

Preface

Dear Friends,

It is a great pleasure in presenting this workbook on Cost Management. The aim of this venture is to impart expert knowledge on various topics, which are of current importance world over. Most of the topics not only call for deeper understanding on the subject but also involve better presentation and transparency of information to investors, etc.

This workbook is intended primarily for students who are preparing for Cost Management paper at a senior level for all professional bodies.

The workbook basically confines to classroom discussions and the problems chosen here have been modeled from various standard works on the topics.

AUTHORS

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Cost management

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1 CHAPTER MARGINAL COSTING

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PVR, BEP & MOS-FORMULA APPLICATION:

A: Single product profit statement

Particulars	Amount
Sales	XXX
Less: Variable cost	XXX
Contribution	XXX
Less: Fixed cost	XXX
Profit	XXX

B: Multi-product profit statement

Particulars	A	B	C	Total
Sales	XXX	XXX	XXX	XXX
Less: Variable cost	XXX	XXX	XXX	XXX
Contribution	XXX	XXX	XXX	XXX
Less: Specific Fixed cost	XXX	XXX	XXX	XXX
Total	XXX	XXX	XXX	XXX
Less: General fixed cost				XXX
Profit				XXX

C: Formula

- 1) PVR = $(\text{Contribution} / \text{Sales})$ (or) $(\text{Change in profit} / \text{change in sales}) * 100$
- 2) Contribution = Sales X PVR
- 3) Sales = Contribution / PVR
- 4) BEP (in units) = Fixed Cost / Unit contribution.
- 5) BEP (in Rs.) = Fixed Cost / PVR.
- 6) MOS (in units) = Profit / unit contribution
- 7) MOS (in Rs.) = Actual Sales – Break even sales (or) Profit / PVR
- 8) Indifference point (in units) = Difference in Fixed Cost / Difference in Unit Variable Cost (or) unit contribution
- 9) Indifference point (in Rs.) = Difference in Fixed Cost / PVR
- 10) Shut down point (Rs) = $[\text{Avoidable Fixed Cost} - \text{Shut down Cost}] / \text{PVR}$
- 11) Shut down point (units) = $[\text{Avoidable Fixed Cost} - \text{Shut down Cost}] / \text{Contribution per unit}$

D: Assumptions in Marginal Costing

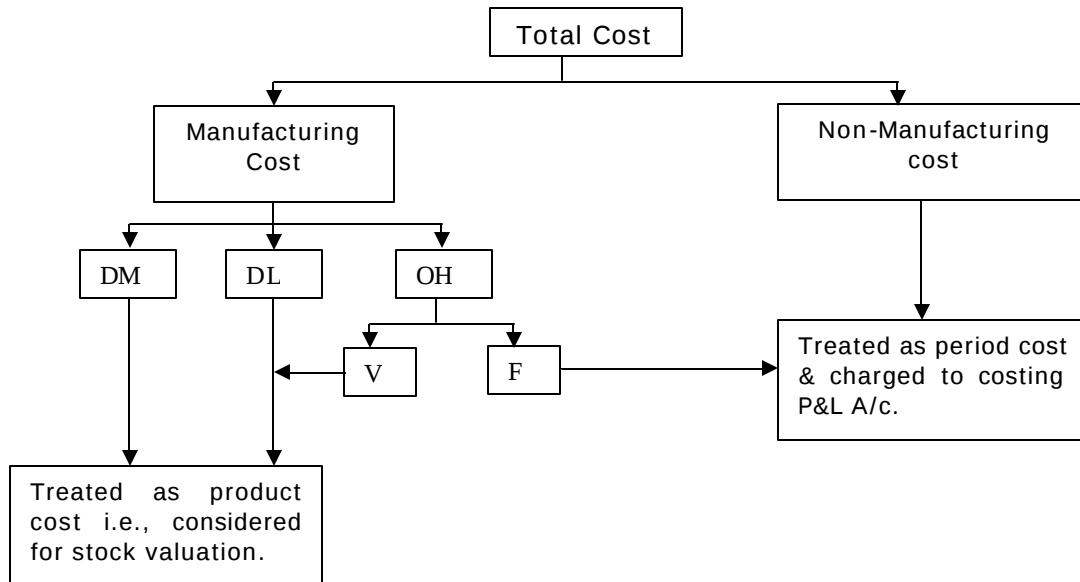
- 1) Absolute fixed cost is constant irrespective of level of activity.
- 2) Unit variable cost & selling price are constant.
- 3) Only volume is influencing the cost & revenue.
- 4) Constant sales mix.

E: Steps in solving problems involving limiting factor

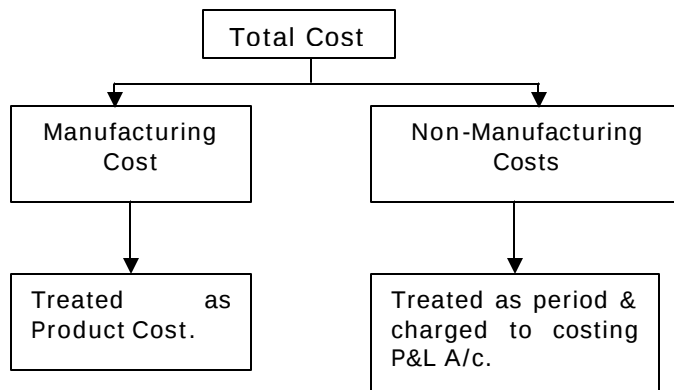
- 1) Identification of limiting factor.
- 2) Finding unit contribution.
- 3) Finding contribution per unit of limiting factor.
- 4) Ranking products based on (3).
- 5) Allocation of scarce resources.

F: Marginal Costing Vs Absorption Costing

Marginal Costing



Absorption Costing



Note: Stock valuation

1. Under marginal costing system the stock is valued at Variable manufacturing cost
2. Under absorption costing system the stock is valued at total manufacturing cost

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Question 1: Single product marginal cost sheet

A company producing a single article sells it at Rs.10 each. The marginal cost of production is Rs.6 each and fixed cost is Rs.400 per annum.

Calculate

- (a) The P/V ratio;
- (b) The break-even sales;
- (c) The sales to earn a profit Rs.500;
- (d) Profit at sales Rs.3, 000;
- (e) New break-even point if sales price is reduced by 10%.
- (f) MOS when the profit earned in Rs.200 and PVR – 40%.

Question 2: Sensitivity analysis

The Super company owns and operates six outlets in and around Kansas City. You are given the following corporate budget data for next year:

Revenues	10,000,000
Fixed costs	1,700,000
Variable costs	8,200,000

Variable costs change with respect to the number of units sold.

Required

Compute the budget operating income for each of the following deviations from the original budget data. (Consider each case independently.)

- a. A 10% increase in contribution margin, holding revenues constant.
- b. A 10% decrease in contribution margin, holding revenues constant.
- c. A 5% increase in fixed costs.
- d. A 5% decrease in fixed costs.
- e. An 8% increase in units sold.
- f. An 8% decrease in units sold.
- g. A 10% increase in fixed costs and 10% increase in units sold.
- h. A 5% increase in fixed costs and 5% decrease in variable costs.

Question: 3 Sensitivity analysis

If labour costs and material cost are likely to go up by 10% and 5% respectively per unit, what is the percentage increase necessary in selling price to keep the P/V of 20% as before, assuming that the ratio between material and labour is 3:2, and variable overheads is nil.

Question: 4 Merger of plants

A, B and C are three similar plants under the same management who want them to be merged for better operation. The details are as under:-

Plant	A	B	C
Capacity Operated %	100	70	50
	Rs.	Rs.	Rs.
	(in lakhs)	(in lakhs)	(in lakhs)
Turnover	300	280	150
Variable cost	200	210	75
Fixed costs	70	50	62

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Find out

- The capacity of the merged plant for break-even.
- The profit at 75% capacity of the merged plant.
- The turnover from the merged plant to give a profit of Rs.28 lakhs.

Question: 5

Segregation of Variable and Fixed Overhead

From the following information in respect of the semi-variable expenses obtain the fixed and variable elements using the following methods.

- Level of activity method.
- High low method.
- Simultaneous method.
- Scatter Graph method
- Least squares method

Find the probable amount of the semi-variable expense for the month of July, when the volume of production would be 60 units.

Month	Production	Semi variable expense
January	40	110
February	20	90
March	50	130
April	100	190
May	70	150
June	80	170

Question :6

Volume analysis

The following figures for profit & sales are obtained from the accounts of X Co. Ltd.

Year	Sales	Profit
	Rs.	Rs.
2002	20,000	2,000
2003	30,000	4,000

- Find out Contribution Sales Ratio.
- What is Break Even Sales
- Find out the sales to earn a profit of Rs.6000 in 2004.
- What is the profit when sales are Rs.12000 in 2004?

Question 7(a)

Shut down/Continue point

A firm incurs a fixed cost of Rs.1, 20,000 at 60% capacity. At 0% capacity, fixed cost is only Rs.40, 000. If its VC Ratio is 80%, find out the Shutdown point.

Question 7(b)

Shut down/Continue point

A paint manufacturing company manufacture 2,00,000 per annum medium – sized tins of “Spray Lac Paints” when working at normal capacity. It incurs the following costs of manufacturing per unit:

	(Rs.)
Direct Material	7.80
Direct Labour	2.10
Variable overheads	2.50
Fixed overheads	4.00
Product Cost per unit	16.40

The selling price is Rs.21 per and variable selling and administrative expenses is 60 paise per tin.

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During the next quarter only 10,000 units can be produced and sold. Management plans to shut down the plant estimating that the fixed manufacturing cost can be reduced to Rs.74, 000 for the quarter. When the plant is operating, the fixed overheads are incurred at a uniform rate throughout the year. Additional costs of plant shutdown for the quarter are estimated at Rs.14, 000.

- (a) Express your opinion, as to whether the plant should be shut down during the quarter, and
- (b) Calculate the shut down point for the quarter in terms of number of tins.

Question: 8 Shut down or continue

The annual budget of a company at 60% and 80% levels of performance is as under:

Level of Performance	60 %	80 %
	Rs.('000)	Rs.('000)
Direct Material	360	480
Direct Labour	480	640
Production Overhead	252	276
Administration Overhead	124	132
Selling & Distribution Overhead	136	148
	1352	1676

The company is in great difficulties at the present moment in selling its products and is now operating at 50% level.

The sales revenue for the year is estimated at Rs.9,90,000. The Directors are seriously considering suspending operations till the market picks up.

Market Research undertaken by the Company reveals that there is every indication that in about twelve months' time, the sales will pick up and the company can comfortably operate at 75% level of performance and earn a sales income of Rs.18 lakhs in that year.

The Sales personnel of the company do not want to suspend operations for fear of adverse reactions in the market; but the Directors want to decide the issue purely on financial consideration.

If the manufacturing and other operations of the company are suspended for a year, it is estimated that:

- a. The present fixed costs could be reduced to Rs.2,20,000 per annum.
- b. The settlement cost of personnel not required would amount to Rs.1,50,000.
- c. The maintenance of plant has to go on and that would cost Rs.20,000 per annum.
- d. On resuming operations, the costs connected with opening after a shut-down would amount to Rs.80,000.

Submit a report to the Directors and indicate therein, based on purely financial consideration, whether it would be advisable or not to suspend the company's operation in the current year.

Question: 9 Indifference point—Rudimentary

Two businesses AB Ltd. and CD. Ltd. sell the same type of product in the same type of market. Their budgeted Profit and Loss Accounts for the year ending 2005 are as follows:

	A.B Ltd.		C.D Ltd.	
	Rs.	Rs.	Rs.	Rs.
Sales		1,50,000		1,50,000
Less: Variable costs	1,20,000		1,00,000	
Fixed costs	15,000		35,000	
		1,35,000		1,35,000
Net profit budgeted		15,000		15,000

You are required to:

- a. Calculating the break-even point of each business;

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- b. Calculate the sales volume at which each of the business will earn Rs.5,000 profit; and
- c. State which business is likely to earn greater profits in conditions of:
 - i. Heavy demand for the product;
 - ii. Low demand for the product.
 Give your reasons.

Question: 10

Indifference point-- Rudimentary

Company	Variable cost per unit	Fixed cost
P	9	60000
Q	5	90000

At what sale range is P more profitable than Q and vice versa? Assume that both the products have the same selling price.

Question: 11

Differential costing

A company has a capacity of producing 1,00,000 units of certain products in a month. The Sales Department reports that the following schedule of sale prices is possible.

Volume of production	Selling price per unit
%	Rs.
60	0.90
70	0.80
80	0.75
90	0.67
100	0.61

The variable cost of manufacture between these levels is Re.0.15 per unit and fixed cost Rs.40,000.

- a. Prepare a statement showing incremental revenue and differential cost at each stage. At which volume of production will the profit be maximum?
- b. If there is a bulk offer at Rs.0.50 per unit for the balance capacity over the maximum profit volume for export and price quoted will not affect the internal sale, will you advise accepting this bid and why?

Question :12

Differential costing

X Ltd., having an installed capacity of 1,00,000 units of a product is currently operating at 70% utilisation. At current levels of input prices, the FOB unit costs (after taking credit for applicable export incentives) work out as follows:

Capacity Utilisation	FOB Unit Costs
%	Rs.
70	97
80	92
90	87
100	82

The company has received three foreign offers from different sources as under:

Source A	5,000 units at Rs.55 per unit FOB
Source B	10,000 units at Rs.52 per unit FOB
Source C	10,000 units at Rs.51 per unit FOB

Advise the company as to whether any or all export orders should be accepted or not.

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Question :13 Sales mix and BEP

Aravind Ltd. Manufactures and sells four products under the brand names A, B, C & D the following details are provided in respect of the products.

Product	A	B	C	D
% in Sales Value	30	40	20	10
% of Variable cost to selling price	60	70	80	30

The total budgetary sales (100%) are Rs.10, 00,000 p.m. fixed costs are Rs.2, 50,000 p.m. The company's new sales manager Aravind has suggested a change in sales mix keeping the total sales at Rs.10, 00,000 per month. His suggestion is as under:

Product	A	B	C	D
% in Sales Value	25	40	30	5

- (1) Calculate the break-even point for the Company, under the existing sales mix.
- (2) Compute the effect of implementing the suggested change in sales mix.
- (3) Explain the reasons for the effect of change in sales mix despite total sales and fixed cost being the same.

Question: 14 Sales mix and BEP

The budgeted results of A Co. Ltd. include:

Product	Sales value (Rs.)	P/V ratio
A	50,000	50%
C	80,000	40%
O	1,20,000	30%

Fixed overhead for the period Rs.1,00,000.

The directors are worried about the results of the company. They have requested you to prepare a statement showing the amount of loss of expected and recommend a change in the sales of each product or in total mix which will eliminate the expected loss.

Question: 15 Multiple break even points

A firm sells its product at Rs.25 per unit. Its Cost behaviour for various production ranges is:

Units of production	Cumulative fixed Cost	Variable Cost per Unit
0 –16,000	2,50,000	16.00
16,001 – 60,000	3,50,000	17.00
60,001 and above	5,00,000	20.00

Identify the break-even point(s) in units.

Question :16 Multiple break even points

SCV is a leading cable TV service provider with its operations spread over different cities. It has recently been approached by the city of Chennai to operate its cable television operations. Chennai city officials have become tired to reporting on the cable television company they have operated for the past five years.

SCV makes the following assumptions in its planning after negotiations with key parties.

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A basic set of 10 cable television stations will be offered at Rs.20 per month per subscriber. These 10 stations include a sports channel, a news channel and other general audience channels. Chennai would remain ownership of the physical facilities and would maintain them in working condition. Under a leasing agreement, SCV will pay Chennai the following charges:

- Fixed Commitment Charges: Rs.50, 000 per month if number of subscribers is 10,000 or less and Rs.75, 000 per month, if the number of subscribers is more than 10,000.
- Variable Revenue Share: 10% of the monthly revenues from the first 10,000 subscribers and 5% from additional subscribers.

SCV will receive the ten channels in its basic service form Interlink cable. Interlink acts as an intermediary between cable television stations and companies such as SCV, which sell to individual subscribers. Interlink charges a monthly-fixed fees of Rs.20, 000 plus monthly charge of Rs.8 per subscriber for the first 20,000 subscribers and Rs.6 per subsequent subscriber.

SCV estimates its own operating costs to include both a fixed and a variable component. The fixed component is Rs.55, 000 per month upto 20,000 subscribers. It is expected to increase by Rs.15, 000 per month, if number of subscribers exceeds 20,000. The variable cost per subscriber is Rs.2 per month.

Required:

- a) How does the contribution margin per subscriber behave over the 0 to 30,000 – subscriber range?
- b) Calculate the break even number of subscribers per month for SCV.
- c) What is the operating income per month to SCV with (a) 10,000 (b) 20,000 & (c) 30,000 subscribers? Comment on the results.

Question: 17

Multiple break even points

Kalyan University conducts a special course on 'Computer Applications' during summer. For this purpose, it invites applications from graduates. An entrance test is given to the candidates and based on the same, a final selection of a hundred candidates is made. The entrance test consists of four objective type of Examination and is spread over four days, one examination per day. Each candidate is charged a fee of Rs.50 for taking up the entrance test. The following data was gathered for the past two years:

Statement of Net Revenue from the Entrance Test for the course on "Computer Application"		
	Year 1 (Rs.)	Year 2 (Rs.)
Gross Revenue (Fees collected)	1,00,000	1,50,000
Costs		
Valuation	40,000	60,000
Question booklets	20,000	30,000
Hall rent at Rs.2, 000 per day	8,000	8,000
Honorarium to Chief Administrator	6,000	6,000
Supervision charges (1 supervisor for every 100 candidates at Rs.50/- per day)	4,000	6,000
General Administration Expenses	6,000	6,000
Total Cost	84,000	1,16,000
Net revenue	16,000	34,000

Required to compute:

- (a) The budgeted net revenue if 4,000 candidates take up the entrance test in Year 3.
- (b) The break even number of candidates.
- (c) The number of candidates to be enrolled if the net income desired is Rs.20, 000/-.

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Question: 18

Step fixed cost

The Chakrapani Ltd's Cost behaviour is as follows:

Production range in units	Fixed cost
0- 20000	Rs. 160000
20001 – 65000	Rs. 190000
65001 – 90000	Rs. 210000
90001 – 100000	Rs. 250000

At an activity of 70000 units per year, variable costs total 280000. Full capacity is 100000 units per year.

Required:

1. Production is now set at 50000 units per year with a sales price of Rs.7.50 per unit. What is the minimum number of additional units needed to be sold in an unrelated market at Rs.5.50 per unit to show a net profit of Rs.3000 per year?
2. Production is now set at 60000 units per year. By how much may sales promotion costs be increased to bring production up to 80000 units and still earn a net profit of 5% of total sales if the selling price is held at Rs.7.50?
3. If net profit is currently Rs.10000 with fixed costs at Rs.160000 and a 2% increase in price will leave units sold unchanged but increase profits by Rs.5000. What is the present volume in units?

Question: 19

Marginal costing vs Absorption costing

From the following data compute the profit under (a) Marginal costing, and (b) Absorption costing and reconcile the difference in profit.

	Rs. per unit
Selling price	8
Variable cost	4
Fixed cost	2

Normal volume of production is 26,000 units per quarter.

The opening and closing stocks consisting of both finished goods and equivalent units of work-in-progress are as follows:-

	Qr. I	Qr. II	Qr. III	Qr. IV	Total
Opening stock [units]	-	-	6,000	2,000	-
Production	26,000	30,000	24,000	30,000	1,10,000
Sales	26,000	24,000	28,000	32,000	1,10,000
Closing stock	-	6,000	2,000	-	-

Question: 20

Marginal costing vs Absorption costing

A new subsidiary of a group of companies was established for the manufacture and sale of Product X. during the first year of operations 90,000 units were sold at Rs.20 per unit. At the end of the year, the closing stocks were 8,000 units in finished goods store and 4,000 units in work-in-progress, which were complete as regards material content, but only half complete in respect of labour and overheads. You are to assume that there were no opening stocks. The work-in-progress account had been debited during the year with the following costs:

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Cost item	(Rs.)
Direct materials	7,14,000
Direct labour	4,00,000
Variable overhead	1,00,000
Fixed overhead	3,50,000

Selling and administration costs for the year were:

Cost item	Variable cost per unit sold	Fixed cost
Selling (Rs.)	1.50	2,00,000
Administration (Rs.)	0.10	50,000

The accountant of the subsidiary company had prepared a profit statement on the absorption costing principle, which showed a profit of Rs.11, 000.

The financial controller of the group, however, had prepared a profit statement on a marginal costing basis, which showed a loss. Faced with these two profit statements, the director responsible for this particular subsidiary company is confused.

Required to

- Prepare a statement showing the equivalent units produced and the production cost of one unit of Product X by element of cost and in total;
- Prepare a profit statement on the absorption costing principle which agrees with the company accountant's statement;
- Prepare a profit statement on the marginal costing basis;
- Reconcile the difference between the profits arrived in (b) & (c).

Question : 21

Indifference point -- Advanced

The current average weekly trading results of the HOTEL SARAVANA BHAVAN are shown below:

	(Rs.)	(Rs.)
Turnover		2,800
Operating costs:		
Materials	1,540	
Power	280	
Staff	340	
Building occupancy costs	460	2,620
Profit		Rs.180

The average selling price of each meal is Rs.4; materials and power may be regarded as a variable cost varying with the number of meals provided. Staff costs are semi-variable with a fixed cost element of Rs.200 per week; the building occupancy costs are all fixed.

Required:

Calculate the number of meals required to be sold in order to earn a profit of Rs.300 per week.

- The owners of the restaurant are considering expanding their business and using under-utilized space by diversifying into

Either (1) take –away foods, **or** (2) high quality meals.

The sales estimates for both proposals are rather uncertain and it is recognized that actual sales volume could be up to 20% either higher or lower than that estimated.

The estimated sales and costs of each proposal are:

Sales volume, per week	Take-away foods 720	High quality meals 200
	Meals (Rs.)	Meals (Rs.)
Average selling price, per meal	1.60	6.00
Variable costs, per meal	0.85	4.66
Incremental fixed costs, per week	610.00	282.00

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If either of the above proposals were implemented it has been estimated that the existing restaurant's operations would be affected as follows:

- (i) As a result of bulk purchasing, material costs incurred would be reduced by 10 p per meal. This saving would apply to all meals produced in the existing restaurant.
- (ii) Because more people would be aware of the existence of the restaurant it is estimated that turnover would increase. If the 'take-away food' section were opened then for every ten take-away meals sold the existing restaurant's sales would increase by one meal, alternatively if the 'high quality meals' section were open then for every five such meals sold the existing restaurant's sales would increase by one meal.

A specific effect of implementing the 'take-away food' proposal would be a change in the terms of employment of the staff in the existing restaurant, the result of which would be that the staff wage of Rs.340 per week would have to be regarded as a fixed cost.

Required:

Calculate, for each of the proposed methods of diversification:

- (i) The additional profit, which would be earned by the owners of the restaurant if the, estimated sales were achieved.
- (ii) The sales volume at which the owners of the restaurant would earn no additional profit from the proposed diversification.

Question :22

Indifference point -- Advanced

Super Press Ltd is considering launching a new monthly magazine at a selling price of Rs.1 per copy. Sales of the magazine are expected to be 5,00,000 copies per month, but it is possible that the actual sales could differ quite significantly from this estimate.

Two different methods of producing the magazine are being considered and neither would involve any additional capital expenditure. The estimated production costs for each of the two methods of manufacture, together with the additional marketing and distribution costs of selling the new magazine, are summarized below:

	Method A	Method B
Variable costs	55p per copy	50p per copy
Specific fixed costs	Rs.80, 000 per month	Rs.1, 20,000 per month

For semi-variable cost the following estimates have been obtained:

3,50,000 copies	Rs.55, 000 per month	Rs.47, 500 p.m.
4,50,000 copies	Rs.65, 000 per month	Rs.52, 500 p.m.
6,50,000 copies	Rs.85, 000 per month	Rs.62, 500 p.m.

It may be assumed that the fixed cost content of the semi-variable costs will remain constant throughout the range of activity shown.

The company currently sells a magazine covering related topics to those that will be included in the new publication and consequently it is anticipated that sales of this existing magazine will be adversely affected. It is estimated that for every ten copies sold of the new publication, sales of the existing magazine will be reduced by one copy.

Sales and cost data of the existing magazine are shown below:

Sales	2,20,000 copies per month
Selling price	85p per copy
Variable costs	35p per copy
Specific fixed costs	Rs.80, 000 per month

Required:

- (a) Calculate, for each production method, the net increase in company profits which will result from the introduction of the new magazine, at each of the following levels of activity:
 - 5,00,000 copies per month
 - 4,00,000 copies per month
 - 6,00,000 copies per month

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- (b) Calculate, for each production method, the amount by which sales volume of the new magazine could decline from the anticipated 5,00,000 copies per month, before the company makes no additional profit from the introduction of the new publication.
- (c) Briefly identify and conclusions which may be drawn from your calculations.

Question: 23

Limiting factor - Basic

The following particulars are extracted from the records company:-

	Product A	Product B
	Per unit	Per unit
Sales	Rs.100	Rs.120
Consumption of material	2 kg.	3 kg.
Material Cost	Rs.10	Rs.15
Direct wages cost	Rs.15	Rs.10
Direct expenses	Rs.5	Rs.6
Machine Hours used	3	2
Overhead expenses:		
Fixed	Rs.5	Rs.10
Variable	Rs.15	Rs.20

Direct wages per hour is Rs.5.

- a. Comment on profitability of each product (both use the same raw material) when
 - i. Total sales potential is limited;
 - ii. Raw material is in short supply;
 - iii. Production capacity (in terms of machine hours) is the limiting factor.
- b. Assuming Raw Material as the key factor, availability of which is 10,000 kg. and maximum sales potential of each product being 3,500 units, find out the product mix which will yield the maximum profit.

Question: 24

Limiting factor - ADVANCED

As a part of its rural upliftment programme, the Government has put under cultivation a farm of 96 hectares to grow tomatoes of four varieties: Royal Red, Golden Yellow, Juicy Crimson and Sunny Scarlet. Of the total, 68 hectares are suitable for all four varieties but the remaining 28 hectares are suitable for growing only Golden Yellow and Juicy Crimson. Labour is available for all kinds of farm and is no constraint. The market requirement is that all four varieties of tomatoes must be produced with a minimum of 1,000 boxes of any one variety.

The farmers engaged have decided that the area devoted to any crop should be in terms of complete hectares and not in fractions of a hectare. The other limitation is that not more than 20,000 boxes of any one variety should be produced. The following data are relevant.

	Varieties			
	Royal Red	Golden Yellow	Juicy Crimson	Sunny Scarlet
Annual Yield:				
Boxes per hectare	350	100	70	180
Costs:	Rs.	Rs.	Rs.	Rs.
Direct materials per hectare	476	216	196	312
Labour:				
Growing per hectare	896	608	371	528
Harvesting and packing per box	3.60	3.28	4.40	5.20
Transport per box	5.20	5.20	4.00	9.60
Market price per box	15.38	15.87	18.38	22.27

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Fixed overheads per annum	Rs.
Growing	11,200
Harvesting	7,400
Transport	7,200
General Administration	10,200

Required:

- Within the given constraints, the area to be cultivated with each variety of tomatoes if the largest total profit has to be earned.
- The amount of such profit in rupees.

Question: 25

Limiting factor - MAKE OR BUY

A company is preparing its production budget for the year ahead. Two of its processes are concerned with the manufacture of three components, which are used in several of the company's products. Capacity (machine hours) in each of these two processes is limited to 2,000 hours.

Production costs are as follows:

	Component X	Component Y	Component Z
	(Rs. per unit)	(Rs. per unit)	(Rs. Per unit)
Direct materials	15.00	18.50	4.50
Direct labour	12.00	12.50	8.00
Variable overhead	6.00	6.25	4.00
Fixed overhead			
Process M	6.00	6.00	4.50
Process N	10.50	10.50	3.50
	49.50	53.75	24.50

Requirements for components X, Y and Z (in units) for the following year:

X	300
Y	300
Z	450

Fixed overhead is absorbed on the basis of machine hours at the following rates:

Process M	Rs.3.00 per hour
Process N	Rs.3.50 per hour

Components X and Z could be obtained from an outside supplier at following prices per unit

X	Rs.44.00
Z	Rs.23.00

Required:

- Demonstrate that insufficient capacity is available to produce the requirements for components X, Y and Z in the year ahead, and calculate the extent of the shortfall.
- Determine the requirements for bought-in components in order to satisfy the demand for components at minimum cost.

Question: 26

Limiting factor - MAKE OR BUY

A processing company, EF, is extremely busy. It has increased its output and sales from 12,900 kg in quarter 1 to 17,300 kg in quarter 2 but, though demand is still rising, it cannot increase its outputs more than another 5% from its existing labour force which is now at its maximum. Data in quarter 2 for its four products were:

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	P	Q	R	S
Output (kg)	4,560	6,960	3,480	2,300
Selling price (Rs. per kg)	16.20	11.64	9.92	13.68
Costs (Rs. per kg):				
Direct labour (at Rs.6 per hour)	1.96	1.30	0.99	1.70
Direct materials	6.52	4.90	4.10	5.42
Direct packaging	0.84	0.74	0.56	0.70
Fixed overhead (absorbed on basis of direct labour cost)	3.92	2.60	1.98	3.40
Total	13.24	9.54	7.63	11.22

The XY Company has offered to supply 2,000 kg of any one of the products at a delivered price of 90% of EF's selling price. The company will then be able to produce extra another product in its place up to the plant's total capacity.

Required to state, with supporting calculations:

Which product should be purchased and which other product should be produced in its place up to the plant's total capacity so that the company reports the maximum profit? Assume XY's quality and delivery are acceptable.

Question: 27

Limiting factor - ADVERTISE OR NOT

X Ltd manufactures and sells a range of sports equipments. The marketing director would like to increase X Ltd's share of the market, and is considering an advertising campaign in order to stimulate demands for the products.

Two alternative sales budgets have been put forwarded for the year ahead.

	Product (000 units)			
	A	B	C	D
Budget 1 – without advertising	180	280	260	150
Budget 2 – with advertising	200	310	285	165

The advertising campaign would cost Rs.2, 90,000.

Selling prices and variable production costs are budgets as follows: [Rs. per unit]

Products	A	B	C	D
Selling prices	9.95	11.95	22.95	19.95
Variable production costs:				
Direct materials	4.20	5.50	12.70	10.40
Direct labour	1.70	1.70	2.80	2.65
Variable overheads	0.60	0.60	1.00	0.90

The variable overheads are absorbed on a machine hour basis at a rate of Rs.1.00 per machine hour. Fixed overheads total Rs.25, 70,000. Production capacity is limited to 7,15,000 machine hours in the year ahead. Products A and C could be bought-in, and X Ltd would be prepared to do this to make up any shortfall of production requirements if necessary and justify. Products A and C could be bought-in for Rs.8.90 per unit and Rs.20.00 per unit respectively.

If the advertising campaign was shown to be successful, increased production requirements would then be met in the long run by investment in additional facilities. In the meantime, the company would like to assess the potential of the advertising campaign in the year ahead, and if justified, determine the best way to obtain the required quantities of Products A and C.

Required:

On the basis of expectations for the year ahead, determine whether investment in the advertising campaign would be worthwhile and how production facilities would be best utilized.

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Question: 28

Limiting factor - SPACE CONSTRAINT IN A RETAIL SHOP

Z Ltd is a retailer with a number of shops selling a variety of merchandise. The company is seeking to determine the optimum location of selling space in its shops. Space is devoted to ranges merchandise in modular units, each module occupying seventy square meters of space. Either one or two modules can be devoted each range. Each shop has seven modular units.

Z Ltd has tested the sale of different ranges of merchandise and determined the following sales productivities:

	Sales in Rs.per module per week	
	1 Module	2 Module
Range A	6,750	6,250
Range B	3,500	3,150
Range C	4,800	4,600
Range D	6,400	5,200
Range E	3,333	3,667

The contribution (selling price – product cost) percentages of sales the five ranges are as follows:

Range A	20%
Range B	40%
Range C	25%
Range D	25%
Range E	30%

Operating costs are Rs.5, 600 per shop per week and are apportioned to ranges based on an average rate per module.

Required:

- Determine the allocation of shop space that will optimize profit, clearly showing the ranking order for the allocation of modules.
- Calculate the profit of each of the merchandise ranges selected in (a) above, and of the total shop.

Question: 29

ENQUIRY ON STAND - ALONE STATUS

The manager of a business has received enquiries about printing three different types of advertising leaflet. Information concerning these three leaflets is shown below:

	A	B	C
Selling prices per 1000 leaf lets	100	220	450
Estimated printing costs:			
Variable per 1000 leaflets	40	70	130
Specific fixed costs per month	2,400	4,000	9,500

In addition to specific fixed costs a further Rs. 4,000/- per month would be incurred in renting special premises if any or all of the above three leaflets were printed. The minimum printing order would be for 30,000 of each type of leaflet per month and the maximum possible order is estimated to be 60,000 of each leaflet per month.

Required

- Assuming that orders have been received to print each month 50,000 of both leaflet A and leaflet B calculate the quantity of leaflet C which would need to be ordered to produce an overall profit, for all three leaflets of Rs. 1,800/- per month.
- It is possible that a special type of paper used in printing leaflets will be difficult to obtain during the first few months. Three estimated consumption of this special paper for each type of leaflet is:

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Leaflet A	2 packs per 1000 leaflets
Leaflet B	6 packs per 1000 leaflets
Leaflet C	16 packs per 1000 leaflets

Advise the manager on the quantity of each leaflet which should be printed in order to maximize profit in the first month, if 50,000 of each type of leaflet have been printed there remains unfulfilled order of 10,000 for each type of leaflet and there 170 packs of special paper available for the rest of the month. What will be your reaction if the printing quantity is to be pack of 1000 leaflets?

- iii. Comment on the profitability of the leaflets assuming that they are stand-alone products.
- iv. Comment on the profitability, without making the above assumption.

Question: 30

Deleting a product line

The budgeted product profitability report of Midland Ltd for each of its products for the forthcoming year is as follows:

(Rupees in thousands)						
Product	V	W	X	Y	Z	Total
Sales	4,400	4,900	6,500	5,100	9,100	30,000
Manufacturing Costs:						
Materials	220	660	1,320	1,100	1,650	4,950
Labour	500	800	1,500	1,400	1,800	6,000
Production OH Variable	250	350	400	500	720	2,220
Production OH Fixed	350	600	1,100	1,000	950	4,000
Sub-total	1,320	2,410	4,320	4,000	5,120	17,170
Transport and Delivery Cost:						
Transport	120	360	720	600	650	2,450
Packaging	200	100	200	100	300	900
Sub-total	320	460	920	700	950	3,350
Selling and Advertising Expenses	720	545	525	555	755	3,100
Administration	660	735	975	765	1,365	4,500
Total Cost (Rs.)	3,020	4,250	6,740	6,020	8,190	28,120
Profit (Rs.)	1,380	750	(240)	(920)	920	1,880

The management accounts provides the following additional information concerning the basis on which the above report was prepared.

- (1) Material costs are a combination of variable material cost and a 10% surcharge which is added to the basic variable material cost in order to recover the fixed cost of storage and stores administration.
- (2) Labour is to be considered a variable cost.
- (3) Fixed production overhead comprises some directly attributable fixed costs, which are allocated to their appropriate product together with an apportionment of general fixed production overhead. The general production overhead amounts to Rs.30, 00,000 and is apportioned in proportion to labour costs, i.e. 50% of labour costs. The attributable fixed cost is avoidable if the product to which it relates is not produced.
- (4) Transport charge comprises a fixed cost of Rs.4, 50,000 and a variable charge. The fixed cost is apportioned to products in proportion to their material costs.
- (5) Selling and advertising expenses comprise advertising expenses directly related, and therefore directly attributed to each product and a sales commission, which equals 5% of sales revenue. Advertising costs are avoidable fixed costs.
- (6) Administration is a fixed cost and is apportioned in proportion to sales revenue.
- (7) Packaging is a variable cost.

The managing director feels that product X and Y should not be produced as they both result in a loss.

The marketing manager makes two points:

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- 1) Sales of any product can be increased by up to 40% of the sales figures contained on the above report merely by pursuing an additional expensive advertising campaign. If any product were selected to have its sales increased the additional advertising campaign would cost three times the currently planned cost of advertising that product. The relationship between advertising cost and increased sales applies to each product and has a proportional relationship, e.g. sales could be increased by 20% if advertising costs were increased by 150%.
- 2) By reducing sales (and production) of product X the demand for either V or W will rise depending upon which product is offered as a substitute for X. if V is offered as the substitute then each Rs.1 reduction in sales of X will cause a increase in sales of V of Rs.0.45. if W is the substitute then each Rs.1 reduction in sales of X will cause an increase in sales of W of Rs.0.50.

Required:

- a) Advise the managing director of the desirability of ceasing production of products X and Y and prepare a statement, which shows the effect that not producing X and Y will have on the profits of Midland Ltd.
- b) Show the effect of pursuing the advertising campaign mentioned by the marketing manager in order to increase sales of each product by 40%. Indicate which products it would be worth be worthwhile advertising.
- c) If only Rs.12, 00,000 is available for advertising indicate which products should then be advertised?
- d) Should sales (and production) of X be reduced in favour of either V or W? Show the effect of reducing sales of X to zero.

Question: 31

Deleting a factory

Lakshmana Ltd. manufactures a particulars type of lawn mower, which sells for Rs.150. Head office is in Ayodhya and its factories, are in three widely separated towns Brindavan Mathura and Panchavati. The company is facing not only increasing competition, but also a falling market for its product. The sales director forecasts that this year's sales will be 16% less than those for the year ended 30th April and that there is no possibility of an increase in selling price. It can be assumed that cost prices will not change during the year.

You are required to evaluate for management the possibility of closing one of the factories and of changing the output of one or both of the remaining two to maximise profit.

The summarised profit and loss statement for the year ended 30th April are as follows:

	Factories (in '000)		
	Brindavan	Mathura	Panchavati
Direct materials	1,200	4,800	2,400
Direct wages	600	3,000	1,440
Price cost	1,800	7,800	3,840
Variable production overhead	150	840	360
Fixed production overhead	750	2,640	1,200
Production cost	2,700	11,280	5,400
Administration overhead	300	1,800	840
Variable selling overhead	300	1,440	480
Fixed selling overhead	450	1,560	1,080
Head office costs	300	1,200	600
Total cost	4,050	17,280	8,400
Profit	450	720	600
Sales	4,500	18,000	9,000

Additional data:

- (i) Costs of closing down each factory can be ignored; it has been forecast that such costs will be offset by sale of plant, etc.

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- (ii) In general, there is sufficient capacity available at each factory to undertake additional production, if required. Each factory could increase its output up to twice the past year's level without the need for major investment, but additional costs would be incurred in respect of supervision, storage, maintenance etc. these additional facilities are readily available in each factory and their costs are forecast as follows:

	Brindavan Rs.'000	Mathura Rs.'000	Panchavati Rs.'000
If output compared with that of past year rises by			
1% - 25%	300	500	300
26% - 50%	350	600	400
51% - 75%	400	800	600
76% - 100%	500	1,000	700

- (iii) Transport costs would be affected if one of the factories were closed because the remaining factories would be required to supply customers in the particular area concerned. It is expected that sales in each area will be reduced in line with the sales director's forecast. Extra costs of transport per unit are forecasted as:

To factory Brindavan area	Rs.10
To factory Mathura area	Rs.15
To factory Panchavati area	Rs.12

Question: 32 Deletion – SERVICE SECTOR

As assistant to the accountant of a public passenger transport authority, you have been asked to:

- Prepare a statement showing the profitability of routes R1, R2 and R3 including the contribution per vehicle and contribution per mile after deducting all direct costs;
- Comment on a proposal that route R3 be discontinued;
- Comment on a proposal to reduce the service on route R3 by half on the assumption that only 4 vehicles would be used, operating for a total of 100,000 miles per annum and that the estimated revenue from passengers would be reduced by Rs.40,000 per annum. (You may assume that any surplus vehicles could be readily sold for their written down values.)

The latest information available for the last twelve months is as follows:

Routes	R1	R2	R3	Total
Number of vehicles used	12	16	8	36
Total mileage on each route in thousands	300	400	200	900
	Rs.000	Rs.000	Rs.000	Rs.000
Revenue from passengers	210	296	116	622
Direct costs – variable	150	200	100	450
Direct costs – fixed (specific to vehicles)	36	48	24	108
Fixed costs – apportioned (garage maintenance and administration)	24	32	16	72

Question: 33 Export or not

The Everest Snow Company manufactures and sells direct to consumers 10,000 jars of "Everest Snow" per month at Rs.1.25 per jar. The company's normal production capacity is 20,000 jars of snow per month. An analysis of costs for 10,000 jar show:

Direct material	1,000
Direct labour	2,475
Power	140
Miscellaneous supplies	430
Jars	600
Fixed expenditure for manufacture, selling & distribution	7,955
Total	12,600

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The company has received an offer for the export under a different brand name of 1,20,000 jars per annum at Re.0.75 a jar.

Write a short report on the advisability or otherwise of accepting the offer.

Question: 34

Sell or further process

A chemical company carries on production operations in two processes. Materials first pass through Process I, where a compound is produced. During the year the company produced 160000 kg of compound at a cost of Rs 160000.

Any quantity of the compound can be sold for Rs.1.60 per kg. Alternatively, it can be transferred to process II for further processing and packing to be sold as Star comp for Rs.2.00 per kg. Further materials are added in process II such that for every kg of compound used, 2 kg of star comp result.

Out of 1,60,000 kg, 40,000 kg are sold as compound and 1,20,000 kg are passed through process II for sale as Star comp. Process II has facilities to handle up to 1,60,000 kg of compound if required. The costs incurred in process II (other than the cost of the compound) are:

	1,20,000 kg of compound Input	1,60,000 Kg of Compound Input
Material (Rs.)	1,20,000	1,60,000
Processing Costs (Rs.)	1,20,000	1,40,000

Required:

- Demonstrate that it is worthwhile further processing 1,20,000 kg of compound.
- Calculate the minimum acceptable selling price per kg, if a potential buyer could be found for the additional output of Starcomp that could be produced with the remaining compound.

Question: 35

Preventive maintenance vs. break down maintenance

The budget estimates of a company using sophisticated high-speed machines based on a normal working of 50,000 machine hours during 2002 are as under:

	(Rs. Lakhs)
Sales (1,00,000 units)	100
Raw materials	20
Direct wages	20
Factory overheads – variable	10
- Fixed	10
Selling and distribution overheads – variable	5
- Fixed	5
Administration overheads-fixed	10
Total costs	80
Profit	20

Since the demand for company's product is high, the budget committee explores the possibilities of increasing the production. The Technical Director stated that maintenance has not been given due importance in the budget and that if preventive maintenance is introduced, the breakdown repair costs and hours lost due to break-down can be reduced and consequently production can be increased.

In support of this, he presented the following data, showing how injection of more and more funds on preventive maintenance will bring down the breakdown repair costs and reduce or eliminate the machine stoppages due to breakdown:

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Proposed Expenditure on Preventive maintenance	Expenditure estimated to be incurred on break-down	Machine hours saved
Rs. 19,200	Rs. 1,92,000	Nil
38,400	1,53,600	800
76,800	1,15,200	1,600
1,53,600	76,800	2,400
3,07,200	57,600	3,200
6,14,400	-	4,000

Using the differential cost and contribution concept, advise the management up to what level breakdown hours can be reduced to increase production and maximise profits of the company consistent with minimum costs.

Question: 36 Reprocessing defectives

Random samples of the product of a Factory reveals that 70% products are of standard quality, 15% are of second grade, 10% are of third grade, and the balance is scrapped. Selling price per unit of the product is Rs.100. out of the aforesaid list price 20% discount is allowed. In case of the second and third grades the discounts are 40% and 60% respectively.

The monthly production is 5,000 units gross. Variable Cost per unit is Rs.40. fixed Overheads amount to Rs.100000 per month.

The second grade product will require Rs.10, and the third grade Rs.20 per unit for reprocessing. Consider if reprocessing of the defectives should be undertaken.

Question: 37 Pricing and optimum output

A manufacturer has three products, A, B, and C. Currently sales, cost and selling price details and processing time requirements are as follows:

	Product A	Product B	Product C
Annual sales (units)	6,000	6,000	750
Selling price (Rs.)	20.00	31.00	39.00
Unit cost (Rs.)	18.00	24.00	30.00
Processing time required per unit (hours)	1	1	2

The firm is working at full capacity (13,500 processing hours per year). Fixed manufacturing overheads are absorbed into unit costs by a charge of 200% of variable cost. This procedure fully absorbs the fixed manufacturing overhead.

A review of the selling prices is in progress and it has been estimated that, for each product, an increase in the selling price would result in a fall in demand at the rate of 2,000 units for an increase of Rs.1 and similarly, that a decrease of Rs.1 would increase demand by 2,000 units. Specifically the following price/demand relationships would apply:

Product A		Product B		Product C	
Selling price	Estimated demand	Selling price	Estimated demand	Selling price	Estimated demand
24.50	2,000	34.00	2,000	39.00	2,000
23.50	4,000	33.00	4,000	38.00	4,000
22.50	6,000	32.00	6,000	37.00	6,000
21.50	8,000	31.00	8,000	36.00	8,000
20.50	10,000	30.00	10,000	35.00	10,000
19.50	12,000	29.00	12,000	34.00	12,000
18.50	14,000	28.00	14,000	33.00	14,000

From this information you are required to calculate the best selling prices, the best production plan and the net profit that this plan should produce.

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Question: 38

Competitive bidding

XY Ltd is to quote for contract No. 1701 to supply 10,000 units of a certain product to a large group with branches throughout the country.

It knows that the group will accept the lowest bid and, from past experience and good intelligence within the industry, estimates the following probabilities of bids at various levels (in multiples of Rs.5 only).

Price bid	Probability of bids at that price
45	0.05
50	0.10
55	0.20
60	0.25
65	0.25
70	0.10
75	0.05
	1.00

XY Ltd's out-of-pocket costs for these items are Rs.32 per unit.

Required to calculate the price XY Ltd should bid for this contract if it wishes to obtain the contract and maximize its profit margin.

Question: 39

Pricing under uncertainty

Z Ltd is considering various product pricing and material purchasing options with regard to a new product it has in development. Estimates of demand and costs are as follows:

		Sales volume at	
Selling price		Rs.15	Rs.20
Forecasts	Probability	(000 units)	(000 units)
Optimistic	0.3	36	28
Most likely	0.5	28	23
Pessimistic	0.2	18	13
Variable manufacturing costs (excluding materials) per unit		Rs.3	Rs.3
Advertising and selling costs		Rs.25, 000	Rs.96, 000
General fixed costs		Rs.40, 000	Rs.40, 000

Each unit requires 3 kg of material and because of storage problems any unused material must be sold at Re.1 per kg. The sole suppliers of the material offer three purchase options, which must be decided at the outset, as follows:

- (i) Any quantity at Rs.3 per kg, or
- (ii) A price of Rs.2.75 per kg for a minimum quantity of 50,000 kg, or
- (iii) A price of Rs.2.50 per kg for a minimum quantity of 70,000 kg.

You are required, assuming that the company is risk neutral, to

- (a) Prepare calculations to show what pricing and purchasing decisions the company should make, clearly indicating the recommended decisions;
- (b) Calculate the maximum price you would pay for perfect information as to whether the demand would be optimistic or most likely pessimistic.

Question: 40

Marginal costing under uncertainty

Nooks Ltd. which makes only one product, sells 10,000 units of its product making a loss of Rs.10000/-. The variable cost per unit of the product is Rs.8/- and the fixed cost is Rs.30000/-.

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Sales Units	Probability
10,000	0.10
12,000	0.15
14,000	0.20
16,000	0.30
18,000	0.25

- What is the probability that the company will continue to make losses?
- What is the probability that the company will make a profit of Rs.6000?
- What is the probability that the profit will be at the most Rs.2000?

Question: 41

Expected value of perfect information

D. Ltd. has to choose one between two machines – Machine A has low fixed costs and high unit variable costs whereas Machine B has high fixed costs and low unit variable costs. Consequently machine A is suited to low level demand while Machine B is suited to high level demand. It is assumed that there are only two possible demand levels – low and high – and the estimated probability of each of these events is 0.5. The estimated profits for each demand level are as follows;

	Low demand	High Demand
	Rs.	Rs.
Machine A	1,00,000	1,60,000
Machine B	10,000	2,00,000

There is a possibility of employing a firm of marketing consultants who would be able to provide a perfect prediction of the actual demand. What is the maximum amount the company should be prepared to pay the consultants for the additional information?

If D. Ltd. does not employ the marketing consultants; it has, by itself, to choose between the two machines. In that case work out the regret criteria.

Question: 42

Subcontract or not

A Company producing and selling a range of consumer durable appliances has its after-sales service work done by local approved sub-contractors.

The company is now considering carrying out all or some of the work itself and it has chosen one area in which to experiment with the new routine.

Some of the appliances are so large and bulky that repair / service work can only be done at the customers homes. Others are small enough for sub-contractors to take them back to their local repair workshops, repair them, and re-deliver them to the customer. If the company does its own after-sales service, it proposes that customers would bring these smaller items for repair to a local company service centre which would be located and organized to deal with visitors.

There is a **list price** to customers for the labour content of any work done and for materials used. However, the majority of the after – sales service work is done under an annual maintenance contract taken out by customers on purchasing the product; this covers the labour content of any service work to be done; but customers pay for materials used.

The price structure is:

For materials:

Price to sub-contractor : Company cost plus 10%

Price to customer : Sub-contractor's price plus 25%

For labour: Price to sub-contractor:

Work done under maintenance contract: 90% of list price

Ad hoc work (i.e. work NOT done under maintenance contract): 85% of list price.

Records show that 60% by value of the work has to be carried out customers' homes, while the remainder can be done anywhere appropriate.

The annual income that the company currently receives from sub-contractors for the area in which the experiment is to take place is:

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(Rs. '000)		
Labour	- Under maintenance contract	30
	- Ad hoc	12
Materials	- Under maintenance contract	18
	- Ad hoc	6
		66

The company expects the volume of after – sales work to remain the same as last year for the period of the experiment.

The company is considering the following options:

- (1) Set up a local service centre at which it can service small appliances only. Work at customers' houses would continue to be done under sub-contract.
- (2) Set up a local service centre to act only as a base for its own employees who would only service appliances at customers' homes. Servicing of small appliances would continue to be done under sub-contract.
- (3) Set up a local combined service centre plus base for all work. No work would be sub-contracted.

If the company were to do service work, annual fixed costs are budgeted to be:

Options	1	2	3
	(Rs.000)	(Rs.000)	(Rs.000)
Establishment costs (rent, rates, light, etc.)	40	15	45
Management costs	20	15	30
Storage staff costs	10	10	15
Transport costs (all vans / cars hired)	8	65	70
Repair / service staff	70	180	225

You are required:

To recommend which of the three options the company should adopt from a financial viewpoint.

Question: 43

Subcontract or own work force

A construction company has accepted a contract to lay underground pipe work. The contract requires that 2500m of 10" pipe and 2000m of 18" pipe be laid each week.

The limiting factor is the availability of specialized equipment. The company owns 15 excavating machines (type A) and 13 lifting and joining machines (type B). The normal operating time is 40 hours a week but up to 50% overtime is acceptable to the employees.

The time taken to handle each meter of pipe is:

Size of pipe	Minutes per meter	
	Machine A	Machine B
10"	6	12
18"	18	12

The costs of operating the machines are:

	Machine A	Machine B
	(Rs.)	(Rs.)
Fixed costs, per week, each	450	160
Labour, per crew, per hour:		
Up to 40 hours per week	10	12
Over 40 hours per week	15	18

The costs of materials and supplies per meter are:

10"	Rs.10
18"	Rs.5

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A subcontractor has offered to lay any quantity of the 10" pipe at Rs.18 per meter and of the 18" pipe at Rs.12 per meter.

You are required to:

- (a) Calculate the most economical way of undertaking the contract;
- (b) State the weekly cost involved in your solution to (a) above;

Question: 44

Production location

The PTO Division of the Galva Manufacturing Company produces the same power take-off units for the farm equipment business in two plants, a newly renovated, automated plant in Peoria, and an older, less automated plant in Moline. The PTO Division expected to produce and sell 192,000 power take-off units during the coming year. The following data are available for the two plants.

	Peoria		Moline	
Selling price		150.00		150.00
Variable manufacturing cost per unit	72.00		88.00	
Fixed manufacturing cost per unit	30.00		15.00	
Sales commission (5% of revenues)	7.50		7.50	
Variable marketing and distribution cost per unit	6.50		6.50	
Fixed marketing and distribution cost per unit	19.00		14.50	
Total cost per unit		135.00		131.50
Operating income per unit		Rs.15.00		Rs.18.50
Production rate per day	400 units		320 units	

All fixed costs per unit are calculated based on a normal year of 240 working days. When the number of working days exceeds 240, variable manufacturing costs increase by Rs.3.00 per unit in Peoria and Rs.8.00 per unit in Moline. Capacity for each plant is 300 working days per year.

Wishing to take advantage of the higher operating income per unit at Moline, PTO's production manager has decided to manufacture 96,000 units at each plant. This production plan results in Moline operating at capacity (320 units per day x 300 days) and Peoria operating at its normal volume (400 units per day x 240 days). Galva's corporate controller is not happy with this plan because he does not believe it represents optimal usage of PTO's plants.

Required:

- a. Determine the breakeven point in units for the Peoria and Moline plants.
- b. Calculate the operating income that would result from the production manager's plan to produce 96,000 units at each plant.
- c. Determine how the production of the 192,000 units should be allocated between the Peoria and Moline plants to maximize operating income for the PTO Division. What is the maximum operating income that the PTO Division can earn? Show your calculations.

Question: 45

Cost of prediction error

Modern Packaging Corporation specializes in the manufacture of plastic bottles through moulding operations. The firm has four moulding machines, each capable of producing 100 bottles per hour. The firm estimates that the variable cost of producing a plastic bottle is 20 paise. The bottles are sold for 50 paise each.

A local toy company that would like the firm to produce a moulded plastic toy for them has approached management. The Toy Company is willing to pay Rs.3 per unit for the toy. The variable cost to manufacture the toy will be Rs.2.40. In addition, Modern Packaging Corporation would have to incur a cost of Rs.20,000 to construct the needed mould exclusively for this order. Because the toy uses more plastic and is of a more intricate shape than a bottle, a moulding machine can produce only 40 units per hour. The customers want 1,00,000 units. Assume that modern packaging corporation has the total capacity of 10,000 machine hours available during the period in which the toy company wants the delivery of toys. The firm's fixed costs, excluding the costs to construct the toy mould, during the same period will be Rs.200,000.

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Required

- If the management predicts that the demand for its bottles will require the use of 7,500 machine hours (or) less during the period, should the special order be accepted? Give reasons.
- If the management predicts that the demand for its bottles will be higher than its ability to produce bottles, should the order be accepted? Why?
- The management has located a firm that has just entered the moulded plastic business. This firm has considerable excess capacity and more efficient moulding machines and is willing to subcontract the toy job (or) any portion of it, for Rs.2.80 per unit. It will construct its own toy mould. Determine modern Packaging Corporation's minimum expected excess machine hour capacity needed to justify production any portion of the order itself rather than subcontracting it entirely.
- The management predicted that it would have 1600 hours of excess machine capacity available during the period. Consequently, it accepted the toy order and subcontracted 36000 units to the other plastic company. In fact, demand for bottles turned out to be 9,00,000 units for the period. The firm was able to produce only 8,40,000 units because it had produced the toys. What was the cost of the prediction error of failure to predict demand correctly?

Question: 46

Market penetration – INCREMENTAL ANALYSIS

Cool Ltd., sells a gadget and has estimated the market capacity as 50,000 units a year. The directors have set the company, a sales objective of between 50% and 80% of this potential. The sales force is divided into five equal areas and the objective is expected to be achieved by using the salesmen in the following manner.

No of salesmen used per area	5	6	7	8	9	10	11
Penetration expected % market	50	58	65	71	76	78	80

All the products are manufactured at one location at an ex-factory cost of Rs.80 each and are sold at a standardised price of Rs.100 each. The transport and installation cost varies in relation to the distance from the factory as under

Sales area	1	2	3	4	5
Variable distribution cost Rs. per unit	10	8	6	4	2

At present 35 salesmen are employed at an average cost of Rs. 8,000/- each per annum. In 2001 the company employed its sales force equally in all these 5 areas. However in 2002 the company decided to use 25 salesmen to meet the basic 50% penetration in all areas and to concentrate the other ten salesmen equally in the two areas where the unit contribution is highest.

The calculations shown below indicate that in 2002 the profit will be nearly 6% lower than that in 2001.

	(Rs. In 000)			
	2001		2002	
Income from Sales		3,250		3,060
Ex-factory cost	2,600		2,448	
Distribution cost	195		167	
Salesmen cost	280	3,075	280	2,895
Total Contribution		175		165

You are required to:

- Analyze the total contribution area-wise for both 2001 and 2002.
- Explain briefly why concentrating on highest contribution areas has not increased profit.
- Calculate the highest total contribution possible using 35 salesmen.

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Question: 47

Inferior or Superior Grade Of Material

In the last quarter of 2001/02 it is estimated that RAGHUVARA LTD will have produced and sold 20,000 units of their main product by the end of the year. At this level of activity it is estimated that the average unit cost will be:

	(Rs.)
Direct material	30
Direct labour	10
Overhead: Fixed	10
Variable	10
	60

This is in line with the standard set at the start of the year. The management accountant of RAGHUVARA LTD is now preparing the budget for 2002/03. He has incorporated into his preliminary calculations the following expected cost increases:

Raw material: price increase of 20%

Direct labour: wage rate increased of 5%

Variable overhead: increase of 5%

Fixed overhead: increase of 25%

The production manager believes that if a cheaper grade of raw material were to be used, this would enable the direct material cost per unit to be kept to Rs.31.25 for 2002/03. The cheaper material would, however, lead to a reject rate estimated at 5% of the completed output and it would be necessary to introduce an inspection stage at the end of the manufacturing process to identify the faulty items. The cost of this inspection process would be Rs.40, 000 per year (including Rs.10, 000 allocation of existing factory overhead).

Established practice has been to reconsider the product's selling price at the time the budget is being prepared. The selling price is normally determined by adding a mark-up of 50% to unit cost. On this basis the product's selling price for 2001/02 has been Rs.90 but the sales manager is worried about the implications of continuing the cost-plus 50% rule for 2002/03. He estimates that demand for the product varies with price as follows:

Price Rs.	80	84	88	90	92	96	100
Demand (000)	25	23	21	20	19	17	15

You are required to decide whether RAGHUVARA LTD should use the regular or the cheaper grade of material and to calculate the best price for the product, the optimal level of production and the profit that this should yield.

Question: 48

CVP Analysis- A Guide To Product Design

Bharat Ltd is considering proposals for design changes in one of a range of soft toys. The proposals are as follows:

- (a) Eliminate some of the decorative stitching from the toy.
- (b) Use plastic eyes instead of glass eyes in the toys (two eyes per toy).
- (c) Change the filling material used. It is proposed that scrap fabric left over from the body manufacture be used instead of the synthetic material, which is currently used.

The design change proposals have been considered by the management team and the following information has been gathered:

- (i) Plastic eyes will cost Rs.15 per hundred whereas the existing glass eyes cost Rs.20 per hundred. The plastic eyes will be more liable to damage on insertion into the toy. It is estimated that scrap plastic eyes will be 10% of the quantity issued from stores as compared to 5% of issues of glass eyes at present.
- (ii) The synthetic filling material costs Rs.80 per tonne. One tonne of filling is sufficient for 2,000 soft boys.

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- (iii) Scrap fabric to be used as filling material will need to be cut into smaller pieces before as and this will cost Rs.0.05 per soft toy. There is sufficient scrap fabric for the purpose.
- (iv) The elimination of the decorative stitching is expected to reduce the appeal of the product, with an estimated fall in sales by 10% from the current level. It is not felt that the change in eyes or filling material will adversely affect sales volume. The elimination of the stitching will reduce production costs by Rs.0.60 per soft toy.
- (v) The current sales level of the soft toy is 3,00,000 units per annum. Apportioned fixed costs per annum are Rs.4, 50,000. The net profit per soft toy at the current sales level is Rs.3.

Required:

- (a) Using the information given in the question, prepare an analysis, which shows the estimated effect on annual profit if all three proposals are implemented, and which enables management to check whether each proposal will achieve an annual target profit increase of Rs.25, 000. The proposals for plastic eyes and the use of scrap fabric should be evaluated after the stitching elimination proposal has been evaluated.
- (b) Calculate the percentage reduction in sales due to the stitching elimination at which the implementation of all three design change proposals would result in the same total profit from the toy as that earned before the implementation of the changes in design.

Question: 49

CVP Analysis in Hotel Industry

A hotel budget for the year 2002 shows the following room occupancy:

		Average %
January	- March	45
April	- June	60
July	- September	90
October	- December	55

Revenue for the year is estimated to be Rs.3 million and arises from three profit centers:

Accommodation* 45%: Restaurant 35%: Bar 20%: Total 100%

*The accommodation revenue is earned from several different categories of guest, each of which pays a different rate per room.

The three profit centers have the following percentage gross margins:

	Accommodation		Restaurant		Bar	
	(%)		(%)		(%)	
Revenue		100		100		100
Wages	20		30		15	
Cost of sales	-		40		50	
Direct costs	10		10		5	
		30		80		70
Gross margin		70		20		30

Fixed costs for the year are estimated to be Rs.5, 65,000.

Capital employed is Rs.7 million.

As a means of improving the return on capital employed, two suggestions have been made:

- (i) To offer special two-night holidays at a reduced price of Rs.25 per night. It is expected that those accepting the offer would spend an amount equal to 40% of the accommodation charge in the restaurant, and 20% in the bar. Assume that the same PVR is maintained.
- (ii) To increase prices. Management is confident that there will be no drop in volume of sales if restaurant prices are increased by 10% and bar prices by 5%. Accommodation prices would also need to be increased.

You are required:

- (a) To calculate the budgeted return on capital employed before tax;
- (b) To calculate

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- (i) How many two-night holidays would need to be sold each week in the three off-peak quarters to improve the return on capital employed (ROCE) by a further 4% above the percentage calculated in (a) above;
- (ii) By what percentage the prices of accommodation would need to be increased to achieve the desired increase in ROCE shown in (b) (i) above;

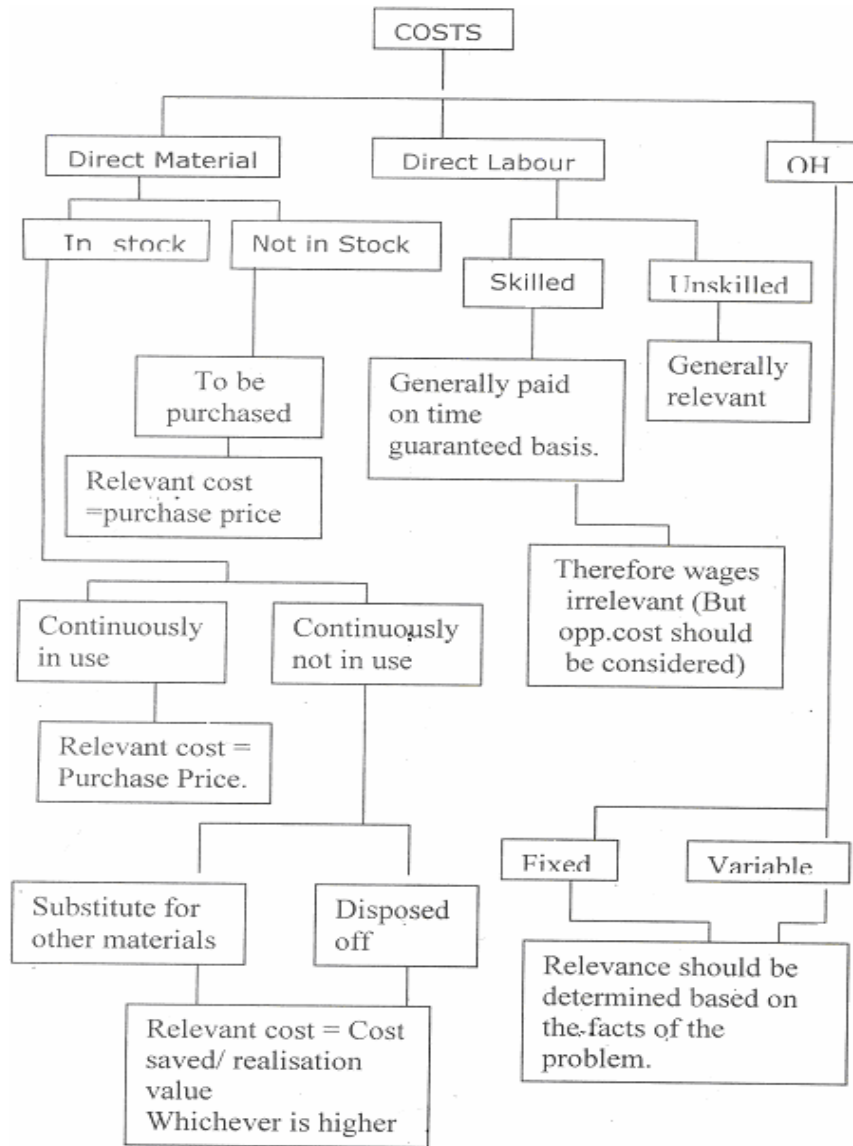
Question: 50

Break even charts

A company produces a single article and sells at Rs.10 each. The marginal cost of production is Rs.6 each and total fixed cost of the concern is Rs.400 per annum.

- (i) Construct a break-even chart and show: -
 - (a) Break-even point;
 - (b) Margin of safety at sales Rs.1, 500;
 - (c) Angle of incidence;
- (ii) Construct contribution chart & Profit chart.

RELEVANT COSTING



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Question: 1

Relevant cost of materials

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

Material	Total units required	Units already in stock	Book value of units in stock Rs. / unit	Realisable value Rs. / unit	Replacement cost Rs. / unit
A	1,000	0	-	-	6
B	1,000	600	2	2.5	5
C	1,000	700	3	2.5	4
D	200	200	4	6	9

- a) Material B is used regularly by X Ltd. and if stocks were required for this job they would need to be replaced to meet other production demand.
- b) Materials C and D are in stock as the result of previous excess purchase and they have a restricted use. No other use could be found for material C but material D could be used in another job as substitute for 300 units of Material E, which currently cost Rs. 5 per unit (of which the company has no units in stock at the moment).

What are the relevant costs of material, in deciding whether or not to accept the contract? Assume all other expenses on this contract to be specially incurred beside the relevant cost of material are Rs.550.

Question: 2

Relevant cost of labour

Ram Ltd is evaluating the feasibility of a contract requiring supply of 1000 units of component ZED. The labour specification for this contract is as follows:

Type of labour	Hours per unit	Rate per hour	Remarks
Skilled labour	4	5	#Difficult to recruit. #Paid on time-guaranteed basis.
Unskilled labour	6	3	#To be specifically hired for this contract.

Ascertain the relevant cost of labour for this contract.

Question: 3

Opportunity cost of labour

A Ltd is at present carrying out a research project, which requires spending of Rs 40000 towards skilled labour. They are highly skilled and it is difficult to replace them. They are paid on time guaranteed basis. Had they not been employed in this project, they could have been used in some other productive job fetching revenue of Rs 150000 to the company. For this job, the company has to incur a prime cost of Rs 100000.

Ascertain the relevant labour cost for this research project.

Question: 4

Relevance of temporary worker's wages

XYZ Ltd received an order to produce 10000 units of a Component named super-X. It requires 5 hours of skilled labour. The company already has in its roll an employee possessing the necessary skills, who is currently paid Rs 5 per hour on time guaranteed basis. At present he is busy with an urgent job, which would be affected on undertaking this order. To get this job continued the company has to hire a temporary employee who will be paid at Rs 4 per hour. Ascertain the relevant labour cost for producing the component super-X.

Question: 5

Cost savings due to deployment of labour

A Ltd is in construction business, which also carries out painting and maintenance work during severe, winter not being conducive for construction activities. At present the company is evaluating the viability of a proposal to build a housing complex, for which it has to employ contract basis a team of highly skilled craftsmen. The compensation for this team works out to

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Rs 300000. Though a period of 9 months is sufficient for completion of the contract, due to spells of bad weather it is estimated to be over in a year's time. During winter, this team could be used for painting and maintenance work already undertaken by the company, which otherwise would required to be subcontracted to outsiders. For this, the company has received quotations from two jobbing builders, one for Rs 50000 and another for Rs 40000. This painting and maintenance work, which if done by the company requires spending on material Rs 10000. Ascertain the relevant labour cost for building the housing complex.

Question: 6 **Relevance of overheads**

ABC Ltd receives an offer for producing 1000 units of components used in manufacture of aircraft. For manufacturing each and every unit 4 machine hours are required. The company absorbs overheads on the basis of machine hours. Currently, the machine hour rate is Rs 20 per hour, of which Rs 7 is variable and Rs 13 is fixed. If the contract is accepted, the company will additionally incur a fixed overhead of Rs 3200. Ascertain the relevant overhead cost for this contract.

Question: 7 **Continue or abandon project**

A research project, which to date has cost the company Rs.1, 50,000, is under review. It is anticipated that should the project be allowed to proceed, it will be completed in approximately one year when the results would be sold to a government agency for Rs.3, 00,000.

Shown below are the additional expenses, which the managing director estimates will be necessary to complete the work.

Materials - Rs.60, 000.

This material, which has just been received, is extremely toxic and if not used on the project would have to be disposed of by special means, at cost of Rs.5,000.

Labour - Rs.40, 000.

The men are highly skilled and very difficult to recruit. They were transferred to the project from a production department and, at a recent board meeting, the works director claimed that if the men were returned to him he could earn the company each year Rs.1, 50,000 extra sales. The accountant calculated that the prime cost of those sales would be Rs.1, 00,000 and the overhead absorbed (all fixed) would amount to Rs.20, 000.

Research staff - Rs.60, 000.

A decision has already been taken that this will be the last major piece of research undertaken, and consequently when work on the project ceases the staff involved will be made redundant. Redundancy and severance pay have been estimated at Rs.25, 000.

Share of general building services - Rs.35, 000.

The managing director is not very sure what is included in this expense. He knows, however, that the accounts staff charges similar amounts every year to each department.

Required:

Assuming the estimates are accurate, advise the managing director whether the project should be allowed to proceed. You must carefully and clearly explain the reasons for your treatment of each expense item.

Question: 8 **Accept or reject contract**

JB Limited is a small specialist manufacturer of electronic components and the makers of aircraft for both civil and military purposes use much of its output. One of the few aircraft manufacturers has offered a contract to JB Limited for the supply, over the next twelve months, of 400 identical components.

The data relating to the production of each component is as follows:

- (i) Material requirements:
3 kg material M1 – see note 1 below
2 kg material P2 – see note 2 below
1 Part No. 678 – see note 3 below

Note 1. Material M1 is in continuous use by the company. 1000 kg are currently held in stock at a book value of Rs.4.70 per kg but it is shown that future purchases will cost Rs.5.50 per kg.

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Note 2. 1,200 kg of material P2 are held in stock. The original cost of this material was Rs.4.30 per kg but as the material has not been required for the last two years it has been written down to Rs.1.50 per kg scrap value. The only foreseeable alternative use is as a substitute for material P4 (in current use) but this would involve further processing costs of Rs.1.60 per kg. The current cost of material P4 is Rs.3.60 per kg.

Note 3. It is estimated that the Park No. 678 could be bought for Rs.50 each.

- (ii) Labour requirements: Each component would require five hours of skilled labour and five hours of semi-skilled. An employee possessing the necessary skills is available and is currently paid Rs.5 per hour. A replacement would, however, have to be obtained at a rate of Rs.4 per hour for the work, which would otherwise be done by the skilled employee. The current rate for semi-skilled work is Rs.3 per hour and an additional employee could be appointed for this work.
- (iii) Overhead: JB Limited absorbs overhead by a machine hour rate, currently Rs.20 per hour of which Rs.7 is for variable overhead and Rs.13 for fixed overhead. If this contract is undertaken it is estimated that fixed costs will increase for the duration of the contract by Rs.3, 200. Spare machine capacity is available and each component would require four machine hours.

You are required to:

State whether or not the contract should be accepted and support your conclusion with appropriate figures for presentation to management.

Question: 9 **Accept or reject contract**

The Arya Ltd has been offered a contract that, if accepted, would significantly increase next year's activity levels. The contract required the production of 20,000 kg of Product X and specifies a contract price of Rs.100 per kg. The resources used in the production of each kg of X include the following:

Cost item	Resources per kg of X
Labour	
Grade 1	2 hours
Grade 2	6 hours
Materials	
A	2 units
B	1 litre

Grade 1 labour is highly skilled and, although it is currently under-utilized in the firm, it is Arya Ltd's policy to continue to pay grade 1 labour in full. Acceptance of the contract would reduce the idle time of grade 1 labour. Idle time payments are treated as non-production overheads.

Grade 2 is unskilled labour with a high turnover, and is considered a variable cost.

The costs to Arya of each type of labour are

Grade 1	Rs.4 per hour
Grade 2	Rs.2 per hour

The material required to fulfill the contract would be drawn from those materials already in stock. Material A is widely used within the firm, and any usage for this contract will necessitate replacement. Material B was purchased to fulfill an expected order that was not received; if material B is not used for the contract, it will be sold. For accounting purposes FIFO is used. The various values and costs for A and B are:

	A per unit (Rs.)	B per litre (Rs.)
Book value	8	30
Replacement cost	10	32
Net realizable value	9	25

A single recovery rate for fixed factory overheads is used throughout the firm, even though some fixed production overheads could be attributed to single products or departments. The overhead is recovered per productive labor hour, initial estimates of next year's activity which excludes the

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current contract, show fixed production overhead Rs. 6,00,000 and productive labour hours of 3,00,000. Acceptance of the contract would increase fixed production overheads by Rs.2, 28,000.

Variable production overheads are accurately estimated at Rs.3 per productive labour hour. Acceptance of the contract would be expected to encroach on the sales and production of another product Y, which is also made by Arya Ltd. It is estimated that sales of Y would then decrease by 5,000 units in the next year only. However, this forecast reduction in sales of Y would enable attributable fixed factory overheads of Rs.58, 000 to be avoided. Information on Y is as follows:

	Per unit
Sales price	Rs.70
Labour: Grade 2	4 hours
Materials: relevant variable costs	Rs.12

Required:

Advise Arya on the desirability of the contract.

Question: 10 Minimum short-run pricing

Vishwakarma is a builder. His business will have spare capacity over the coming six months and he has been investigating two projects.

Project A

Vishwakarma is tendering for a school extension contract. Normally he prices a contract by adding 100% to direct costs, to cover overheads and profit. He calculates direct costs as the actual cost of materials valued on a first-in-first-out basis, plus the estimated wages of direct labour. But for this contract he has prepared more detailed information.

Four types of material will be needed:

Material	Quantity (units):		Price per unit: (in Rs.)		
	Needed for contract	Already in stock	Purchase price of units in stock	Current purchase price	Current resale price
Z	1,100	100	7.00	10.00	8.00
Y	150	200	40.00	44.00	38.00
X	600	300	35.00	33.00	25.00
W	200	400	20.00	21.00	10.00

Z and Y are in regular use. Neither X nor W is currently used; X has no foreseeable use in the business, but W could be used on other jobs in place of material currently costing Rs.16 per unit.

The contract will last for six months and requires two craftsmen, whose basic annual wage cost is Rs.16, 000 each. To complete the contract in time it will also be necessary to pay them a bonus of Rs.700 each. Without the contract they would be retained at their normal pay rate, doing work, which will otherwise be done by temporary workers, engaged for the contract period at a total cost of Rs.11, 800.

Three casual labourers would also be employed specifically for the contract at a cost of Rs.4, 000 each.

The contract will require two types of equipment: general- purpose equipment already owned by Vishwakarma, which will be retained at the end of the contract, and specialized equipment to be purchased second-hand, which will be sold at the end of the contract.

The general-purpose equipment cost Rs.21, 000 two years ago and is being depreciated on a straight-line basis over a seven-year life (with assumed zero scrap value). Equivalent new equipment can be purchased currently for Rs.49, 000. Second-hand prices for comparable general-purpose equipment, and those for the relevant specialized equipment, are shown below.

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	General – purpose equipment		Specialized equipment	
	Purchase price	Resale price	Purchase price	Resale price
	(Rs.)	(Rs.)	(Rs.)	(Rs.)
Current	20,000	17,200	9,000	7,400
After 6 months:				
If used for 6 months	15,000	12,600	7,000	5,800
If not used	19,000	16,400	8,000	6,500

The contract will require the use of a yard on which Vishwakarma has a four-year lease at a fixed rental of Rs.2, 000 per year. If Vishwakarma does not get the contract the yard will probably remain empty. The contract will also incur administrative expenses estimated at Rs.5, 000.

Project B

If Vishwakarma does not get the contract he will buy a building plot for Rs.20, 000 and build a house. Building costs will depend on weather conditions:

Weather condition	A	B	C
Probability	0.4	0.4	0.2
Building costs (excluding land)	Rs.60, 000	Rs.80, 000	Rs.95, 000

Similarly the price obtained for the house will depend on market conditions:

Market condition	D	E
Probability	0.7	0.3
Sale price (net of selling expenses)	Rs.1, 00,000	Rs.1, 20,000

Vishwakarma does not have the resources to undertake both projects. The costs of his supervision time can be ignored.

Requirements:

- (a) Ignoring the possibility of undertaking project B, calculate:
 - (i) The price at which Vishwakarma would tender for the school extension contract if he used his normal pricing method, and
 - (ii) The tender price at which you consider Vishwakarma would neither gain nor lose by taking the contract.
- (b) Explain, with supporting calculations, how the availability of project B should affect Vishwakarma's tender for the school extension contract.

Question: 11

Limiting factor and relevant costing

Following a fire at the factory of Elgar Ltd, the management team met to review the proposed operations for the next quarter. The fire had destroyed all the finished goods stock, some of the raw materials and about half of the machines in the forming shop.

At the meeting of the management team the following additional information was provided.

- (i) Only 27,000 machine hours of forming capacity will be available in the forthcoming quarter. Although previously it was thought that sales demand would be the only binding limitation on production it has now become apparent that for the forthcoming quarter the forming capacity would be a limiting factor.
- (ii) It will take about three months to reinstate the forming shop to its previous operational capacity. Hence the restriction on forming capacity is for the next quarter only.
- (iii) Some details of the product range manufactured by Elgar are provided in the following table:

Product	A	B	C	D	E
Sales price (Rs.)	50	60	40	50	80
Units of special material required for production:					
W or X	2	2	2	1	3
Y	-	-	-	-	6
Z	1	2	1	1	-
Other direct material costs (Rs.)	6	12	6	5	13
Other variable production costs (Rs.)	8	4	8	4	4
Fixed production costs (based on standard costs) (Rs.)	6	3	6	3	3
Forming hours required	5	6	2	10	6

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- (iv) The forecasts of demand, in units, for the forthcoming quarter are:

	Product A	Product B	Product C	Product D	Product E
Units demanded	2,000	2,000	4,000	3,000	4,000

It was originally intended that the number of units produced would equal the units demanded for each product.

- (v) Due to a purchasing error there is an excess of material W in stock. This has a book value of Rs.6 per unit, which is also its current replacement cost. This could be sold to realize Rs.4 per unit after sales and transport costs. Material X could be used instead of material W; material X is not in stock and has a current replacement cost of Rs.5 per unit.
- (vi) Material Y was in stock at a book value of Rs.2 per unit, which is its normal cost if ordered 3 months in advance, but the stocks of this material were entirely destroyed by the fire. In order to obtain the material quickly a price of Rs.3 per unit will have to be paid for the first 3000 units obtained in the quarter and any additional units required will cost Rs.6 per unit. These special prices will apply only to this quarter's purchases.
- (vii) The fire destroyed some of the stock of material Z. The remaining stocks of 2,000 units have a book value of Rs.7 per unit. The replacement price for Z is currently Rs.8 per unit.
- (viii) As a result of the fire it is estimated that the fixed production costs will be Rs.42, 000 for the next quarter and the administration and office overheads will amount to Rs.11, 500.
- (ix) The demand figures shown in note (iv) include a regular order from a single customer for 3,000 units of C, and 3,000 units of E.

This order is usually placed quarterly and the customer always specifies that the order be fulfilled in total or not at all.

Required:

- (a) Ignoring the information contained in note (ix) for this section of the question, determine the optimum production plan for the forthcoming quarter and the resulting profit.
- (b) Prepare a statement, which clearly shows the management of the company the financial consequences of both acceptance and rejection of the order mentioned in note (ix).

Question: 12

Launching of new product using spare capacity.

Ram Ltd has spare capacity in two of its manufacturing departments – Department 4 and Department 5. A five-day week of 40 hours is worked but there is only enough internal work for three days per week so that two days per week (16 hours) could be available in each department. In recent months Ram Ltd has sold this time to another manufacturer but there is some concern about the profitability of this work.

The accountant has prepared a table giving the hourly operating costs in each department. The summarized figures are as follows:

	Department 4	Department 5
	(Rs.)	(Rs.)
Power costs	40	60
Labour costs	40	20
Overhead costs	40	40
	120	120

The labour force is paid on a time basis and there is no change in the weekly wage bill whether or not the plant is working at full capacity. The overhead figures are taken from the firm's current overhead absorption rates. These rates are designed to absorb all budgeted overhead (fixed and variable) when the departments are operating at 90% of full capacity (assume a 50 week year). The budgeted fixed overhead attributed to Department 4 is Rs.36, 000 p.a. and that for Department 5 is Rs.50, 400 p.a.

As a short term expedient the company has been selling processing time to another manufacturer who has been paying Rs.70 per hour for time in either department. This customer is very willing to continue this arrangement and to purchase any spare time available but Ram

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Ltd is considering the introduction of a new product on a minor scale to absorb the spare capacity.

Each unit of the new product would require 45 minutes in Department 4 and 20 minutes in Department 5. The variable cost of the required input material is Rs.10 per unit. It is considered that:

- With a selling price of Rs.100 the demand would be 1,500 units p.a.;
- With a selling price of Rs.110 the demand would be 1,000 units p.a.; and
- With a selling price of Rs.120 the demand would be 500 units p.a.

You are required to calculate the best weekly programme for the slack time in the two manufacturing departments and to determine the best price to charge for the new product.

Question: 13 Allow strike or not

(a) A company manufacturing agricultural machinery is faced with the possibility of a strike by its direct production workers engaged on the assembly of one of its machine.

The trade union is demanding an increase of 7% back-dated to the beginning of its financial year and the company expect that if a strike does take place, it will last four weeks after which the union will settle for an increase of 5% similarly back-dated.

The machine whose production would be affected by the strike is sold to distributors at a discount of 20% from the current recommend-selling price of Rs.3, 000.

Estimated costs for the machines are:

	Fixed per year	Variable per machine
	Rs.	Rs.
Production	16,000	1,800
Distribution	1,000	100

Direct labour costs comprise 40% of the variable production costs.

The budgeted output is 27,500 machines in 50 working weeks per year.

If the strike takes the company expects the following events:

- Maintenance staff, whose wages are included in the fixed production costs, would be used to carry out an overhaul of the conveyor system using Rs.25, 000 worth of material. An outside contractor at a cost of Rs.1, 00,000 including materials, would otherwise undertake this overhaul.
- Sales of 650 machines would be lost to competition. The balance that would ordinarily have been produced during the strike period could, however, be sold, but these machines would have to be made up in overtime working which would be at an efficiency rate of 90% of normal. This would entail additional fixed costs of Rs.10, 000 and wage payments at time and one-half.

You are required to

State, with explanations and full supporting data, whether from a purely economic point of view you would advise the management to allow the strike to go ahead, rather than agree to the union's demand.

(b) Assume that the strike goes ahead, and that it lasts three weeks, after which agreement is reached between the company and the union for a 6% pay increase backdated to 1st January. Assume also that the anticipated loss of sales to competitors of 650 machines occurs and overtime working makes up the balance.

A newspaper reports that the cost of the strike to the company was Rs.5 million. The trade union counters this claim by insisting that the company, to its benefit, contrived the strike, as the machines were selling at a loss.

You are required to

- (i) Comment on the statements made by the press and the trade union;
- (ii) State, with supporting calculations, whether the company was justified in using overtime working to produce the balance of machines saleable but not produced during the strike.

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Question: 14

Effect of strike

Supreme Auto Ltd suffered a strike by production labour that lasted for two weeks. During that period, no cars were produced. The company issued a statement to the press that the cost of the strike was Rs.50 crores this figures was estimated on the basis of lost production of 1000 vehicles of an average price of Rs.5 lakhs each. The company's accountant feels that this figure is released in a hurry and overstates the cost of the strike.

He produces the following statement to support his views:

	Rs. in lakhs
Materials (Rs.1 lakh per car)	1,000
Production Labour (Rs.0.50 lakh per car)	500
Depreciation of machinery	1,750
Overhead (200% of production labour)	1,000
Total expenses avoided	4,250
Loss of revenue	5,000
Cost of strike	750

The following additional information is available

- Depreciation of machines is based on the straight-line method of calculation. However, the plant manager estimates that the machines will fall in value by Rs.125 lakhs per week regardless of the level of production. He feels that in addition, its value will fall by Rs.150 lakhs for every 100 cars that are produced.
- Overhead expenses are recorded at the rate of 200% on production labour. Most of the overhead expenses are unaffected by the level of production; for example, rent, rates, maintenance and staff wages. But some such as power and lighting vary directly with production. The general manager estimates that the later type of overhead expenses amount to Rs.10 lakhs for every 100 cars produced.
- During the period of the strike, the maintenance staff, whose wages are included in the fixed overhead expenses, carried out a major overhaul on some of the machines using material costing Rs.10 lakhs. This overhaul would normally have been performed by an outside contractor at a price (including materials) of Rs.100 lakhs.
- The sales manager feels that about 50% of the production lost could be made up and sold in the next month by the production labour working overtime. Labour is paid at the rate of time and half for overtime working.

You are requested to advise a major shareholder who doubts the validity of both and press statement and the accountant's statement as to the true cost of the strike.

Question: 15

Relevant costing and uncertainty

W Ltd. is to produce new products in Short-term Venture which will utilize some obsolete materials and expected spare capacity. The new product will be advertised in Quarter I with production and sales taking place in Quarter II. No further production or sales are anticipated. Sales volumes are uncertain but will, to some extent, be a function of sales price. The possible sales volumes and the advertising costs associated with each potential sales price are follows:

Sales price Rs.20 per unit		Sales price Rs.25 per unit		Sales price Rs.40 per unit	
Sales Volume (units000's)	Probability	Sales Volume (units000's)	Probability	Sales Volume (units 000's)	Probability
4	0.1	2	0.1	0	0.2
6	0.4	5	0.2	3	0.5
8	0.5	6	0.2	10	0.2
-	-	8	0.5	15	0.1
Advertising cost	Rs.20,000	Rs.50,000		Rs.1,00,000	

The resources use in the production of each unit of the product are

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Production	: Grade I – 2 Hours : Grade II – 1 Hours
Materials	X – 1 units Y – 2 units

The normal cost per hour of labour is

Grade	I – Rs.2
Grade	II – Rs.3

However, before considering the effect of the current venture there is expected to be 4,000 hours of idle time for each grade of labour in Quarter II. Idle time is paid at the normal rates.

Material X is in stock at a book value of Rs.8 per unit is widely used within the firm and any usage for the purposes of this venture will require replacing. Replacement cost in Rs.9 per unit.

Material Y is obsolete stock. There are 16,000 units in stock at a book value of Rs.3.50 per unit any stock not used will have to be disposed of a cost, to W. Ltd. of Rs.2 per unit. Further quantities of Y can be purchased for Rs.4 per unit.

Overhead recovery rates are:

Variable Overhead Rs.2 per direct labour hour worked. Fixed Overhead Rs.3 per direct labour hour worked. Total fixed overheads not alter as a result of the current venture.

Feedback from advertising will enable the extract demand to be determined at the end of Quarter I and production in Quarter II and production in Quarter if will be set to equal that demand. However it is necessary to decide now on the sales price in order that it can be incorporated into the advertising campaign.

Required:

- (a) Calculate the expected money value of the venture at each sales price and on the basis of this advice W Ltd. of its best Course of action.
- (b) Briefly explain why the management of w. Ltd. might rationally reject the sales price leading to the highest expected money value and prefer one of the other sales prices.

Question: 16

Joint products and relevant costing

A Company processes a raw material into five products. In Process 1, products AXE and BXE are produced in 1 : 1 ratio. Product AXE then passes on to Process 2 where it is processed into CXE and DXE. Product BXE is used in Process 3 to produce the product EXE.

Product AXE yields products CXE and DXE in the ratio of 7 : 3. CXE is processed further in Process 4 after which it is sold for Rs.18 per unit. DXE may be sold immediately at Rs.14.40 per unit or it may be processed further in Process 5 after which it can be sold for Rs.20.80 per unit.

EXE is processed in Process 6 where normal spoilage of 5% occurs. The spoiled units are disposed of at a price of Rs.2 per unit. EXE sells at Rs.15.20 per unit.

The costs incurred during a period are as under:

Process	Output Units	Costs Rs.
1	1,00,000	5,41,500
2	50,000	1,50,000
3	50,000	1,08,000
4	35,000	1,30,000
5	15,000	1,00,000
6	47,500	97,000

The output of Process 6 represents good units. The process costs are variable costs.

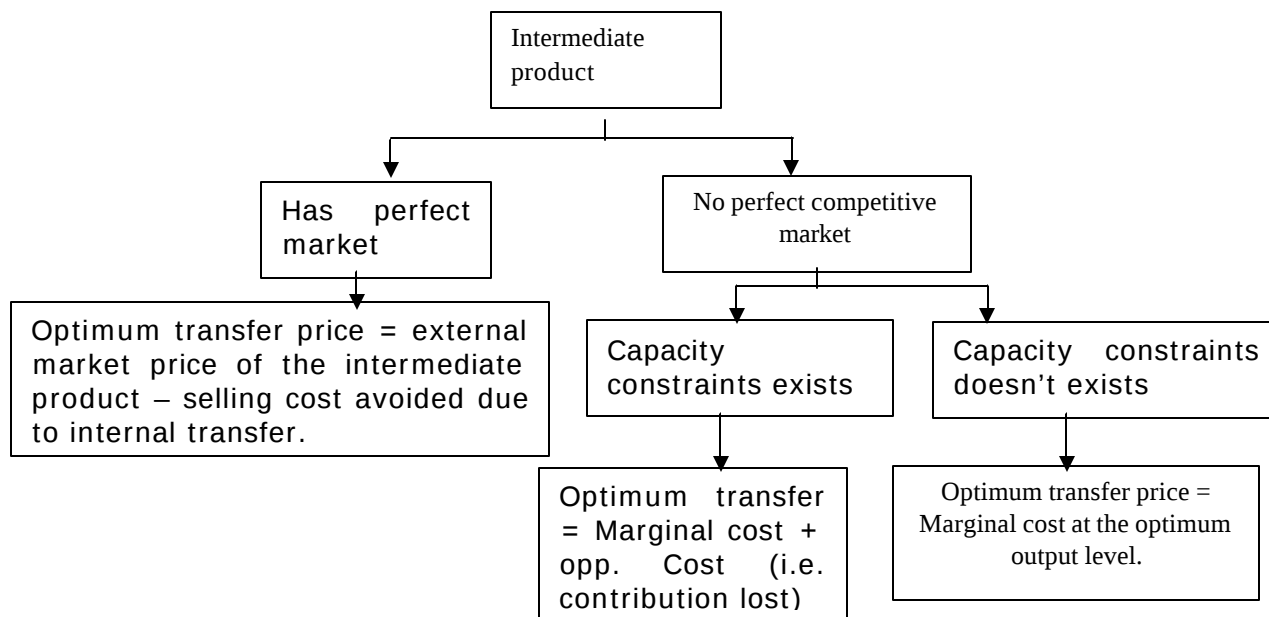
Required:

- (i) Prepare a statement showing the apportionment of joint costs to Products AXE and BXE and Products CXE and DXE.
- (ii) State with supporting calculations whether the Product DXE should be processed in Process 5 or not.
- (iii) Prepare a statement of profit for the period based on your decision at (ii) above.

TRANSFER PRICING

Objectives

- a) Goal congruence.
- b) Reasonable performance measurement
- c) Divisional authority



Note: “Optimum output level” means output level at which the marginal cost of the supplying division equals the net marginal revenue of the receiving division.

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Question: 1

Transfer pricing conflicts

A Company with two manufacturing divisions is organised on profit centre basis. Division 'A' is the only source for the supply of a component that is used in Division B in the manufacture of a product KLIM. One such part is used in each unit of the product KLIM. As the demand for the product is not steady, Division B can obtain order in increased quantities only by spending more on sales promotion and by reducing the selling prices. The Manager of Division B has accordingly prepared the following forecast of sales quantities and selling prices.

Sales in units per day	Average selling price per unit of klim Rs.
1,000	5.25
2,000	3.98
3,000	3.30
4,000	2.78
5,000	2.40
6,000	2.01

The manufacturing cost of KLIM in Division B is Rs.3, 750 for first 1000 units and Rs.750 per 1000 units in excess of 1000 units. Division A incurs a total cost of Rs.1, 500 per day for an output upto 1000 components and the total costs will increase by Rs.900 per day for every additional 1000 components manufactured.

The manager of Division A states that the operating results of his division will be optimized if the transfer price of Component is set at Rs.1.20 per unit and he has accordingly set the aforesaid transfer price for his supplies of the component to Division B.

Required:

- Prepare a schedule showing the profitability at each level of output of Division A and Division B.
- Find the Profitability of the Company as a whole at the output level at which
 - Division A's net profit is maximum.
 - Division B's net profit is maximum.
- If the Company is not organised on profit centre basis, what level of output will be chosen to yield the maximum profit.

Question: 2

Transfer pricing conflicts

A Company has two divisions. South division manufactures an intermediate product for which there is no immediate external market. North division incorporates this intermediate product into a final product, which it sells. One unit of the intermediate product is used in the production of the final product. The expected units of the final product, which North division estimates it can sell at various selling prices, are as follows:

Net selling price (Rs.)	Quantity sold (Units)
100	1,000
90	2,000
80	3,000
70	4,000
60	5,000
50	6,000

The costs of each division are as follows:

	South Division (Rs.)	North Division (Rs.)
Variable cost per unit	11	7
Fixed costs per annum	60,000	90,000

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The transfer price is Rs. 35 for the intermediate products, and is determined on a full cost-plus basis.

You are required to:

- (a) Prepare profit statements for each division and the company as a whole for the various selling prices.
- (b) State which selling price maximizes the profit of North division and the company as a whole, and comment on why the latter selling price is not selected by North division.
- (c) State which transfer pricing policy will maximize the company's profit under a divisional organization. Assume that there is no capacity constraint.
- (d) State the implications of transfer pricing policy in (c) above on south division's profitability.

Question: 3

Goal congruence in transfer pricing

Division A of a large divisionalized organization manufactures a single standardized product. Some of the output is sold externally whilst the remainder is transferred to Division B where it is a sub-assembly in the manufacture of that division's product. The unit costs of Division A's product are as follows:

	(Rs.)
Direct material	4
Direct labour	2
Direct expense	2
Variable manufacturing overheads	2
Fixed manufacturing overheads	4
Selling and packing expense – variable	1
	15

Annually 10,000 units of the product are sold externally at the standard price of Rs.30.

In addition to the external sales, 5,000 units are transferred annually to Division B at an internal transfer charge of Rs.29 per unit. This transfer price is obtained by deducting variable selling and packing expense from the external price since this expense is not incurred for internal transfers. Division B incorporates the transferred-in goods into a more advanced product. The unit costs of this product are as follows:

	(Rs.)
Transferred-in term (from Division A)	29
Direct material and components	23
Direct labour	3
Variable overheads	12
Fixed overheads	12
Selling and packing expense variable	1
	80

Division B's manager disagrees with the basis used to set the transfer price. He argues that the transfers should be made at variable cost plus an agreed (minimal) mark-up since he claims that his division is taking output that Division A would be unable to sell at the price of Rs.30.

Partly because of this disagreement, the company's sales director has recently made a study of the relationship between selling price and demand for each division. The resulting report contains the following table:

Customer demand at various selling prices:

Division A			
Selling price	Rs.20	Rs.30	Rs.40
Demand	15,000	10,000	5,000
Division B			
Selling price	Rs.80	Rs.90	100
Demand	7,200	5,000	2,800

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The manager of Division B claims that this study supports his case. He suggests that a transfer price of Rs.12 would give Division A a reasonable contribution to its fixed overheads while allowing Division B to earn a reasonable profit. He also believes that it would lead to an increase of output and an improvement in the overall level of company profits.

You are required:

- (a) To calculate the effect that the transfer pricing system has had on the company's profits, and
- (b) To establish the likely effect on profit of adopting the suggestion by the manager of Division B of a transfer price of Rs.12.

Question: 4 Conflict resolution

A and B are two manufacturing divisions of C Ltd. Both of these divisions make a single standardized product; A makes product I and B makes product J. Every unit of J requires one unit of I. The required input of I is normally purchased from division A but sometimes it is purchased from an outside source.

The following table gives details of selling price and cost for each product:

	Product I	Product J
	(Rs.)	(Rs.)
Established selling price	30	50
Variable costs		
Direct material	8	5
Transfers from A	-	30
Direct labour	5	3
Variable overhead	2	2
	15	40
Divisional fixed cost (per annum)	Rs.5, 00,000	Rs.2, 25,000
Annual outside demand with current selling prices (units)	1,00,000	25,000
Capacity of plant (units)	1,30,000	30,000
Investment in division	Rs.66, 25,000	Rs.12, 50,000

Division B is currently achieving a rate of return well below the target set by the central office. Its manager blames this situation on the high transfer price of product I. Division A charges division B for the transfers of I at the outside supply price of Rs.30. The manager of division A claims that this is appropriate since this is the price 'determined by market forces'. The manager of B has consistently argued that intra group transfers should be charged at a lower price based on the costs of the producing division plus a 'reasonable' mark-up.

The board of C Ltd is concerned about B's low rate of return and the divisional manager has been asked to submit proposals for improving the situation. The board has now received a report from B's manager in which he asks the board to intervene to reduce the transfer price charged for product I. The manager of B also informs the board that he is considering the possibility of opening a branch office in rented premises in a nearby town, which should enlarge the market for product J by 5,000 units per year at the existing price. He estimates that the branch office establishment costs would be Rs.50, 000 per annum.

Advise the management as to how the above transfer pricing conflict could be resolved. Also compute the ROCE of both the divisions before and after the implementation of your recommendation. Also evaluate the proposal for opening of the new branch.

Question: 5 Make or buy decision- Group company reaction

Companies RP, RR, RS and RT are members of a group. RP wishes to buy an electronic control system for its factory and, in accordance with group policy, must obtain quotations from companies inside and outside of the group.

From outside of the group the following quotations are received:

Company A quoted Rs.33,200.

Company B quoted Rs.35,000 but would buy a special unit from RS for Rs.13,000. To make this unit, however, RS would need to buy parts from RR at a price of Rs.7,500. The inside quotation

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was from RS whose price was Rs.48,000. This would require RS buying parts from RR at a price of Rs.8,000 and units from RT at a price of Rs.30,000. However, RT would need to buy parts from RR at a price of Rs.11,000.

Additional data are as follows:

- (1) RR is extremely busy with work outside the group and has quoted current market prices for all its products.
- (2) RS costs for the RP contract, including purchases from RR and RT, total Rs.42,000. For the Company B contract it expects a profit of 25% on the cost of its own work.
- (3) RT prices provide for a 20% profit margin on total costs.
- (4) The variable costs of the group companies in respect of the work under consideration are:
RR: 20% of selling price.
RS: 70% of own cost (excluding purchases from other group companies)
RT: 65% of own cost (excluding purchases from other group companies).

You are required, from a group point of view, to recommend, with appropriate calculations, whether the contract should be placed with RS or Company A or Company B.

Question: 6

Apportionment of company's profit

AB LIMITED, which buys and sells machinery, has three departments:

- New machines (manager, Newman)
- Second-hand machines (manager, Handley)
- Repair workshops (manager, Walker)

In selling new machines Newman is often asked to accept an old machine in part exchange. In such cases the old machine is disposed of by Handley. The workshops do work both for outside customers and also for the other two departments. Walker charges his outside customers for materials at cost and for labour time at Rs.8 per hour. This Rs.8 is made up as follows:

	Per hour (Rs.)	
Fixed costs	2.00	(10,000 budgeted hours per annum)
Variable costs	4.50	
Profit	1.50	
	Rs.8.00	

AB Limited wishes to go over to a profit centre basis of calculations so as to be able to reward its three managers according to their results. It wishes to assess the situation in the context of the following transaction:

Newman sold to PQ Limited a new machine at list price of Rs.16, 000, the cost of which to AB Limited was Rs.12, 000. To make the sale, however, Newman had to allow PQ Limited Rs.5, 000 for its old machine in part exchange.

PQ Limited's old machine was in need of repair before it could be re-sold and Newman and Handley were agreed in their estimate of those repairs as Rs.50 in materials and 100 hours of workshops labour time. That estimate was proved to be correct when the workshops undertook the repair. At the time of taking PQ Limited's machine in part exchange Handley would have been able to buy a similar machine from other dealers for Rs.3, 700 without the need for any repair. When the machine had been repaired he sold it to ST Limited for Rs.4, 200.

You are required to:

- (a) Show how you would calculate to profit contribution for each of the three departments from the above transaction.
- (b) Re-calculate the profit contribution for each department if there were the following alternative changes of circumstances:
 - 1) When the workshops came to repair the old machine they found that they required an extra 50 hours of labour time because of a fault not previously noticed.
 - 2) Before deciding on the figure he would allow PQ Limited for their old machine, Newman asks Walker to estimate the cost of repairs. This estimates is Rs.50 in materials and 100 hours of workshops labour time. When, however, workshops came to repair the old machine, it took them 50% longer than estimated.

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Question: 7 Scarce capacity and shadow price

Black and Brown are two divisions in a group of companies and both require intermediate products Alpha and Beta which are available from divisions A and B respectively. Black and Brown divisions convert the intermediate products into products Blackalls and Brownalls respectively. The market demand for Blackalls and Brownalls considerably exceeds the production possible, because of the limited availability of intermediate products Alpha and Beta. No external market exists for Alpha and Beta and no other intermediate product market is available to Black and Brown divisions.

Other data are as follows:

Black division	
Blackalls:	Selling price per unit Rs.45 Processing cost per unit Rs.12 Intermediate products required per unit: Alpha: 3 units Beta: 2 units
Brown division	
Brownalls:	Selling price per unit Rs.54 Processing cost per unit Rs.14 Intermediate products required per unit: Alpha: 2 units Beta: 4 units
A division	
Alpha	Variable cost per unit Rs.6 Maximum production capacity 1,200 units
B division	
Beta:	Variable cost per unit Rs.4 Maximum production capacity 1,600 units

The solution to a linear programming model of the situation shows that the imputed scarcity value (shadow price) of Alpha and Beta is Rs.0.50 and Rs.2.75 per unit respectively and indicates that the intermediate products be transferred such that 200 units of Blackalls and 300 units of Brownalls are produced and sold.

Required:

- (a) Calculate the contribution earned by the group if the sales pattern indicated by the linear programming model is implemented.
- (b) Where the transfer prices are set on the basis of variable cost plus shadow price, show detailed calculations for
 - (i) The contribution per unit of intermediate product earned by divisions A and B and
 - (ii) The contribution per unit of final product earned by Black and Brown divisions.
- (c) Comment on the results derived in (b) and on the possible attitude of management of the various divisions to the proposed transfer pricing and product deployment policy.
- (d) In the following year the capacities of divisions A and B have each doubled and the following changes have taken place:
 - (1) **Alpha:** There is still no external market for this product, but A division has a large demand for other products which could use the capacity and earn a contribution of 5% over cost. Variable cost per unit for the other products would be the same as for Alpha and such products would use the capacity at the same rate as Alpha.
 - (2) **Beta:** An intermediate market for this product now exists and Beta can be bought and sold in unlimited amounts at Rs.7.50 per unit. External sales of Beta would incur additional transport costs of Rs.0.50 per unit, which are not incurred in inter-divisional transfers.

The market demand for Blackalls and Brownalls will still exceed the production availability of Alpha and Beta.

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- (i) Calculate the transfer prices at which Alpha and Beta should now be offered to Black and Brown divisions in order that the transfer policy implemented will lead to the maximization of group profit.
- (ii) Determine the production and sales pattern for Alpha, Beta, Blackalls and Brownalls, which will now maximize group contribution and calculate the group contribution thus achieved. It may be assumed that divisions will make decisions consistent with the financial data available.

Question: 8

Sensitivity analysis vis-à-vis transfer pricing

An industrial group of companies includes two divisions: A and B. the output of Division A is product A, two units of which are used by Division B for every one of its product B. Division B has first call on Division A's output but there is a separate market outside the group for the balance of Division A's output. All the output of Division B is sold outside the group. The maximum capacity of Division A is 1,30,000 units of A and that of Division B is 50,000 units of B per annum. Each division maintains a stable level of stocks throughout the year. The group would like to examine the results of using different bases of transfer pricing under different scenarios (ie situations that could be expected to arise).

The bases of transfer pricing are

Absorbed standard cost	AS
Market price	MP
Variable cost plus a lump sum of 80% of Division A's fixed cost	VC

Scenario number	Product A		Product B	
	Market price (per unit)	Total demand (thousand units)	Market price (per unit)	Total demand (thousand units)
	Rs.		Rs.	
15	30	100	100	40
23	25	70	90	30
29	35	130	90	30

Costs per unit are:

	Product A	Product B	
Variable cost	Rs.20	Rs.12	(Exclusive of 2 units of Product A)
Fixed cost	Rs.5	Rs.18	
Budgeted volume in units per annum	1,00,000	40,000	

Part 1

You are required to calculate the profits shown by Division A and by Division B for the following seven situations:

Scenario	Basis of Transfer pricing		
15	MP	VC	-
23	-	VC	AS
29	MP	VC	AS

Part 2

Assume that Division B receives an overseas order for 20,000 units of B that will in no way influence its other clientele.

- (a) As manager of Division B state, with supporting calculations, whether you would recommend acceptance of the order in the following two situations:

Scenario	Price per unit (ex factory)	Basic of transfer pricing
23	Rs.55	AS
29	Rs.65	MP

- (b) If you were Managing Director of the whole group state, with very brief reasons, whether you would recommend acceptance of the orders in (a) (i) and (a) (ii) above.

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Question: 9

Effect of transfer pricing for MNCs

IBM Inc. manufactures and sells desktop computers. IBM has three divisions, each of which is located in a different country;

- a. China Division – Manufactures memory devices and keyboard.
- b. South Korea division – Assembles desktop computers, using internally manufactured parts and memory devices and keyboards from china division.
- c. U.S. Division – packages and distribution desktop computers.

Each division is run as a profit center. The costs for the work done in each division that is associated with a single desktop computer unit are as follows:

Variable costs:	
China Division	1000 Yuan
South Korean division	240000 won
US division	100Rs.
Fixed costs:	
China Division	1800 Yuan
South Korean division	320000 won
US division	200Rs.
Chinese income tax rate on China division's operating income	40%
South Korean Division – income tax rate	20%
US income tax rate on US division operating income	30%

Each desktop computer is sold to retail outlets in the United States for Rs.3,200. Assume that the current foreign exchange rates are:

8 Yuan = 1Rs.

800 won = 1Rs..

Both the China and the South Korea divisions sell part of their production under a private label. The china division sells the comparable memory/keyboard package used in each IBM desktop computer to a Chinese manufacturer for 3600 Yuan. The South Korea division sells the comparable desktop computer to a South Korean distributor for 1040000 won.

Required:

- Calculate the after – tax operating income per unit earned by each division under each of the following transfer-pricing methods:
 - (a) Market price
 - (b) 200% of full costs
 - (c) 300% of variable costs
- Which transfer pricing methods will maximise the net income per unit of user IBM Inc.?

Question: 10

Different basis of transfer pricing

SV Ltd. manufactures a product, which is obtained basically from a series of mixing operations. The finished product is packaged in the company made glass bottles and packed in attractive cartons.

The company is organised into two independent divisions viz. One for the manufacture of the end product and the other for the manufacture of glass bottles. The product manufacturing division can buy all the bottle requirements from the bottle manufacturing division.

The general manager of the bottle manufacturing division has obtained the following quotations from the outside manufacturers for the empty bottles.

Volume empty bottles	Total purchase value (Rs.)
8,00,000	14,00,000
12,00,000	20,00,000

A cost analysis of the bottle manufacturing division for the manufacture of empty bottles reveals the following production costs:

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Volume empty bottles	Total Cost (Rs.)
8,00,000	10,40,000
12,00,000	14,40,000

The production cost and sales value of the end product marketed by the product manufacturing division are as under.

Volume (Bottle of end Product)	Total cost of end product* (Rs.)	Sales value (packed in bottles) (Rs.)
8,00,000	64,80,000	91,20,000
12,00,000	96,80,000	1,27,80,000

There has been considerable discussion at the corporate levels as to the use of proper price for transfer of empty bottles from the bottle manufacturing division to product manufacture division. This interest is heightened because a significant portion of the Divisional General Manager's salary is in incentive bonus based on profit centre results.

As the corporate management accountant is responsible for defining the proper transfer prices for the supply of empty bottles by the bottle manufacturing division to the product manufacturing division, you are required to show for the two levels of volume of 8,00,000 and 12,00,000 bottles the profitability by using (i) market price and (ii) share profit relative, to the cost involved basis for the determination of transfer prices. The profitability position should be furnished separately for the two divisions and the company as a whole under each method. Discuss also the effect of these methods on the profitability of the two divisions.

*Excluding the cost of empty bottles.

Question: 11 Optimum transfer price- No intermediate market

A group of highly integrated divisions wishes to be advised as to how it should set transfer prices for the following interdivisional transactions:

Division L sells all its output of product LX to Division M. To 1 kg of LX, Division M adds other direct materials and processes it to produce 2 kg of product MX that it sells outside the group.

The price of MX is influenced by volume offered and the following cost and revenue data are available:

Division L:

The variable costs of LX are (per kg) at 50000 kg:

Direct materials	4.00
Direct labour	2.00
	6.00

The following cost increases are expected at different levels of production per annum:

Direct materials	At 60,000 kg p.a. increases to Rs.5.00 per kg
	At 90,000 kg p.a. increases to Rs.5.50 per kg
	At 1,00,000 kg p.a. increases to Rs.6.00 per kg
Direct labour:	At 80,000 kg p.a. increases to Rs.2.50 per kg
	At 1,00,000 kg p.a. increases to Rs.3.00 per kg

Fixed Overhead	Under 70,000 kg	Rs.2, 10,000 p.a.
	70,000 – 79,999 kg	2,60,000 p.a.
	80,000 – 89,999 kg	2,80,000 p.a.
	90,000 or more kg	3,10,000 p.a.

Division M:

To produce 1 kg of product MX, the following variable cost is incurred for each 0.5 kg of LX used (at 100000 kg of MX):

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Other direct materials	Rs.1.50
Processing cost	Rs.3.50
	Rs.5.00 Per kg MX produced

The following cost increases are expected at different levels of production of MX per annum:

Other direct Materials:	At 1,40,000 kg p.a. increase to Rs.1.75 per kg.
	At 1,60,000 kg p.a. increase to Rs.2.00 per kg.

Processing:	At 1,80,000 kg p.a. increase to Rs.4.00 per kg.
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		(Rs.)
Fixed overhead:	Under 1,20,000 kg	2,50,000 p.a.
	1,20,000 – 1,39,999 kg	2,80,000 p.a.
	1,40,000 – 1,59,999 kg	2,90,000 p.a.
	1,60,000 – 1,99,999 kg	3,20,000 p.a.
	2,00,000 or more kg	3,60,000 p.a.
Selling price:	Up to 1,99,999 kg	Rs.16.00 per kg
	2,00,000 or more kg	Rs.15.50 per kg

You are required to:

Recommend, with supporting calculations and explanations, the most appropriate narrow range of transfer price per kg for product LX as between the two divisions; assume that any changes in output are in steps of 10,000 kg of product LX and 20,000 kg of product MX.

Question: 12

Optimum output in imperfect markets

Easwar and Bramha are divisions of Krishna Ltd. Both divisions have a wide range of activities. You are an accountant employed by Krishna Ltd and the Finance Director has asked you to investigate a transfer-pricing problem.

Easwar makes an engine, the Z80, which it has been selling to external customers at Rs.1, 350 per unit. Bramha wanted to buy Z80 engines to use in its own production of dories; each dory requires one engine. Easwar would only sell if Bramha paid Rs.1, 350 per unit. The managing director of Easwar commented:

“We have developed a good market for this engine and Rs.1, 350 is the current market price. Just because Bramha is not efficient enough to make a profit is no reason for us to give a subsidy.”

Bramha has now found that engines suitable for its purpose can be bought for Rs.1, 300 per unit from another manufacturer. Bramha is preparing to buy engines from this source.

From information supplied by the divisions you have derived the following production and revenue schedules, which are applicable over the capacity range of the two divisions:

Annual no. of units	Easwar's Total manufacturing cost for Z80 engines (Rs.000)	Easwar's Total revenue from outside sales of Z80 engines (Rs.000)	Bramha's Total cost of producing dories excluding engine costs (Rs.000)	Bramha's Total revenue from sales of dories (Rs.000)
100	115	204	570	703
200	185	362	1,120	1,375
300	261	486	1,670	2,036
400	344	598	2,220	2,676
500	435	703	2,770	3,305
600	535	803	3,320	3,923
700	645	898	3,870	4,530
800	766	988	4,420	5,126

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Requirements:

- (a) Ignoring the possibility that Bramha could buy engines from another manufacturer, calculate to the nearest 100 units:
 - (i) The quantity of Z80 production that would maximize profits for Krishna Ltd, and
 - (ii) The consequent quantity of Z80 units that would be sold to external customers and the quantity that would be transferred to Bramha.
- (b) Explain the issues raised by the problems of transfer pricing between Easwar and Bramha, and discuss the advantages and disadvantages of the courses of action, which could be taken.

Question: 13

Produce or procure

Versatile Vehicles Ltd., manufacturers of specialised vehicles, are organised along decentralised lines with each manufacturing division operating as a separate profit centre. Division A normally purchases its entire requirements of Components 'X' from division E at a unit price of Rs.175. division E has informed division A that the unit price will have to be increased to Rs.200. division A has ascertained that it can still purchase an equivalent component from another external manufacturer for Rs.175 and has decided to change suppliers. Division E has appealed to the group chairman for the decision to be reversed. Data available are:

A's annual purchase of 'X' (number)	5,000
E's variable costs per unit of 'X'	Rs.140
E's fixed costs per unit	Rs.40

You are required to state with reasons whether in each of the following cases, Division A should purchase externally.

- (a) Assuming that there are no alternative uses for E's internal facilities;
- (b) Assuming that by not producing the 5,000 units of 'X' for A the manufacturing facilities at E could be used for other products so as to produce an annual net cash operating contribution of Rs.1, 70,000.

Assuming that there are no alternative uses for E's internal facilities and that the price from external suppliers drops a further Rs.40.

ACTIVITY BASED COSTING

Question: 1

Traditional product costing Vs ABC.

Having attended a CIMA course on activity-based costing (ABC) you decide to experiment by applying the principles of ABC to the four products currently made and sold by your company. Details of the four products and relevant information are given below for one period:

Product	A	B	C	D
Output in units	120	100	80	120
Costs per unit:	(Rs.)	(Rs.)	(Rs.)	(Rs.)
Direct material	40	50	30	60
Direct labour	28	21	14	21
Machine hours (per unit)	4	3	2	3

The four products are similar and are usually produced in production runs of 20 units and sold in batches of 10 units.

Using a machine hour rate currently absorbs the production overhead, and the total of the production overhead for the period has been analysed as follows:

	(Rs.)
Machine department costs (rent, business rates, depreciation and supervision)	10,430
Set-up costs	5,250
Stores receiving	3,600
Inspection / Quality control	2,100
Materials handling and despatch	4,620
Total	26000

You have ascertained that the 'cost drivers' to be used are as listed below for the overhead cost shown:

Cost	Cost Driver
Set up costs	Number of production runs
Stores receiving	Requisition raised
Inspection / Quality control	Number of production runs
Materials handling and despatch	Orders executed

The number of requisition raised on the stores was 20 for each product and the number of orders executed was 42, each orders being for a batch of 10 of a product. You are required.

- To calculate the total costs for each product if all overhead costs are absorbed on a machine hour basis;
- To calculate the total costs for each product, using activity-based costing;
- To calculate and list the unit product cost from your figures in (a) and (b) above, to show the differences and to comment briefly on any conclusions, which may be drawn which could have pricing and profit implications.

Question: 2

Construction of cost pool

Trimake Limited makes three main products, using broadly the same production methods and equipment for each. A conventional product costing system is used at present, although an activity-based costing (ABC) system is being considered. Details of the three products for a typical period are:

Product	Labour hours per unit	Machine hours per unit	Material cost per unit (Rs)	Volume (Units)
X	$\frac{1}{2}$	$1\frac{1}{2}$	20	750
Y	$1\frac{1}{2}$	1	12	1,250
Z	1	3	2	7,000

Direct labour costs Rs.6 per hour and production overheads are absorbed on a machine hour basis.

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The rate for the period is Rs.28 per machine hour.

You are required to calculate the cost per unit for each product using conventional methods.

Further analysis shows that the total of production overheads can be divided as follows:

	(%)
Costs relating to set-ups	35
Costs relating to machinery	20
Costs relating to materials handling	15
Costs relating to inspection	30
Total production overhead	100%

The following activity volumes are associated with the product line for the period as a whole.
Total activities for the period:

Product	Number of set-ups	Number of movements of materials	Number of inspections
X	75	12	150
Y	115	21	180
Z	480	87	670
	670	120	1,000

You are required to

Calculate the cost per unit for each product using ABC principles.

Question: 3

Traditional costing vs. ABC

Damodar Ltd., produces two products A and B. Product A requires two components (namely part-1 & part-2) whereas product B requires part-3 & part-4. There are two production departments (machinery and fitting), which are supported by five service activities (material procurement, material handling, maintenance, quality control and set up).

Additional information is as follows:

Production details:	Product A	Product B
Annual volume produced	3,00,000 units	3,00,000 units
Annual direct labour hours:		
Machinery department	5,00,000 DLH	6,00,000 DLH
Fitting department	1,50,000 DLH	2,00,000 DLH

Overhead Cost Analysis

	(Rs.000s)
Material handling	1,500
Material procurement	2,000
Set-up	1,500
Maintenance	2,500
Quality control	3,000
Machinery (machinery power, depreciation etc.) ^b	2,500
Fitting (machine, depreciation, power etc.) ^b	2,000
	15,000

(a) It may be assumed that these represent fairly homogeneous activity-based cost pools.

(b) It is assumed these costs (depreciation, power etc.) are primarily production volume driven and that direct labour hours are an appropriate surrogate measure of this.

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Cost Driver Analysis

Cost Driver	Annual Cost Driver Volume per Component			
	Part 1	Part 2	Part 3	Part 4
Material movements	180	160	1,000	1,200
Number of orders	200	300	2,000	4,000
Number of set-ups	12	12	300	300
Maintenance hours	7,000	5,000	10,000	8,000
Number of inspections	360	360	2,400	1,000
Direct labour hours- machinery-fitting	1,50,000	3,50,000	2,00,000	4,00,000
Direct labour hours	50,000	1,00,000	60,000	1,40,000

You are required to compute the unit costs for products A and B using (i) a traditional volume-based product costing system and (ii) an activity-based costing system.

Note: Under traditional system, the overheads of service department are allocated to production departments in the ratio of 13:8.

Question: 4 ABC, retail product-line profitability

Family Supermarkets (FS) decides to apply ABC analysis to three product lines – backed goods, milk and fruit juice, and frozen foods. It identifies four activities and activity-cost rates for each activity as follows:

Ordering	Rs.100 per purchase order
Delivery and receipt of merchandise	Rs.80 per delivery
Shelf-stocking	Rs.20 per hour
Customer support and assistance	Rs.0.20 per item sold.

The revenues, cost of goods sold, store support costs, and activity area usage of the three product lines are as follows:

	Baked Goods	Milk and Fruit Juice	Frozen Products
Financial data			
Revenue	Rs.57, 000	Rs.63, 000	Rs.52, 000
Cost of goods sold	38,000	47,000	35,000
Store support	11,400	14,100	10,500
Activity area usage (cost-allocation base)			
Ordering (purchase orders)	30	25	13
Delivery (deliveries)	98	36	28
Shelf-stocking (hours)	183	166	24
Customer support (items sold)	15,500	20,500	7,900

Under its previous costing system, FS allocated support costs to products at the rate of 30% of cost goods sold.

Required:

- (1) Use the previous costing system to prepare a product-line profitability report for FS.
- (2) Use the ABC system to prepare a product-line profitability report for FS.
- (3) What new insights does the ABC system in requirement 2 provide to FS managers?

Question: 5 ABC in Health Centre

Shanthi Health Center runs four programs: (1) alcoholic rehabilitation, (2) drug-addict rehabilitation, (3) children's services, and (4) after-care (counseling and support of patients after release from a mental hospital).

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The center's budgets for 2005 is as follows:

Professional salaries:		
6 physicians x Rs.1, 00,000	6,00,000	
19 psychologists x Rs.50, 000	9,50,000	
23 nurses x Rs.25, 000	5,75,000	21,25,000
Medical supplies		3,00,000
General overhead (administrative salaries, rent, utilities, etc.)		12,75,000
		37,00,000

Ramaa, the director of the center, is keen on determining the cost of each program. She has limited funds and needs to decide on whether to allocate funds to alcoholic rehabilitation or drug-addict rehabilitation. Her decision rule is that if the cost to treat a drug-addict patient for a year were more than 15% higher than the cost to treat an alcoholic patient for a year, the alcohol program would receive additional funds.

At present she allocates costs of medical supplies on the basis of number of physicians employed in each program and general overhead on the basis of direct-labor costs (where direct labor is defined to include the time of doctors, psychologists, and nurses multiplied by the salary rate of each).

Ramaa compiled the following data describing employee allocations to individual programs:

	Alcohol	Drug	Children	After Care	Total employees
Physicians		2	4		6
Psychologists	6	4		9	19
Nurses	4	6	4	9	23

Eighty patients are in residence in the alcohol program, each staying about six months. Thus, the clinic provides 40 patient-years of service in the alcohol program. Similarly, 100 patients are involved in the drug program for about six months each. Thus the clinic provides 50 patient-years of service in the drug program.

Ramaa has recently become aware of activity-based costing as a method to refine costing systems. She asks her accountant, Pavan, how she should apply this new technique. Pavan obtains the following information:

- (1) Consumption of medical supplies depends on the number of patients in each department and the length of their stays (that is, patient-years).
- (2) General overhead costs consists of
- (3)

Rent and clinic maintenance	Rs.2, 00,000
Administrative costs to manage patient charts, food, laundry	8,00,000
Laboratory services	2,75,000
Total	Rs.12, 75,000

- (4) Other information about individual departments:

	Alcohol	Drug	Children	After care	Total
Square feet of space occupied by each program	9,000	9,000	10,000	12,000	40,000
Patient-years of service	40	50	50	60	200
Number of laboratory tests	400	1,400	3,000	700	5,500

Required

- (1)
 - (a) Compute indirect cost-rates for medical supplies and general overhead under Ramaa's existing costing system.
 - (b) What is the cost of each program and the cost per patient-year of the alcohol and drug programs, using Ramaa's existing costing system?
 - (c) Using the existing costing system, should Ramaa allocate additional funds to the drug program or to the alcohol program?

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(2)

- (a) Selecting cost-allocation bases that you believe are the most appropriate for allocating indirect costs to programs, calculate the indirect-cost rates for medical supplies, rent and clinic maintenance; administrative cost rate for patient charts, food, and laundry; and laboratory services.
- (b) Using an activity-based costing approach to cost analysis, calculate the cost of each program and the cost per patient-year of the alcohol and drug programs.
- (c) Using the ABC system, should Ramaa allocate additional funds to the drug program or to the alcohol program?

Question: 6

ABC and traditional product costs

Repak Ltd is a Warehousing and Distribution Company, which receives products from customers, stores the products and then re-packs them for distribution as required. There are three customers for whom the service is provided – John Ltd, George Ltd and Paul Ltd. The products from all three customers are similar in nature but have varying degrees of fragility. Basic budget information has been gathered for the year to 30 June and is shown in the following table:

	Products handled (cubic metres)
John Ltd	30,000
George Ltd	45,000
Paul Ltd	25,000
	Costs (Rs.000)
Packaging materials (see note 1)	1,950
Labour – basic	350
- Overtime	30
Occupancy	500
Administration and management	60

Note 1: Packaging materials are used in re-packing each cubic metre of product for John Ltd, George Ltd and Paul Ltd in the ratio 1:2:3 respectively. This ratio is linked to the relative fragility of the goods for each customer.

Additional information has been obtained in order to enable unit costs to be prepared for each of the three customers using an activity-based costing approach. The additional information for the year to 30 June has been estimated as follows:

- (i) Labour and overhead costs have been identified as attributable to each of three work centres – receipts and inspection, storage and packing as follows:

	Cost allocation proportions		
	Receipt and inspection	Storage	Packing
	%	%	%
Labour – basic	15	10	75
- Overtime	50	15	35
Occupancy	20	60	20
Administration and management	40	10	50

- (ii) Studies have revealed that the fragility of different goods affects the receipt and inspection time needed for the products for each customer. Storage required is related to the average size of the basic incoming product units from each customer. The re-packing of goods for distribution is related to the complexity of packaging required by each customer. The relevant requirements per cubic metre of product for each customer have been evaluated as follows:

	John Ltd.	George Ltd.	Paul Ltd.
Receipt and inspection (minutes)	5	9	15
Storage (square metres)	0.3	0.3	0.2
Packing (minutes)	36	45	60

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Required

Calculate the budgeted average cost per cubic metre of packaged products for each customer each of the following two circumstances:

- (i) Where only the basic budget information is to be used,
- (ii) Where the additional information enables an activity-based costing approach to be applied.

Question: 7

ABC & Product pricing

KL currently manufactures over 100 products of varying levels of design complexity. A single, plant-wide overhead absorption rate (OAR), based on direct labour hours, is used to absorb overhead costs.

In the quarter-ended march, KL's manufacturing overhead costs were;

	(Rs.000)
Equipment operation expenses	125
Equipment maintenance expenses	25
Wages paid to technicians	85
Wages paid to stores men	35
Wages paid to dispatch staff	40
	310

During the quarter, RAM Management Consultants were engaged to conduct a review of KL's cost accounting systems. RAM report includes the following statement:

'In KL's circumstances, absorbing overhead costs in individual products on a labour hour absorption basis is meaningless. Overhead costs should be attributed to products using an activity based costing (ABC) system. We have identified the following as being the most significant activities:

- (1) Receiving component consignments from suppliers
- (2) Setting up equipment for production runs
- (3) Quality inspections
- (4) Dispatching goods orders to customers.

Our research has indicated that, in the short term, KL's overheads are 40% fixed costs and 60% variable. Approximately half the variable overheads vary in relation to direct labour hours worked and half vary in relation to the number of quality inspections. This model applies only to relatively small changes in the level of output during a period of two years or less.'

Equipment operation and maintenance expenses are apportionable as follows:

- Component stores (15%), manufacturing (70%) and goods dispatch (15%).

Technician wages are apportionable as follows:

- Equipment maintenance (30%), setting up equipment for production runs (40%) and quality inspections (30%).

During the quarter

- A total of 2,000 direct labour hours were worked (paid at Rs.12 per hour),
- 980 component consignments were received from suppliers,
- 1,020 production runs were set up,
- 640 quality inspections were carried out, and
- 420 goods orders were dispatched to customers.

KL's production during the quarter included components R,S and T. the following information is available:

	Component R	Component S	Component T
Direct labour hours worked	25	480	50
Direct material costs	Rs.1, 200	Rs.2, 900	Rs.1, 800
Component consignments received	42	24	28
Production runs	16	18	12
Quality inspections	10	8	18
Goods orders dispatched	22	85	46
Quantity produced	560	12,800	2,400

In April 2001 a potential customer asked KL to quote for the supply of a new component (Z) to a given specification. 1,000 units of Z are to be supplied each quarter for a two-year period. They will be paid for in equal installments on the last day of each quarter. The job will involve an initial

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design cost of Rs.40, 000 and production will involve 80 direct labour hours, Rs.2, 000 materials, 20 component consignments, 15 production runs, 30 quality inspections and 4 goods dispatches per quarter.

KL's Sales Director comments:

Now we have a modern ABC system, we can quote selling prices with confidence. The quarterly charge we quote should be the forecast ABC production cost of the units plus the design cost of the Z depreciated on a straight-line basis over the two years of the job-to which we should add a 25% mark-up for profit. We can base our forecast on costs experienced in the quarter-ended march.

Requirements

- Calculate the unit cost of components R,S and T using KL's existing cost accounting system (single factory labour OAR).
- Explain how an ABC system would be developed using the information given. Calculate the unit cost of components R, S and T, using this ABC system.
- Calculate the charge per quarter that should be quoted for supply of components Z in a manner consistent with the Sales Director's comments. Advise KL's management on the merits of this selling price, having regard to factor you consider relevant.

Note: KL's cost of capital is 3% per quarter.

Question: 8

ABC & Sales promotion strategy

Manchester Technology Ltd., manufactures two types of printed circuit boards, namely PC board and TV board. The market for TV board is competitive and price-sensitive. Manchester plans to sell 65,000 TV boards in 2001 at a price of Rs.150 per unit. PC board is a recent addition to Manchester's product line, which incorporates the latest technology, enabling it to be sold at a premium price. The 2001 plans also include the sale of 40,000 PC boards at Rs.300 per unit. Manchester's management group is meeting to discuss how to spend the sales and promotion Rupees for 2001. The sales manager believes in concentrating sales promotion efforts on TV board, while the production manager recommends the other, since the cost sheet project the contribution from PC board to be twice as that of TV board.

The present cost-accounting system shows that the following costs apply to the PC and TV boards.

	PC Board	TV Board
Direct material	Rs.140	Rs.80
Direct labour	4 hr.	1.5 hr.
Machine time	1.5 hr.	0.5 hr.

Variable manufacturing overhead is applied on the basis of direct-labor hours. For 2001, variable overhead is budgeted at Rs.11, 20,000, and direct-labor hours are estimated at 2,80,000. The hourly rates for machine time and direct labor are Rs.10 and Rs.14, respectively. The company applies a material-handling charge at 10 percent of material cost. This material-handling charge is not included in variable manufacturing overhead.

The financial controller Mr. Frank intends to install ABC system and has collected the relevant information to this end.

The only cost that remains the same for both the costing systems is the cost of direct material. The cost drivers will replace all other costs in the traditional system.

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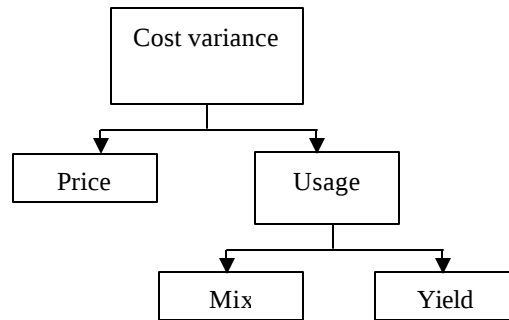
Budgeted Cost	In Rs.	Cost Driver	Budgeted Annual Activity for Cost Driver
Procurement	4,00,000	Number of parts	40,00,000 parts
Production scheduling	2,20,000	Number of boards	1,10,000 boards
Packaging and shipping	4,40,000	Number of boards	1,10,000 boards
Machine setup	4,46,000	Number of setups	2,78,750 setups
Hazardous waste disposal	48,000	Pounds of waste	16000 pounds
Quality control	5,60,000	Number of inspections	1,60,000 inspections
General supplies	66,000	Number of boards	1,10,000 boards
Machine insertions	1200000	Number of machine insertions	3000000 machine insertions
Manual insertions	4000000	Number of manual insertions	1000000 manual insertions
Wave soldering	132000	Number of boards	110000 boards

Required per Unit	PC Board	TV Board
Parts:	55	25
Machine insertions	35	24
Manual insertions	20	1
Machine setups	3	2
Hazardous waste disposal	0.35 lb.	0.02 lb.
Inspections	2	1

Required

- (1) On the basis of Manchester's unit cost data given in the problem, calculate the total contribution margin expected in 2001 for the PC board and the TV board.
- (2) On the basis of an activity-based costing system, calculate the total contribution margin expected in 2001 for the PC board and the TV board.
- (3) Explain how a comparison of the results of the two costing methods may impact the decisions made by Manchester's management group.

Material Variance



$SQ \times SP$	$AQ \times AP$	$AQ \times SP$	$RSQ \times SP$
1	2	3	4

Formula

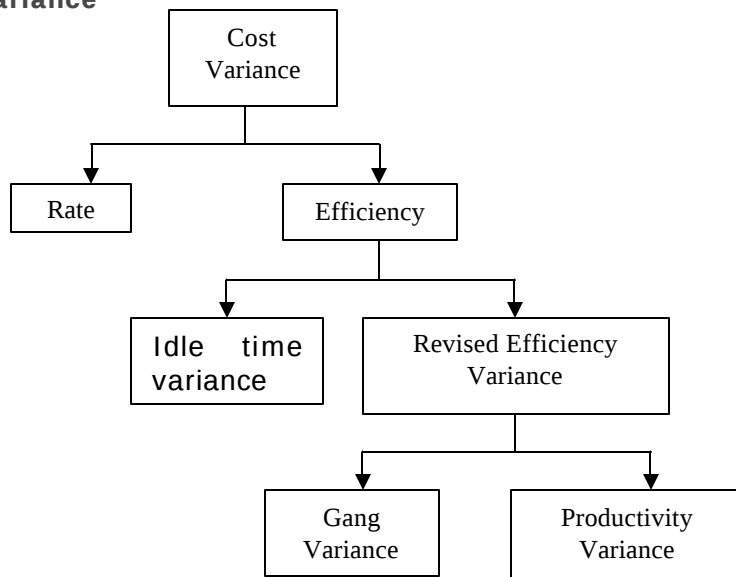
Cost variance	= 1-2
Price variance	= 3-2
Usage variance	= 1-3
Mix variance	= 4-3
Yield variance	= 1-4

Note:

SQ = Standard Quantity
 AQ = Actual Quantity (Input)
 RSQ = Revised Standard Quantity (standard mix of actual input)
 SP = Standard price
 AP = Actual price

Note: Under Partial Plan, price variance will be computed only on the quantity consumed/issued for production. Under Single Plan, price variance will be computed at the time of purchases for the entire quantity bought. Unless the problem states that it should be tried under Single Plan, all problems will be handled only under Partial Plan

Labour Variance



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SH x SR	AH x AR	AH x SR	RSH x SR
1	2	3	4

Formula

Cost variance	= 1-2
Rate variance	= 3-2
Efficiency variance	= 1-3
Gang Mix variance	= 4-3
Productivity/Yield variance	= 1-4

Note:

Where there is idle time:

Idle time variance = Idle time x Standard Rate. It will always be adverse.

Revised efficiency variance = SH x SR – AH (worked) x SR

SH = Standard Hours.

AH = Actual Hours

RSH = Revised Standard Hours. (Standard mix of actual hours worked)

AR = Actual rate per hour.

SR = Standard rate per hour.

Variable overhead variance:

AO x SR p.u	Actual overhead	variable	AH x SR (per hr)
1	2		3

Formula

Variable OH Cost Variance	= 1-2
Variable OH Expenditure Variance	= 3-2
Variable OH Efficiency variance	= 1-3.

AO = Actual output

AH = Actual Hours.

SR = Standard rate

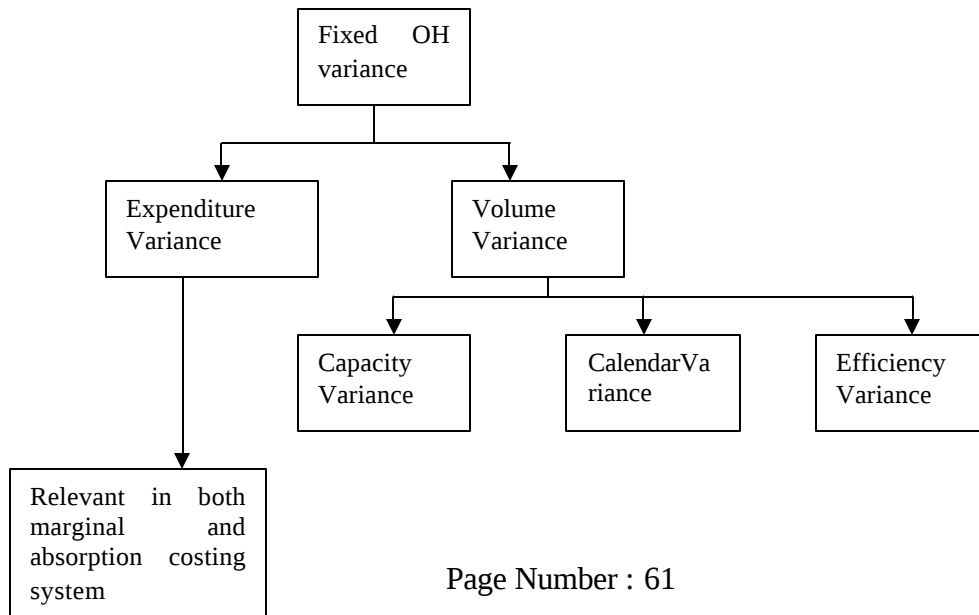
Computation

SR/unit = Budgeted variable overhead/Budgeted output.

SR/hour = Budgeted variable overhead/Budgeted hours

Fixed overhead variance:

- Implies under/over absorption.
- Relevant only in absorption costing system.



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AO x SR	Actual fixed OH	Budgeted fixed OH	AH x SR (per hour)	Possible fixed overhead
1	2	3	4	5

Formula

Fixed OH cost variance	= 1-2.
Fixed OH expenditure variance	= 3-2
Fixed OH volume variance	= 1-3
Fixed OH capacity variance	= 4-3 or 4-5*
Fixed OH calendar variance	= 5-3
Fixed OH efficiency variance	= 1-4.

* Usage of 4-5 shall be called for only when there is a difference between actual days worked and days budgeted. Only on such occasions calendar variance would emerge.

Computation

SR/unit = Budgeted Fixed overhead/Budgeted output.

SR/hour = Budgeted Fixed overhead/Budgeted hours

Possible fixed overhead: (Budgeted Fixed Overhead/Budgeted days) x Actual days worked

Sales variance:

This can be approached in two ways,

- Total approach.
- Margin approach.

Total approach:

BQ x BP	AQ x AP	AQ x BP	RBQ x BP
1	2	3	4

Margin approach:

BQ x BM	AQ x AM	AQ x BM	RBQ x BM
1	2	3	4

Formula

Sales variance	= 1-2.
Price variance	= 3-2.
Volume variance	= 1-3.
Mix variance	= 4-3.
Quantity variance	= 1-4.

Note: Unlike cost variances, the negative value variances would indicate favourable attribute and the positive value would be reflecting adverse quality.

BQ = Budgeted Quantity.

AQ = Actual Quantity.

RBQ = Revised Budgeted Quantity. (Budgeted mix on actual sales value)

BP = Budgeted Price.

AP = Actual Price.

BM = Budgeted Margin.

AM = Actual Margin.

Computation:

BM = BP – Standard cost (including fixed cost)

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AM = AP – Standard cost (including fixed cost). It is to be understood that actual cost was already compared with standard cost; hence the influence of cost variance is not affecting sales variances at all. Therefore actual price is compared only with standard cost.

In marginal costing system, “Margin” means contribution.

BM = BP – Standard cost (only variable cost)

AM = AP – Standard cost (only variable cost)

Standard Costing Ratios:

- Efficiency Ratio = $\frac{\text{Output Expressed in terms of standard hours}}{\text{(Actual hours spent for producing the output.)}}$
- Production volume ratio (activity ratio) = $\frac{\text{(Actual output in standard hours)}}{\text{output in standard hours.}}$ (Budgeted)
- Capacity utilization ratio = $\frac{\text{(Practical capacity in std. Hours – Budgeted capacity)}}{\text{(Practical capacity in std. Hours).}}$

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Basic issues in standard costing

Question: 1 Find out missing items for the following situations:

Situations	Std mix ratio	N L in %	Actual output	Actual Input	Std Qty of input	SM of Actual Input	Std Output
1	75:25	10	4095	4750			
2	60:40	15	16150	18900			
3	80:20	14	10406	11900			
4	2:1	17.5	104775	130000			
5	50:50	16	29400	34500			
6	1000 Kgs of input = 1600 cms of output	NA	14000 cms	9000 kgs			

Question: 2 The following data are available for a product. Standard material cost per unit of output: 2Kgs @ Rs.20 per kg.
During a period actual details are as under

Actual output	10000 units
Material used	22000 kgs
Actual price per kg	Rs.25

Find out material variances.

Question: 3 Find out the in Direct Material, the missing figures: Rs. Lacs

Price variance – Favourable	2.5
Mix variance – Adverse	1.2
Yield variance – Favourable	1.6
Usage Variance	?
Cost Variance	?

Question: 4 Find out the details of variance of Direct Labour:

Rate variance – Favourable	7.5
Gang Mix variance – Adverse	2.2
Yield variance – Favourable	3.6
Efficiency variance	2.1
Idle time variance	?
Cost Variance	?
Revised Efficiency variance	?

Question: 5 The standard set for a chemical mixture of a firm is as under:

Material	Standard mix %	Standard price per kg (Rs.)
A	40	20
B	60	30

The standard loss in production is 10%. During a period, the actual consumption and price paid for a good output of 189 kg are as under:

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Material	Quantity in kg.	Actual price per kg (Rs.)
A	90	18
B	110	34

Calculate material variances.

Question: 6 V Ltd produces an article by blending two basic raw materials. It operates a standard costing system and the following standards have been set for raw materials:

Material	Standard mix	Standard price per Kg
A	40%	Rs.4.00
B	60%	Rs.3.00

The standard loss in processing is 15%. During April the company produced 1700 Kgs of finished product. The positions of stocks and purchases for the month of April are as under

Material	Opening stock	Closing stock	Purchases	Purchase price
A	35 Kgs	5 Kgs	800 Kgs	Rs.4.25
B	40 Kgs	50 Kgs	1200 Kgs	Rs.2.50

Calculate the material variances

- on the assumption that the company follows FIFO basis of accounting for inventories and the opening stock is to be taken at standard prices
- on the assumption that the company follows FIFO basis of accounting for inventories and the opening stock is to be taken at Rs.4.15 and 2.90 respectively
- On the assumption that the company follows LIFO and the consumption above current purchases in A shall be taken at Standard price.

Question: 7 SC Limited manufactures a special floor tile which measures $\frac{1}{2}$ m x $\frac{1}{4}$ m x 0.01m. The tiles are manufactured in a process, which requires the following standard mix:

Material	Quantity	Price (Rs.)	Amount (Rs.)
A	40	1.5	60
B	30	1.2	36
C	10	1.4	14
D	20	0.5	10
			Rs.120

Each mix should produce 100 square metres of floor tiles of 0.01 m thickness. During April, the actual output was 46,400 tiles from an input of:

Material	Quantity	Price (Rs.)	Amount (Rs.)
A	2,200	1.6	3,520
B	2,000	1.1	2,200
C	500	1.5	750
D	1,400	0.5	700
			Rs.7,170

Calculate material variances.

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Question: 8 Following are the information on Direct Material items

Items	
Standard Price per unit of input	Rs.2.50
Standard quantity for actual output	12000 Kgs
No of Kgs bought during a period	13700 Kgs
Rate of Purchases	Rs.2.45
No of Kgs sent to production	12125 Kgs

Find out material cost variances under

(a) Partial Plan

(b) Single Plan.

Pass journal entries under both the plans.

Question: 9

(a) Find out the missing figures from the following:

Variable overhead efficiency variance – Favourable	Rs. 7500
Variable overhead expenditure variance – Favourable	Rs.10000
Variable overhead cost variance	?

(b) Find out the missing figures from the following:

Fixed overhead efficiency variance	10000 A
Fixed overhead capacity variance	12000 F
Fixed overhead volume variance	3000 F
Fixed overhead expenditure variance	7500 A
Fixed overhead calendar variance	?
Fixed overhead cost variance	?

Question: 10

Investigation of variance

A company using a detailed system of standard costing finds that the cost of investigation of variances is Rs.20000. If after investigation an out of control situation is discovered, the cost of correction is Rs.30000. If no investigation is made, the present value of extra cost involved is Rs.150000. The probability of the process being in control is 0.82 and the probability of the process being out of control is 0.18. You are required to advise:

- i. Whether investigation of the variances should be undertaken or not; and
- ii. The probability at which it is desirable not to institute investigation into variances.

Question: 11

Price variance- at the time of purchase

Shown below is the standard material cost of a tube of industrial adhesive, which is the only product manufactured by Gum Ltd:

	(Rs. per tube)
Materials:	
Powder	1.50
Chemical	0.60
Tube	0.30
Total standard material cost	2.40

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Items	Requirement per unit of output	Opening stock	Purchases	Issues
Powder	2 lb	1500 lb	10000 lb. @ Rs 0.70 per lb.	9800 lb
Chemicals	$\frac{1}{4}$ litre	200 litres	Lot-1 600 litres @ Rs 2.3 per litre. Lot-2 600 litres @ Rs 2.5 per litre.	1050 litres
Tubes	1 tube	100 tubes	Lot-1: 200 tubes @ Rs 0.40 per tube. Lot-2: 5000 tubes @ Rs 0.30 per tube	

During the previous month 4,500 tubes of adhesive were produced, there were no work in progress stocks at the beginning or end of the month.
The above materials are used exclusively in the production of the adhesive and it is the policy of the company to calculate any price variance when the materials are purchased.

Required:

Compute material variances.

Question: 12 Labour variances

The data obtained from a manufacturing concern are:

Particulars	Men	Women
Number in standard gang	20	10
Standard rate per hour	9	8
Number in actual gang	16	14
Actual rate per hour (Rs)	10	7

In a 48 hour-week, the gang as actually composed, produced 1200 standard hours. Compute labour variances.

Question: 13 Idle time variance

In a certain factory-

Normal number of operators in department	50
Normal number of hours paid for in a week	40
Standard rate per hour (Rs)	8
standard output of department per hour, taking into account the normal idle time (units)	20
Actual rate per hour (Rs)	9

In a particular week, it was ascertained that 1000 units were produced despite 20% of the time paid for was lost owing to power failure. Compute labour variances.

Question: 14 Variable overhead variance

XYZ Company has established the following standards for variable factory overhead.

Standard hours per unit: 6

Variable overhead per hour: Rs.2/-

The actual data for the month are as follows:

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Actual variable overheads incurred	Rs.2,00,000
Actual output (units)	20,000
Actual hours worked	1,12,000

Required:

Calculate variable overhead variances:

- Variable overhead cost variance.
- Variable overhead expenditure variance.
- Variable overhead efficiency variance.

Question: 15

Fixed overhead variance

A manufacturing company operating a standard costing system has the following data in respect of July, 2006:-

Actual number of working days	22
Actual man-hours worked during the month	8,600
Units produced	850
Actual fixed overhead incurred	Rs.3,600

The following information is obtained from the company's budget and standard cost data: -

Budgeted number of working days per month	20
Budgeted man-hours per month	8,000
Standard man-hours per unit produced	10
Standard fixed overhead rate per man-hour	Re.0.50

Calculate fixed overhead variances.

Question: 16

Variable and fixed overhead variances

From the following figures are extracted from the books of a company, compute appropriate variances:

Particulars	Budget	Actual
Output in units	12000	13000
Hours	6000	6600
Fixed overhead	Rs.2400	2500
Variable overhead	Rs.12000	13300
No of days	50	54

Question: 17

Fixed overhead variance- Closing WIP

Calculate fixed production overhead variances in as much details as possible, in the following situation:

	Budget	Actual
Fixed overhead (Rs.)	2,46,000	2,59,000
Direct labour (hours)	1,23,000	1,41,000
Output (units)	6,15,000	(see below)

The company operates a process costing system. At the beginning of the period 42,000 half completed units were in stock. During the period 6, 80,000 units were completed and 50,000 half completed units remained in stock at the end of the period.

Question: 18

Production ratios

The budgeted production for July in the finishing department of a pottery manufacturer is, 4,500 cups, 4,000 saucers and 6,250 plates. In one standard hour a direct operative is expected to be able to finish either, 30 cups, or 40 saucers, or 25 plates. During period July, 400 direct labour hours were worked and actual production was, 4,260 cups, 6,400 saucers and 3,950 plates.

Required:

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Using the above information calculate for July:

- (i) Productivity/ efficiency ratio
- (ii) Production volume/activity ratio
- (iii) Capacity utilization ratio.

Question: 19

Sales variances – Total and Margin approach

You are required to calculate sales variances under total and margin approach using the data given below:

	Unit selling price (Rs)	Unit Cost (Rs)	Unit profit (Rs)	Qty (units)	Total profit (Rs)	Sales (Rs)
Budget						
A	30	16	14	1,500		
B	10	9	1	3,500		
C	20	18	2	1,000		
Actual:						
A			15	1,100	16,500	34,100
B			1	5,200	5,200	52,000
C			4	1,100	4,400	24,200
Total (Rs)					26,100	1,10,300

Question: 20

Market size and market share variance

Super computers manufacture and sell three related PC models. The budgeted and actual data for 2002 is as follows:

Budgeted for 2002				
	Selling price per unit Rs.	Variable cost per unit Rs.	Contribution margin per unit Rs.	Sales volume in units Rs.
PC	24,000	14,000	10,000	7,000
Portable PC	16,000	10,000	6,000	1,000
Super PC	1,00,000	60,000	40,000	2,000
Actual for 2002				
	Selling price per unit Rs.	Variable cost per unit Rs.	Contribution margin per unit Rs.	Sales volume in units Rs.
PC	22,000	10,000	12,000	8,250
Portable PC	13,000	8,000	5,000	1,650
Super PC	70,000	50,000	20,000	1,100

Super computers derived its total unit sales budget for 2002 from the internal management estimate of a 20% market share and an industry sales forecast by computer manufactures association of 50,000 units. At the end of the year the association reported actual industry sales of 68,750 units.

Required to compute:

1. Market share variance
2. Market size variance
3. Sales quantity variance.

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Question: 21

Missing figures

Compute the missing data indicated by “?” from the following:

Particulars	Product-R	Product-S
Budgeted units	?	400
Actual units	500	?
Budgeted unit selling price	12	15
Actual unit selling price	15	20
Sales price variance	?	?
Sales volume variance	1200F	?
Total sales variance	?	?

Sales mix variance for both the products together was Rs 450F.

Question: 22

Missing figures

A Company manufactures two products, which have the following standard costs for direct materials and direct labour:

Product-1	Actual production= 42, 100 units
Material requirement per 100 units of output	Labour requirement per 100 units of output
Material-M 98 kg @ 0.78 per kg	Department-X 10 hours @ Rs 4.2 per hour
Actual material consumed = 41200 Kg	Actual labour hours worked = 4190 hours.
Actual price per Kg = Rs 0.785	Actual labour rate = Rs. 4.2.
Actual material cost= Rs 32342.	Actual labour cost = Rs 17598.

Product-2	Actual production=?
Material requirement per 100 units of output	Labour requirement per 100 units of output
Material-N 33 kg @ 2.931 per kg	Department-Y 9 hours @ Rs 4.5 per hour
Actual material consumed =?	Actual labour hours worked =?
Actual price per Kg =?	Actual labour rate = Rs 4.55
Actual material cost= Rs 23828.	Actual labour cost =?

Overheads:

Department	Predetermined recovery rate	Amount
X	Rs 3.60 per DLH	Rs 14763
Y	Rs 2.90 per DLH	?

Variances:

Direct materials	Material-M	Material-N
Price	?	Rs.233A
Usage	?	Rs.5F
Total	?	Rs.228A
Direct labour	Department-X	Department-Y
Rate	?	?
Efficiency	?	Rs.342F
Total	Rs.84F	?
Production overhead	?	Rs.142A

Required:

Calculate the missing figures.

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Question: 23

Variances and reconciliation

The budgeted production of a company is 20000 units per month. The standard cost sheet is as under:

Direct Material	1.5 Kgs @ Rs.6 per Kg
Direct Labour	6 hours @ Rs.5 per hour
Variable Overhead	6 hours @ Rs.4 per hour
Fixed Overhead	Rs.3 per unit
Selling price	Rs.72 per unit

The following are the actual details for a month:

Actual sales	18750 units
Actual production	18750 units
Direct Material	29860 Kgs @ Rs.5.25 per Kg
Direct Labour	118125 hours @ Rs.6 per hour
Fixed Overhead	Rs.40000
Variable overhead	Rs.525000

Required:

- (i) Calculate all variances
- (ii) Prepare reconciliation statement from budgeted profit as well as from standard profit.

Question: 24

Variances and reconciliation

From the following information show how profit had gone up in detail:

Particulars	2004	2005
Materials	100000	132000
Labour	60000	66000
Variable overhead	12000	14000
Fixed overhead	20000	24000
Total cost	192000	236000
Profit	8000	17000
Sales	200000	253000

During the year 2005, selling price and material prices have each gone up by 10% and labour rate by 15%, when compared to 2004.

Question: 25

Variance, Reconciliation in Process industry

The following particulars being a standard for a product set as under:

Particulars	Qty or hrs per unit	Rate in Rs.	Amount per unit
Direct Material A	2 Kgs	3	6
B	1 Kg	4	4
Direct Wages	5 hours	4	20
Variable overheads	5 hours	1	5
Fixed overheads	5 hours	2	10
Total			45
Standard profit			5
Standard Selling price			50

Budgeted output is 8000 units per month. In June 2005, the company produced and sold 6000 units

Other actual data are as follows:

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Particulars	Rs.
Sales value	305000
Material A 14850 Kgs	43065
Material B 7260 Kgs	29750
Direct Wages 32000 hours	127500
Variable overhead	30000
Fixed overhead	80600

Closing working in progress was 600 units in respect of which materials A and B were fully issued and labour and overhead were 50% complete. The direct labour hours worked were 31800. Analyze the variances and present reconciliation statement in all possible ways.

Question: 26

Reconciliation-marginal costing system

A company which employs a salesman in each of its territories has decided to use the following standards salesmen's performance:

- a) Target sales are based on each territory's annual potential. For territory 1 these are Rs.1, 80,000 p.a. and for territory 2 these are Rs.2, 95,000 p.a.
- b) Each territory's standard sales mix contribution is 32%
 - I. Commission is payable at 3½% of sales.
 - II. If sales exceed 110% of target, an extra 1% of the excess is payable.
 - III. If the contribution percentage is above standard, commission increases by 20% of the gain.
 - IV. If the contribution percentage is below standard, commission decreased by 10% of the loss.
- c) Standard salesmen's expenses and travelling costs:
- d) Mileage allowance at 0.2 miles per Rs. of sales
- e) Travelling costs at Rs.0.15 per mile.

Territory	Actual sales	Actual sales mix contribution	Actual mileage run	Fixed expenses incurred	Budgeted fixed expenses
1	Rs.2,40,000	29%	58,000	Rs.2,900	Rs 2000
2	Rs.2,70,000	33%	42,000	Rs.1,800	Rs 2000

You are required to:

- (a) Calculate
 1. The standard profit for Territory 1
 2. The actual profit for Territory 2;
- (b) Calculate variances that show the performance of the salesman in each of the two territories.

Question: 27

Reconciliation-under traditional & opportunity cost method

Blue Ltd manufactures a single product, the standards of which are as follows:

Standard per unit:	(Rs.)	(Rs.)
Standard selling price		268
Less: Standard cost:		
Material (16 units at Rs.4)	64	
Labour (4 hours at Rs.3)	12	
*Overheads (4 hours at Rs.24)	96	172
Standard profit		96

*Total overhead costs are allocated on the basis of budgeted direct labour hours. The following information relates to last month's activities:

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	Budgeted	Actual
Production and sales	600 units	500 units
Direct labour	2,400 hours at Rs.3	2,300 hours at Rs.3
Fixed overheads	Rs.19,200	Rs.20,000
Variable	Rs.38,400	Rs.40,400
Materials	9,600 units at Rs.4 per unit	9,600 units at Rs.4 per unit

The actual selling price was identical to the budgeted selling price and there was no opening or closing stocks during the period.

You are required to calculate the variances and reconcile the budgeted and actual profit for each of the following methods:

- The traditional method.
- The opportunity cost method assuming materials are the limiting factor and materials are restricted to 9,600 units for the period.
- The opportunity cost method assuming labour hours are the limiting factor and labour hours are restricted to 2,400 hours for the period.
- The opportunity cost method assuming there are no scarce inputs.

Question: 28

Reconciliation for a service business unit

Tardy Taxis operates a fleet of taxis in a provincial town. In planning its operations for November 2002 it estimated that it would carry fare-paying passengers for 40,000 miles at an average price of Rs.1 per mile. However, past experience suggested that the total miles run would amount to 250% of the fare-paid miles. At the beginning of November it employed ten drivers and decided that this number would be adequate for the month ahead.

The following cost estimates were available:

Employment costs of a driver	Rs.1,000 per month
Fuel costs	Rs.0.08 per mile run
Variable overhead costs	Rs.0.05 per mile run
Fixed overhead costs	Rs.9,000 per month

In November 2002 revenue of Rs.36, 100 were generated by carrying passengers for 38,000 miles. The total actual mileage was 1, 05,000 miles. Other costs amounted to:

Employment costs of drivers	Rs.9,600
Fuel costs	Rs.8,820
Variable overhead costs	Rs.5,040
Fixed overhead costs	Rs.9,300

Requirements:

- Prepare a budgeted and actual profit and loss account for November 2002, indicating the total profit variance.
- Under marginal costing system, reconcile the budgeted and actual profits.

Question: 29

Reverse working

A small company making a single product produces accounts for a costing period as follows:

Direct materials	396
Direct wages	596
Variable overheads	970
Fixed overheads	520
Profit	488
Sales	2970

Budgeted units = 1000.

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Actual units produced and sold = 960.
 Standard direct wages rate Rs 0.3 per hour.
 Standard variable overhead rate Rs. 0.5 per hour.
 Cost variances during the period are as follows:

Variances	Favourable	Unfavourable
Material price	-	4
Material usage	-	8
Wage rate	10	-
Labour efficiency	-	30
Variable overhead efficiency	-	50
Variable overhead expenditure	40	-
Fixed overhead expenditure	-	20
Sales price	30	-

From this information prepare for the period the original budgeted income statement clearly showing the standards with respect to each element of cost.

Question: 30 Reverse working

A company manufactures a food product, data for which for one week have been analysed as follows:

Standard cost data:	(Rs.)
Direct materials: 10 units at Rs.1.50	15
Direct wages : 5 hours at Rs.4.00	20
Production overhead: 5 hours at Rs.5.00	25
Total	Rs.60

Profit margin is 20% of sales price.

Budgeted sales are Rs.30, 000 per week.

Actual data:	Rs
Sales	29,880
Direct materials	6,435
Direct wages	8,162

Analysis of variances:

		Adverse	Favourable
Direct Materials:	Price	585	
	Usage		375
Direct Labour:	Rate		318
	Efficiency	180	
Production Overhead:	Expenditure		200
	Volume		375

It can be assumed that the production and sales achieved resulted in no changes of stock.

You are required, from the data given, to calculate:

- The actual output;
- The actual profit;
- The actual price per unit of material;
- The actual rate per labour hour;
- The amount of production overhead incurred;
- The amount of production overhead absorbed;
- The production overhead efficiency variance;
- The selling price variance;
- The sales volume profit variance;

Question: 31 Reverse working

A Company produces a product, which has a standard variable production cost of Rs 8 per unit made up as follows:

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Direct materials	Rs 4.6 (2 Kg * Rs 2.3)
Direct labour	Rs 2.1 (0.7 hours * Rs 3 per hour)
Variable overheads	Rs 1.3

Fixed manufacturing costs are treated as period cost. The following information is available for the period just ended:

Variable manufacturing cost of sales (at standard cost)	263520
Opening stock of finished goods (at standard cost)	120800
Closing stock of finished goods (at standard cost)	146080
Direct material price variance	2571A
Raw material used in manufacture (at actual cost)	170310
Direct labour rate variance	4760A
Direct labour efficiency variance	3240F

Required for the period ended:

1. Number of units produced
2. Raw material usage variance
3. Total actual direct labour cost
4. Actual cost per Kg of raw material.

Question: 32 Partial plan

Material purchased 10,000 pieces at Rs.1.10	Rs.11,000
Material consumed 9,500 pieces at Rs.1.10	Rs.10,450
Actual wages paid 2,475 hours at Rs.3.50	Rs.8,662.50
Actual factory expenses incurred Rs.17,000 (Budgeted Rs.16,500)	
Units produced:	900 units and sold at Rs.60 per unit.
The standard rates and prices are as under:	
Direct materials	Re.1.00 per unit
Standard input	10 pieces per unit
Direct labour rate	Rs.3.00 per hour
Standard labour requirement	2.5 hours per unit
Overheads	Rs.6.00 per labour hour

Pass journal entries

Question: 33 Single plan-comprehensive

From the information given below relating to a manufacturing company.

- A. Write up the cost ledger and prepare a costing profit and loss account showing the appropriate variance for the year ended 30th April.
- B. Ascertain the profit stated in the financial accounts for the year ended 30th April, and reconcile this with the profit shown in your answer to a. above.

In addition to the normal financial accounts, the company kept cost control accounts. The balances on these accounts on 30th April of the previous year were as follows:

Particular		At Standard Cost
General Ledger Control A/c		69,00,000
Raw materials	20,50,000	
Work-in-progress	36,80,000	
Finished Goods	11,70,000	
	69,00,000	69,00,000

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The following is a summary of transactions during the current year ended 30th April.

S.no	Particulars	Rs.'000
1	Purchase of Raw Materials on credit	8090
2	Material price variance, calculated at the time of purchase (A)	190
3	Material usage variance (A)	50
4	Direct Wages actual (13,00,000 hours)	6780
5	Standard @ Rs.5 per hour	6550
6	Indirect Wages	2310
7	Depreciation	1050
8	Indirect Material and expenses	1930
9	Administration, selling and distribution expenses	5850
10	Debenture interest	360
11	Donation	20
12	Grant to staff benevolent fund	250
13	Material issued to production at Standard prices	8000
14	Factory OH absorbed to production at Rs.4 per standard DLH	5240
15	Sales on credit	31470
16	Payment received from borrowers (interest on loans)	70
17	Abnormal loss account	100

Note:

- (i) The following items of expenditure and income will not be considered in cost books: (a) Debenture interest, (b) Donation, (c) Grant to staff benevolent Fund, (d) Income from interest.
- (ii) All variances, viz. material usage variance, direct wage variance, overhead variance and abnormal loss will be charge to costing profit and loss account administration selling and distribution overhead will be charged to costing profit and loss account.
- (iii)

	At Standard Cost (Rs.)	At Actual Cost (Rs.)
Opening Stock		
Raw material	20,50,000	21,00,000
Work-in-progress	36,80,000	36,50,000
Finished Goods	11,70,000	12,50,000
Closing Stock		
Raw Material	18,00,000	17,90,000
Work-in-Progress	34,50,000	35,10,000
Finished Goods	11,90,000	12,00,000

Question: 34

Planning and operating variances

County Preserves produce jams, marmalade and preserves. All products are produced in a similar fashion; the fruits are low temperature cooked in a vacuum process and then blended with glucose syrup with added citric acid and pectin to help setting.

Margins are tight and the firm operates a system of standard costing for each batch of jam.

The standard cost data for a batch of raspberry jam are:

Fruit extract	400 kg	At Rs.0.16	Per kg
Glucose syrup	700 kg	At Rs.0.10	Per kg
Pectin	99 kg	At Rs.0.332	Per kg
Citric acid	1 kg	At Rs.2.00	Per kg
Labour	18 hrs	At Rs.36.25	Per hour

Standard processing loss 3%

The summer of 2002 proved disastrous for the raspberry crop with a late frost and cool, cloudy conditions at the ripening period, resulting in a low national yield. As a consequence, normal

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prices in the trade were Rs.0.19 per kg for fruit extract although good buying could achieve some savings. The impact of exchange rates on imports of sugar has caused the price of syrup to increase by 20%.

The actual results for the batch were:

Fruit extract	428 kg	At Rs.0.18	Per kg
Glucose syrup	742 kg	At Rs.0.12	Per kg
Pectin	125 kg	At Rs.0.328	Per kg
Citric acid	1 kg	At Rs.0.95	Per kg
Labour	20 hrs	At Rs.3.00	Per hour

Actual output was 1,164 kg of raspberry jam.

You are required to

- Calculate the ingredients planning variances that are deemed uncontrollable;
- Calculate the ingredients operating variances that are deemed controllable;
- Comment on the advantages and disadvantages of variance analysis using planning and operating variances;
- Calculate the mixture and yield variances;
- Calculate the total variances for the batch.

Question: 35

Planning and operating variances

Tungach Ltd make and sell a single product. Demand for the product exceeds the expected production capacity of Tungach Ltd. The holding of stocks of the finished product is avoided if possible because the physical nature of the product is such that it deteriorates quickly and stocks may become unsaleable.

A standard marginal cost system is in operation. Feedback reporting takes planning and operational variances into consideration.

The management accountant has produced the following operating statement for period 9:

Tungach Ltd.		
Operating Statement – Period 9		
	(Rs.)	(Rs.)
Original budgeted contribution		36,000
Revision variances:		
Material usage	9,600(A)	
Material price	3,600(F)	
Wage rate	1,600(F)	4,400(A)
Revised budgeted contribution		31,600
Sales volume variance:		
Causal factor		
Extra capacity	4,740(F)	
Productivity drop	987.5(A)	
Idle time	592.5(A)	
Stock increase	2,370(A)	790(F)
Revised standard contribution for sales achieved		32,390
Other variances:		
Material usage	900(F)	
Material price	3,120(A)	
Labour efficiency	1,075(A)	
Labour idle time	645(A)	
Wage rate	2,760(A)	6,700A
Actual contribution		25,690

(F) = Favourable (A) = adverse

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Other data are available as follows:

- (i) The original standard contribution per product unit as determined at period 1 was:

	(Rs.)	(Rs.)
Selling price		30
Less: Direct material 1.5 kilos at Rs.8	12	
Direct labour 2 hours at Rs.4.50	9	21
Contribution		9

- (ii) A permanent change in the product specification was implemented from period 7 onwards. It was estimated that this change would require 20% additional material per product unit. The current efficient price of the material has settled at Rs.7.50 per kilo.
- (iii) Actual direct material used during period 9 was 7,800 kilos of Rs.7.90 per kilo. Any residual are due to operational problems.
- (iv) The original standard wage rate overestimated the degree of trade union pressure during negotiations and was 20p higher than the rate subsequently agreed. Tungach Ltd made a short-term operational decision to pay the workforce at Rs.4.60 per hour during periods 7 to 9 in an attempt to minimize the drop in efficiency likely because of the product specification change. Management succeeded in extending the production capacity during period 9 and the total labour hours paid for were 9,200 hours. These included 150 hours of idle time.

- (v)

Budgeted prodn. and sales quantity (period 9)	4,000 units
Actual sales quantity (period 9)	4,100 units
Actual production quantity (period 9)	4,400 units

- (vi) Stocks of finished goods are valued at the current efficient standard cost.

Required:

- (a) Prepare detailed figures showing how the material and labour variances in the operating in the operating statement have been calculated.
- (b) Prepare detailed figures showing how the sales volume variance has been calculated for each causal factor shown in the operating statement.

Question: 36

Operating & planning variances

Casement Ltd makes windows with two types of frame; plastic and mahogany. Products using the two types of materials are made in separate premises under the supervision of separate production managers.

Data for the three months ended 30 November 2002 are shown below.

	Plastic		Mahogany		Totals	
	Budget	Actual	Budget	Actual	Budget	Actual
Sales units (Rs.000)	3,000	2,500	1,000	1,250	4,000	3,750
Sales revenue	660	520	340	460	1,000	980
Materials	(147)	(120)	(131)	(160)	(278)	(280)
Labour	(108)	(105)	(84)	(85)	(192)	(190)
Fixed production overheads	(162)	(166)	(79)	(83)	(241)	(249)
Sales commissions	(33)	(26)	(17)	(23)	(50)	(49)
Other selling and admn. Costs					(128)	(133)
Net profit					111	79

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Casement Ltd sells to a wide variety of users, so that window sizes and shapes vary widely; consequently a square metre of window is adopted as the standard unit for pricing and costing. Sales budgets were based on the exception that the company's share of the regional market in windows would be 12%. The Window Federation's quarterly report reveals that sales in the regional market totalled 25,000 units in the three months ended 30 November 2002.

The managing director of Casement Ltd is concerned that the company that the company's sales and profit are below budget; she wants a full analysis of sales variances as well as an analysis of the cost variances which can be obtained from the data.

Labour costs comprise the wages of shop-floor employees who receive a fixed wage for a 40-hour week; no overtime is worked. Production managers receive a fixed monthly salary which is included in production overheads, plus an annual personal performance bonus (excluded from the above data) which is decided by the board of directors at the end of each year. Sales representatives are paid a monthly retainer plus commission of 5% on all sales.

Requirements:

Prepare a variance report for the managing director on the results for the quarter ended 30 November 2002, providing market share and market volume (or size) variances, sales mix variance and basic cost variances, from the available information.

LEARNING CURVE

Learning Curve

$$y = ax^b$$

y = Average time taken per unit for "x" units.

x = Cumulative units.

a = Time taken for 1st unit.

$$B = \frac{\text{Log (learning rate expressed in decimals)}}{\text{Log 2.}}$$

Log Computation steps:

- Ascertain number of digits.
- From the total digits deduct 1.
- The result from step 2 is the integer portion.
- Take the Log book, see Log for the 1st two digits (from the left)

Eg., log of 15, go to 15 on the left and check up on the top against 0. Since the no of digits being 2, the answer shall be 1.1761. Similarly if the log of 1.5 should be ascertained from the same 15 but it will be taken as 0.1761, similarly for 150, the answer is 2.1761 and so on. The decimal portion picked up from the log table is technically referred to as mantissa. So mantisaa shall be added or deducted from the integer portion.

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Question:1 Learning curve- method-1 & method-2 (Formula method)

Direct labour hours to assemble the first unit of new equipment were 400. Assuming that this type of assembly will experience a learning effect of 90%. Compute the average direct labour for the 3rd & the 4th units as also for the 5th to 8th units.

Find also the average labour for the 6th & 7th units. B = -0.1520.

Question: 2 Formula method for batches

A first batch of 25 transistor radios took a total of 250 direct labour hours. It is proposed to assemble another 40 units. What will be the average labour per unit in this lot? Assume that there is 85% learning rate. B=-0.23455.

Question: 3 Computation of cumulative units

A company has found that the average direct labour just after completion of X units was 26.4 hours. The average at the end of the first unit was 52 hours. If there is learning curve effect of 85% what been the total output to date?

Question: 4 Learning curve- A bidding tool

Suraksha, an electronics firm, has designed a new model of fire alarm system and assembled a first unit as a prototype for demonstration. The direct labour expended on this unit was 260 hours and the direct material cost was Rs.37, 000. The direct labour rate is Rs.30 per hour. Following successful demonstrations to potential customers, confirmed orders have been received for supply of 50 units during the first six months and a supply of 75 units during the following six months.

The company wishes to set competitive prices for the supplies in each of the periods by passing on the benefits of learning curve effect of 80% that is normally applicable to this type of product assembly. Further, the variable overhead in regular production runs is estimated to be 125% of the direct labour cost and the fixed overhead is charged at 75% of direct labour cost. In view of the large production volumes it is expected that a 5% discount can be got on the materials used for the first six months and a 10% discount for the second six months.

The company sets the selling price with a 40% mark-up on the cost. Determine the selling price per unit that should be set for the orders in each of the six months. B=-0.3220.

Question: 5 Learning curve- A bidding tool

Bandookwala & Co, a firearms manufacturer, has designed a new type of gun and a first lot of 25 guns assembled for test purposes had the following costs:

Direct materials	24,500	} Proportional to direct labour
Direct labour	22,500	
Variable overheads	16,875	
Fixed overheads	11,250	
Total costs	75,125	

BSF being satisfied with this gun have asked the lowest bid for supply of 1,000 guns. The company will pass on the benefits of learning of 85% to the client in setting the bid. The company will set a selling price to earn 40% gross profit margin. Determine the unit price that should be bid.

Question: 6 Learning curve & capital budgeting

EGM manufactures electrical goods on behalf of various clients as per their requirements. Currently having lost one major client, EGM is left with a large surplus of skilled labour. This labour cannot be retrenched nor can additional be recruited. EGM located HHG a marketing firm in household goods, for whom it can offer manufacturing facilities to find gainful work for the

KALPESH CLASSES

skilled labour that may be otherwise idle. EGM has compiled the following information so as to arrive at a decision whether to undertake manufacture on behalf of HHDG.

Capital outlay on special machine Rs.2 lakhs (machine having no salvage value). Incremental overheads Rs.1 lakh per annum. Cost of materials Rs.180 per unit. Skilled labour rate Rs.30 per hour. The contract if entered into must be for a period of three years and HHDG will offer a unit price of Rs.260 valid for all the three years. A first unit trial run took 10 hours of direct labour of a skilled workman. It is expected that on repetitive production there will be learning effect of 82%.

HHDG will accept all the production that EGM is capable of. It was also assessed that the surplus skilled labour available will be adequate to manufacture 3,000 units in the first year. The cost of capital for EGM is 18%. You may assume that all cash flows occur at the year-end, except for the capital outlay that has to be at the start of year 1.

What decision should EGM take with regard to acceptance of the contract for HHDG? B=-0.2864.

Question: 7

Learning curve in fixing labour standards

Sundaram Products Ltd manufactures complex electronic measuring instruments for which highly skilled labour required. Conventional standard costing has been used for some time but problems have been experienced in setting realistic standards for labour costs.

Analysis of production times has shown that there is a learning effect of 90%.

During period 11 the following data were recorded:

Cumulative production at start of period	526 units
Production in period	86 units
Wages paid	Rs.71, 823 for 6,861 actual hours
Material actual cost	Rs.20, 850
Actual overheads for period	Rs.1, 52,600

Budgeted and standard cost data for Electronometers:

Budgeted production	86 units
Budgeted overhead	Rs.1, 50,903
Standard labour cost	Rs.10 per hour
Standard material cost per unit	Rs.250

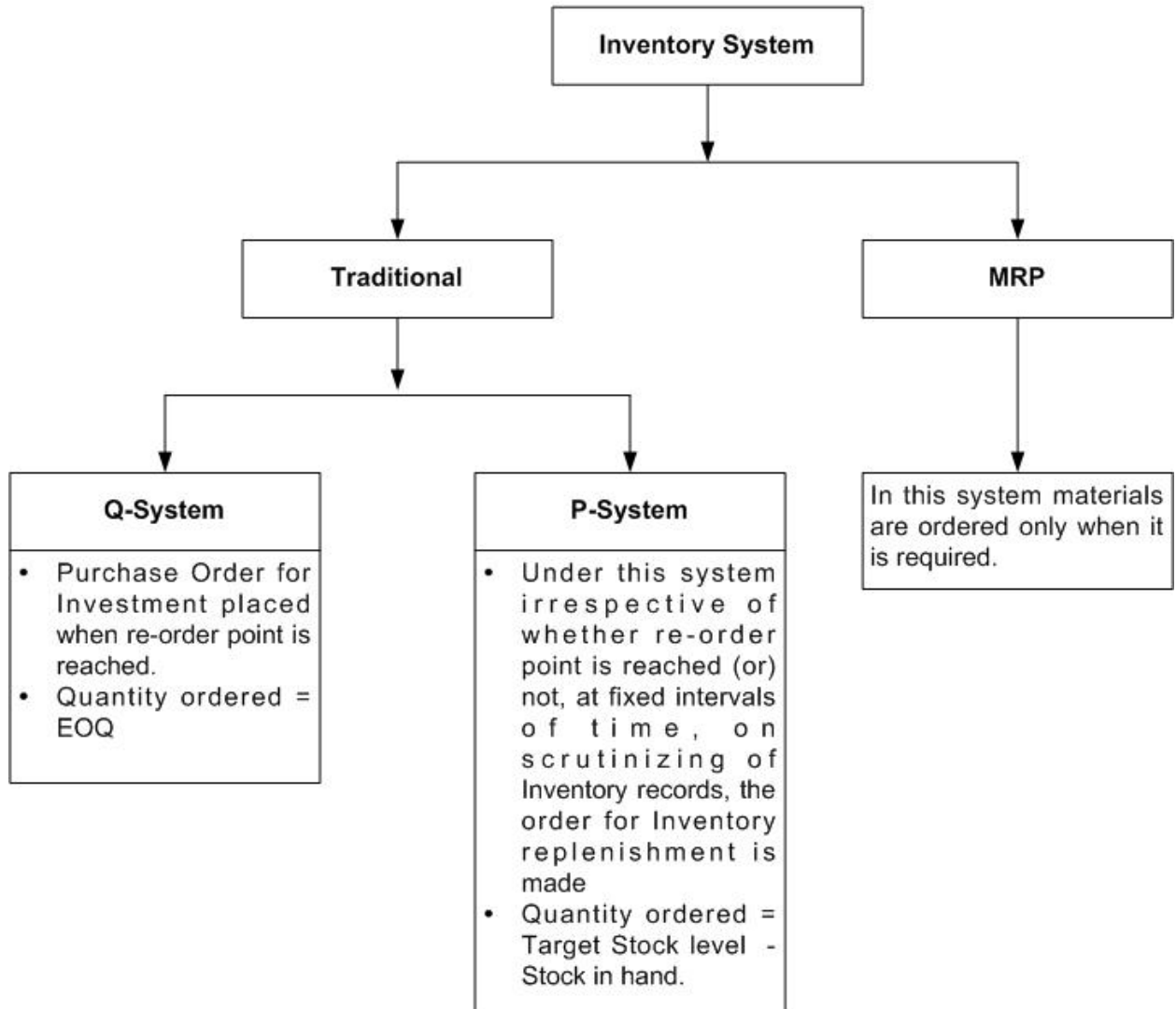
You are required to:

- Calculate and analyse where possible the materials, labour and overhead cost variances;
- Calculate a total standard cost for Electronometers.

MATERIAL REQUIREMENT PLANNING

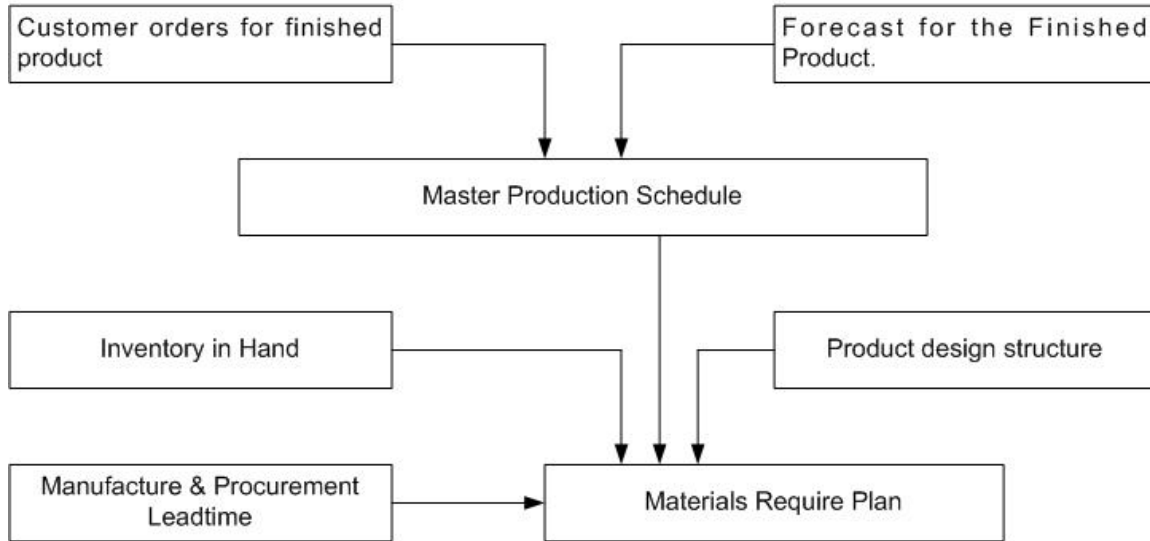
MATERIAL REQUIREMENT PLANNING

(I)



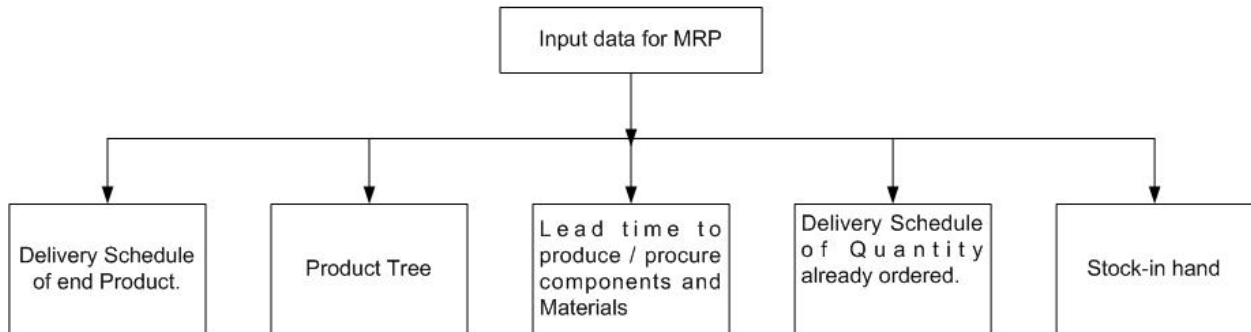
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(II) How MRP Operates?



Input Data for Material Requirement Planning

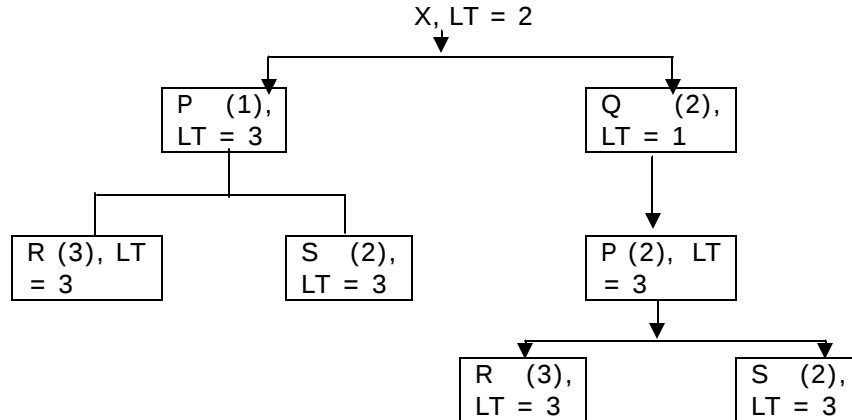
(III)



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Question: 1 Timing of order release

The product structure and the lead times for a finished product 'X' are given in figure below. If 100 units of X are required in week 12 and if none of the components, sub-assemblies and the end product are either on hand or on order. Compute the amounts and dates of the planned order releases for all the components and sub-assemblies. Assume that there is no particular order size and therefore all the order quantities are lot for lot.



Question: 2 Construction of product tree

The manufacture of Product x, requires the assembly of modules a, b and c. Two modules, each of a and c and only one module of b is needed to make one unit of x. Module a is made from the sub-assemblies d (2 needed), e (1 needed) and f (2 needed). D is made from components i j and k. To make one sub-assembly of d, two components each of j and l are required and 1 of component k. Sub-assembly f needs components l and m (one each). Module c needs sub-modules of g and h in quantities of two units and one unit, respectively. Sub-module g is, in turn, assembled from five units each of components i and j. Item i needs 1 unit each of components n and o.

Draw the product structure based on the above information.

If 100 units of x are to be produced, what are the requirements at the various levels of the product? Write an indented Bill of Materials and calculate the requirement of materials at the various levels.

Calculate the net requirements if the quantities on hand and/or on order are as shown below. A safety stock of i of 400 is seen as essential as it is used sometimes in another product y whose demand is not all that predictable.

Item	On Hand	On Order
D	70	-
E	-	100
f	50	100
I	500	500

Question: 3 Preparation of MRP

Given the following information, how many units are on hand at the end of week 9? Which are the weeks in which the orders may be placed?

Order Quantity = 200		Week								
Lead Time = 2 weeks		1	2	3	4	5	6	7	8	9
Requirements		90	10	140	55	5	15	115	95	100
Scheduled Receipts										
On Hand at the End of the Period	110									
Planned Order Release										

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Question: 4

MRP with safety stock

Geetha Industries uses MRP for its production materials planning. The table below provides the information about a particular component X. The demand for this component is somewhat uncertain and in order to take care of a sudden spurt in the demand, a safety stock of 50 items is recommended.

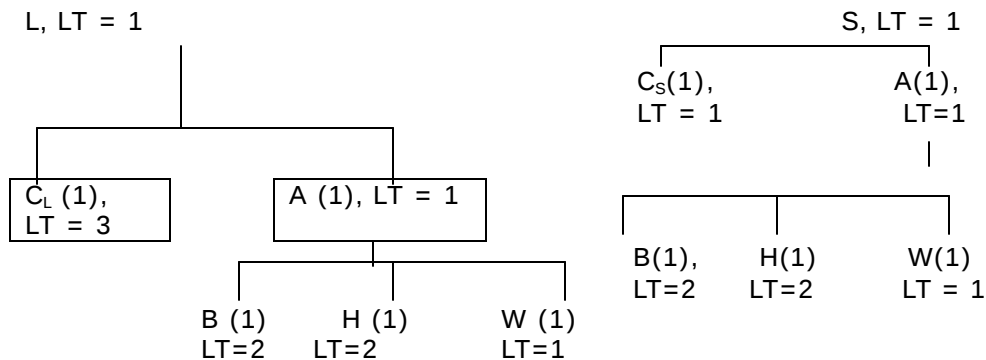
Order quantity=250	Weeks								
Lead Time = 3 weeks	1	2	3	4	5	6	7	8	9
Requirements	40	100	70	150	20	20	50	100	70
Scheduled Receipts		250							
On Hand at the end of the period 150									
Planned Order release									

During which week/weeks should the receipts be planned? When should the orders be placed? What is the expected on hand position at the end of week 9?

Question: 5

MRP-comprehensive

Bhagyadeep Industries is a small-scale unit which assembles decorative lamps. These are available in two models, Lakshmi (L) and Saraswathi (S). The lamp base assembly (A) consisting of the Base (B), the Holder (H) and Wire coil (W) is common to both the models; however, the shades or covers (C) for the two models of lamps are different. The lead times are as given in figure below:

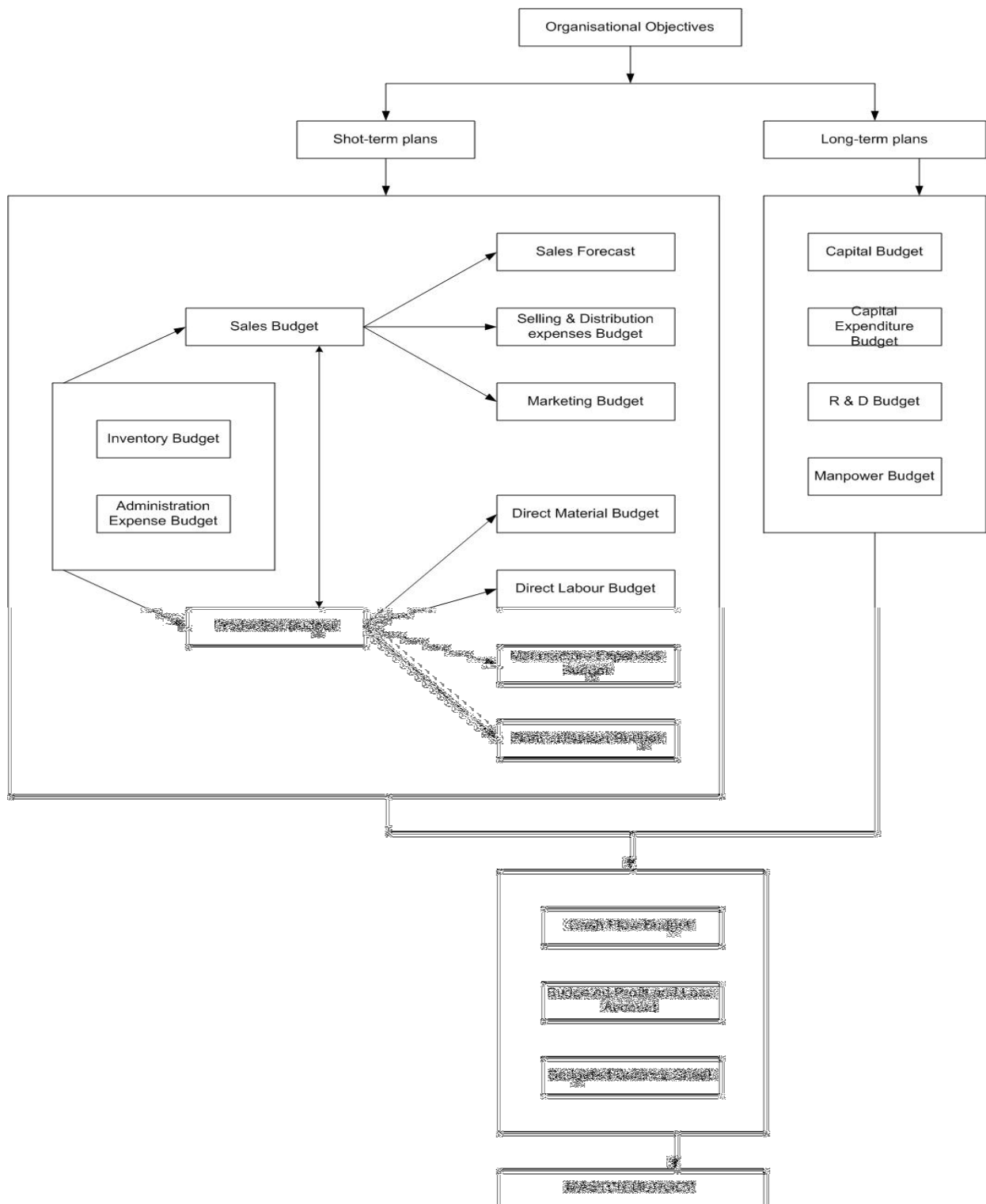


At the beginning of week 1, the materials position is as follows:

On Hand		Scheduled Receipts	
Base:	25 units	Cover (Saraswathi):	During week 2, 50 units
Holders:	100 units	Wireless-coil: (During week 3), 100 units	

If an order of 100 Lakshmis and 50 Saraswatis is to be filed by the sixth week, calculate the materials requirements plan. Assume that the items are ordered as required (there is no fixed lot size).

BUDGETARY CONTROL



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Question: 1

Labour utilization budget

The direct labour requirement of three of the products manufactured in a factory, each involving more than one labour operation, are estimated as follows:

Direct labour hours per unit (in minutes)

Product Operation	X	Y	Z
A	18	42	30
B	-	12	24
C	9	6	-

The factory works 8 hours per day, 6 days in a week. The budget quarter is taken as 13 weeks and during a quarter, lost hours due to leave and holidays and other causes are estimated to be 124 hours. The budgeted hourly rates for the workers manning the operation A, B and C are Rs.2, Rs.2.50 and Rs.3 respectively. The budgeted sales of the products during the quarter are X-9000 units, Y-15000 units and Z-12000 units.

There is a opening stock of 5000 units of Y and 4000 units of Z and it is proposed to build up a stock at the end of the budget quarter as X-1000 units and Z-2000 units prepare a manpower budget for the quarter showing for each operation

- a. Direct labour hours
- b. Direct labour cost and
- c. The number of workers

Question: 2

Master Budget

ABC Ltd. makes 2 types of polish, one for floors and one for cars. It sells both types to industrial users only in one-litre containers. The specification for the 2 types of products per batch of 100 litres.

Materials	Floor-Polish	Car-Polish
Delta	120 litres	100 litres
Gamma	20 Kg	10 KG
Containers cost per 100	Rs.100	Rs.100
Direct labour manufacturing	12 man hours	16 man hours
Primary packing	5 man hours	5 man hours

During the months to end of 30th September, the company expects to sell 15000 litres of floor polish at Rs.9 per litre and 25000 litre of car polish at Rs.7 per litre.

Materials are expected to cost Re.1 per litre for delta and Rs.8 a kg for gamma. Manufacturing wages in the industry look like being stable at Rs.6 per hour and packing wages at Rs 4 per hour throughout the period.

Flexible overhead expense are operated for manufacture and packing departments based on the number of man-hours worked. These budgets for six months to end of September are:

Manufacturing Department	Primary Packing Department
5000 man hours Rs 40,000	1700 man hours Rs 26,000
6000 man hours Rs.50,000	1900 man hours Rs.28,000
7000 man hours Rs.60,000	2100 man hours Rs 30,000
8000 man hours Rs 80,000	2300 man hours Rs 32,000

General administrative overhead are budgeted at Rs.37,000. At the beginning of the period 1st April packed stocks will be:

Floor polish	2000 litres
Cat polish	3000 litres

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By end of the period 30th September, it is desired to maintain the packed stocks of the products at 3000 litres and 4000 litres respectively.

The following are required:

1. A statement of standard prime cost per 100 litres of each product
2. A sales and production budget (in quantities) of the six months to 30th September
3. A profit forecast for the period. Show separate gross profit for the two products but do not attempt to allocate overhead between them. No overheads are included in to stock valuations

Question: 3

Master Budget

Manufactures Ltd. produce three products from three basic raw materials in three departments. The company operates a budgetary control system and values its stock of finished goods on a total cost basis. From the following data, you are required to produce for the month of July 2004 the following budgets.

- Production
- Material usage
- Purchases
- Profit and loss account for each product and in total.

Budgeted data for July 2004

	A	B	C
Sales	1500000	1080000	1680000
Stock of finished products at July 2004	3000 units	2000 units	2500 units
Department	I	II	III
Production overhead	239000	201300	391200
Direct labour hours	47800	67100	65200

Direct material stock at July 1, 2004 is M1-24500, M2-20500 and M3-17500 units. The company is introducing a new system of inventory control which should reduce stocks. The forecast is that stocks as at 31st July 2004 will be reduced as follows. Raw materials by 10% and finished products by 20%.

Fixed production overhead is absorbed on a direct labour hour basis. It is expected that there will be no work-in-progress at the beginning or end of the month.

Administration cost absorbed by products at a rate of 20% of production cost and selling and distribution cost is absorbed by products at a rate of 40% of production cost.

Profit is budgeted as a percentage of total cost as follows.

Product A-25% product B-12.5% product C-16 2/3%

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Standard cost data per unit of product:

		Price per unit	Product (units)		
Direct material	M1	2.00	A	B	C
	M2	4.00	5	-	12
	M3	1.00	-	10	9
			5	5	-
		Rate per hour	(Hours)		
Direct wages Department	I	2.50	4	2	2
	II	2.00	6	2	3
	III	1.50	2	4	6
Other variable costs			Rs. 10	Rs. 20	Rs. 15

Question: 4

Production; Purchase & Labour budgets

- (a) A company manufactures three products: chairs, tables and benches. From the following information you are to produce:
- A production budget showing quantities to be manufactured and factory unit costs of each product;
 - A purchasing budget detailing quantities to be purchased and the total cost of materials;
 - A direct wages budget showing hours to be worked in total and gross wages to be paid.

	Chairs	Tables	Benches
Sales in the next trading period (unit)	4,000	1,000	500
Material requirements			
Timber (per unit) @ Rs. 8 per ft ³	0.5 ft ³	1.2 ft ³	2.5 ft ³
Upholstery per unit @ Rs.4 per yd ²	0.2 yds ²	-	-

Fixing and finishing material costs, 5% total material cost.

Labour requirements:

	Chairs	Tables	Benches
Carpenters (hours per unit) @ Rs. 6 per hour	0.75	0.8	1.3
Fixers and finishers (hours per unit) @ Rs. 4.8 per hour	0.25	0.3	1.0

Fixed factory overheads are estimated at Rs.6253 for the trading period and these are recovered on the basis of labour hours.

	Chairs	Tables	Benches
Finished stocks at beginning of period	200	300	40
Finished stocks at end of period	400	100	50

Particulars	Timber	Upholstery
Opening stock	600 ft ³	400 yd ²
Closing stock	650 ft ³	260 yd ²

- (b) The trading period to which this budget relates is of four weeks' duration. The labour force is expected to perform as follows:

	Carpenters	Fixers
Normal hours per week, per person	40	40
Absenteeism and lateness	10%	15%

Calculate how many carpenters and fixers should be employed?

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Question: 5

Functional budgets

Vista Electronics manufactures two different types of coils used in electric motors. In the falls of the current year. Erica Becker, the controller, compiled the following data.

Sales forecast for 2000 (all units to be shipped in 2000):

Product	Units	Price
Light coil	60,000	Rs.65
Heavy coil	40,000	95

Raw material prices and inventory levels:

Raw Material	Expected Inventories January 1, 2000	Desired Inventories, December 31, 2000	Anticipated Purchase Price in Rs.
Sheet metal	32,000 lb.	36,000 lb.	8
Copper wire	29,000 lb	32,000 lb.	5
Platform	6,000 units	7,000 units	3

Use of raw material:

Raw Material	Amount Used per Unit	
	Light Coll	Heavy Coll
Sheet metal	4 lb	5 lb
Platform		1 unit

Direct-labor requirements and rates:

Product	Hours per Unit	Rate per Hour
Light coil	2	Rs.15
Heavy coil	3	20

Overhead is applied at the rate of Rs.2 per direct-labor hour.

Finished-goods inventories (in units):

Product	Expected January 1, 2000	Desired December 31, 2000
Light coil	20,000	25,000
Heavy coil	8,000	9,000

Manufacturing overhead:

Overhead Cost Item	Activity-Based Budget Rate
Purchasing and material handling	Rs.25 per Rupee of sheet metal and cooper wire purchased.
Depreciation, utilities and inspection	Rs.4.00 per coil produced (either type)
Shipping	Rs.1.00 per coil shipped (either type)
General manufacturing overhead	Rs.3.00 per direct-labor hour

Required: Prepare the following budgets for 2000.

- 1) Sales budget (in Rupees).
- 2) Production budget (in units).
- 3) Raw-material purchases budget (in quantities).
- 4) Raw-material purchases budget (in Rupees).
- 5) Direct-labor budget (in Rupees).
- 6) Manufacturing overhead budget (in Rupees).

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Question: 6

Principal budget factor

In its budgets for the period ahead, a company is considering two possible sales forecasts for its three products:

Product		A	B	C
(i)	Sales units	22,000	40,000	6,000
	Selling price per unit	10.00	6.00	7.50
(ii)	Sales units	30,000	50,000	7,000
	Selling price per unit	9.00	5.70	7.10

Variable costs per unit expected to be the same at the different levels of possible sales. The variable costs per units are as follows:

	Product A (Rs.)	Product B (Rs.)	Product C (Rs.)
Direct material	3.00	2.00	4.00
Direct labour	2.00	1.50	1.00
Variable overhead	1.00	0.50	0.50

Fixed overheads are expected to total Rs.1,50,000. These are expected to be unaffected by the possible changes in activity which are being considered.

Due to recent high labour turnover and problems of recruitment, direct labour will be restricted to a maximum of Rs.1,35,000 in the period. It can be assumed that all labour is of the same grade and is freely transferable between products. Other resources are expected to be generally available.

Required:

Take each of the possible forecasts in turn.

- Say what the principal budget factor is for each of the forecasts.
- For each forecast, calculate the sales budget that you would recommend to maximize profits.
- What profit would you expect from each sales budget?

In order to answer these questions you must assume that the three products must be sold either all the higher prices or all at the lower prices.

Question: 7

Revised operating budget

Toronto Business Associates, a division of Maple Leaf Services Corporation, offers management and computer consulting services to clients throughout Canada and the northeastern United states. The division specializes in website development and other Internet applications. The corporate management at Maple Leaf Services is pleased with the performance of Toronto Business Associates for the first nine months of the current year and has recommended that the division manager, Richard Howell, submit a revised forecast for the remaining quarter, as the division has exceeded the annual plan year-to-date by 20 percent of operating income. An unexpected increase in billed hour volume over the original plan is the main reason for this increase in income. The original operating budget for the first three quarters for Toronto Business Associates follows.

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TORONTO BUSINESS ASSOCIATES 20x1 Operating Budget				
	1st Quarter	2nd Quarter	3rd Quarter	Total for First Three Quarters
Revenue:				
Consulting fees:				
Computer system consulting	4,21,875	4,21,875	4,21,875	12,65,625
Management consulting	3,15,000	3,15,000	3,15,000	9,45,000
Total consulting fees	7,36,875	7,36,875	7,36,875	22,10,625
Other revenue	10,000	10,000	10,000	30,000
Total revenue	7,46,875	7,46,875	7,46,875	22,40,625
Expenses:				
Consultant salary expenses	3,86,750	3,86,750	3,86,750	11,60,250
Travel and related expense	45,625	45,625	45,625	1,36,875
General and administrative expenses	1,00,000	1,00,000	1,00,000	3,00,000
Depreciation expense	40,000	40,000	40,000	1,20,000
Corporate expense allocation	50,000	50,000	50,000	1,50,000
Total expenses	6,22,375	6,22,375	6,22,375	18,67,125
Operating income	1,24,500	1,24,500	1,24,500	3,73,500

Howell will reflect the following information in his revised forecast for the fourth quarter.

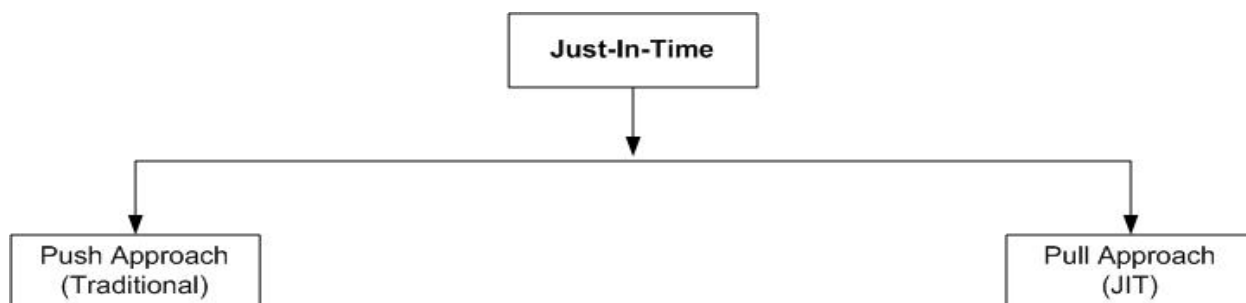
- ; Toronto Business Associates currently has 25 consultants on staff, 10 for management consulting and 15 for computer systems consulting. Three additional management consultant have been hired to start work at the beginning of the fourth quarter in order to meet the increased client demand.
- ; The hourly billing rate for consulting revenue will remain at 90 per hour for each management consultant and 75 per hour for each computer consultant. However, due to the favorable increase in billing hour volume when compared to the plan, the hours for each consultant will be increased by 50 hours per quarter.
- ; The budgeted annual salaries and actual annual salaries, paid monthly, are the same: 50,000 for a management consultant and 46,000 for a computer consultant. Corporate management has approved a merit increase of 10 percent at the beginning of the fourth quarter for all 25 existing consultants, while the new consultants will be compensated at the planned rate.
- ; The planned salary expense includes a provision for employee fringe benefits amounting to 30 percent of the annual salaries. However, the improvement of some corporate wide employee programs will increase the fringe benefits to 40 percent.
- ; The original plan assumes a fixed hourly rate for travel and other related expenses for each billing hour of consulting. These are expense that are not reimbursed by the client, and the previously determined hourly rate has proven to be adequate to cover these costs.
- ; Other revenue is derived from temporary rentals and interest income and remains unchanged for the fourth quarter.
- ; General and administrative expense have been favourable at 7 percent below the plan; this 7 percent savings on fourth quarter expenses will be reflected in the revised plan.
- ; Depreciation of office equipment and personal computers will stay constant at the projected straight-line rate.
- ; Due to the favourable experience for the first three quarters and the division's increased ability to absorb costs, the corporate management at Maple Leaf Services has increased the corporate expenses allocation by 50 percent.

Required:

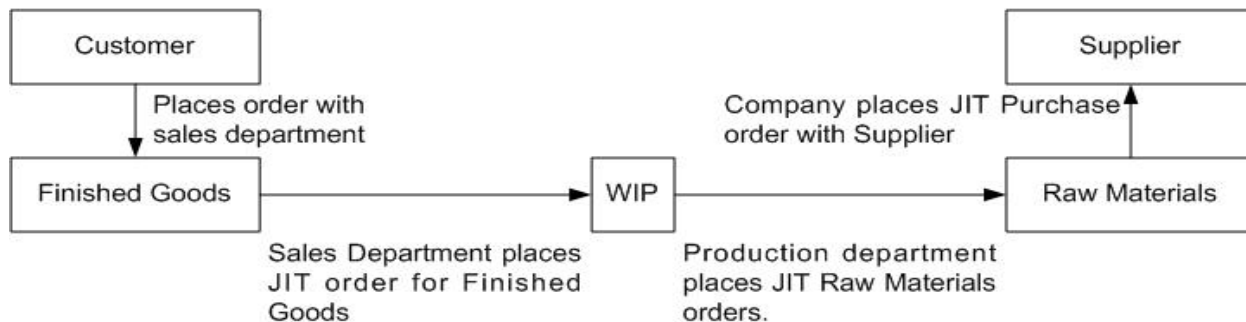
- 1) Prepare a revised operating budget for the fourth quarter for Toronto Business Associates that Richard Howell will present to corporate management.
- 2) Discuss the reasons why an organization would prepare a revised operating budget.

STRATEGIC COST MANAGEMENT

SN	TOPICS
1	Just in time & Back flush costing
2	Target costing
3	Life cycle costing
4	Total quality management

**Push Approach**

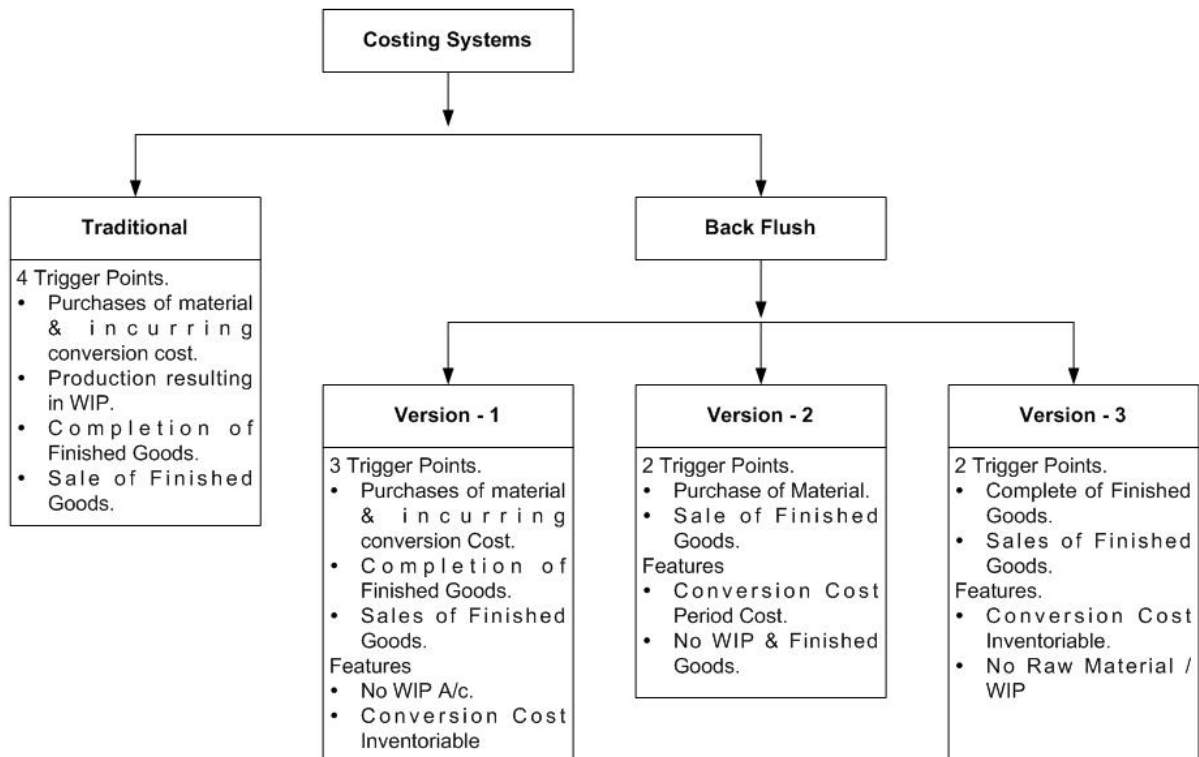
■ Represents unused Raw Material / Unfinished WIP/ Unsold Finished.

Pull Approach

Note: Under pull approach there will be no inventory of raw materials or WIP or finished goods since they are purchase or produced on receiving customer order.

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Back Flush costing



Trigger Point means point at which entry is passed in Cost Ledger Accounts.

Life Cycle Costing (LCC):

Usually a product's, life has four phases – introduction, growth, maturity, and decline.

Life cycle costing has been developed indirectly by rapid development in technology, which has shortened the life cycle of most products. "Standard costing" aims at controlling costs over a product's productive (economic) life - which used to be a long period in earlier days. On the other hand "Capital budgeting" considers a project life up to the time the asset becomes commercially operative. In life cycle costing when the product's life has been shortened all those costs that enter the whole life of it are taken into account in management decision making. It is thus an improvement over traditional cost follows cost by functions life Correlation Coefficient & D, production, marketing, etc. The aim is to adopt a policy which will maximize the return over the cost object's total life.

Since, the whole life cycle of the cost object is considered the importance of cost reduction and revenue opportunity is stressed under Product Life Costing.

Life cycle costing – as it compasses all business functions in the value chain from R & D to customer service expected to be incurred on a product or a project including environmental cleanup costs as well – is also called "cradle to grave" costing.

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Just in time & Back flushing

Question: 1 JIT-a cost reduction tool

The management of Alliance Enterprises recently decided to adopt a just-in-time inventory policy to curb steadily rising costs and free up cash for purposes of investment. The company anticipates that inventory will decrease from Rs.36, 00,000 to Rs.6, 00,000, with the released funds to be invested at a 12 percent return for the firm. Additional data follow:

- ? Reduced inventories should produce savings in insurance and property taxes of Rs.27, 000.
- ? Alliance will lease 75 % of an existing warehouse to another firm for Rs.2 per square foot. The warehouse has 30,000 square feet.
- ? Because of the need to handle an increased number of small shipments from suppliers, Alliance will remodel production and receiving-dock facilities at a cost of Rs.6, 00,000. The construction costs will be depreciated over a 10-year life.
- ? A shift in suppliers is expected to result in the purchase and use of more expensive raw materials. However, these materials should give rise to fewer warranty and repair problems after Alliance's finished product is sold, resulting in a net savings for the firm of Rs.25, 000.
- ? Three employees who currently earn Rs.30, 000 each will be directly affected by the just-in-time adoption decision. Two employees will be transferred to other positions with Alliance; one will be terminated.
- ? Reduced raw material inventory levels and accompanying stock outs will cost Alliance Rs.70, 000.

Required:

Compute the annual financial impact of Alliance's decision to adopt a just-in-time inventory system.

Question: 2 Just in time-cost savings

SteelTech Ltd., is an automotive supplier that uses automatic screw machines to manufacture precision parts from steel bars. SteelTech's inventory of raw steel averages Rs.6, 00,000 with a turnover rate of four times per year. John, president of SteelTech, is concerned about the costs of carrying inventory. He is considering the adoption of just-in-time inventory procedures in order to eliminate the need to carry any raw steel inventory. John has asked the company's financial controller, to evaluate the feasibility of JIT for the corporation. He has identified the following effects of adopting JIT.

- ? Without scheduling any overtime, lost sales due to stock outs would increase by 35,000 units per year. However, by incurring overtime premiums of Rs.40, 000 per year, the increase in lost sales could be reduced to 20,000 units. This would be the maximum amount of overtime that would be feasible for SteelTech.
- ? Two warehouses presently used for steel bar storage would no longer be needed. SteelTech rents one warehouse from another company at an annual cost of Rs.60, 000. The other warehouse is owned by SteelTech and contains 12,000 square feet. Three-fourths of the space in the owned warehouse could be rented out for Rs.1.50 per square foot per year.
- ? Insurance totaling Rs.14, 000 per year would be eliminated.

SteelTech's projected operating results for 2001 are as follows. Long-term capital investments by SteelTech are expected to produce a rate of return of 20 percent before taxes.

STEELTECH, INC.		
Budgeted Income Statement		
For the Year Ended December 31, 2001 (in thousands)		
Sales (9,00,000 units)		Rs.10, 800
Cost of goods sold:		
Variable	Rs.4, 050	
Fixed	1,450	5,500
Gross margin		Rs.5, 300
Selling and administrative expenses:		

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Variable	Rs.900	
Fixed	1,500	2,400
Income before interest and income taxes		Rs.2, 900
Interest expenses		900
Income before taxes		Rs.2, 000

Required

Calculate the estimated savings or loss for SteelTech, Ltd. that would result in 2001 from the adoption of just-in-time inventory methods. Ignore income taxes.

Question: 3

Back flush costing-version-1

Road Warrior Corp., assembles hand-held computers that have scaled-down capabilities of laptop computers. Each hand-held computer takes 6 hours to assemble. Road Warrior uses a JIT production system a back flush costing system with three trigger points:

- ◆ Purchase of direct (raw) materials.
- ◆ Completion of finished units of product.
- ◆ Sale of finished goods.

There are no beginning inventories of materials or finished goods. The following data are for August 2000:

Direct (raw) materials purchased	Rs.27, 54,000
Direct (raw) materials used	27,33,600
Conversion cost incurred	7,23,600
Conversion costs allocated	7,50,400

Road Warrior records direct materials purchased and conversion costs incurred at actual costs. When finished goods are sold, the back flush costing system “pulls through” standard direct materials costs (Rs.102 per unit) and standard conversion costs (Rs.28 per unit). It produced 26,800 finished goods units in August 2000 and sold 26,400 units. The actual direct materials cost per unit in August 2000 was Rs.102 while the actual conversion cost per unit was Rs.27.

Required:

- (1) Prepare summary journal entries for August 2000
- (2) Post the entries in requirement 1 to T-accounts for applicable Inventory: Raw and In-Process, Conversion Costs Control, Conversion Costs Allocated, and Cost of Goods Sold.

Question: 4

Back flush costing – version-2

Assume the same facts in P3, except for the following change. Road Warrior Corp., now uses a back flush costing system with the following two trigger points:

- ◆ Purchase of direct (raw) materials
- ◆ Sale of finished goods

The Inventory Control account here will include direct materials purchased but not yet in production, materials in work in process, and materials in finished goods but not sold. No conversion costs are inventoried. Any under-or over allocated conversion costs are written off monthly to costing P&L account.

Required:

- (1) Prepare summary journal entries for August.
- (2) Post the entries in requirement 1 to T-accounts for Inventory Control, Conversion Costs Control, Conversion Costs Allocated, and Cost of Goods Sold.

Question: 5

Back flush costing-version-3

Assume the same facts as in Question 3 except now Road Warrior uses only two trigger points, the completion of finished unit of product and the sale of finished goods. Any under or over allocated costs are written off monthly to costing P&L account.

Required:

- (1) Prepare summary journal entries for August

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- (2) Post the entries in requirement 1 to T-accounts for Finished Goods Control, Conversion Cost Control, Conversion Costs Allocated, and Costs of Goods Sold.

Target costing

Question: 6

Target costing-an insight

For many years, Leno Corporation has used a straightforward cost-plus pricing system, marking its goods up approximately 25 percent of total cost. The company has been profitable; however, it has recently lost considerable business to foreign competitors that have become very aggressive in the marketplace. These firms appear to be using target costing. An example of Leno's problem is typified by item no. 8976, which has the following unit-cost characteristics:

Direct material	Rs.30
Direct labor	75
Manufacturing overhead	50
Selling and administrative expenses	25

The going market price of an identical product of comparable quality is Rs.195, which is significantly below what Leno is charging.

Required:

- (1) Contrast cost-plus pricing and target costing. Which of the two approaches could be aptly labeled price-led costing? Why?
- (2) What is Leno's current selling price of item no.8976?
- (3) If Leno used target costing for item no.8976, what must happen to costs if the company desires to meet the market price and maintain its current rate of profit on sales? By how much?
- (4) Would the identification of value-added and non-value-added costs assist Leno in this situation? Briefly explain.
- (5) Suppose that by previous cost-cutting drives, costs had already been "pared to the bone" on item no.8976. What might Leno be forced to do with its markup on cost to remain competitive? By how much?

Question: 7

Product modification strategy

Danish Furniture (DF) manufactures easy-to-assemble wooden furniture for home and office. The firm is considering modification of a table to make it more attractive to individuals and businesses. The table is small, can be used to hold a computer printer or fax machine, and has several shelves for storage.

The company's marketing department surveyed potential buyers of the table regarding five proposed modifications. The 200 survey participants were asked to evaluate the modifications by using a five-point scale that ranged from 1 (strongly disagree) to 5 (strongly agree). Their responses, along with DF's related unit costs for the modifications, follow.

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	1	2	3	4	5
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Add cabinet doors in storage area (Rs.6.00)	10	20	30	60	80
Expand storage area (Rs.2.50)	10	40	70	50	30
Add security lock to storage area (Rs.1.65)	30	60	50	40	20
Give table top a more rich, marble appearance (Rs.4.25)	10	20	50	60	60
Extend warranty to five years (Rs.5.10)	40	70	30	35	25

The table currently costs Rs.64 to produce and distribute and DF's selling price for this unit averages Rs.80. The current selling price for these tables with all or some of the aforesaid features averages Rs.95.

Required:

- (1) Why is there a need in target costing to (a) focus on the customer and (b) have a marketing team become involved with product design?
- (2) DF's marketing team will evaluate the survey responses by computing a weighted-average rating of each of the modifications. This will be accomplished by weighting (multiplying) the point values (1, 2, etc.) by the frequency of responses, summing the results, and dividing by 200. Rank the popularity of the five modifications using this approach.
- (3) Management desires to earn approximately the same rate of profit on sales that is being earned with the current design.
 - (a) If DF uses target costing and desires to meet the current competitive selling price, what is the maximum cost of the modified table?
 - (b) Which of the modifications should DF consider?

Assume that DF wanted to add a modification or two that you excluded in your answer to requirement 3(b). What process might management adopt to allow the company to make its target profit for the table? Briefly explain.

Question: 8 Cost-plus pricing Vs target pricing

Ford Ltd. manufactures and sells 15,000 units of a raft, RF17, in 2001. The full cost per unit is Rs.200. Ford earns a 20% return on an investment of Rs.18, 00,000 in 2001.

Required:

- (1) Calculate the selling price of RF17 in 2001. Calculate the markup percentage on the full cost per unit of RF17 in 2001.
- (2) If the selling price in requirement 1 represents a markup percentage of 40% on variable costs per unit, calculate the variable cost per unit of RF17 in 2001.
- (3) Calculate ford's operating income if it had increased the selling price to Rs.230. at this price ford would have sold 13,500 units of RF17. Assume no change in total fixed costs. Should ford have increased the selling price of RF17 to Rs.230?

In response to competitive pressure, ford must reduce the price of RF17 to Rs.210 in 2002, in order to achieve sales of 15,000 units. Ford plans to reduce its investment to Rs.16, 50,000. If ford wants to maintain a 20% return on investment, what is the target cost per unit in 2002?

Question: 9 Target costing & value engineering

Cauvery Ltd. manufactures two component parts for the television industry:

- ◆ T: Annual production and sales of 50,000 units at a selling price of Rs.40.60 per unit.
- ◆ Premia: Annual production and sales of 25,000 units at a selling price of Rs.60 per unit.

Cauvery includes all R & D and design costs in engineering costs. Assume that Cauvery has no marketing, distribution, or customer-service costs.

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The direct and indirect costs incurred by Cauvery on T and Premia are as follows:

	T	Premia	Total
Direct materials costs (variable)	8,50,000	6,00,000	14,50,000
Direct manufacturing labor costs (variable)	3,00,000	2,00,000	5,00,000
Direct machining costs (fixed)	1,50,000	1,00,000	2,50,000
Indirect manufacturing costs			
Machine setup costs			86,250
Testing costs			4,87,500
Engineering costs			4,50,000
Indirect manufacturing costs			10,23,750
Total costs			32,23,750

Cauvery's management identifies the following activity cost pools, cost drivers for each activity, and the cost per unit of cost driver for each overhead cost pool:

Manufacturing Activity	Description of Activity	Cost Driver	Cost Per Unit of Cost Driver
(1) Setup	Preparing machine to manufacture a new batch of products	Setups-hours	Rs.25 per setup-hour
(2) Testing	Testing components and final product (Cauvery tests each unit of T and Premia individually)	Testing-hours	Rs.2 per testing-hour
(3) Engineering	Designing products and processes and ensuring their smooth functioning	Complexity of product and process	Costs assigned to products by special study

Over a long-run horizon, Cauvery's management views direct materials costs and direct manufacturing labor costs as variable with respect to the units of T and Premia produced, and overhead costs as variable with respect to their chosen cost drivers. For example, setup costs vary with the number of setup-hours. Direct machining costs represent the cost of machine capacity dedicated to the production of each product (50,000 hours at Rs.3 per hour for T). These costs are fixed and are not expected to vary over the long-run horizon. Additional information is as follows:

	T	Premia
(1) Production batch sizes	500 units	200 units
(2) Setup time per batch	12 hours	18 hours
(3) Testing and inspection time per unit of product produced	2.5 hours	4.75 hours
(4) Engineering costs incurred on each product	Rs.1, 70,000	Rs.2, 80,000

Cauvery is facing competitive pressure to reduce the price of T and has set a target price of Rs.34.80, well below its current price of Rs.40.60. the challenge for Cauvery is to reduce the cost of T. Cauvery's engineers have proposed new product design and process improvements for the "New T" to replace T. The new design would improve product quality, and reduce scrap and waste. The reduction in prices will not enable Cauvery to increase its current unit sales. (However, if Cauvery does not reduce prices, it will lose sales.)

The expected effects of the new design relative to T are as follows:

- Direct materials costs for New T are expected to decrease by Rs.2.00 per unit.
- Direct manufacturing labor costs for New T are expected to decrease by Rs.0.50 per unit.
- Machining time required to make New T is expected to decrease by 20 minutes. It currently takes 1 hour to manufacture 1 unit of T. The machines will be dedicated to the production of New T.
- New T will take 7 setup-hours for each setup.
- Time required for testing each unit of New T is expected to be reduced by 0.5 hour.
- Engineering costs will be unchanged.

Assume that the batch sizes are the same for New T as for T. If Cauvery requires additional resources to implement the new design, it can acquire these additional resources in the quantities needed. Further assume the costs per unit of cost driver for the New T are the same as those for T.

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Required:

- (1) Calculate the full cost per unit for T and Premia using activity-based costing.
- (2) What is the markup on the full cost per unit for T?
- (3) What is Cauvery's target cost per unit for New T if it is to maintain the same markup percentage on the full cost per unit as it had for T?
- (4) Will the New T design achieve the cost reduction targets that Cauvery has set? Explain.
- (5) What price will Cauvery charge for New T if it uses the same markup percentage on the full cost per unit for New T as it did for T?
- (6) What price should Cauvery charge for New T? Specify any other management actions that Cauvery should take regarding New T.

Question: 10

Value-added & non value-added cost

Vijay Associates, a small structural design firm, prepares architectural drawings for various clients to ensure the structural safety of buildings. The architectural plans are then submitted to local government departments for approval. Vijay's income statement for 2001 follows:

Revenues	Rs.6, 80,000
Salaries of professional staff (8,000 hours x Rs.50 per hour)	4,00,000
Travel	18,000
Administration and support	1,60,000
Total costs	Rs.78, 000
Operating income	Rs.1, 02,000

An analysis of the percentage of time spent by professional staff on various activities gives this data:

Doing calculations and preparing drawings for clients	75%
Checking calculations and drawings	4%
Correcting errors found in drawings (not billed to clients)	7%
Making changes in response to client requests (billed to clients)	6%
Correcting errors to meet government building code requirements (not billed to clients)	8%
Total	100%

Assume administration and support costs vary with professional labor costs.

Required:

Consider each requirement independently. There is no connection between the requirements.

- (1) How much of the total costs in 2001 are value-added, non value-added, or in the gray area in between? Explain your answers briefly. What actions can Vijay take to reduce its costs?
- (2) Suppose Vijay continued to check all calculations and drawings but could eliminate all errors so that it did not need to spend any time making corrections and, as a result, could proportionately reduce professional labor costs. Calculate Vijay's operating income.

Now suppose Vijay could take on as much business as it could get done, but it could not add more professional staff. Assume, as in requirement 2, that Vijay could eliminate all errors so that it does not need to spend any time making corrections. Suppose Vijay could use the time saved to increase revenues proportionately. Assume travel costs will remain at Rs.18, 000. Calculate Vijay's operating income.

Life cycle costing

Question: 11

Product life cycle income statement

Decision Support Systems (DSS) is examining the profitability and pricing policies of its software division. The DSS software division develops software packages for engineers. DSS has collected data on three of its more recent packages:

- ◆ EE – 46: package for electrical engineers.
- ◆ ME – 83: package for mechanical engineers.
- ◆ IE – 17: package for industrial engineers.

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Summary details on each package over their two-year “cradle-to-grave” product lives are as follows:

Package	Selling Price	Number of Units Sold	
		Year 1	Year 2
EE – 46	Rs.250	2,000	8,000
ME – 83	300	2,000	3,000
IE – 17	200	5,000	3,000

Assume that no inventory remains on hand at the end of year 2.

DSS is deciding which product lines to emphasize in its software division. In the past two years, the profitability of this division has been mediocre. DSS is particularly concerned with the increase in R & D costs in several of its divisions. An analyst at the software division pointed out that for one of its most recent packages (IE – 17), major efforts had been made to reduce R & D costs.

Last week Nancy Sullivan, the software division manager, attended a seminar on product life-cycle management. The topic of life cycle reporting was discussed. Sullivan decides to use this approach in her own division. She collects the following life-cycle revenue and cost information for the EE – 46, ME – 83, and IE – 17 packages:

	(Rs. in '000)					
	EE – 46		ME – 83		IE – 17	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Revenues	500	200	600	900	1000	600
Costs						
R & D	700	0	450	0	240	0
Design of product	185	15	110	10	80	16
Manufacturing	75	225	105	105	143	65
Marketing	140	3,60	1,20	150	240	208
Distribution	15	60	24	36	60	36
Customer service	50	325	45	105	220	388

Required:

- (1) How does a product life-cycle statement differ from an income statement that is calendar-based? What are the benefits of using a product life-cycle reporting format?
 - (2) Present a product life-cycle income statement for each software package. Which package is the most profitable, and which is the least profitable? Ignore the time value of money.
- How do the three software packages differ in their cost structure (the percentage of total costs in each category)?

Question: 12 Life cycle costing

Destin Products makes digital watches. Destin is preparing a product life-cycle budget for a new watch, MX3. Development on the new watch is to start shortly. Estimates about MX3 are as follows:

Life-cycle units manufactured and sold	4,00,000
Selling price per watch	Rs.40
Life-cycle costs	
R & D and design costs	Rs.10, 00,000
Manufacturing	
Variable costs per watch	Rs.15
Variable costs per batch	Rs.600
Watches per batch	500
Fixed costs	Rs.18, 00,000
Marketing	
Variable costs per watch	Rs.3.20
Fixed costs	Rs.10, 00,000

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Distribution	
Variable costs per batch	Rs.280
Watches per batch	160
Fixed costs	Rs.7, 20,000
Customer-service costs per watch	Rs.1.50

Ignore the time value of money.

Required:

- (1) Calculate the budgeted life-cycle operating income for the new watch.
- (2) What percentage of the budgeted total product life-cycle costs the end of the R&D and design stages will incur?
- (3) An analysis reveals that 80% of the budgeted total product life-cycle costs of the new watch will be locked in at the end of the R & D and design stages. What implications do this finding have for managing MX3's costs?
- (4) Destin's Market Research Department estimates that reducing MX3's price by Rs.3 will increase life-cycle unit sales by 10 percent. If unit sales increase by 10%, Destin plans to increase manufacturing and distribution batch sizes by 10% as well. Assume that all variable costs per watch, variable costs per batch, and fixed costs will remain the same. Should Destin reduce MX3's price by Rs.3? Show your calculations.

Total quality management

Question: 13

Effect of quality management Programme

Calton Ltd. makes and sell a single product. The existing product unit specifications are as follows:

Direct material X:	8 sq. metres at Rs.4 per sq. metre
Machine time:	0.6 running hours
Machine cost per gross hour:	Rs.40
Selling price:	Rs.100

Calton Ltd., require to fulfil orders for 5,000 product units per period. There are no stocks of product units at the beginning or end of the period under review. The stock level of material X remains unchanged throughout the period.

The following additional information affects the costs and revenues:

- (1) 5% of incoming material from suppliers is scrapped due to poor receipt and storage organization.
- (2) 4% of material X input to the machine process is wasted due to processing problems.
- (3) Inspection and storage of material X costs Rs.0.10 pence per sq. metre purchased.
- (4) Inspection during the production cycle, calibration checks on inspection equipment, vendor rating and other checks costs Rs.25,000 per period
- (5) Production quantity is increased to allow for the downgrading of 12.5% of product units at the final inspection stage. Downgraded units are sold as 'second quality' units at a discount of 30% on the standard selling price.
- (6) Production quantity is increased to allow for returns from customers which are replaced free of charge. Returns are due to specification failure and account for 5% of units initially delivered to customers. Replacement units incur a delivery cost of Rs.8 per unit. 80% of the returns from customers are rectified using 0.2 hours of machine running time per unit and are re-sold as 'third quality' products at a discount of 50% on the standard selling price. The remaining returned units are sold as scrap for Rs.5 per unit.
- (7) Product liability and other claims by customers is estimated at 3% of sales revenue from standard product sales.
- (8) Machine idle time is 20% of gross machine hours used (i.e. running hours = 80% of gross hours).
- (9) Sundry costs of administration, selling and distribution total Rs.60,000 per period.

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(10) Calton Ltd is aware of the problem of excess costs and currently spends Rs.20,000 per period in efforts to prevent a number of such problems from occurring.

Calton Ltd. is planning a quality management programme which will increase its excess cost prevention expenditure from Rs.20,000 to Rs.60,000 per period. It is estimated that this will have the following impact.

- (1) A reduction in stores losses of material X to 3% of incoming material.
- (2) A reduction in the downgrading of product units at inspection to 7.5% of units inspected.
- (3) A reduction in material X losses in process to 2.5% of input to the machine process.
- (4) A reduction in returns of products from customers to 2.5% of units delivered.
- (5) A reduction in machine idle time to 12.5% of gross hours used.
- (6) A reduction in product liability and other claims to 1% of sales revenue from standard product sales.
- (7) A reduction in inspection, calibration, vendor rating and other checks by 40% of the existing figure.
- (8) A reduction in sundry administration, selling and distribution costs by 10% of the existing figure.
- (9) A reduction in machine running time required per product unit to 0.5 hours.

Required:

- (a) Prepare summaries showing the calculation of (i) total production units (pre-inspection), (ii) purchases of material X (sq. metres), (iii) gross machine hours. In each case the figures are required for the situation both before and after the implementation of the additional quality management programme, in order that the orders for 5,000 product units may be fulfilled.
- (b) Prepare profit and loss account for Calton Ltd for the period showing the profit earned both before and after the implementation of the additional quality management programme.
- (c) Comment on the relevance of a quality management programme and explain the meaning of the terms internal failure costs, external failure costs, appraisal costs and prevention costs giving examples for each, taken where possible from the information in the question.

Question: 14

Sell, rework or reconstitute

Novel Accessories have been manufacturing alloy figurettes to be fitted on car bonnets. One of the figurettes resembles a tiny model of Asokan Pillar with the Lion Capitol. As the cars fitted with these have been mistaken by public as belonging to Government dignitaries, on a complaint, the police authorities have banned the use of this on car bonnets. The company is now left with inventories of 8,000 units of this figurette and manufacturing cost per unit were as follows:

	Rs.
Material	1.20
Labour	0.80
Fixed overhead	0.50
	2.50

Prior to being banned, the selling price was Rs.5 per unit. The casts for this figurette costs Rs.1,000, when originally acquired. The company has examined the situation and has come out with three alternative courses of action.

- (i) Sell the units as scrap for Rs.6,500.
- (ii) Rework them by putting a base on them which would allow them to be sold as drawing room curios at a price of Rs.3.20 each. Such work would require Rs.2 per unit of additional labour and a fixed overhead charge of Re.1 each would be entailed in terms of the company's absorption costing system. No further materials would be required.
- (iii) Melt them down and use the material as substitute in a strong selling line where the metal currently used costs 50% more than the metal used in the figurette. This process would incur a material loss of three-eighths of the original metal.

You are required to examine each of these alternatives and arrive at the decision which would result in the greatest benefit to the company. Your calculations should be justified by appropriate reasoning and explanation.

1. Hungarian method for solving assignment problem:

1. Row operation: Identify least number in each row & subtract it from all numbers in that row.
2. Column operation: In the matrix resulting from the step 1, identify least number in each column & subtract it from all numbers in that column.
3. Cover all the Zeros in the matrix resulting after step 2 with minimum number of lines. If number of lines = order of matrix then go to step 5 else go to step 4.
4. Identify the least uncovered number; add it to numbers lying in the intersection of two lines; subtract it from uncovered numbers.
5. Allocation: Identify row with only one zero & make allocation in the cell having zero as its value & draw line against in the column where the cell is placed. Continue in the process till you make all the allocation.

Note:

The above steps solve a minimisation balance assignment problem.

2. Maximisation balance assignment problem.

Convert the problem into minimisation problem by identifying highest number in the assignment matrix and reducing all other numbers from it. Then apply Hungarian method to solve the problem.

3. Minimisation unbalanced assignment problem.

An assignment problem is said to be unbalanced if the number of rows not equal to number of columns. The first step is to balance the given matrix by adding a dummy row or column and then proceed to apply Hungarian method. Dummy row or column should be assigned zero as value.

4. Maximisation unbalanced assignment problem.

First balance the problem and then convert it into minimisation and proceed to apply Hungarian method.

5. Prohibited routes

Where an assignment problem prohibits making an allocation in the particular cell such problem is said to be having prohibited routes. In such case allocate a very high cost "M" or "8" to such cell and proceed to apply Hungarian method.

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Rudimentary problems

Question: 1 Minimisation balanced

A machine tool company decides to make four subassemblies through four persons. Each person is to receive only one subassembly. The cost of each assembly is determined by the bids by each person and is shown in the table in hundreds of rupees. Assign the different subassemblies to contractors so as to minimize the total cost.

	Persons			
Subassembly	1	2	3	4
1	15	13	14	17
2	11	12	15	13
3	13	12	10	11
4	15	17	14	16

Question: 2 Maximisation balanced

A manager has 4 subordinates and 4 tasks. The subordinates differ in efficiency. His estimate of the production each would do is given in the table. How the task should be allocated one to one man, so that total production is maximized.

	Subordinates			
Task	I	II	III	IV
1	8	26	17	11
2	13	28	4	26
3	38	19	18	15
4	19	26	24	10

Question: 3 Minimisation- unbalanced

A has one surplus truck in each cities A, B, C, D & E and one deficit truck in each of the cities 1, 2, 3, 4, 5 & 6. The distance between the cities in kilometers is shown in the matrix below.

Cities	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	3	10

Find the assignment of trucks from the cities in surplus to cities in deficit so that the total distance covered by vehicles in minimum.

Question: 4 Maximisation-unbalanced

A management consulting firm has a backlog of 4 contracts. Work on these contracts must be started immediately. 3 project leaders are available for assignment to the contracts. Because of the varying work experience of the leaders, the profit to consulting firm will vary based on the assignment as shown below. The unassigned contract can be completed by subcontracting the work to an outside consultant. The profit on the subcontract is zero. Find the optimal assignment.

	Contract			
Project Leader	1	2	3	4
A	13	10	9	11
B	15	17	13	20
C	6	8	11	7

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Question: 5

Multiple optimal solutions

Solve the minimal assignment problem whose effectiveness matrix is

Jobs	Men			
	1	2	3	4
I	2	3	4	5
II	4	5	6	7
III	7	8	9	8
IV	3	5	8	4

Question: 6

Prohibited routes

WELLDONE Company has taken the third floor of a multi-storeyed building for rent with a view to locate one of their zonal offices. There are five main rooms in this floor to be assigned to five managers. Each room has its own advantages and disadvantages. Some have windows; some are closer to the washrooms or to the canteen or secretarial pool. The rooms are of all different sizes and shapes. Each of the five managers was asked to rank their room preferences amongst the rooms 301, 302, 303, 304 and 305. Their preferences were recorded in a table as indicated below:

MANAGER				
M ₁	M ₂	M ₃	M ₄	M ₅
302	302	303	302	301
303	304	301	305	302
304	305	304	304	304
*	301	305	303	*
*	*	302	*	*

Most of the managers did not list all the five rooms since they were not satisfied with some of these rooms and they have left off these from the list. Assuming that their preferences can be quantified by numbers, find out as to which manager should be assigned to which room so that their total preference ranking is a minimum.

Formulation problems

Question: 7

Airline scheduling

An airline operates seven days a week has time-table as shown below. Crews must have a minimum layover of 5 hours between flights. Obtain the pairing of flights that minimizes layover time away from home. For any given pairing the crew will be based at the city that results in smaller layover. For each pair also mention the town where the crew should be based.

Flight no.	Delhi	Jaipur	Flight no.	Jaipur	Delhi
	Departure	Arrival		Departure	Arrival
1	7.00	8.00	101	8.00	9.15
2	8.00	9.00	102	8.30	9.45
3	13.30	14.30	103	12.00	13.15
4	18.30	19.30	104	17.30	18.45

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Question: 8

Travelling salesmen

A travelling salesman has to visit 5 cities. He wishes to start from a particular city, visit each city once and return to his starting point. The travelling cost for each city from a particular city is given below:

To city

		A	B	C	D	E
From city	A	X	4	7	3	4
	B	4	X	6	3	4
	C	7	6	X	7	5
	D	3	3	7	X	7
	E	4	4	5	7	X

What is the sequence of visit of the salesman, so that the cost is minimum?

Question: 9

Production scheduling

An organization producing 4 different products viz. A, B, C and D having 4 operators viz. P, Q, R and S, who are capable of producing any of the four products, works effectively 7 hours a day. The time (in minutes) required for each operator for producing each of the product are given in the cells of the following matrix along with profit (Rs. Per unit).

Operator	Product			
	A	B	C	D
P	6	10	14	12
Q	7	5	3	4
R	6	7	10	10
S	20	10	15	15
Profit (Rs. / Unit)	3	2	4	1

Find out the assignment of operators to products which will maximize the profit.

Question: 10

Data entry job allocation

A firm employs typists for piecemeal work on an hourly basis. There are five typists available and their charges and speeds are different. According to an earlier understanding, only one job is given to one typist and the typist is paid for full hours even if he works for a fraction of an hour. Find the least cost allocation for the following data:

Typist	Rate / Hour	Pages / Hour	Job	No. of Pages
A	Rs.5	12	P	200
B	Rs.6	14	Q	176
C	Rs.3	8	R	150
D	Rs.4	10	S	300
E	Rs.4	11	T	180

Question: 11

Seminar scheduling

To stimulate interest and provide an atmosphere for intellectual discussion, a finance faculty in a management school decides to hold special seminars on four contemporary topics - leasing, portfolio management, private mutual funds, swaps and options. Such seminars should be held once a week in the afternoons. However, scheduling these seminars (one for each topic, and not more than one seminar per afternoon) has to be done carefully so that the number of students who cannot attend a particular seminar on a specific day is as follows:

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	Leasing	Portfolio Management	Private Mutual Funds	Swaps and Options
Monday	50	40	60	20
Tuesday	40	30	40	30
Wednesday	60	20	30	20
Thursday	30	30	20	30
Friday	10	20	10	30

Find an optimal schedule of the seminars. Also find out the total number of students who will be missing at least one seminar.

Question: 12 Replacement decisions

Average time taken by an operator on a specific machine is tabulated below. The management is considering replacing one of the old machines by a new one and the estimated time for operation by each operator on the new machine is also indicated.

Machines

Operators	1	2	3	4	5	6	New
A	10	12	8	10	8	12	11
B	9	10	8	7	8	9	10
C	8	7	8	8	8	6	8
D	12	13	14	14	15	14	11
E	9	9	9	8	8	10	9
F	7	8	9	9	9	8	8

Find out an allocation of operators to the old machines to achieve a minimum operation time.

- Reset the problem with the new machine and find out the allocation of the operators to each machine and comment on whether it is advantageous to replace an old machine to achieve a reduction in operating time only.
- How will the operators be reallocated to the machines after replacement?

Question: 13 Territorial allocation

Six salesmen are to be allocated to six sales regions so that the cost of allocation of the job will be minimum. Each salesman is capable of doing the job at different cost in each region. The cost matrix is given below:

Region

Salesman		I	II	III	IV	V	VI
	A	15	35	0	25	10	45
	B	40	5	45	20	15	20
	C	25	60	10	65	25	10
	D	25	20	35	10	25	60
	E	30	70	40	5	40	50
	F	10	25	30	40	50	15

(Figures are in rupees)

- Find the allocation to give minimum cost. What is the cost?
- Now suppose the above table gives earning of each salesman at each region. How can you find an allocation so that the earning will be maximum?
Determine the solution with optimum earning.
- There are restrictions for commercial reasons that A cannot be posted to region V and E cannot be posted to region II.

Write down the cost matrix suitably after imposing the restrictions.

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Question: 14

Liquidity management

X holds stock of different companies. For a certain problem he is compelled to sell off four of his holdings. Since he wants the money over the next five months, he sells not more than one stock in any month. He has estimated the sale proceeds in each of the next five months as follows:

(Rs. '000)

	June	July	Aug	Sep	Oct
S1	13	16	14	19	17
S2	18	20	13	18	12
S3	17	15	10	22	18
S4	19	18	14	21	15

Find what will be the optimum plan of X and how much money can he realise by sales?

Question: 15

Market research and assignment

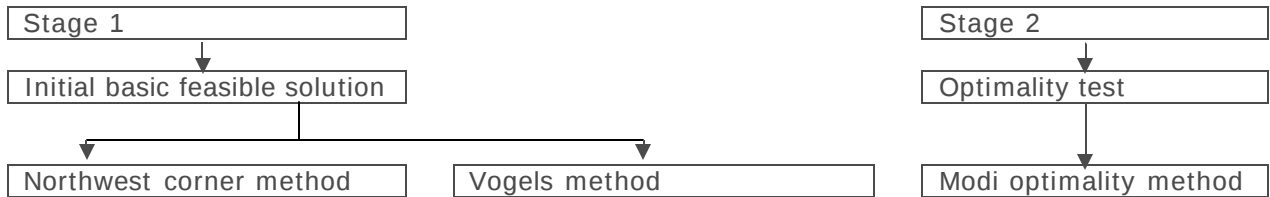
The market research team of the Look Forward Company requires some household data from four different cities. The team has to perform this job in two days- the next Saturday and Sunday. It plans to spend half a-day in each of the cities. The relevant data are given here:

	Probability of a Household Contact			
	City 1	City 2	City 3	City 4
Day and Time				
Saturday Morning	0.32	0.85	0.16	0.64
Saturday Evening	0.60	0.56	0.95	0.80
Sunday Morning	0.70	0.35	0.40	0.62
Sunday Evening	0.10	0.72	0.64	0.90
Number of households expected to interview	150	100	200	200

How should the team plan its visit to the four cities so that the expected response may be maximised? State this expected response.

TRANSPORTATION

Stages in solving transportation problems



Steps in Vogels method

1. Find the difference between two least cost cells in every row and column.
2. Identify the row or column with the highest of the difference. It is in this row or column where allocation should be made.
3. In the row or column selected in step two, identify the least cost cell. It is in this cell allocation should be made.
4. Quantity to be allocated is the least of demand and supply.
5. Reduce the quantity allocated from they respect demand and supply.
6. Cancel other cells in the row or column where the demand or supply has became zero.
7. Continue the above steps till all allocations are made.

Note:

Where there arises a tie in differences in rows or columns, select that row or column which is having least of least cost cell. If there arises tie there also make allocation in any of the rows or columns which is tied.

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Rudimentary problems

Question: 1 Minimisation-balanced

Obtain the IBFS for the following & also determine whether they satisfy the optimality test.

	Warehouse-1	Warehouse-2	Warehouse-3	Supply
Factory-1	6	8	4	14
Factory-2	4	9	8	12
Factory-3	1	2	6	5
Demand	6	10	15	-

Question: 2 Minimisation-balanced-degeneracy

Find optimal solution for the following problem

	Warehouse-1	Warehouse-2	Warehouse-3	Supply
Factory-1	50	30	220	1
Factory-2	30	45	170	3
Factory-3	250	200	50	4
Demand	4	2	2	

Question: 3 Maximisation-unbalanced

Consider the following transportation profit table & determine the optimal solution

	Warehouse-1	Warehouse-2	Warehouse-3	Warehouse-4	Supply
Factory-1	40	25	22	33	100
Factory-2	44	35	30	30	30
Factory-3	38	38	28	30	70
Demand	40	20	60	30	

Question: 4 Multiple optimal solutions

Solve the following Transportation problem

	Warehouse-1	Warehouse-2	Warehouse-3	Warehouse-4	Supply
Factory-1	5	3	6	2	19
Factory-2	4	7	9	1	37
Factory-3	3	4	7	5	34
Demand	16	18	31	25	-

Question: 5 Prohibited routes

	Godown1	Godown2	Godown3	Godown4	Godown5	Godown6	Stock availability
Factory1	7	5	7	7	5	3	60
Factory2	9	11	6	11	*	5	20
Factory3	11	10	3	2	2	8	90
Factory4	9	10	9	6	9	12	50
Demand	60	20	40	20	40	40	

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Formulation problems

Question: 6 Trans-shipment

Madhav Ltd. has decided to launch an addition to its product range. The new product may be distributed through any combination of the two company warehouses W1 and W2. The available annual production capacities for the new product are:

100 units at plant P_1

200 units at plant P_2

100 units at plant P_3

The three major concentrations of customer demand are at locations D1, D2 and D3 which are estimated to require each year:

90 units at D1

80 units at D2

90 units at D3

The unit production costs amount to 3, 4 and 1 at P_1 , P_2 and P_3 respectively. The unit handling costs at the warehouse amount to 2 and 3 at W1 and W2 respectively.

The unit transportation costs from plant to warehouse and unit delivery costs from warehouse to customer are as follows:

	W1	W2		D1	D2	D3
P1	6	6	W1	3	5	8
P2	5	5	W2	5	3	9
P3	13	4				

(All costs are in Rs.)

Required:

Determine an optimum production and distribution schedule.

Question: 7 Cash management

A firm is facing a short term cash flow problem which, over the next three months, will necessitate a bank loan. The timing of this loan, which will be at an interest rate of 2% per month is seen to be important as the loan will be used to balance the cash inflow from accounts receivable and the cash outflow from accounts payable, which are estimated to be as follows:

Month	Accounts receivable (Rs. '000)	Accounts payable (Rs. '000)
July	15	20
August	25	30
September	35	40

You may assume that both accounts receivable and accounts payable have to be settled by the end of September. In any month, accounts will be received at sufficient time to finance the firm's own payments in that month, however, in July and August, payment to suppliers can be delayed by at most one month but in doing so, and the firm will lose the 2% discount that it would otherwise receive for payment within 30 days.

All bank loans must be agreed at the start of any month and they attract a minimum of one month's interest. Any surplus cash can be deposited with the bank earning 1% interest per month. (Due to the short-term nature of the problem, you may ignore the compounding of interest).

Required:

- Determine the optimum solution using the transportation algorithm.
- If the discount offered for the payment of August accounts within 30 days is increased to 3%, explain whether this would affect the optimum solutions.

Question: 8 Supply management

The Brown Chemical Company produces a special oil-based material which is currently in short supply. Four of Brown's customers have already placed orders which in total exceed the

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combined capacity of its two plants and the company needs to know how it should allocate its production capacity to maximise profits.

The following distribution costs per unit have been determined.

Customer	C1 Rs.	C2 Rs.	C3 Rs.	C4 Rs.
Plant X	16	15	14	18
Plant Y	15	15	14	15

The variable unit production costs are Rs. 10 per plant X and Rs. 12 for plant Y. Since the four customers are in different industries, the pricing structure allows different prices to be charged to different customers. (The material undergoes slight variations for each customer at negligible costs). These prices are Rs. 46 for C1, Rs. 42 for C2, Rs. 40 for C3 and Rs. 44 for C4.

The customer's orders (in units) are:

C1	C2	C3	C4
2000	5000	3500	2500

and the plant capacities at X and Y in the period concerned are 6000 and 3000 units respectively.

Due to an industrial dispute the company can only supply customer C3 from plant Y.

Required:

(a) Use the transportation algorithm to determine the optimum solution.

(b) If the industrial disputes were to be resolved so that customer C3 could be supplied from plant X, how would this affect your solution?

Question: 9

Recruitment planning

As a result of an expansion in production capacity, the management of Minerva Manufacturing Ltd., has decided to take additional employees at each of its five plants in the South-West of India. The numbers required at each plant are:

Plant	1	2	3	4	5
Employees required	45	74	50	82	63

All its employees currently come from three large towns in the area. Upon contracting the main employment agency in each town, Minerva finds that the numbers of suitable people available for employment are as follows:

Agency (town)	A	B	C
People available	120	100	154

Because of the rural situations of the five plants, Minerva has agreed with the trade unions concerned that daily return travelling expenses from each town will be paid by the company to all employees. The rate is currently 12p per mile, and the distances (in miles) between each plant and each town are as follows:

Town	1	2	3	4	5
A	6	2	2	6	3
B	14	9	4	5	3
C	10	4	11	3	4

- How many people should Minerva aim to employ from each town in order to minimise the additional travelling expenses incurred?
- What is the minimum value of these expenses in connection with the additional 314 employees?
- In order to appear not to be unfair to potential employees from any one of the three towns, it has now been decided that the 60 people who are surplus to requirements should be

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spread equally between the three towns, i.e., 20 from each. How much more than in (a) would the company have to pay out each day in travelling expenses in order to achieve this at minimum cost?

Question: 10

Retrenchment planning

Management of Ranga Ltd is very much worried about the continuing recession in the country. The company has 7 divisions (A to G). They have decided to close four divisions namely A, B, C and D and transfer some of the employees to the remaining divisions. Personnel at the units to be closed have signified a willingness to move to any of the three remaining units and the company is willing to provide them with removal costs. The technology of production is different to some degree at each unit and retraining expenses will be incurred on transfer. Not all existing personnel can be absorbed by transfer and a number of redundancies will arise. Cost of redundancy is given as a general figure at each unit is to be closed. Number employed A-200 B-400 C-300 D-200

Rs. thousands per person

Retraining costs	A	B	C	D
Transfer to :				
Unit E	0.5	0.4	0.6	1.3
Unit F	0.6	0.4	0.6	0.3
Unit G	0.5	0.3	0.7	0.3
Removal costs:				
Transfer to :				
Unit E	2.5	3.6	3.4	3.7
Unit F	2.4	4.6	3.4	1.7
Unit G	2.5	2.7	3.3	2.7
Redundancy payments	6.0	5.0	6.0	7.0

Additional personnel required at units remaining open: E-350 F-450 G-200.

Use the transportation method to obtain an optimal solution to the problem of the cheapest means to transfer personnel from the units to be closed to those which will be expanded.

Question: 11

Product distribution

The XYZ Tobacco Company purchases tobacco and stores in warehouses located in the following four cities:

Warehouse Location	Capacity (Tonnes)
City A	90
City B	50
City C	80
City D	60

The warehouses supply to cigarette companies in three cities that have the following demand:-

Cigarette company	Demand (Tonnes)
Bharat	120
Janata	100
Red Lamp	110

The following railroad shipping costs per tonne (in hundred rupees) have been determined:

From	To →	Bharat	Janata	Red Lamp
A		7	10	5
B		12	9	4
C		7	3	11
D		9	5	7

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Because of railroad construction, shipments are temporarily prohibited from warehouse at city A to Bharat Cigarette Company.

(a) Find the optimal distribution of XYZ Tobacco Company.

(b) Are there multiple optimal solutions? If there are alternative optimal solutions, identify them.

Question: 12

Regular or overtime production

A company has factories at A, B and C which supply warehouses at D, E, F and G. monthly factory capacities are 250, 300 and 400 units respectively for regular production. If overtime production is utilised, factories A and B can produce 50 and 75 additional units respectively at overtime-incremental costs of Rs.4 and Rs.5 respectively. The current warehouse requirements are 200, 225, 275 and 300 units respectively. Unit transportation costs in rupees from factories to warehouses are as follows:

From	To	D	E	F	G
A		11	13	17	14
B		16	18	14	10
C		21	24	13	10

Determine the optimum distribution for this company to minimize costs.

Question: 13

Inventory management and transportation

ABC manufacturing company wishes to develop a monthly production schedule for the next months. Depending upon the sales commitments, the company can either keep the production constant, allowing fluctuations in inventory or inventories can be maintained at a constant level, with fluctuating production. Fluctuating production necessitates in working overtime, the cost of which is estimated to be double the normal production cost of Rs.12 per unit. Fluctuating inventories result in inventory carrying cost of Rs.2 per unit. If the company fails to fulfil its sales commitment, it incurs a shortage cost of Rs.4 per unit per month. The production capacities for the next the three months are shows below.

Production capacity			
Month	Regular	Overtime	Sales
1	50	30	60
2	50	0	120
3	60	50	40

Determine the optimal production schedule.

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Note:

Slack variables are used when there is $\leq$ sign in the constraint functions. If the sign is $\geq$ then surplus variables are to be used. When surplus variables are used then artificial variables should be included in the solution.

Note:

When artificial variable is used then it should be assigned a very high cost M in the objective function so that it will not form part of our final solution

Note:

Steps for minimisation problem are all most same as that of maximisation. However in ascertaining whether solution is optimal there should be no negative number in the NER.

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Question: 1

Maximisation-simplex

$$\begin{array}{ll} \text{Maximize} & Z = 3x_1 + 4x_2 \\ \text{Subject to} & 2x_1 + 3x_2 = 16 \quad (\text{machining time}) \\ & 4x_1 + 2x_2 = 16 \quad (\text{assembly time}) \\ & x_1 = 0, x_2 = 0 \end{array}$$

Question: 2

Minimization simplex

A small township of 15,000 people requires, on the average, 3, 00,000 gallons of water daily. The city is supplied water from a central water-works where the water is purified by such conventional methods as filtration and chlorination. In addition, two different chemical compound (i) softening chemical and (ii) health chemical are needed for softening the water and for health purposes. The waterworks plans to purchase two popular brands that contain these chemicals. One unit of Chemico Corporation's product gives 8 Pounds of softening chemical and 3 Pounds of health chemical. One unit of Indian Chemical's product contains 4 Pounds and 9 Pounds per unit, respectively, for the same purposes.

To maintain the water at a minimum level of softness and to meet a minimum programme of health protection, experts have decided that 150 and 100 Pounds of the two chemicals that make up each product must be added to water daily. At a cost of Rs.8 and Rs.10 per unit respectively for Chemico's and Indian Chemical's products, what is the optional quantity of each product that should be used to meet the minimum level of softness and minimum health standard?

Question: 3

Infeasible solution

$$\begin{array}{ll} \text{Maximize} & Z = 20x_1 + 30x_2 \\ \text{Subject to} & 2x_1 + x_2 = 40 \\ & 4x_1 - x_2 = 20 \\ & x_1 = 30 \\ & x_1, x_2 = 0 \end{array}$$

Question: 4

Unbounded solution

$$\begin{array}{ll} \text{Maximize} & Z = 10x_1 + 20x_2 \\ \text{Subject to} & 2x_1 + 4x_2 = 16 \\ & x_1 + 5x_2 = 15 \\ & x_1, x_2 = 0 \end{array}$$

Question: 5

Multiple optimal solution

$$\begin{array}{ll} \text{Maximize} & Z = 8x_1 + 16x_2 \\ \text{Subject to} & x_1 + x_2 = 200 \\ & x_2 = 125 \\ & 3x_1 + 6x_2 = 900 \\ & x_1, x_2 = 0 \end{array}$$

Question: 6

Construction of dual

Write the dual for the following LPP:

(a) Type-1

$$\begin{array}{ll} \text{Maximize} & Z = 40x_1 + 35x_2 \\ \text{Subject to} & 2x_1 + 3x_2 = 60 \\ & 4x_1 + 3x_2 = 96 \\ & x_1, x_2 = 0 \end{array}$$

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(b) Type-2

$$\begin{array}{ll}
 \text{Minimize} & Z = 10x_1 + 20x_2 \\
 \text{Subject to} & 3x_1 + 2x_2 = 18 \\
 & x_1 + 3x_2 = 8 \\
 & 2x_1 - x_2 = 6 \\
 & x_1, x_2 = 0
 \end{array}$$

(c) Type-3

$$\begin{array}{ll}
 \text{Maximise} & Z = 8x_1 + 10x_2 + 5x_3 \\
 \text{Subject to} & x_1 - x_3 = 4 \\
 & 2x_1 + 4x_2 = 12 \\
 & x_1 + x_2 + x_3 = 2 \\
 & 3x_1 + 2x_2 - x_3 = 8 \\
 & x_1, x_2, x_3 = 0
 \end{array}$$

(d) Type-4

$$\begin{array}{ll}
 \text{Maximise} & Z = 3x_1 + 5x_2 + 7x_3 \\
 \text{Subject to} & x_1 + x_2 + 3x_3 = 10 \\
 & 4x_1 - x_2 + 2x_3 = 15 \\
 & x_1, x_2 = 0 \\
 & x_3 \text{ unrestricted in sign}
 \end{array}$$

Question: 7 Interpretation of dual

One unit of product A contributes Rs.7 and requires 3 units of raw material and 2 hours of labour. One unit of product B contributes Rs.5 and requires one unit of raw material and one hour of labour. Availability of the raw material at present is 48 units and there are 40 hours of labour.

- Formulate it as a linear programming problem.
- Write it's dual.
- Solve the dual with Simplex method and find the optimal product mix and shadow prices of the raw material and labour.

Question: 8 Short cut substitution

$$\begin{array}{ll}
 \text{Maximise} & Z = 6x_1 + 20x_2 \\
 \text{Subject to} & 2x_1 + x_2 = 32 \\
 & 3x_1 + 4x_2 = 80 \\
 & x_1 = 8 \\
 & x_2 = 10
 \end{array}$$

Question: 9 Interpretation of final simplex table

The simplex tableau for a maximization problem of linear programming is given here:

C_j	x_j	x_1	x_2	S_1	S_2	Quantity (b_j)
5	x_2	1	1	1	0	10
0	S_2	1	0	-1	1	3
	C_j	4	5	0	0	
	Z_j	5	5	5	0	
	$C_j - Z_j$	-1	0	-5	0	

Answer the following questions, giving reasons in brief:

- Is this solution optimal?
- Are there more than one optimal solution?
- Is this solution degenerate?
- Is this solution feasible?
- If S_1 is slack in machine A (in hours / week) and S_2 is slack in machine B (in hours / week), which of these machines is being used to the full capacity when producing according to this solution?

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- (f) A customer would like to have one unit of product x_1 and is willing to pay in excess of the normal price in order to get it. How much should the price be increased in order to ensure no reduction of profits?

Formulation problems

Question: 10 Optimum Product-mix

WELL TYPE Manufacturing Company produces three types of typewriters; Manual type-writer Electronic typewriters, and Deluxe Electronic typewriters. All the three models are required to be machined first and then assembled. The time required for the various models are as follows:

Type	Machine Time (in hour)	Assembly Time (in hour)
Manual Typewriter	15	4
Electronic Typewriter	12	3
Deluxe Electronic Typewriter	14	5

The total available machine time and assembly time are 3,000 hours and 1,200 hours respectively. The data regarding the selling price and variable costs for the three types are:

	Manual	Electronic	Deluxe Electronic
Selling Price (Rs.)	4,100	7,500	14,600
Labour, Material and other variable costs (Rs.)	2,500	4,500	9,000

The company sells all the three types on credit basis, but will collect the amounts of the first next month. The labour, material and other variable expenses will have to be paid in cash. The company has taken a loan of Rs.40, 000 from a co-operative bank and this company will have repaid it to the bank on 1st April, 2005. The TNC Bank from whom this company has borrowed Rs.60, 000 has expressed its approval to renew the loan.

The Balance Sheet of this Company as on 31.3.05 is as follows:			
Liabilities	Rs.	Assets	Rs.
Equity Share Capital	1,50,000	Land	90,000
Capital Reserve	15,000	Building	70,000
General Reserve	1,10,000	Plant & Machinery	1,00,000
Profit & Loss a/c	25,000	Furniture & Fixtures	15,000
Long term loan	1,00,000	Vehicles	30,000
Loan from TNC Bank	60,000	Inventory	5,000
Loan from Co-op. Bank	40,000	Receivables	50,000
		Cash	1,40,000
Total	5,00,000	Total	5,00,000

The company will have to pay a sum of Rs.10, 000 towards the salary from top management executives and other fixed overheads for the month. Interest on long term loans is to be per every month at 24% per annum. Interest on loans from TNC and Co-operative Banks may be taken to be Rs.1, 200 for the month. Also this company has promised to deliver 2 Manual typewriters and 8 Deluxe Electronic typewriters to one of its valued customers next month. Also make sure that the level of operation in this company is subject to the availability of cash next month. This company will also be able to sell all their types of typewriter in the market. The Senior Manager of this company desires to know as to how many units of each typewriter must be manufactured in the factory next month so as to maximize the profits of the company. Formulate this as a linear programming problem. The formulated problem need not be solved.

Question: 11 Planning-production & financing

Consider a company that must produce two products over a production period of three months of duration. The company can pay for materials and labour from two sources:
The firm faces three decisions:

- (1) How many units should it produce of Product 1?

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- (2) How many units should it produce of Product 2?
 (3) How much money should it borrow to support the production of the two products?

In making these decisions, the firm wishes to maximize the profit contribution subject to the conditions stated below:

- (i) Since the company's products are enjoying a seller's market, it can sell as many units as it can produce. The company would therefore like to produce as many units as possible subject to production capacity and financial constraints. The capacity constraints, together with cost and price data, are given in Table -1.

Capacity, Price and Cost data					
Product	Selling Price (Per unit)	Cost of Production (Per unit)	Requirement Hours per unit in Department		
			A	B	C
1	14	10	0.5	0.3	0.2
2	11	8	0.3	0.4	0.1
Available hours per production period of three months			500	400	200

- (ii) The available company funds during the production period will be Rs.3 lakhs.
 (iii) A bank will give loans up to Rs.2 lakhs per production period at an interest rate of 20 percent per annum provided the company's acid (quick) test ratio is at least 1 to 1 while the loan is outstanding. Take simplified acid-test ratio given by

$$\frac{\text{Surplus cash on hand after production} + \text{Accounts receivable}}{\text{Bank Borrowing} + \text{Interest accrued thereon}}$$

- (iv) Also make sure that the needed funds are made available for meeting the production costs.

Formulate the above as a Linear Programming Problem.

Question: 12 Input mix planning

A refinery makes 3 grades of petrol (A, B, C) from 3 crude oils (d, e, f) Crude can be used in any grade but the others satisfy the following specifications.

Grade	Specifications	Selling Price per litre
A	Not less than 50% crude d Not more than 25% crude e	8.0
B	Not less than 25% crude d Not less than 50% crude e	6.5
C	No specifications	5.5

There are capacity limitations on the amount of the three crude elements that can be used;

Crude	Capacity	Price per litre
D	500	9.5
E	500	5.5
F	300	6.5

It is required to produce the maximum profit.

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Question: 13

Graphical approach-Maximisation

Maximise $z = 22x + 18y$

Subject to

$$X + y = 20$$

$$360x + 240y = 5760$$

$$x, y \geq 0.$$

Solve the LPP under graphical method.

Question: 14

Graphical approach-Minimisation

Minimise $Z = 10x + 4y$

Subject to

$$4x + y = 80$$

$$2x + y = 60$$

$$x, y \geq 0.$$

Solve the LPP under graphical method.

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- (d) If the project due date is 18 weeks what is the probability of not meeting the due date.
- (e) What due date has about 90% chance of being met?
- (f) Find probability of reaching event-5 in 9 days.
- (g) Also find the event variances.

Duration of weeks

Activities (I-j)	to	tm	tp
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

Question: 5

PERT

A small project consisting of eight activities has the following characteristics

Activity	Preceding activity	Time estimates in weeks		
		Most optimistic	Most likely	Most pessimistic
A	None	2	4	12
B	None	10	12	26
C	A	8	9	10
D	A	10	15	20
E	A	7	7.5	11
F	B,C	9	9	9
G	D	3	3.5	7
H	E,F,G	5	5	5

- a. Draw the PERT network for the project
- b. Determine the critical path
- c. Prepare the activity schedule for the project
- d. If a 30 week deadline is imposed , what is the probability of completing the project within the time limit.
- e. If the project manager wants to be 99% sure that the project is completed on the scheduled date, how many weeks before that date should he start the project work?

Question: 6

Crashing

A small maintenance project consists of jobs in the table below. With each job is listed its normal time and a minimum or crash time in days. The cost in Rs. Per day of each job is also given:

Job(i-j)	Normal days	Crash days	Crash cost per day
1-2	9	6	20
1-3	8	5	25
1-4	15	10	30
2-4	5	3	10
3-4	10	6	15
4-5	2	1	40

- a) What is the normal project length and minimum project length?
- b) Determine the minimum crashing cost of schedules ranging from normal length down to, and including, the minimum length schedule.

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- c) Overhead costs total Rs.60/day. What is the optimum length schedule in terms of both crashing and overhead cost?

Question: 7 Crashing

A small project is having 7 activities. The relevant data about these activities is given below:

Activity	Dependence	Normal duration (days)	Crash duration (days)	Normal cost (Rs)	Crash cost (Rs)
A	-	7	5	500	900
B	A	4	2	400	600
C	A	5	5	500	500
D	A	6	4	800	1000
E	B, C	7	4	700	1000
F	C, D	5	2	800	1400
G	E, F	6	4	800	1600

- (a) Find out normal and minimum duration
 (b) What is the percentage increase in cost to complete the project in 21 days?

Question: 8 Crashing

The following table shows for each activity needed to complete the project the normal time, shortest time in which the activity can be completed of a building contract and the cost per day for reducing the time of each activity. The contract includes a penalty clause of Rs 100 per day over 17 days. The overhead cost per day is Rs 160.

Activity	Normal time (in days)	Shortest time (in days)	Cost of reduction per day
1-2	6	4	80
1-3	8	4	90
1-4	5	3	30
2-4	3	3	-
2-5	5	3	40
3-6	12	8	200
4-6	8	5	50
5-6	6	6	-

The cost of completing the eight activities in normal time is Rs. 6500.

- a. Calculate the normal duration of the project, its cost and the critical path.
 b. Calculate and plot on graph the cost time function for the project and state
 (i) The lowest cost and associated time.
 (ii) The shortest time and associated cost.

Question: 9 Resource allocation

Find out the time required to complete the project. No. of persons: 4

Job (I-j)	tn	Men
1-2	10	1
1-3	6	2
1-5	5	3
2-3	0	0
2-6	8	1
3-4	10	2
4-7	10	3
5-6	7	1
6-7	5	2

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Question: 10

Resource leveling with times scale diagram

Activity	Activity time	Men required
1-2	4	3
1-3	6	6
3-5	5	7
2-4	5	5
3-6	4	5
4-7	5	4
5-7	3	3
6-7	7	4

Calculate the minimum number of men required to complete the above project in time.

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Question: 4

Network simulation

A project consists of 7 activities. The time for performance of each of the activity is as follows:-

Activity	Immediate	Time	Probability
A	-	3	0.2
		4	0.6
		5	0.2
B	-	4	1.0
C	A	1	1.0
D	B,C	4	0.8
		5	0.2
E	D	3	0.1
		4	0.3
		5	0.3
		6	0.3
F	D	5	0.20
		7	0.80
G	E,F	2	0.5
		3	0.5

- Draw a network and identify critical path using expected time.
- Simulate the project for 5 times using random number and find the critical paths?

68	13	09	20	73	07	72
99	93	18	24	22	07	29
57	33	49	65	92	98	00
57	12	31	96	85	92	91
77	37	34	11	27	10	59

Question: 5

Simulation in dental clinic

Dr. Strong is a dentist who schedules all her patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of the work, their probabilities and time required to complete them:-

Category	Filling	Crown	Cleaning	Extraction	Check up
Time Required (minutes)	45	60	15	45	15
Probability	0.40	0.15	0.15	0.10	0.20

Simulation the dentist clinic for 4 hours and determine the average waiting time for the patients as well as idleness of the doctor. Arrival time of 1st patient is 8 A.M. Random numbers are as follows,

40	82	11	34
25	66	17	79

Question: 6

Repair team strength

A plant has a large number of similar machines. The machines breakdown randomly and the breakdowns are independent of each other. Once a machine breaks down, it has to be taken out of production till the time it is repaired. On the basis of the past data, the following distributions have been constructed.

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No. of Break downs per Hour	Probability	No.of Hours Required for Repair Per Breakdown	Probability
0	0.900	1	0.100
1	0.085	2	0.240
2	0.012	3	0.450
3	0.003	4	0.165
		5	0.040
		6	0.005

Each hour that a machine remains idle due to being, or waiting to be repaired, it costs the plant Rs.80 per hour by way of lost production. If a repairman is paid at Rs.8 per hour, how many repairmen should be hired by the company to service the machine breakdowns? For the purpose, simulate the system for a 50-hour period and use the following random numbers, reading row-wise starting with the NW corner.

For breakdowns

100 375 084 990 128 660 310 852 635 737
 985 118 834 886 995 654 801 743 699 098
 914 803 441 125 636 611 154 945 424 235
 044 005 359 598 460 321 692 195 451 948
 980 331 809 797 186 740 541 116 483 690

For Repair times

765 648 196 093 801 340 455 020 053 035
 672 121 099 195 981 783 389 421 125 623

Question: 7

Purchase Quantity Decision

Great Book Stores, a leading bookstore, wishes to carry "Cost Management" in stock. Demand is probabilistic and replenishment of stock takes 2 days (eg., if an order is placed on April 1, it will be delivered on April 3). The probabilities of demand are given: -

Daily Demand	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of Rs.10 per order. A carrying cost of Rs.0.50 per book per day is also incurred by the store. The inventory carrying cost is calculated on the basis of stock at the end of each day. The manager of the bookstore wishes to compare two options for inventory decision –

- (A) Order 5 books, when the inventory at the beginning of the day plus orders outstanding is less than 8 books.
- (B) Order 8 books, when the inventory at the beginning of the day plus order outstanding is less than 8 books.

Currently (beginning of the 1st day) the store of 8 books plus 6 books ordered 2 day ago and expected to arrive the next day. Using Monte Carlo Simulation for 10 cycles, recommend which option the manager should choose? The following random numbers may be used – 89, 34, 78, 63, 61, 81, 93, 16, 13, 73. Assume that the demand on any day can be met out of opening stock and quantities received during the day.

Question: 8

Machinery Idle Time Estimation

A process involves the production of a particular component, which is then installed into an end product. Past observation has indicated that the average production time for the component is 4 minutes but fluctuations about the average do occur. The following probability distribution has been derived:

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Production time (min)	2	3	4	5	6	7
Probability	0.10	0.25	0.40	0.10	0.10	0.05

The average time taken to install a component is 3 minutes but this also fluctuates and the following probability distribution has been derived:

Installation time (min)	2	3	4	5
Probability	0.30	0.45	0.15	0.10

The current system uses one operative for installation but the company is considering employing another operative on the installation process. Simulate 10 the current system, using the following 2 digit random numbers:

20, 74, 94, 22, 93, 45, 44, 16, 04, 32; and 03, 62, 61, 89, 01, 27, 49, 50, 90, 98.

Question: 9 Evaluation of Storage Facilities – Single Digit Random Numbers

Arial Ltd. trades in a perishable commodity. Each day it receive supplies of the goods from a wholesaler but the quantity supplied is a random variable, as is subsequent retail customer demand for the commodity. Both supply and demand are expressed in batches of 50 units and over the past working year (consider 300 days) the company has kept records of supplies and demands. The results are given in the following table:

Wholesaler supplies	No. of days occurring	Customers Demand	No. of days occurring
50	60	50	60
100	90	100	60
150	90	150	150
200	60	200	30

Arial buys the commodity at Rs.6 p.u. and sells at Rs.10 p.u. at present, there are no storage facilities and unsold units at the end of the day are worthless. Arial estimates that each unit of unsatisfied demand on any day costs them Rs.2.

Use the following random numbers for supply – 8, 4, 8, 0, 3, 3 and for demand – 4, 7, 9, 6, 1, 5. Simulate six days trading and estimate annual profit. Return the exercise to estimate value of storage facilities.