

The Cost Accountant finds that the original standard cost data for the product is missing from the cost department files. The variance analysis for December, 2015 is held up for want of this data.

You are required to calculate:

- (i) Standard price per kg. of direct material.
 - (ii) Standard quantity for each unit of output.
 - (iii) Standard rate of direct labour hour.
 - (iv) Standard time for actual production.
 - (v) Standard variable overhead rate. (8 Marks)
- (b) After 15 days of working the following progress is noted for the network of an erection job:
- (i) Activity 1–2, 1–3, and 1–4 completed as per original schedule.

- (ii) Activity 2–4 is in progress and will be completed in 3 more days.
 (iii) Activity 3–6 is in progress and will need 18 days more for completion.
 (iv) Activity 6–7 appears to present some problem and its new estimated time of completion is 12 days.
 (v) Activity 6–8 can be completed in 5 days instead of originally planned for 7 days.



You are required to:

- (i) Updated the above diagram after 15 days of the start of work based on the assumption given above.
 (ii) Write down the critical path with total project duration (8 Marks)

Answer

(a) (i) Standard Price per Kg. of Direct Material

$$\begin{aligned} \text{Material Price Variance} &= \text{Standard Cost of Actual Quantity} - \text{Actual Cost} \\ \Rightarrow 5,000 \text{ (F)} &= \text{Standard Cost of Actual Quantity} - ₹ 5,20,000 \end{aligned}$$

$$\begin{aligned} \text{Standard Cost of Actual Quantity} &= ₹ 5,20,000 + ₹ 5,000 \\ &= ₹ 5,25,000 \end{aligned}$$

$$\begin{aligned} \text{Standard Cost of Actual Quantity} &= \text{Standard Price per Kg.} \times \text{Actual Quantity} \\ \Rightarrow ₹ 5,25,000 &= \text{Standard Price per Kg.} \times 1,05,000 \text{ Kg.} \end{aligned}$$

$$\begin{aligned} \text{Standard Price per Kg.} &= \left(\frac{₹ 5,25,000}{1,05,000 \text{ Kg.}} \right) \\ &= ₹ 5 \end{aligned}$$

(ii) Standard Quantity for each unit of output

Material Usage Variance = Standard Cost of Standard Quantity for Actual Output – Standard Cost of Actual Quantity

⇒ 25,000 (A) = Standard Cost of Standard Quantity for Actual Output – ₹ 5,25,000

Standard Cost of Standard Quantity for Actual Output
= ₹ 5,25,000 – ₹ 25,000
= ₹ 5,00,000

Standard Cost of Standard Quantity for Actual Output
= Standard Price per Kg. × Standard Quantity for Actual Output

⇒ ₹ 5,00,000 = ₹ 5 × Standard Quantity for Actual Output

Standard Quantity for Actual Output
= $\left(\frac{₹ 5,00,000}{₹ 5} \right)$
= 1,00,000 Kg.

Standard Quantity for each unit of output
= $\left(\frac{1,00,000 \text{ Kg.}}{10,000 \text{ units}} \right)$
= 10 Kg.

(iii) Standard Rate of Direct Labour Hour

Direct Labour Rate Variance = Standard Cost of Actual Time – Actual Cost

⇒ 15,500 (A) = Standard Cost of Actual Time – ₹ 3,08,000

Standard Cost of Actual Time
= ₹ 3,08,000 – ₹ 15,500
= ₹ 2,92,500

Standard Cost of Actual Time
= Standard Rate per hr. × Actual Hours
⇒ ₹ 2,92,500 = Standard Rate per hr. × 19,500 hrs.

Standard Rate per hr. = $\left(\frac{₹ 2,92,500}{19,500 \text{ hrs.}} \right) = ₹ 15$

(iv) Standard Time for Actual Production

Labour Efficiency Variance = Standard Cost of Standard Time for Actual Production – Standard Cost of Actual Time

⇒ 7,500 (F) = Standard Cost of Standard Time for Actual Production – ₹ 2,92,500

Standard Cost of Standard Time for Actual Production
 = ₹ 2,92,500 + ₹ 7,500
 = ₹ 3,00,000

Standard Cost of Standard Time for Actual Production
 = Standard Rate per hr. × Standard Time for Actual Production
 ⇒ ₹ 3,00,000 = ₹ 15 × Standard Time for Actual Production

Standard Time for Actual Production
 = $\left(\frac{₹ 3,00,000}{₹ 15} \right)$
 = 20,000 hrs

(v) Standard Variable Overhead Rate

Variable Overhead Variance = Standard Variable Overheads for Production – Actual Variable Overheads

⇒ 10,000 (A) = Standard Variable Overheads for Production – ₹ 4,10,000

Standard Variable Overheads for Production
 = ₹ 4,10,000 – ₹ 10,000
 = ₹ 4,00,000

Standard Variable Overheads for Production
 = Standard Variable Overhead Rate per Unit × Actual Production (Units)
 ⇒ ₹ 4,00,000 = Standard Variable Overhead Rate per Unit × 10,000 units

Standard Variable Overhead Rate *per unit*
 = $\left(\frac{₹ 4,00,000}{10,000 \text{ units}} \right)$
 = ₹ 40

Or

Standard Variable Overheads for Production

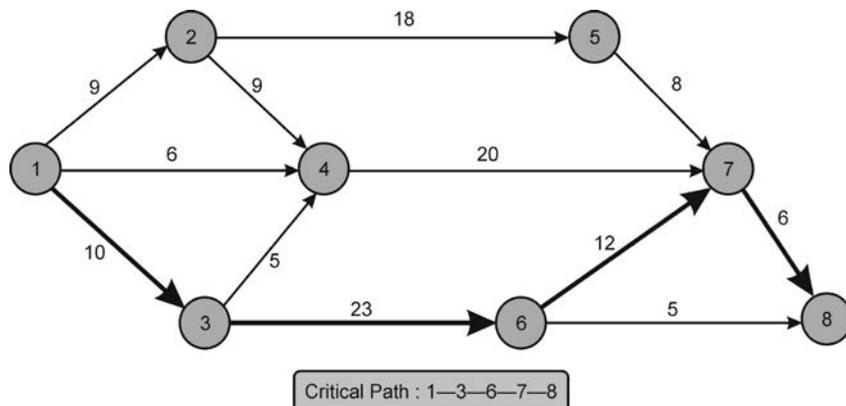
$$\begin{aligned} &= \text{Standard Variable Overhead Rate per Hour} \times \text{Standard Hours for Actual Production} \\ \Rightarrow \text{₹ } 4,00,000 &= \text{Standard Variable Overhead Rate per Hour} \times 20,000 \text{ hrs} \end{aligned}$$

Standard Variable Overhead Rate *per hour*

$$\begin{aligned} &= \left(\frac{\text{₹ } 4,00,000}{20,000 \text{ hrs}} \right) \\ &= \text{₹ } 20 \end{aligned}$$

- (b) (i) The new formulation of the problem is as follows:
- Activities 1–2, 1–3 and 1–4 completed in 9 Days, 10 Days and 6 Days respectively as per Original Schedule.
 - Activity 2–4 needs 9 Days (15 + 3 – 9) instead of Original Schedule of 7 Days.
 - Activity 3–6 needs 23 Days (15 + 18 – 10) instead of Original Schedule of 12 Days.
 - Activity 6–7 needs higher duration of 12 Days instead of Original Planned 7 Days.
 - Activity 6–8 needs lesser duration of 5 Days instead of Original Planned 7 Days.
 - Activities 2–5, 3–4, 4–7, 5–7, 7–8 need 18 Days, 5 Days, 20 Days, 8 Days, 6 Days respectively as per Original Schedule.

The updated network based on the above listed activities will be as follows:



(ii) Various Paths with Duration of *updated network* are as follows:

Path	Duration (Days)
1-2-5-7-8	41 (9 + 18 + 8 + 6)
1-2-4-7-8	44 (9 + 9 + 20 + 6)
1-4-7-8	32 (6 + 20 + 6)
1-3-4-7-8	41 (10 + 5 + 20 + 6)
1-3-6-7-8	51 (10 + 23 + 12 + 6)
1-3-6-8	38 (10 + 23 + 5)

Critical Path is 1-3-6-7-8 with

Duration of 51 Days.

Question 5

(a) MP Ltd. has developed a special product. Details are as follows:

The product will have a life cycle of 5,000 units. It is estimated that market can absorb first 4,500 units at ₹ 64 per unit and then the product will enter the "decline" stage of its life cycle.

The company estimates the following cost structure:

Direct Labour..... ₹ 6 per hour

Other variable costs..... ₹ 19 per unit

Fixed costs will be ₹ 40,000 over the life cycle of the product. The labour rate and both of these costs will not change throughout the product's life cycle.

The first batch of 100 units will take 1,000 labour hours to produce. There will be an 80% learning curve that will continue until 2,500 units have been produced. Batches after this level will each take the same amount of time as the 25th batch. The batch size will always be 100 units.

Calculate:

- (i) The cumulative average time per batch for the first 25 batches.
- (ii) The time taken for the 25th batch if average time for 24 batches is 359.40 hours.

(iii) The average selling price of the final 500 units that will allow the company to earn a total profit of ₹ 80,000 from the product.

(Note: Learning coefficient is –0.322 for learning rate of 80%).

The values of Logs have been given for calculation purpose:

$\log 2 = 0.30103$, $\log 3 = 0.47712$, $\log 5 = 0.69897$, antilog of 2.534678 = 342.51, antilog of 2.549863 = 354.70, antilog of 2.555572 = 359.40, antilog of 2.567698 = 369.57 (8 Marks)

(b) XY Ltd. is manufacturing a consumer product and doing marketing through 200 depots all over the country. The company is considering closing down the depots and resorting to dealership arrangements. The total turnover of the company is ₹ 160 crores per annum. The following information is given for each depot.

	₹ in lakhs
Annual turnover.....	80.00
Average inventory.....	16.00
Administrative expenses per annum.....	1.60
Staff salary per annum.....	2.88

The inventory carrying cost is 16% p.a. which is also the interest rate prevailing in the market for working capital finance. The other fixed cost per annum is ₹ 16 crores. Marketing through dealers would involve engaging dealers for each area. The dealers will assure minimum sales for each area. This would result in increasing the capacity utilization from 80% to 100%. At present the company's P/V ratio is 20%. Marketing through dealers would involve payment of commission of 8% on sales. Half of the existing depot staff will have to be absorbed in the company. The dealer will deposit ₹ 3.20 crores with company on which interest at 12% p.a. will be paid.

You are required to work out the impact on profitability of the company by accepting the proposal. (8 Marks)

Answer

(a) (i) The cumulative average time *per batch* for the first 25 batches

The usual learning curve model is

$$y = ax^b$$

Where

- y = Average time per batch (hours) for x batches
- a = Time required for first batch (hours)
- x = Cumulative number of batches produced
- b = Learning coefficient

The Cumulative Average Time *per batch* for the first 25 batches

$$\begin{aligned}
 y &= 1,000 \times (25)^{-0.322} \\
 \log y &= \log 1,000 - 0.322 \times \log 25 \\
 \log y &= \log 1,000 - 0.322 \times \log (5 \times 5) \\
 \log y &= \log 1,000 - 0.322 \times [2 \times \log 5] \\
 \log y &= 3 - 0.322 \times [2 \times 0.69897] \\
 \log y &= 2.549863 \\
 y &= \text{antilog of } 2.549863 \\
 y &= 354.70 \text{ hours}
 \end{aligned}$$

(ii) The time taken for the 25th batch

$$\begin{aligned}
 \text{Total Time for first 25 batches} &= 354.70 \text{ hours} \times 25 \text{ batches} \\
 &= 8,867.50 \text{ hours}
 \end{aligned}$$

$$\text{Total Time for first 24 batches} = 359.40 \text{ hours} \times 24 \text{ batches} = 8,625.60 \text{ hours}$$

$$\begin{aligned}
 \text{Time taken for 25th batch} &= 8,867.50 \text{ hours} - 8,625.60 \text{ hours} \\
 &= 241.90 \text{ hours}
 \end{aligned}$$

(iii) Average 'Selling Price' of the final 500 units

Particulars	Amount (₹)
Direct Labour [(8,867.50 hrs. + 241.90 hrs. × 25 batches) × ₹ 6]	89,490
Add: Other Variable Costs (5,000 units × ₹ 19)	95,000
Add: Fixed Costs	40,000
Total Life Cycle Cost	2,24,490
Add: Desired Profit	80,000
Expected Sales Value	3,04,490
Less: Sales Value (4,500 units × ₹ 64)	2,88,000
Sales Value (Decline Stage) ... (A)	16,490
Sales Units (Decline Stage) ... (B)	500
Average Sales Price <i>per unit</i> ... (A)/(B)	32.98

(b) Comparative Profit Statement 'Existing Vs Proposed Situation'

(₹ In Crores)

	Existing	Proposed
Sales	160.00	200.00
Less: Variable Cost (80% of Sales)	128.00	160.00

Contribution	32.00	40.00
Less: Administration Expenses ($\text{₹}0.016 \times 200$ Depots)	3.20	---
Staff Salaries ($\text{₹}0.0288 \times 200$ Depots)	5.76	2.88
Inventory Carrying Cost ($\text{₹} 0.16 \times 200$ Depots $\times 16\%$)	5.12	---
Other Fixed Costs	16.00	16.00
Commission on Sales (@8%)	---	16.00
Profit	1.92	5.12
Add: Savings on Interest on Deposit ($\text{₹} 3.20 \times 200^* \times 4\%$)	---	25.60
Total Profit	1.92	30.72

The above analysis shows that if Proposal is accepted, the Profit will increase from ₹ 1.92 Crores to ₹ 30.72 Crores.

(*)

It has been assumed that 'total number of dealers' are equal to 'total number of depots' i.e. 200.



This question can also be solved by using 'incremental' approach.

Question 6

(a) A manufacturing unit of ABC Co. Ltd. has presented the following details:

Average units produced and sold per month... 2,40,000

No. of workers..... 80

Sales value..... ₹ 60 Lacs

Contribution..... ₹ 24 Lacs

Wage rate..... ₹ 5 per unit

The production manager proposes to introduce a new automated machine due to which following changes will take place:

1. No. of units produced and sold are expected to increase by 20%.
2. No. of workers will be reduced to 60.
3. With a view to provide incentive for increased production, production manager intends to offer 1 % increase in wage rate for every 3% increase in average individual output achieved.
4. Decrease in selling price by 2%.

Required:

Calculate amount of extra contribution after introduction of new automated machine and give your recommendations. (8 Marks)

- (b) A manufacturer produces two types of products i.e. X and Y. Each of these products requires three types of processing. The processing time for each unit and the profit per unit are given in the following table:

	Product X (hours/unit)	Product Y (hours/unit)	Available capacity per day (hours)
Process I	12	12	840
Process II	3	6	300
Process III	8	4	480
Profit per unit (₹)	5	7	

Applying Graphical method, how many units of each product should the company manufacture per day in order to maximize profit? (8 Marks)

Answer**(a) Workings**

Present Average Output *per employees per month*

$$= \frac{\text{Total Present Output}}{\text{Total Number of Present Employees}}$$

$$= \frac{2,40,000 \text{ units}}{80 \text{ Employees}}$$

$$= 3,000 \text{ units}$$

Future Average Output *per employees per month* = $\frac{\text{Total Future Output}}{\text{Total Number of Future Employees}}$

$$= \frac{2,40,000 \text{ units} \times 120\%}{60 \text{ Employees}}$$

$$= \frac{2,88,000 \text{ units}}{60 \text{ Employees}}$$

$$= 4,800 \text{ units}$$

Present Piece Work Rate = ₹ 5.00 *per unit*

Proposed Piece Work Rate = Present Piece Work Rate + Incentive*

$$= ₹ 5.00 + ₹ 5 \times 20\%$$

$$= ₹ 6 \text{ per unit}$$

Incentive*

1% Increase in 'Wage Rate' for - Every 3% Increase in 'Average Individual Output Achieved'

$$\begin{aligned} \text{Change in Output (\%)} &= \frac{4,800 \text{ units} - 3,000 \text{ units}}{3,000 \text{ units}} \\ &= 60\% \\ \text{Change in Wage Rate (\%)} &= \frac{60\%}{3\%} \times 1\% \\ &= 20\% \\ \text{Present Sales Price per unit} &= ₹ 25.00 \\ &\quad (\text{₹ } 60,00,000 / 2,40,000 \text{ units}) \\ \text{Proposed Sale Price per unit} &= ₹ 24.50 \\ &\quad (\text{₹ } 25 - 2\% \times \text{₹ } 25.00) \\ \text{Present Variable Cost} &= ₹ 60,00,000 - ₹ 24,00,000 \\ &= ₹ 36,00,000 \\ \text{Present Variable Cost Excluding Wages per unit} &= \frac{\text{Contribution} - \text{Wages}}{\text{Present output (units)}} \\ &= \frac{₹ 36,00,000 - (2,40,000 \text{ units} \times ₹ 5)}{2,40,000 \text{ units}} \\ &= ₹ 10.00 \text{ per unit} \end{aligned}$$

Statement of 'Extra Monthly Contribution'

Particulars	₹
Sales Value (2,88,000 units × ₹ 24.50)	70,56,000
Less: Variable Costs Ex Wages (2,88,000 units × ₹ 10)	28,80,000
Less: Wages (2,88,000 units × ₹ 6)	17,28,000
Contribution (Proposed Plan)	24,48,000
Less: Present Contribution	24,00,000
Increase in Contribution	48,000

Recommendations

The above analysis shows monthly increase in contribution amounting to ₹ 48,000. Hence, the production manager's proposal should be accepted.

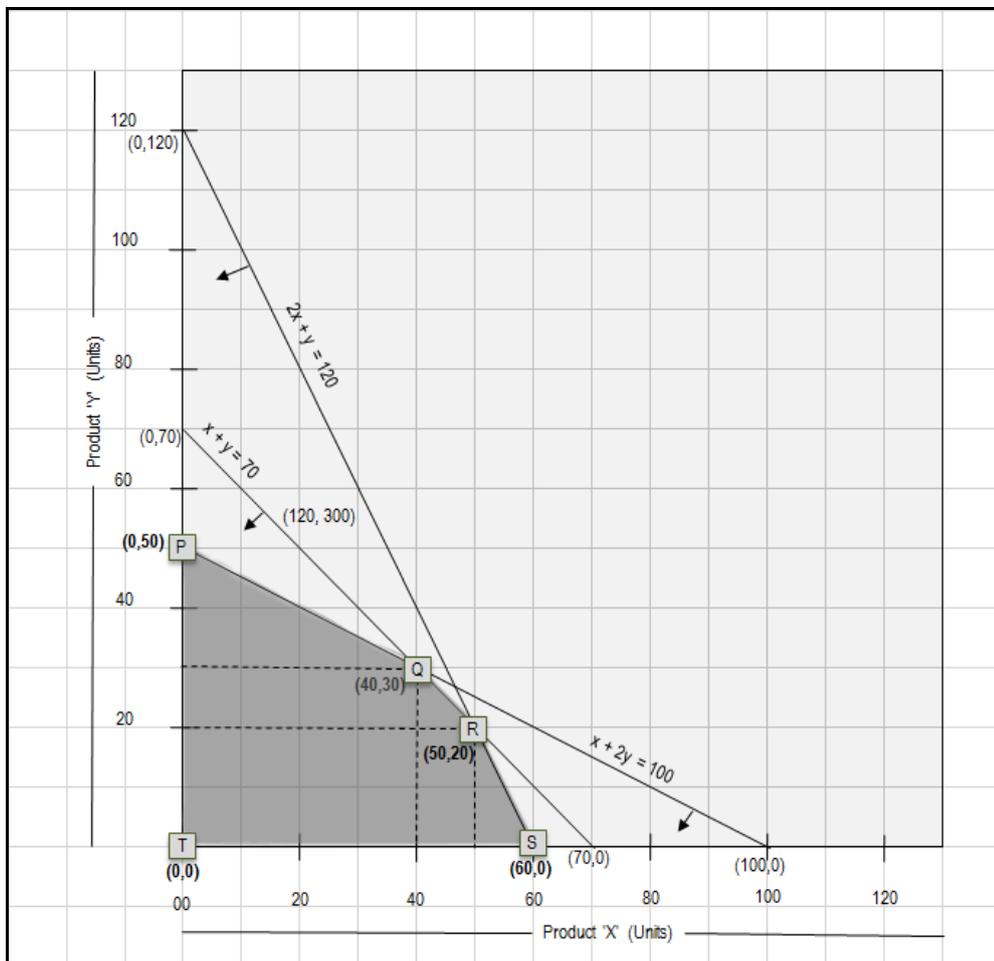
(b) The new formulation of the problem is as follows:

Let x and y denote the number of units produced for the product X & Y respectively.

The linear programming model for the given problem is:

Maximize			
$Z = 5x + 7y$			
Subject to the Constraints:			
$12x + 12y \leq 840$	Or	$x + y \leq 70$	(Process-I)
$3x + 6y \leq 300$	Or	$x + 2y \leq 100$	(Process-II)
$8x + 4y \leq 480$	Or	$2x + y \leq 120$	(Process-III)
$x, y \geq 0$			

The graphical solution for the problem is given below:



The shaded portion in the diagram represents the feasible region.

Value of the objective function at the feasible points is calculated below:

Point	Co-Ordinates of the Corner Points of the Feasible Region (value of x and y)	Value of the objective function $Z = 5x + 7y$
P	(0,50)	₹350
Q	(40,30)	₹410
R	(50,20)	₹390
S	(60,0)	₹300
T	(0,0)	₹0

Since at Point Q manufacturer makes *maximum profit* hence product mix at Point Q i.e. 40 units of Product X and 30 units of Product Y should be produced.

Question 7

Answer any **four** out of the following **five** questions:

(a) Answer the following independent situation relating to an assignment problem with a minimization objective:

- (i) Just after row and column minimization operations, we find that a particular row has two zeros. Does this implies that the 2 corresponding numbers in original matrix before any operation were equal? Why?
- (ii) Under the usual notation, where A_{32} means the element at the intersection of the 3rd row and 2nd column, we have, in a 4×4 assignment problem, A_{24} and A_{32} figuring in the optimal solution. What can you conclude about the remaining assignment? Why?

(4 Marks)

(b) Classify the following under appropriate categories in Balanced Score Card:

- (i) Research and development
- (ii) New product introduction
- (iii) Price
- (iv) Cost leadership
- (v) Sales penetration
- (vi) Profitability
- (vii) Sales
- (viii) Quality

(4 Marks)

(c) How would you use the Monte Carlo simulation method in inventory control? (4 Marks)

- (d) Indicate 2 activity drivers in respect of each of the following activity cost pools:
- (i) Manufacturing cost
 - (ii) Human resources cost
 - (iii) Marketing and sales costs
 - (iv) Accounting costs (4 Marks)
- (e) What is penetration pricing? What are the circumstances in which this policy can be adopted? (4 Marks)

Answer

- (a) (i) Under the Hungarian Assignment Method, the prerequisite to assign any job is that each row and column must have a zero value in its corresponding cells. If any row or column does not have any zero value then to obtain zero value, each cell values in the row or column is subtracted by the corresponding minimum cell value of respective rows or columns by performing row or column operation. This means *if any row or column have two or more cells having same minimum value then these row or column will have more than one zero*. However, having two zeros does not necessarily imply two equal values in the original assignment matrix just before row and column operations. Two zeroes in a same row can also be possible by two different operations i.e. one zero from row operation and one zero from column operation.
- (ii) The order of matrix in the assignment problem is 4×4 . The total assignment (allocations) will be four. In the assignment problem when any allocation is made in any cell then the corresponding row and column become unavailable for further allocation. Hence, these corresponding row and column are crossed mark to show unavailability. In the given assignment matrix two allocations have been made in A_{24} (2nd row and 4th column) and A_{32} (3rd row and 2nd column). This implies that 2nd and 3rd row and 2nd and 4th column are unavailable for further allocation.

Therefore, the other allocations are at either at A_{11} and A_{43} or at A_{13} and A_{41} .

- (b) Classification of Items under Appropriate Categories in Balance Scorecard

S. No.	Items(Goals)	Categories in Balance Scorecard
(i)	Research and Development	Innovation and Learning Perspective
(ii)	New Product Introduction	Internal Business Perspective
(iii)	Price	Customer Perspective
(iv)	Cost Leadership	Innovation and Learning Perspective
(v)	Sales Penetration	Internal Business Perspective
(vi)	Profitability	Financial Perspective

(vii)	Sales	Financial Perspective
(viii)	Quality	Customer Perspective

(c) Use of Monte Carlo Simulation can be explained with the following steps involved in the method:

- (i) Define the problem and select the measure of effectiveness of the problem that might be inventory shortages per period.
- (ii) Identify the variables which influence the measure of effectiveness significantly for example, number of units in inventory.
- (iii) Determine the proper cumulative probability distribution of each variable selected with the probability on vertical axis and the values of variables on horizontal axis.
- (iv) Get a set of random numbers.
- (v) Consider each random number as a decimal value of the cumulative probability distribution with the decimal enter the cumulative distribution plot from the vertical axis. Project this point horizontally, until it intersects cumulative probability distribution curve. Then project the point of intersection down into the vertical axis.
- (vi) Then record the value generated into the formula derived from the chosen measure of effectiveness. Solve and record the value. This value is the measure of effectiveness for that simulated value. Repeat above steps until sample is large enough for the satisfaction of the decision maker.

(d) Activity Cost Driver for Activity Cost Pools

S.No.	Activity Cost Pools	Activity Drivers
(i)	Manufacturing Cost	1. Number of machine hours
		2. Number of direct labor hours
		3. Number of field support visits
		4. Number of jobs scheduled
		5. Number of machine setups
		6. Number of maintenance work orders
		7. Number of parts in product
		8. Number of parts in stock
		9. Number of price negotiations
		10. Number of purchase orders
		11. Number of scheduling changes
		12. Number of shipments

(ii)	Human Resource Cost	1. Number of employee
		2. Number of training Hours
		3. Number of benefit changes
		4. Number of insurance claims
		5. Number of pension changes
		6. Number of recruiting contacts
(iii)	Marketing and Sales Cost	1. Number of customer service contacts
		2. Number of orders processed
		3. Number of sales contact made
		4. Number of advertisement
		5. Number of sales personnel
(iv)	Accounting Cost	1. Number of billings
		2. Number of cash receipts
		3. Number of check payments
		4. Number of general ledger entries
		5. Number of reports issued
		6. Number of responsibility centre

- (e) Penetration Pricing means a price suitable for penetrating mass market as quickly as possible through *lower price offers*. This method is also used for pricing a new product. In order to popularize a new product penetrating pricing policy is used initially. This pricing policy is in favour of using a low price as the principal instrument for penetrating mass markets early. It is opposite to skimming pricing. The low pricing policy is introduced for the sake of *long-term survival* and profitability and hence it has to receive careful consideration before implementation. It needs an analysis of the scope for market expansion and hence considerable amount of research and forecasting are necessary before determining the price.

Circumstances for Adoption

The three circumstances in which penetrating pricing policy can be adopted are as under:

- (i) When demand of the product is *elastic to price*. In other words, the demand of the product increases when price is low.
- (ii) When there are *substantial savings on large-scale production*, here increase in demand is sustained by the adoption of low pricing policy.
- (iii) When there is *threat of competition*. The prices fixed at a low level act as an entry barrier to the prospective competitions.