

PAPER – 5 : COST MANAGEMENT

QUESTIONS

1. Explain the following in the context of Activity Based Costing;

- (a) unit-level activities;
- (b) batch-level activities;
- (c) product-sustaining activities;
- (d) facility-sustaining activities

2. A budgeted profit statement of a company working at 75% capacity is provided to you below,

Sales	9,000 units at Rs. 32		Rs. 2,88,000
Less:	Direct materials	Rs. 54,000	
	Direct wages	72,000	
	Production overhead:		
	- fixed	42,000	
	- variable	18,000	
			1,86,000
	Gross profit		1,02,000
Less:	Administration, selling and distribution costs:		
	- fixed	36,000	
	- varying with sales volume	27,000	
			63,000
	Net profit		39,000

You are required to:

- (a) calculate the breakeven point in units and in value.
- (b) It has been estimated that:
 - (i) if the selling price per unit were reduced to Rs. 28, the increased demand would utilise 90% of the company's capacity without any additional advertising expenditure, and
 - (ii) to attract sufficient demand to utilise full capacity would require a 15% reduction in the current selling price and a Rs. 5,000 special advertising campaign.

You are required to present a statement showing the effect of the two alternatives compared with the original budget and to advise management which of the three possible plans ought to be adopted, i.e., the original budget plan or (i) above or (ii) above.

- (c) An independent market research study shows that by spending Rs. 15,000 on a special advertising campaign, the company could operate at full capacity and maintain the selling price at Rs. 32 per unit.

You are required to:

- (i) Advise management whether this proposal should be adopted.

3. (a) Consider the following information for Richardson Company for the prior year.

The company produced 1,000 units and sold 900 units, both as budgeted.

There were no beginning or ending work-in-process inventories and no beginning finished goods inventory.

Budgeted and actual fixed costs were equal; all variable manufacturing costs are affected by production volume only; and all variable selling costs are affected by sales volume only.

Budgeted per unit revenues and costs were as follows.

	Per Unit (Rs.)
Sales price	100
Direct materials	30
Direct labour	20
Other variable manufacturing costs	10
Fixed selling costs	5
Variable selling costs	12
Fixed selling costs (Rs. 33,600 total)	4
Fixed administration costs (Rs. 1,800 total)	2

What is the contribution margin earned by Richardson for the prior year ?

- (b) Garland Company uses a standard cost system. The standard for each finished unit of product allows for 3 kgs of plastic at Rs. 0.72 per kg. During December, Garland bought 4,500 kgs of plastic at Rs. 0.75 per kg, and used 4,100 kgs in the production of 1,300 finished units of product. What is the material purchase price variance for the month of December ?
4. A company is organised into two processes. Raw material is introduced into Process A and its output becomes the raw material for Process B. The finished goods of Process B is sold in the market. Process A has a capacity to process an input of 200,000 kg. of raw material per annum. The normal scrap is 10% and 5% of input in Process A and Process B respectively. The realizable value of scrap is Re.1 and Rs.2 per kg. respectively for Processes A and B. The operating data for a year are as under:

	Process A	Process B
Direct Wages	Rs.22,00,000	21,00,000
Overheads	Rs.9,56,000	13,45,800

There are three suppliers of raw material whose price quotations and terms are as under:

Supplier	Price Rs./Kg.	Terms
P	10.00	Maximum quantity offered is Rs.1,20,000 kg.
Q	11.20	Maximum quantity offered is 1,60,000 kg.
R	11.00	If the entire quantity of 2,00,000 kg. is ordered. Otherwise, for any quantity less than 2,00,000 kg. the price charged is Rs.11.60 per kg.

In each case, the raw material is to be collected from the supplier's factory. The variable transport cost for bringing the raw materials is as under:

Supplier	P	Q	R
Variable transport cost per Kg.	Rs.1.20	1.00	1.00

The fixed transport cost will be Rs.2,00,000 per annum irrespective of the supplier from whom the raw material is purchased.

The output of the company emerging from Process B can be sold to three customers at the prices and terms given below:

Customer	Price Rs. /Kg.	Discount	Condition
K	65.00	2%	Maximum quantity acceptable to K is 80,000 Kg.
L	64.00	2%	Maximum quantity acceptable to L is 1,60,000 Kg.

M	61.80	—	Provided the entire production of the company is sold to M
---	-------	---	--

In the case of customers K and L, fixed delivery costs of Rs.5,000 in total per month will be incurred. The variable delivery costs in respect of customers K and L respectively are Rs.2.60 and Rs.1.44 per Kg. Customer M will collect the output from the company's factory at his own cost.

- (i) You are required to indicate with supporting calculations the choice of (a) suppliers and (b) customers.
 - (ii) Based on your recommendation in (i) above, prepare a statement showing the process wise costs and profit of the company for the year.
5. The Bill of Material of a particular finished product 'A123', which cannot be produced beyond 200 units per month is given below.

S. No.	Raw Material description	Standard quantity per finished unit (No)	Standard purchase price per unit (Rs 00)
1	A	1	6
2	B	2	5
3	C	3	4
4	D	4	3
5	E	5	2
6	F	6	1

Standard Fixed overheads are Rs 10,00,000 per month whereas the standard variable overhead rate has been estimated as equal to Rs 1,400 per unit of finished good. You are required to compute the

- (a) standard cost of the product
- (b) compute the production volume variance in case the company produces and sells only 100 units of finished goods in the concerned month.
- (c) compute the usage and material price variances considering the following actual data(actual production and sale: 100 units)

Raw material description	Actual quantity consumed (Nos)	Actual price(Rs 00)
A	102	7
B	201	6
C	310	5
D	415	4
E	540	3
F	610	2

6. ABC Ltd. uses flexible budgets and standard costing for its single product PCM 30 produced at its factory at Solan. The following details relate to a particular months 'Actual' & also provide brief details of 'Standards' established,

Standard Quantity required for producing 1 unit of PCM 30	3 Kgs
Standard cost of the raw material	Rs 4.40 per kg
Cost of actual material purchased and used in the relevant month	Rs 3,36,000
Actual price paid for the raw material in the relevant month	Rs 4.20 per kg
Standard labour time required to produce 1 unit of PCM 30	30 minutes
Standard wage rate	Rs 5 per hour
Actual wage rate	Rs 5.40 per hour

Sufficient direct labour time, equivalent for producing 28,000 units of PCM 30 was utilised, although the actual production in the relevant month was only 25,000 units.

The company has a normal operating capacity of 15,000 hours per month and flexible overhead budgets are:

Hours of operation	12,500	14,000	15,000
Variable production overhead	Rs. 1,50,000	Rs. 1,68,000	Rs. 1,80,000
Fixed production overhead	2,70,000	2,70,000	2,70,000
Total	4,20,000	4,38,000	4,50,000

Actual fixed overheads incurred did not deviate from the budgeted amounts . However , the variable overheads incurred amounted to Rs 1,60,000 in the concerned month.

You are required to:

- (i) calculate the appropriate variances for material, labour and overhead;
 - (ii) show the variances in a statement suitable for presentation to management, reconciling the standard cost with the actual cost of production.
7. (a) Discuss the role of costs in product-mix decisions.
(b) What are the reasons to determine capacity?
(c) Briefly discuss on curvilinear CVP analysis.
 8. Polar Company sells refrigeration components both in India and to a subsidiary located in France. One of the components, Part No. 456, has a variable manufacturing cost of Rs. 30. The part can be sold domestically or shipped to the French subsidiary for use in the manufacture of a residential subassembly. Relevant data with regard to Part No. 456 are shown below.

CM

Part No. 456

Domestic selling price	Rs. 65
Shipping charges to France	15
Cost of acquiring Part No. 456 in France	75
French residential subassembly:	
Sales price	170
Other additional manufacturing costs	55
#Units shipped to France	150,000

#If deemed preferable, these units could be sold in India

Polar's applicable income tax rates are 40% in India and 70% in France.

Polar will transfer part No. 456 to the French subsidiary at either variable manufacturing cost or the domestic market price. On the basis of this information, which one of the following strategies should be recommended to Polar's management.

- a. Transfer 150,000 units at Rs. 30 and the French subsidiary pays the shipping costs.
 - b. Transfer 150,000 units at Rs. 65 and the French subsidiary pays the shipping costs.
 - c. Sell 150,000 units in India and the French subsidiary obtains Part No. 456 in France.
 - d. Transfer 150,000 units at Rs. 65 and have the Indian company absorb the shipping costs.
9. ABC Ltd manufactures Gents wear. It plans to sell cotton baggy shirts at a price of Rs 100 each, the cost of which is Rs 60. During the year, 6000 shirts out of the total 10,000 manufactured were sold. The remaining stock cannot be sold as such shirts are no longer in demand. However there

are two alternative courses available to the sales manager in order to utilise the unsold stock. The shirts can either be recycled as normal shirts instead of the baggy style or they can be sold as rejects. The total cost of recycling is estimated as Rs 2,00,000 and it is forecast that the recycled regular shirt can be sold as Rs 80 each while the scrap value of the outcuff will be Rs 30,000. If the company decides to sell the stocks as rejects, the resulting proceeds will be Rs 80,000.

What shall be your advice to the sales manager?

10. A Company has made 6000 units of a product. The labour content to make each thousand unit is as follows

Unit No. (000)	Labour Content (person-hr)
1	385
2	344
3	325
4	310
5	301
6	292

1. Estimate the learning rate for this product using 1000 units of the product as the unit of production.
 2. Predict the Labour requirements to make the next 2000 units.
11. (a) Describe the concept of Back flushing as used in a JIT system. What problems need to be addressed before implementing such a concept? Briefly discuss.
- (b) "Skimming pricing is a policy where the prices are kept high during the early period of a product's existence". Discuss briefly the reasons for following such a policy.
12. Discuss briefly your understanding of a Balanced Scorecard? What are its advantages ?
13. Methods engineer wants to assign four new methods to work centers. The assignment of new methods will increase Production (in units) and they are given below. If only one method can be assigned to a work center, determine the optimum assignment.

Work Center Methods	A	B	C
1	10	7	8
2	8	9	7
3	7	12	6
4	10	10	8

14. (a) Indicate the possible disadvantages of treating divisions as profit centres
- (b) Explain the role of bench marking in continuous improvement in an organisation.
15. ABC Ltd. makes two produces, Alpha and Beta. The company made a Rs. 500,000 profit last year and proposes an identical plan for the coming year. The relevant data for last year are summarized in Table 1.

Table 1: Actual for last year

	Product	
	Alpha	Beta
Actual production and sales (units)	20,000	40,000
Total costs per unit	Rs.20	Rs.40
Selling price per unit (25% on cost)	Rs.25	Rs.50
Machining time per unit (hours)	2	1
Potential demand at above selling prices (units)	30,000	50,000

Fixed costs were Rs. 4,80,000 for the year, absorbed on machining hours which were fully utilised for the production achieved.

You are required to calculate the plan to maximise profits for the coming year based on the data and selling prices in Table 1.

16. B Limited started trading on 1st November 2003, manufacturing and selling one product. The standard cost per unit was:

Direct material:	Standard price Rs. 10 per kilogram
	Standard quantity 20 kilogram's per unit
Direct labour:	Standard rate of pay Rs. 5.50 per hour
	Standard time allowance 12 hours per unit

Production overhead costs, all classified as fixed, were budgeted at Rs. 9,00,000 per annum. The standard time for producing one unit is 12 machine hours and normal capacity is 60,000 machine hours per annum. Production overhead is absorbed on machine hours.

For the year ended 31st October 2004, the costs incurred and other relevant information is given below.

Direct material used - 1,00,000 kilogram's at a cost of Rs. 10,50,000

Direct wages paid - Rs. 3,10,000 for 62,000 hours

Production overhead - Rs. 9,26,000

Machine capacity used - 60,000 hours

Actual output - 4,800 units

Assume no stocks of work-in-progress or finished goods at year end.

You are required to:

- show the standard product cost for one unit
 - calculate variances for material (Usage and Price), labour(Rate and Efficiency) and overhead.
17. ABC Limited manufactures three types of products namely Product 1, Product 2 and Product 3. The production process requires a single input raw material, a single type of direct labour and a single energy input, electricity. Overheads are shared by all three products. Budgeted details of the three products are shown below;

	Product 1	Product 2	Product 3
Labour hours per unit	0.20	0.25	0.40
Material kg per unit	1.0	1.1	1.3
Kilowatt hours per unit(kwhr)	0.5	0.6	0.8
Budgeted sales in units	10,000	6,000	2,000
Forecasted price (Rs)	15	20	40

The committed fixed overheads are expected to cost Rs 80,000 per period and the unit costs for the input resources are as follows ;

Labour	Rs 20 per hour
Material	Rs 4 per unit
Energy	Rs 6 per kilowatt hour

The actual financial results for ABC Limited for the concerned budgeted period are shown below;

Sales		Rs 3,85,000
Labour	Rs 1,09,452	
Material	96,448	
Energy	61,671	
Variable costs		2,67,571
Committed overhead		84,000
Profits		Rs 33,429

Additional information regarding inputs and outputs during the concerned period are provided to you below;

Outputs			Inputs		
	Quantity	Price		Quantity	Price
Product 1	12,000	Rs 16	Labour	5,212 hours	Rs 21.00
Product 2	5,500	22	Materials	21,920 kg	4.40
Product 3	1,800	40	Energy	10,633 kwhr	5.80

With the help of the above information, you are required to calculate the standard margin(contribution) and subsequently compute the following variances in order to reconcile Budgeted Profits with the Actual Profits;

- Sales –Activity Variance
- Price – Recovery Variance
- Productivity Variance

18. Budgetary control and standard costing are used within an insurance company and a standard cost of Rs. 20 has been set for obtaining and issuing each new life policy.

Prior to the commencement of the annual financial period, the life business manager had forecast that 7,500 policies would be sold during the year and the Rs. 20 standard cost was based on the following budgeted costs for the department. Actual costs are also shown.

Code	Budget	Actual
301	Rs. 30,000	Rs. 33,750
302	30,000	28,500
303	15,000	13,000
431	45,000	50,000
599	30,000	33,000
	150,000	158,250

At the end of the year, it was ascertained that

- 6,750 new life policies had been issued.
- the sales staff and underwriting staff received as salaries pay award of 12½% which had been back-dated to the beginning of the year and this had not been included in the budget.
- expenses on codes 302, 303 and 431 are regarded as direct costs which vary with activity, and those on code 301 are treated as a direct fixed cost whilst those on code 599 are an indirect fixed cost.

You are required to

- (i) present a statement (or control report) for the life business manager showing the variances which have arisen,
 - (ii) comment on the likely cause or causes for each variance identifying, so far as you can from the information given, how much of each variance arises from price differences and how much can be related to efficiency or inefficiency.
19. A project consists of nine activities whose time estimates (in weeks) and other characteristics are given below:

Activity	Preceding Activity	Time Estimates (weeks)		
		Optimistic	Most likely	Pessimistic
A	-	2	4	6
B	-	6	6	6
C	-	6	12	24
D	A	2	5	8
E	A	11	14	23
F	B, D	8	10	12
G	B, D	3	6	9
H	C, F	9	15	27
I	E	4	10	16

- (i) Show the pert network of the project
 - (ii) Identify the critical activities
 - (iii) What is the expected project completion time and its variance
 - (iv) What is the probability of completing the project one week before the expected time?
20. HAL is an aircraft manufacturer that has introduced a new airplane model. It expects the plane to cost Rs. 150,000,000 to manufacture (not including development cost) but their products have historically exhibited an 85% experience curve. Assuming the same experience rate will apply to this product.
1. Compute the cost of computing the each of the first five planes
 2. the average cost per plane to produce the first 25 planes.
21. Distinguish between Marginal and Absorption Costing and highlight the various limitations attributed to the former.
22. The following table gives the activities in a construction project and other relevant information.

Activity	Immediate Predecessor	Time (Days)	Direct Cost (Rs.)		
		Normal	Crash	Normal	Crash
A	-	4	3	60	90
B	-	6	4	150	250
C	-	2	1	38	60
D	A	5	3	150	250
E	C	2	2	100	100
F	A	7	5	115	175
G	D, B, E	4	2	100	240

Indirect cost vary as follows

Days	15	14	13	12	11	10	9	8	7	6
Cost (Rs)	600	500	400	250	175	100	75	50	35	25

- (i) Draw an arrow diagram for the project
- (ii) Determine the optimum project duration.

23. ABC Ltd has been approached by a customer who would like a special job to be done for him, and who is willing to pay Rs. 22,000 for it. The job would require the following materials.

<i>Material</i>	<i>Total units required</i>	<i>Units already in stock</i>	<i>Book value of units in stock Rs./unit</i>	<i>Realisable value Rs. /unit</i>	<i>Replacement cost Rs./unit</i>
A	1,000	0	-	-	6
B	1,000	600	2	2.50	5
C	1,000	700	3	2.50	4
D	200	200	4	6.00	9

Material B is used regularly by ABC Ltd, and if units of B are required for this job, they would need to be replaced to meet other production demand.

Material C and D are in stock as the result of previous over-buying, and they have a restricted use. No other use could be found for material C, but the units of material D could be used in another job as substitute for 300 units of material E, which currently costs Rs. 5 per unit (of which the company has no units in stock at the moment).

Calculate the relevant costs of material for deciding whether or not to accept the order.

24. A manufacturer of the firm is investigating the inventory situation of his company. Distribution of daily demand is

Demand (units)	No. of Days
5	15
6	25
7	30
8	18
9	8
10	4

The lead time distribution in days is given below

Lead time	Probability
3	.2
4	.3
5	.35
6	.15

The ordering cost is Rs. 100 per order; the holding cost is Rs. 3 per unit per day and the shortage cost is Rs. 20 per unit, representing the loss in profits.

Using simulation determines the total inventory cost for specific reorder level and reorder quantity.

Assume the opening inventory is 25 units, the reorder level is 20 units and the reorder quantity is 40 units.

25. The occurrence of the rain in a day is dependent upon whether it rained on the previous day. If it rained on the previous day the rain distribution is given by

Event	Probability
No rain	.50
1 cm rain	.25
2 cm rain	.15
3 cm rain	.05
4 cm rain	.03
5 cm rain	.02

If it did not rained on the previous day the rain distribution is given by

Event	Probability
No rain	.75
1 cm rain	.15
2 cm rain	.06
3 cm rain	.04

Simulate the city's weather for 10 days and determine by simulation the total days without rain as well as the total rain fall during the period. Use the following random numbers

76 78 84 75 02 86 02 78 07 63

For simulation. Assume that for the first day of the simulation it had not rained before.

SUGGESTED ANSWERS/HINTS

1. (a) **Unit-level activities** are performed each time a unit of the product or service is produced. Expenses in this category include direct labour, direct materials, energy costs and expenses that are consumed in proportion to machine processing time (such as maintenance). Unit - level activities consume resources in proportion to the number of units of production and sales volume. For example, if a firm produces 10% more units it will consume 10% more labour cost, 10 % more machine hours and 10% more energy costs. Typical cost drivers for unit level activities include labour hours, machine hours and the quantity of materials processed. These cost drivers are also used by traditional costing systems. Traditional systems are therefore also appropriate for assigning the costs of unit-level activities to cost objects.
- (b) **Batch-related to activities**, such as setting up a machine or processing a purchase order, are performed each time a batch of goods is produced. The cost of batch-related activities varies with the number of batches made, but is common (or fixed) for all units within the batch. For example, set-up resources are consumed when a machine is changed from one product to another. As more batches are produced, more' set-up resources are consumed. It costs the same to set-up a machine for 10 or 5000 items. Thus the demands for the set-up resources are independent of the number of units produced after completing the set-up. Similarly, purchasing resources are consumed each time a purchasing order is processed, but the resources consumed are. independent of the number of units included in the purchase order. Other examples of batch-related costs include resources devoted to production scheduling, first-item inspection and materials movement. Traditional costing systems treat batch-related expenses as fixed costs. However, the more the batch-related activities are required the more the organization must eventually spend to supply resources to perform these activities. Thus ABC systems provide a mechanism for assigning some of the costs of complexity (such as set-ups, customer ordering and purchasing) to the products or services that cause the activity.
- (c) **Product-sustaining activities or service-sustaining activities** are performed to enable the production and sale of individual products (or services). Examples of product sustaining

activities include maintaining and updating product specifications and the technical support provided for individual products and services. Other examples are the resources to prepare and implement engineering change notices, to design processes and test routines for individual products, and to perform product enhancements. The costs of product-sustaining activities are incurred irrespective of the number of units of output or the number of batches processed and their expenses will tend to increase as the number of products manufactured is increased. ABC uses product-level bases such as number of active part numbers and number of engineering change notices to assign these costs to products.

- (d) The final activity category is **facility-sustaining (or. business-sustaining) activities**. They are performed to support the facility's general manufacturing process and include general administrative staff, plant management and property costs. They are incurred to support the organization as a whole and are common and joint to all products manufactured in the plant. There would have to be a dramatic change in activity, resulting in an expansion or contraction in the size of the plant, for facility-sustaining costs to change. Such events are most unlikely in most organizations. Therefore these costs are not assigned to products since they are unavoidable and irrelevant for most decisions. Instead, they are regarded as common costs to all products made in the plant and deducted as a lump sum from the total of the operating margins from all products.

2. (a) **Contribution and Profitability Analysis**

		<i>Total</i>	<i>Per unit</i>
Sales*		Rs 2,88,000	Rs 32
Less	Variable costs		
	Direct material	54,000	6
	Direct wages	72,000	8
	Production Overheads	18,000	2
	Admn , S & D OH	27,000	3
		1,71,000	19
Contribution		1,17,000	13
Less	Fixed Overheads		
	Production	42,000	
	Admn , S & D	36,000	
		78,000	
		39,000	

*Capacity utilisation : 75%

$$\text{P/V Ratio} = (S - V)/S \times 100 = 40.625\%$$

$$\text{BE Sales} = \text{Fixed costs} \div \text{P/V Ratio}$$

$$= 78,000 \div 40.625\%$$

$$= \text{Rs } 1,92,000$$

$$\text{or } 1,92,000 \div \text{Rs } 32 = 6,000 \text{ Units}$$

(b)	Production	90% Capacity(10,800 Units)	100% Capacity(12,000 Units)
	Selling price per unit	Rs 28	Rs 27.20
	Variable cost per unit	19	19.00

Contribution per unit	9	8.20
P/V Ratio	31.143%	30.147%
Total contribution	97,200	98,400
Less Fixed Overheads	78,000	83,000
	19,200	15,400

The P/V Ratio has gone down to 31.143% in the case of alternative b(i) and to 30.147% in alternative b(ii). Therefore the company should follow the original plan as at (a) above

(c)	(i)	Selling price per unit	Rs 32
		Less Variable costs	19
		Contribution per unit	13
		Total contribution (12,000 × Rs 13)	1,56,000
		Less fixed costs	93,000
		Profit	63,000

This proposal may be expected as there is a considerable increase in the profits.

3. (a) Sales price less direct and variable costs × number of units sold = contribution margin
 (Rs 100 – (Rs 30 + Rs 20 + Rs 10 + Rs 12)) × 900 units = Rs 25,200
- (b) (Standard price – actual price) × number of kgs purchased
 (Rs 0.72 – 0.75) × 4,500 kgs = Rs 135 unfavourable

4. (i) (a) **Purchases:**

		P	Q	R	
		Upto	Upto	Any	Equal to
		1,20,000 kg	1,60,000 kg	quantity	2,00,000 kg.
Price (Rs.)		10.00	11.20	11.60	11.00
Variable transport cost (Rs.)		<u>1.20</u>	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Total		<u>11.20</u>	<u>12.20</u>	<u>12.60</u>	<u>12.00</u>
Plan I	Quantity (kgs.)	1,20,000	80000		
	Cost (Rs.)	13,44,000	9,76,000	Total	23,20,000
Plan II	Quantity (kgs.)				2,00,000
	Cost (Rs.)				24,00,000

Plan I being lesser in cost therefore it should be adopted, buy 1,20,000 kg from P and 80,000 kg from Q.

Fixed transport cost being constant is not relevant to the decision.

(b)			Kg.
Production	Process A Input		2,00,000
	Loss 10%		<u>20,000</u>
	Output		1,80,000
	Process B Loss 5%		<u>9,000</u>
	Final output		<u>1,71,000</u>

<i>Sales</i>	<i>K</i>	<i>L</i>	<i>M</i>
	<i>Upto</i>	<i>Upto</i>	<i>1,71,000 kg</i>
	<i>80,000 kg</i>	<i>1,60,000 kg</i>	
Selling Price Rs.	65.00	64.00	61.80
Discount 2%	<u>1.30</u>	<u>1.28</u>	—
Net selling price	63.70	62.72	61.80
Transport (V)	<u>2.60</u>	<u>1.44</u>	—
Net realisation	<u>61.10</u>	<u>61.28</u>	<u>61.80</u>

Plan I sell quantity	1,71,000 kg to M	Sales Revenue (Rs.)	1,05,67,800
Plan II sell quantity	(kgs.) 11,000 to K	1,60,000 to L	
	(Rs.) 6,72,100	98,04,800	<u>1,04,76,900</u>
Fixed delivery charges	Rs. 5,000 × 12		<u>60,000</u>

Since sales realisation is greater on selling to M, entire quantity should be sold to M

(ii) **Costs & profit statement**

Process A	<i>Kg</i>	
Raw materials	2,00,000	23,20,000
Fixed transport		2,00,000
Wages		22,00,000
Overheads		<u>9,56,000</u>
Total		56,76,00
Sale of scrap	<u>20,000 @ 1/-</u>	<u>(20,000)</u>
Net cost	<u>1,80,000</u>	<u>56,56,000</u>
Process B		
Process A	1,80,000	56,56,000
Wages		21,00,000
Overheads		<u>13,45,800</u>
Total	1,80,000	91,01,800
Sale of scrap	<u>9,000 @ 2/-</u>	<u>(18,000)</u>
Net cost	1,71,000	90,83,800
Net sales		<u>1,05,67,800</u>
Profit (Rs.)		<u>14,84,000</u>

5. (a)

Standard Cost Sheet

Description	Cost per unit of Finished Good
Standard Raw Material Cost	Rs 5,600
Variable Overheads	Rs 1,400
Standard Fixed Overheads	Rs 5,000
Standard Cost per Unit of Finished Good	Rs 12,000

(b) Production Volume Variance

Unutilised capacity × Standard Fixed Cost per Finished Good

100 × Rs 5,000 = Rs 5,00,000 Adverse

(c) Usage and Material Price Variance (Actual Production : 100 Units)

Raw Mat	Std Qty/FG	StdQty on actual prod	Actual Qty on actual prod	Act Price per Ut of RM(Rs)	Std Price per Ut of RM(Rs)	Usage Variance(Rs)	Price Variance(Rs)
A	1	100	102	700	600	(1,200)	(10,200)
B	2	200	201	600	500	(500)	(20,100)
C	3	300	310	500	400	(4,000)	(31,000)
D	4	400	415	400	300	(4,500)	(41,500)
E	5	500	540	300	200	(8,000)	(54,000)
F	6	600	610	200	100	(1,000)	(61,000)
						(19,200)	(2,17,800)

6. (i) Standard Variable O.H. rate = Rs. 1,80,000 ÷ 15,000 = Rs. 12 per hr.
 Standard Fixed OH rate = 2,70,000 ÷ 15,000 = Rs. 18 per hr.

Material Variances (Actual Production : 25,000 Units)

St Qty of RM /FG	Std Price of RM/kg	Std Qty of RM on Actual Production	Actual Qty of RM on Actual Production	Actual Price paid for RM	Usage Variance(Rs)	Price Variance(Rs)
(a)	(b)	(c)	(d)	(e)	(c - d) × b	(b - e) × d
3 kg	Rs 4.40	75,000 kgs	80,000	Rs 4.20	(22,000)	16,000

Labour Variances

St time / FG	Std rate per hour	Std time on Actual Production	Actual time on Actual Production	Actual rate per hour	Efficiency Variance(Rs)	Rate Variance(Rs)
(a)	(b)	(c)	(d)	(e)	(c - d) × b	(b - e) × d
30 min	Rs 5	12,500 hrs	14,000 hrs	Rs 5.4	(7,500)	(5,600)

Variable Overhead Variances

Actual variable overhead	= Rs. 1,60,000 (a)
(Rs. 4,30,000 – Rs. 2,70,000)	
Actual Hours worked at Standard V.O.H. rate	= Rs. 1,68,000 (b)
(28,000 × 0.5 hr × Rs. 12)	
Standard Variable O.H. for actual production	= Rs. 1,50,000 (c)
(25,000 units × 0.5 hr × Rs. 12)	
Variable O.H. Expenditure variance	= (a) – (b)
	= Rs. 1,60,000 – Rs. 1,68,000
	= Rs. 8,000 (F)

Variable O.H. Efficiency variance	= (b) – (c)
= Rs. 1,68,000 – Rs. 1,50,000	= Rs. 18,000 (A)

Fixed Overhead Variances

Actual fixed overhead incurred	= Rs. 2,70,000
Budgeted Fixed Overhead	= Rs. 2,70,000
Expenditure Variance	= Nil
Budgeted production	= 30,000 Units
Actual production	= 25,000 Units
Unutilised capacity	= 5,000 Units or 2,500 Hrs
Production volume variance	= 2,500 Hrs × Rs 18 per hr
	= (Rs 45,000)

(ii) Reconciliation

Standard Cost 25,000 × Rs. 30.70	= 7,67,500
----------------------------------	------------

Variances

Materials

	Favourable	Adverse
Price usage	Rs. 16,000	
Usage		Rs. 22,000

Labour

Rate		5,600
Efficiency		7,500

Variable OH

Expenditure	8,000	
Efficiency		18,000

Fixed OH.

Expenditure	-	
Volume		45,000
		74,100 (A)
Actual cost		8,41,600

7. (a) *Role of costs in product mix decisions:* All types of cost involved in cost accounting system are useful in decision making. The cost which plays a major role in product mix decision is the relevant cost. Costs to be relevant should meet the following criteria:

- The costs should be expected as future costs.
- The costs differ among the alternatives courses of action.

While making decision about product mix using the facilities and other available resources, the end results should always aim at profit minimisation. Variable costs are relevant costs in product mix decisions and consequently contribution plays a major role in minimisation of profit. In addition to the relevancy of costs, the other factors and costs that should be taken into account at the time of deciding the products mix are:

- The available production capacity
- The limiting factor (s)
- Contribution per unit of the limiting factor.

(iv) Market demand for the products.

(v) Opportunity costs

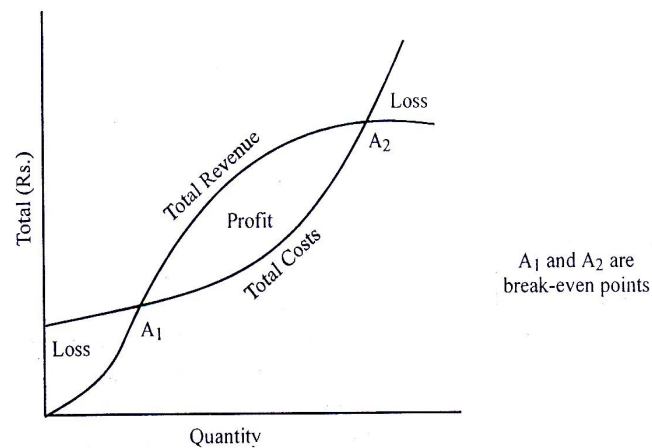
(b) Main reasons for the determination of capacity are as follows:

1. Selecting a base activity for overhead rate determination or overhead distribution.
2. It is required in connection with Schedule VI of the Companies Act for indicating the licenced and installed capacity and also the actual production.
3. It is necessary for the Cost Auditor to give his comments on capacity utilization.
4. It helps to compare the actual capacity utilisation with the budgeted capacity utilisation and to analyse the deviations for taking corrective action.
5. Capacity utilisation is an important factor in price fixation.
6. It enables the company to analyse the under or over absorption of overheads for proper treatment.
7. Capacity determination helps in preparation of flexible budgeting and achieving overall control over the operations of business.

(c) In CVP analysis, the usual assumption is that the total sales line and variable cost line will have linear relationship, that is, these lines will be straight lines. However, in actual practice it is unlikely to have a linear relationship for two reasons, namely:

- after the saturation point of existing demand, the sales value may show a downward trend.
- the average unit variable cost declines initially, reflecting the fact that, as output increases the firm will be able to obtain bulk discounts on the purchase of raw materials and can also benefit from division of labour. When the plant is operated at further higher levels of output, due to bottlenecks and breakdowns the variable cost per unit will tend to increase. Thus the law of increasing costs may operate and the variable cost per unit may increase after reaching a particular level of output.

In such cases, the contribution will not increase in linear proportion i.e. based on the phenomenon of diminishing marginal productivity, the total cost line will not be straight, as assumed but will be of curvilinear shape. This situation will give rise to two break even points. The optimum profit is earned at the point where the distance between sales and total cost is the greatest.



8. **(a)** French sales only $(Rs\ 170 - Rs\ 30 - Rs\ 15 - Rs\ 55) \times .3 = Rs\ 21$

(b) India $(Rs\ 65 - Rs\ 30) \times .6 = Rs\ 21$; French sales $(Rs\ 170 - Rs\ 65 - Rs\ 15 - Rs\ 55) \times .3$
 $= Rs\ 10.50$; $Rs\ 21 + Rs\ 10.50 = Rs\ 31.50$

(c)	India (Rs 65 – Rs 30) × .6	Rs 21
	French (Rs 170 – Rs 75 – Rs 55) × .3	12
	Net profit per unit	Rs 33

- (d) India (Rs 65 – Rs 30 – Rs 15) × .6 = Rs 12 ; French sales (Rs 170 – Rs 65 – Rs 55) × .3 = Rs 15 ; Rs 12 + Rs 15 = Rs 27

Recommendation : Strategy C is the best

9. Relevant cost and benefit analysis

Sale of regular shirts (4,000 × Rs 80)	Rs. 3,20,000
Add: Scrap value of outcuffs	30,000
Total sales	3,50,000
Less: Cost of recycling	2,00,000
Net profit	1,50,000
Sale proceeds from rejects	80,000
Hence it is more profitable to restyle the shirts as regular shirts and sell them subsequently rather than selling the shirts as rejects	

10. The ratio of the first to second thousand $344/385=0.894$; the ratio of second and fourth thousand and ratio of third and sixth thousand are $310/344=0.901$ and $292/325=0.898$. The average is 0.898 or approximately 90%.

The labour required to make the seventh and eight thousand items will be approximately.

$$T_7 = 385 * 7^{(\ln 0.9 / \ln 2)^I} = 286$$

$$T_8 = 385 * 8^{(\ln 0.9 / \ln 2)^I} = 281$$

11. (a) Back flushing in a JIT system

Traditional accounting systems record the flow of inventory through elaborate accounting procedures. Such systems are required in those manufacturing environment where inventory/WIP values are large. However, since JIT systems operate in modern manufacturing environment characterized by low inventory and WIP values, usually also associated with low cost variances, the requirements of such elaborate accounting procedures does not exist.

Back flushing requires no data entry of any kind until a finished product is completed. At that time the total amount finished is entered into the computer system which is multiplied by all components as per the Bill of materials (BOM) for each item produced. This yields a lengthy list of components that should have been used in the production process and this is subtracted from the opening stock to arrive at the closing stock to arrive at the closing stock/inventory.

The problems with back flushing that must be corrected before it works properly are:

- The total production quantity entered into the system must be absolutely correct, if not, then wrong components and quantities will be subtracted from the stock.
- All abnormal scrap must be diligently tracked and recorded. Otherwise materials will fall outside the back flushing system and will not be charged to inventory.
- Lot tracing is impossible under the back flushing system. This is required when a manufacturer needs to keep records of which production lots were used to create a product in case all the items in a lot need be recalled.
- The inventory balance may be too high at all times because the back flushing transactions that relieves inventory usually does so only once a day, during which time

other inventory is sent to the production process. This makes it difficult to maintain an accurate set of inventory records in the warehouse.

(b) Reasons for following skimming pricing policy

It is a policy where the prices are kept high during the early period of a product's existence. This can be synchronised with high promotional expenditure and in the latter years the prices can be gradually reduced. The reasons for following such a policy are as follows:

- (i) The demand is likely to be inelastic in the earlier stages till the product is established in the market.
 - (ii) The gradual reduction in price in the latter years will tend to increase the sales.
 - (iii) This method is preferred in the beginning because in the initial periods when the demand for the product is not known the price covers the initial cost of production.
 - (iv) High initial capital outlays needed for manufacture, results in high cost of production. In addition to this, the producer has to incur huge promotional activities resulting in increased costs. High initial prices will be able to finance the cost of production particularly when uncertainties block the usual sources of capital.
12. The 'Balanced Scorecard' aims to provide information to management to assist in strategic policy formulation and achievement. It emphasizes the need to provide the user with a set of information which addresses all relevant areas of performance in an objective and unbiased fashion. For further details, please refer to chapter 14 of the Institute's Cost Management book.
13. (a) **This problem is of maximization and is also unbalanced** Introducing one more column for a fictitious work center (say D) in order to get balanced assignment problem.

Work Center Methods	A	B	C	D
1	10	7	8	0
2	8	9	7	0
3	7	12	6	0
4	10	10	8	0

For converting it into the minimization problem subtract every element from the maximum element i.e. 12.

Work Center Methods	A	B	C	D
1	2	5	4	2
2	4	3	5	2
3	5	0	6	2
4	2	2	4	2

Apply Hungarian rule for obtaining the solution.

Work Center Methods	A	B	C	D
1	0	3	0	1
2	1	0	0	0
3	5	0	4	3
4	0	0	0	1

Since the minimum number of lines drawn are equal to four. Hence we arrive at the solution as follows.

Work Center Methods	A	B	C	D
1	0	3	0	1
2	1	0	0	0
3	5	0	4	3
4	0	0	0	1

Hence the optimal solution is:

Methods	Work centres	Units
1	C	8
2	D	0
3	B	12
4	A	10
		30

14. (a) The possible disadvantages of treating divisions as profit centres are as follows:

- Divisions may compete with each other and may take decisions to increase profits at the expense of other divisions thereby overemphasizing short term results.
- It may adversely affect co-operation between the divisions and lead to lack of harmony in achieving organisational goals of the company. Thus it is hard to achieve the objective of goal congruence.
- It may lead to reduction in the company's overall total profits.
- The cost of activities which are common to all divisions may be greater for decentralised structure than for centralised structure. It may thus result in duplication of staff activities.
- Top management loses control by delegating decision making to divisional managers. There are risks of mistakes committed by the divisional managers which the top management, may avoid.
- Series of control reports prepared for several departments may not be effective from the point of view of top management.
- It may under utilise corporate competence.
- It leads to complications associated with transfer pricing problems.
- It becomes difficult to identify and define precisely suitable profit centres.
- It confuses division's results with manager's performance.

- (b) Bench marking is a technique which is being adopted as a mechanism for achieving continuous improvement. It is a continuous process of measuring a company's products, services or activities against the other best performing organizations either internal or external to the company. The objective is to ascertain how the processes and activities can be improved. The latest developments, best practices and model examples can be incorporated within various operations of the business of the company. It represents an ideal way of achieving high competitive standards.

15. Statement showing computation of profit

	Products		Total
	Alpha	Beta	
Actual production (units)	20,000	40,000	
Machining time per unit (Hours)	2	1	
Total Machining time required	40,000	40,000	80,000 hrs.
Fixed cost per annum			Rs. 4,80,000
Absorption rate per hour			Rs. 6
Selling price per unit	Rs. 25	Rs. 50	
Less: Variable cost (20 – 12)	8*	(40 – 6) 34*	
Contribution	17	16	
Machining hours	2	1	
Contribution per machining hour	Rs. 8.50	Rs. 16	

* V. Cost = Total Cost – F. Cost.

Therefore, company should first meet the maximum demand of Beta and use the balance of Alpha.

First maximum of Beta should be produced. It will use: 50,000 units $\times$ 1 hr. = 50,000 hrs. Maximum hours are 80,000. Therefore, balance 30,000 hours (i.e. 80,000 hrs. – 50,000 hrs.) should be used for producing Alpha.

Number of Alpha units to be produced will be: 30,000 hrs. $\div$ 2 = 15,000 units.

The profit as per this plan will be –

	Total Contribution
Beta 50,000 units $\times$ Rs. 16 =	8,00,000
Alpha 15,000 units $\times$ Rs. 17 =	<u>2,55,000</u>
	10,55,000
Fixed Cost	<u>4,80,000</u>
	<u>5,75,000</u>
Existing Profit	5,00,000

The company should adopt the revised plan as it yields higher profit. Existing plan is thus not optimal.

16. (a) Computation of Standard Cost per Unit

	Rs
Direct material	200
Direct labour	66
Production Overhead	180
Standard cost per unit	446

(b) Computation of material cost variances (Actual Production :4,800 Units)

Std Qty	Std Price/Kg(Rs)	SQAP	AQAP	Actual price/Kg(Rs)	Usage Variance	Price Variance
(a)	(b)	(c)	(d)	(e)	$(c - d) \times (b)$	$(b - e) \times (d)$
20 Kg	10	96,000 Kgs	1,00,000 Kgs	10.50/Kg	(40,000)	(50,000)

Computation of Labour rate and efficiency variances (Actual Production :4,800 Units)

Std Hrs per Unit	Std Rate/Hr(Rs)	Std Hrs for Actual Production	Actual Hrs for Actual Production	Actual Rate /Hr	Labour Rate Variance	Labour Efficiency Variance
(a)	(b)	(c)	(d)	(e)	$(b - e) \times (d)$	$(c - d) \times (b)$
12	5.50	57,600	62,000	5	31,000	(24,200)

Computation of overhead variances

Capacity	Actual Production	Std Total Fixed Overheads	Actual Total Fixed Overheads	Std Fixed Overhead per unit	Production Volume Variance	Overhead expenditure Variance
(a)	(b)	(c)	(d)	(e)	$(b - a) \times (e)$	$(c - d)$
5,000 Units	4,800 Units	Rs 9,00,000	Rs 9,26,000	180	(36,000)	(26,000)

17. Computation of Standard Margin

	Product 1	Product 2	Product 3
Selling Price	Rs 15.00	Rs 20.00	Rs 40.00
Labour	Rs 4.00	Rs 5.00	Rs 8.00
Material	4.00	4.40	5.20
Energy	3.00	3.60	4.80
Variable costs	Rs 11.00	Rs 13.00	Rs 18.00
Contribution margin	4.00	7.00	22.00

(a) *Sales Activity Variance* = (Actual output – Budgeted output) × Standard margin
 $= (12,000 - 10,000) \times 4 + (5,500 - 6,000) \times 7 + (1,800 - 2,000) \times 22$
 $= \text{Rs } 100 \text{ Favourable}$

(b) *Price –Recovery Variance* = Sales Price Variance – Input Cost Variance

where

Sales Price Variance = (Actual price – Budgeted price) × Actual sales volume

Input cost variance = (Actual unit cost of input - Standard unit cost of input) × Actual inputs consumed.

Sales Price Variance $= [(16 - 15) \times 12,000 + (22 - 20) \times 5,500 + (40 - 40) \times 1,800]$
 $= \text{Rs } 23,000 \text{ Favourable}$

Input Cost Variance

	<i>Actual unit costs</i>	<i>Budgeted unit costs</i>	<i>Difference</i>	<i>Actual Inputs</i>	<i>Input Cost Variances</i>
Labour	21.00	20	1	5,212 hr	Rs 5,212
Materials	4.40	4	0.40	21,920 kg	8,768
Energy (kwhr)	5.80	6	- 0.20	10,633 kwhr	(2,127)
Committed overhead	84,000	80,000	4,000	1	4,000
Input cost variance					Rs 15,853

Hence Price Recovery Variance = Rs 23,000 – Rs 15,853
= Rs 7,147 Favourable

(c) Productivity Variance

	<i>Standard consumption @actual output</i>				<i>Actual Consumption</i>	<i>Diff</i>	<i>Std Price</i>	<i>Usage Variance</i>
	<i>Product 1</i>	<i>Product 2</i>	<i>Product 3</i>	<i>Total</i>				
Labour	2,400	1,375	720	4,495	5,212	717	Rs 20	Rs14,340
Material	12,000	6,050	2,340	20,390	21,920	1,530	4	6,120
Energy	6,000	3,300	1,440	10,740	10,633	- 107	6	(642)
Productivity Variance								Rs19,818

18. (i) Control Report

<i>Code</i>	<i>Fixed budget 7,500 units</i>	<i>Flexed Budget 6,750 units</i>	<i>Actual 6750</i>	<i>Variances</i>
301 Sales salaries	Rs. 30,000	Rs. 30,000	33,750	Rs. 3750 (A)
302 Staff Commission	30,000	27,000	28,500	1,500 (A)
303 Staff expenses	15,000	13,500	13,000	500 (F)
431 Underwriting Staff	45,000	40,500	50,000	9,500 (A)
599 Other Admin Costs	30,000	30,000	33,000	3,000 (A)
	<u>1,50,000</u>	<u>1,41,000</u>	<u>158,250</u>	<u>17,250 (A)</u>

(ii) Sales Salaries. Rs. 3,750 (A) Rate Variance is due to unanticipated pay award.

Sales Commission – Rs. 3000 (F) is due to drop in activity and Rs. 1500 (A) may be due to increasing sales commission oin selected policies or due to inefficiency.

Sales Expenses – Rs. 1500 reduction due to drop in activity and Rs. 500 (F) for improved control.

Underwriting Salaries – Rs. 4,500 (F) due to drop in activity, Rs. 5062 (A) due to unbudgeted salaries increases and Rs. 4,438 (A) due to inefficiency.

Other Administration – Rs. 3,000 (A) seem to have been caused by changes due to high cost suppliers or hiring temporary office staff.

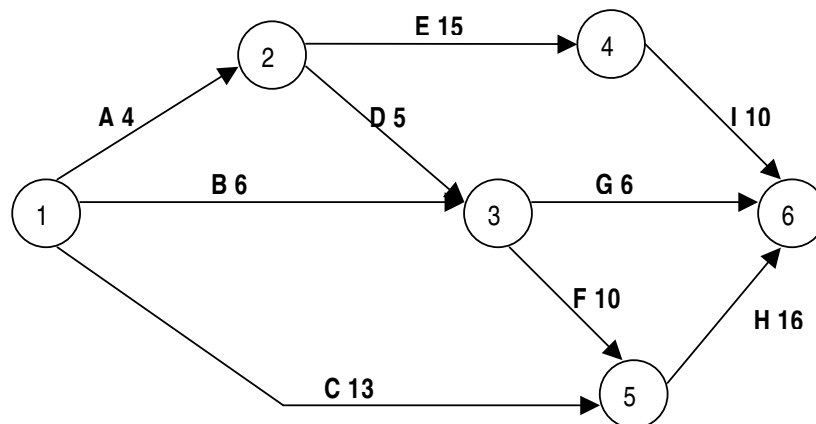
19. (i) The expected duration and variance is given as:

Activity	Optimistic	Most likely	Pessimistic	Expected Duration	Variance
A	2	4	6	4	4/9
B	6	6	6	6	0
C	6	12	24	13	9
D	2	5	8	5	1
E	11	14	23	15	4
F	8	10	12	10	4/9
G	3	6	9	6	1
H	9	15	27	16	9
I	4	10	16	10	4

the length of various path is give in table 2

Table 2: length of paths

Path	Length (weeks)
1 – 2 – 4 – 6	29
1 – 2 – 3 – 6	15
1 – 2 – 3 – 5 – 6	35
1 – 3 – 6	12
1 – 3 – 5 – 6	32
1 – 5 – 6	29



- (ii) Thus the expected project completion time = 35 weeks. The critical path is 1 – 2 – 3 – 5 – 6 and critical activities are:
1 – 2(A), 2 – 3(D), 3 – 5(F) and 5 – 6(H)
- (iii) The variance of the project completion time = $4/9 + 1 + 4/9 + 9 = 98/9$ and the standard deviation = $(98/9)^{1/2} = 3.23$ weeks. The expected project completion times is 35 weeks.

- (iv) The probability of completing the project one week before the expected time is $Z = (X - \mu) / \sigma$.

$$Z = (34 - 35) / 3.23 = - 0.31$$

From the normal area table, area between μ and $Z = - 0.31$ is 0.1217. thus,

$$P(X < 34) = 0.5 - 0.1217 = 0.3783$$

20. Using the 85% experience curve the cost of first five planes should be approximately

$$T_1 = \text{Rs. } 150,000,000 \times 1.0000 = \text{Rs. } 150,000,000$$

$$T_2 = \text{Rs. } 150,000,000 \times 0.8500 = \text{Rs. } 127,500,000$$

$$T_3 = \text{Rs. } 150,000,000 \times 0.7730 = \text{Rs. } 115,950,000$$

$$T_4 = \text{Rs. } 150,000,000 \times 0.7230 = \text{Rs. } 108,450,000$$

$$T_5 = \text{Rs. } 150,000,000 \times 0.6860 = \text{Rs. } 102,900,000$$

From the 85% column in table the total time factor for 25 units is 14.801, so the total cost for the 25 planes will be $\text{Rs. } 150,000,000 \times 14.801 = \text{Rs. } 2,220,150,000$. Dividing this by 25 gives the average cost of Rs. 88,806,000.

21. Marginal Costing vs Absorption Costing

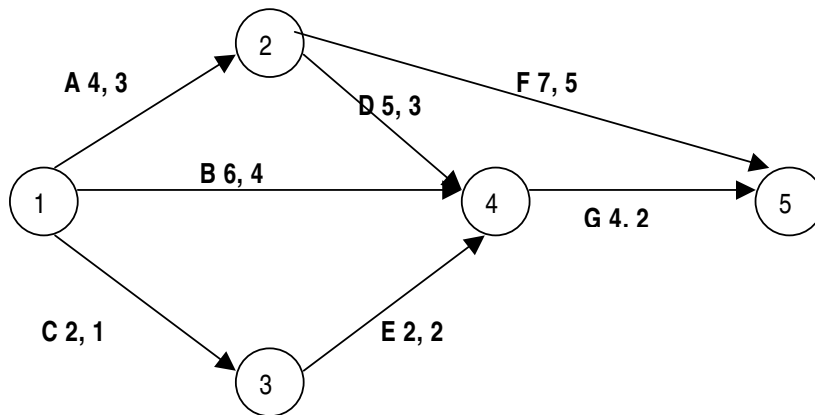
1. While applying Marginal Costing only variable costs are considered for Product Costing and Inventory Valuation purposes whereas both fixed and variable costs are considered while using Absorption Costing.
2. Expenses are classified on the basis of their nature i.e, fixed or variable in Marginal Costing whereas the classification of expenses is done on the basis of functions while applying Absorption Costing.
3. Marginal Costing considers fixed costs as period costs whereas the same costs are considered to be inventoriable costs for Absorption Costing purposes.
4. Marginal Costing reports emphasise more on the Contribution quantum whereas Absorption Costing highlights Net Profits.
5. The difference in the magnitude of the opening and the closing stock does not effect the unit cost of production in case Product Costing is done using the Marginal Costing concepts. However , in case Absorption Costing is used the unit cost of production may be effected due to the impact of fixed overheads.
6. There is no related Volume Variance in case a Marginal Costing system is used. However , in case of an Absorption Costing system , Volume Variance plays a prominent role for decision making and control purposes.

Limitations of Marginal Costing

- The use of Marginal Costing necessitates the need to classify expenses as fixed and variable. Frequently most of the expenses are semi-variable and so need to be divided amongst their variable and fixed components. This is difficult in practical situations.
- Contribution by itself is not a guide towards attaining optimum profitability. It needs to be interpreted along with the key factor.
- It is not practical to exclude overheads of fixed nature for valuing work-in-progress of large contracts. The use of Marginal Costing does not provide with useful results for decision making purposes nor does it give a correct valuation of the work-in-progress in such cases.
- Marginal Costing ignores the time factor as well as the investment involved for decision making purposes. For example two products may have the same Marginal Cost , however one of them can be produced in a shorter time and hence it should be the preferable produce. However , Marginal Costing ignores this time factor. Similarly the

quantum of investment involved for alternative uses available are not considered in Marginal Costing.

22.



from the diagram we have:

Path	Length	
	Normal Time (days)	Crash Time (days)
1 – 2 – 5	11	8 (<i>critical</i>)
1 – 2 – 4 – 5	13 (<i>critical</i>)	8 (<i>critical</i>)
1 – 4 – 5	10	6
1 – 3 – 4 – 5	8	5

Thus the normal duration of completion is 13 days while the minimum (crash) completion time of the project is 8 days.

Cost slope: The per day cost slope for each activity can be obtained as follows:

Cost slope = (Crash cost – Normal cost) / (Normal time – Crash time)

For activity A we have

Cost slope = $(90 - 60) / (4 - 3) = \text{Rs. } 30 \text{ per day}$

For the various activities the cost slopes are:

Activity	Node	Cost slope per day (Rs)
A	1 – 2	30
B	1 – 4	50
C	1 – 3	22
D	2 – 4	50
E	3 – 4	-
F	2 – 5	30
G	4 – 5	70

Crashing the step-wise crashing is given in the table 3 while the cost of completing the project in 13, 12 days is given in table 4

Table 3: Crashing the project

<i>Crashing</i>	<i>Critical Path</i>	<i>Options</i>	<i>Cost</i>	<i>Decisions</i>	<i>Duration after crashing</i>
I	1 – 2 – 4 – 5	1 – 2	30	Crash 1 – 2	12
		2 – 4	50		
		4 – 5	70		
II	1 – 2 – 4 – 5	2 – 4	50	Crash 2 – 4	11
		4 – 5	70		
III	1 – 2 – 4 – 5	2 – 4	50	Crash 2 – 4	10
		4 – 5	70		
IV	1 – 2 – 5	2 – 5, 4 – 5	100	Crash 2 – 5, 4 – 5	9
	1 – 2 – 4 – 5				
	1 – 4 – 5				
	1 – 2 – 5				
V	1 – 2 – 4 – 5	2 – 5, 4 – 5	100	Crash 2 – 5, 4 – 5	8
	1 – 4 – 5				

The length of various paths after each crashing is given here

<i>Path</i>	<i>Normal Length</i>	<i>Length after crashing</i>				
		<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
1 – 2 – 5	11	10	10	10	9	8
1 – 2 – 4 – 5	13	12	11	10	9	8
1 – 4 – 5	10	10	10	10	9	8
1 – 3 – 4 – 5	8	8	8	8	7	6

Table 4: Determination of Total cost

<i>Project Duration (days)</i>	<i>Direct Cost</i>	<i>Indirect Cost</i>	<i>Total Cost (Rs)</i>		
	<i>Normal</i>	<i>Crashing</i>	<i>Total</i>		
13	713	0	713	400	1113
12	713	30	743	250	993
11	713	80	793	175	968
10	713	130	843	100	943 (MIN)
9	713	230	943	75	1018
8	713	330	1043	50	1093

23. Material A is not yet owned. It would have to be bought in full at the replacement cost of Rs. 6 per unit.

Material B is used regularly by the company. There are existing stocks (600 units) but if these are used on the contract under review a further 600 units would be bought to replace them. Relevant costs are therefore 1,000 units at the replacement cost of Rs. 5 per unit.

1,000 units of material C are needed and 700 are already in stock. If used for the contract, a further 300 units must be bought at Rs. 4 each. The existing stock of 700 will not be replaced. If they are used for the contract, they could not be sold at Rs. 2.50 each. The realisable value of these 700 units is an opportunity cost of sales revenue forgone.

The required units of material D are already in stock and will not be replaced. There is an opportunity cost of using D in the contract because there are alternative opportunities either to sell the existing stocks for Rs. 6 per unit (Rs. 1,200 in total) or avoid other purchases (of material E), which would cost $300 \times \text{Rs. } 5 = \text{Rs. } 1,500$. Since substitution for E is more beneficial, Rs. 1,500 is the opportunity cost.

Summary of relevant costs

	Rs.
Material A ($1,000 \times \text{Rs. } 6$)	6,000
Material B ($1,000 \times \text{Rs. } 5$)	5,000
Material C ($300 \times \text{Rs. } 4$) plus ($700 \times \text{Rs. } 2.50$)	2,950
Material D	1,500
Total	15,450

24. The random number intervals are determined in the first place as shown in table 1 and 2

Table 1: Random Number Intervals for Demand (units)

Demand	No. of Days	Prob.	Cum. Prob.	Random No. Interval
5	15	.15	.15	00-14
6	25	.25	.40	15-39
7	30	.30	.70	40-69
8	18	.18	.88	70-87
9	8	.08	.96	88-95
10	4	.04	1.00	96-99

Table 2: Random Number Intervals for Lead Time (in days)

Lead time	Probability	Cum. Probability	Random Number Interval
3	.2	.20	00-19
4	.3	.50	20-49
5	.35	.85	50-84
6	.15	1.00	85-99

Table 3: Simulation Worksheet

Trials	Opening Balance	Random No.	Demand	Closing Balance	Random No.	Lead Time	Ordering Cost	Holding Cost	Shortage Cost
1	25	69	7	18	81	5	100	54	
2	18	61	7	11				33	
3	11	83	8	3				9	
4	3	85	8	0					100
5	0	27	6	0					120
6	40	57	7	33				99	
7	33	81	8	25				75	
8	25	48	7	18	86	6	100	54	
9	18	67	7	11				33	
10	11	52	7	4				12	

11	4	23	6	0					40
12	0	11	7	0					100
13	0	59	5	0					140
14	40	3	5	35				105	
15	35	3	5	30				90	
16	30	74	8	22				66	
17	22	64	7	15	40	4	100	45	
18	15	70	8	7				21	
19	7	43	7	0					0
20	0	87	8	0					160
Total Cost							300	696	660

25. The random number intervals are determined in the first place as shown in table 1 and 2

Table 1 Random Number Intervals (rained previously)

Event	Probability	Cum. Probability	Random Number Interval
No rain	.50	.5	00-49
1 cm rain	.25	.75	50-74
2 cm rain	.15	.90	75-89
3 cm rain	.05	.95	90-94
4 cm rain	.03	.98	95-97
5 cm rain	.02	1.00	98-99

Table 2 Random Number Intervals (No. Rain previously)

Event	Probability	Cum. Probability	Random Number Interval
No rain	.75	.75	00-74
1 cm rain	.15	.90	75-89
2 cm rain	.06	.96	90-95
3 cm rain	.04	1.00	96-99

The rainfall can now be predicted in accordance with the random number generated

Table 3: Simulation Worksheet

Day	Random Numbers	Rainfall (cm)	Table References
1	76	1	Table 2
2	78	2	Table 1
3	84	2	Table 1
4	75	2	Table 1
5	02	No rain	Table 1
6	86	1	Table 2
7	02	No rain	Table 1
8	78	1	Table 2
9	07	No rain	Table 1
10	63	No rain	Table 2

Total days without rain are 4 and total rain is 9 cm