



FINAL GROUP – II MAY, 2005

THE INSTITUTE OF CHARTERED ACCOUNTANTS OF INDIA

FINAL EXAMINATION : MAY, 2005

REVISION TEST PAPERS

GROUP – II

PAPER – 5 : COST MANAGEMENT

1. A client has recently leased facilities for manufacturing a new product. Based on studies made by his staff, the following data have been made available to you:

<i>Estimated annual sales</i>	<i>24,000 Units</i>	
<i>Estimated costs</i>	<i>Amount</i>	<i>Per unit</i>
Material	Rs. 96,000	Rs. 4.00
Direct labour	14,400	0.60
Overhead	24,000	1.00
Administrative expense	28,800	1.20
Total	Rs. 163,200	Rs. 6.80

Selling expenses are expected to be 15 percent of sales, and profit is expected to amount to Rs. 1.02 per unit.

Required:

- Compute the selling price per unit.
 - Project a profit-and-loss statement for the year.
 - Compute a break-even point expressed in rupees and in units, assuming that overhead and administrative expenses are fixed but that other costs are fully variable.
2. Explain, with the aid of simple numeric examples, the logic, purpose and limitation, of each of the following variance analysis exercises:
- The separation of the fixed overhead volume variance into capacity utilisation and efficiency components.
 - The separation of the materials usage variance into materials mixture and materials yield components.
 - The separation of the labour rate variance into planning and operational components.
3. The Dearborn Company manufactures product X in standard batches of 100 units. A standard cost system is in use. The standard costs for a batch are as follows:

Raw materials	60 Kg @ Rs. 4.50/Kg	Rs. 270
Direct labor	36 hr @ @ Rs. 8.25/hour	297
Overhead	36 hr @ Rs. 4.75/hour	171
		Rs. 738

Production for April 2005 amounted to 210 batches. The relevant statistics follows:

Standard output per month	24,000 units
Raw material used	13,000 Kg
Cost of raw material used	Rs. 61,100
Direct labour cost	Rs. 66,924
Overhead cost	Rs. 36,000
Actual hours worked	7,920

The management has noted that actual costs per batch deviate somewhat from standard costs per batch.

Required:

Prepare a statement which will contain a detailed explanation of the difference between the actual costs and standard costs.

4. A company has been making a machine to order for a customer, but the customer has since gone into liquidation, and there is no prospect that any money will be obtained from the winding up of the company.

Costs incurred to date in manufacturing the machine are Rs. 50,000 and progress payments of Rs. 15,000 had been received from the customer prior to the liquidation.

The sale department has found another company willing to buy the machine for Rs. 34,000 once it has been completed.

To complete the work, the following costs would be incurred.

- Materials: these have been bought at a cost of Rs. 6,000. They have no other use, and if the machine is not finished, they would be sold for scrap for Rs. 2,000.
- Further labour costs would be Rs. 8,000. Labour is in short supply, and if the machine is not finished, the work force would be switched to another job, which would earn Rs. 30,000 in revenue, and incur direct costs of Rs. 12,000 and absorbed (fixed) overhead of Rs. 8,000.
- Consultancy fee Rs. 4,000. If the work is not completed, the consultants' contract would be cancelled at a cost of Rs. 1,500.
- General overheads of Rs. 8,000 would be added to the cost of the additional work.

Required:

Assess whether the new customer order should be accepted.

5. (a) ABC Ltd. is tendering for a six-month contract which would require the use of a specialist machine. The machine was purchased four years ago for Rs. 90,000 and now has a net book value of Rs. 35,000. RC Ltd. was about to sell the machine for Rs. 40,000 but if they used it on this contract they can sell it after the six months' for Rs. 25,000. The variable cost of operating the machine for six months would be Rs. 60,000. Ignoring interest costs, identify the relevant cost of using the machine on the contract .
- (b) LF Ltd makes a single product for which the standard costs details are as follows.

	Rs.
Direct material (Rs. 3 per kg)	12
Diect labour (Rs. 8 per hour)	72

Production overhead	18
Total production cost	102

Demand for next period will be 20,000 units. No stocks are held and only 75,000 kg of material and 190,000 hours of labour will be available. What will be the limiting factor next period ?

6. A Company requires four components which are produced in its own Factory, to manufacture a Final Product. However, the Factory has only 20,000 Machine Hours available to manufacture the entire required quantity of the Four Components from its own Factory.

The following further data are available:

	<u>Components</u>			
	<i>AA</i>	<i>BB</i>	<i>CC</i>	<i>DD</i>
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>
<i>Variable Costs</i>				
Direct material	19.00	13.50	12.50	22.00
Direct labour	4.50	4.00	11.00	20.00
Direct expenses	5.00	10.00	5.00	30.00
	<u>28.50</u>	<u>27.50</u>	<u>28.50</u>	<u>72.00</u>
Requirements (Units)	2,000	3,500	1,500	2,800

Direct expenses relate to use of Machine capacity which costs Rs. 5 per machine hour to operate.

An outside party has agreed to deliver four components to the Company's Factory at the following prices per unit.

AA - Rs. 30, BB - Rs. 29.50, CC - Rs. 26.00, DD- Rs. 84.00

A second shift operation would increase direct wages by 25% over the normal shift and fixed overhead will increase by Rs. 250 for each 1000 hrs. (or part thereof) of second shift work.

You are required to:

- (i) Determine which components and what quantities to be manufactured internally within 20,000 Hours available machine capacity.
- (ii) Find out whether it would be profitable to make any of the balance components required on a second shift basis instead of buying from outside.
7. Division A is a profit centre which produces three products X,Y and Z. Each product has an external market.

	<i>X</i>	<i>Y</i>	<i>Z</i>
External market price per unit	Rs 48	Rs 46	Rs 40
Variable cost of production in division A	Rs 33	Rs 24	Rs 28
Labour hrs required per unit in division A	3	4	2

Product Y can be transferred to Division B , but the maximum quantity that can be required for transfer is 300 units of Y.

	<i>X</i>	<i>Y</i>	<i>Z</i>
The maximum external sales are :	800 units	500 units	300 units

Instead of receiving transfers of product Y from Division A , Division B could buy similar product in the open market at a slightly cheaper price of Rs 45 per unit. What should the transfer price be for each unit for 300 units of Y if the total labour hours available in Division A are :

- (a) 3,800 hours (b) 5,600 hours.

8. POV Ltd manufactures three products – X, Y and Z – that use the same machines. The budgeted profit and loss statements for the three products are as follows:

	X	Y	Z
	Rs. '000	Rs.'000	Rs.'000
Sales	1,000	1,125	625
Prime costs	(500)	(562.5)	(437.5)
Variable overheads	(250)	(187.5)	(62.5)
Fixed overheads	(200)	(315)	(130)
Profit/(loss)	50	60	(5)
Annual sales demand (units)	5,000	7,500	2,500
Machine hours per unit	20	21	26

However, after the budget had been formulated, an unforeseen condition has meant that during the next period the available machine capacity has been limited to 2,96,500 hours.

- (a) What is the shortfall in the available machine hours for the next period?
- (b) What is the contribution earned per machine hour on product X?.
- (c) The management accountant has ranked the products in order of preference for production as follows:
- 1st product X
- 2nd product Y
- 3rd product Z

Calculate the number of units of each product that should be manufactured next period.

9. (a) Explain the purpose of a ‘make’ versus ‘buy’ exercise and detail how this purpose may be achieved.
- (b) A company manufactures and sells three components, but has requested its purchasing manager to investigate the prices of an overseas producer. The following costs and prices are made available:

	Component X	Component Y	Component Z
Production(units)	20,000	40,000	80,000
	Rs/Unit	Rs/Unit	Rs/Unit
Direct material cost	0.80	1.00	0.40
Direct labour cost	1.60	1.80	0.80
Direct expense cost	0.40	0.60	0.20
Fixed cost	0.80	1.00	0.40
Selling price	4.00	5.00	2.00
Imported price	2.75	4.20	2.00

Required

- 1) Make your recommendations to management as to whether any component should be purchased on the basis of cost only.

2) What profits will the company make by producing all the components itself?

3) State whether your recommendations in (1) above is likely to affect the profit and by how much.

4) Assuming management proposes to go ahead and import some of the components , what matters would you bring to their attention?
10. ABC Ltd has been approached by a customer who would like a special job to be done for him, and who is willing to pay Rs. 22,000 for it. The job would require the following materials.

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	2.50	5
C	1,000	700	3	2.50	4
D	200	200	4	6.00	9

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

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

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

11. A market gardener is planning his production for next season, and he has asked you as a cost accountant, to recommend the optimal mix of vegetable production for the coming year. He has given you the following data relating to the current year.

	Potatoes	Turnips	Parsnips	Carrots
Area occupied (acres)	25	20	30	25
Yield per acre (tonnes)	10	8	9	12
Selling price per tonne (Rs.)	100	125	150	135
Variable cost per acre (Rs.)				
Fertilizers	30	25	45	40
Seeds	15	20	30	25
Pesticides	25	15	20	25
Direct wages	400	450	500	570

Fixed overhead per annum Rs. 54000

The land that is being used for the production of carrots and parsnips can be used for either crop, but not for potatoes or turnips. The land being used for potatoes and turnips can be used for either crop, but not for carrots or parsnips. In order to provide an adequate market service, the

gardener must produce each year at least 40 tonnes each of potatoes and turnips and 36 tonnes each of parsnips and carrots.

- (a) You are required to present a statement to show:
- the profit for the current year;
 - the profit for the production mix that you would recommend.
- (b) Assuming that the land could be cultivated in such a way that any of the above crops could be produced and there was no market commitment, you are required to:
- advise the market gardener on which crop he should concentrate his production;
 - calculate the profit if he were to do so;
 - calculate in rupees the break-even point of sales.

12. CD Ltd is organized on a divisional basis. Two of the divisions are the Components division and the Products division. The Components division produces components d, e, and f. The components are sold to a wide variety of customers including Products division at the same price. The Products division uses one unit of component d, e, and f respectively in products X, Y, and Z.

Recently, Products division has been forced to work below capacity because of limits in the supply of components from Components division. CD's Chief Executive has therefore directed Components division to sell all its output to Products division.

Price, cost, and output data for Components division are as follows:

Component	d	e	f
	Rs.	Rs.	Rs.
<i>Unit Selling Price</i>	20	20	30
<i>Unit Variable Cost</i>	7	12	10
<i>Period Fixed Cost</i>	50,000	1,00,000	75,000

Components division has a maximum output capacity of 50,000 of which each component must number at least 10,000.

Price, cost, and output data for Products division are as follows:

Product	X	Y	Z
	Rs.	Rs.	Rs.
<i>Unit Selling Price</i>	56	60	60
<i>Unit Variable Cost</i>	10	10	16
<i>Period Fixed Cost</i>	1,00,000	1,00,000	2,00,000

Products division has been forced to operate at 20,000 units below capacity because of lack of components coming from Components division. Products division is able to sell all the output it can produce at the current selling price.

Requirements:

- (a) Assuming all components are supplied to Products division, calculate the different component and product output mixes that would maximize the profit of:
- the Components division,
 - the Products division, and
 - CD Ltd as a whole.

Comment on the effectiveness of the transfer pricing system used by CD Ltd and on the merits of preventing Components division from selling outside the company.

13. ABC Ltd. is a small company that manufactures a lathe attachment for the Turret Lathe market.

The data for manufacturing the attachment are as follows:

For each Batch of 10 Turret Lathes

Component	A	B	C	D	E	Total
Machine hours	10	14	12			
Labour hours				2	1	3
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Variable Cost	32	54	58	12	4	160
Fixed Cost	48	102	116	24	26	316
(apportioned)						
Total Component	80	156	174	36	30	476
costs						

Assembly Costs (all variables) Rs 40 per 10

Selling price Rs 600 per 10

General-purpose machinery is used to make components A, B, and C and is already working to the maximum capability of 4,752 hours and there is no possibility of increasing the machine capacity in the next period. There is labour available for making components D and E and for assembling the product.

The marketing department advises that there will be 50% increase in demand in the next period so the company has decided to buy one of the machine-made components from an outside supplier in order to release production capacity and thus help to satisfy demand.

A quotation has been received from XYZ Ltd for the components, but because this company has not made the components before, it has not been able to give single figure prices. Its quotation is as follows:

Component	Pessimistic		Most Likely		Optimistic	
	Price	Probability	Price	Probability	Price	Probability
A	96	0.25	85	0.5	54	0.25
B	176	0.25	158	0.5	148	0.25
C	149	0.25	127	0.5	97	0.25

It has been agreed between the two companies that audited figures would be used to determine which one of the three prices would be charged for whatever component is bought out.

Requirements:

- (a) Show in percentage form – the maximum increased production availability from the three alternatives, i.e. buying A or B or C.

- (b) Analyse the financial implications of the purchase and assuming a risk neutral attitude, recommend which component to buy out, noting that the production availability will be limited to a 50% increase.
- (c) Prepare a profit statement for the period assuming that the component chosen in (b) is bought out and that the extra production is made and sold (show your workings).
14. (a) ABC Ltd manufactures 'PCM30'. 'PCM30' comprises of three basic ingredients, the standard mix and price of which are as follows:

To produce 1 kg of 'PCM30'

BACLB(Barium chloride base)	0.9 kg at Rs2.50 per kg
SHCL(Sodium hydrochlorite)	0.1 kg at Rs 10.50 per kg
BASH(a secret formula)	0.05 kg at Rs 14.50 per kg

SHCL and BASH are interchangeable ingredients. ABC Ltd's production facilities are highly automated and there is no direct labour. Fixed overheads are budgeted at Rs 5,00,000 per month and production is budgeted to run at 20,000 kg of PCM 30 per month. Fixed overheads are absorbed through BACLB usage. During the course of January, 21,500 kg of PCM 30 are produced with the following figures for material consumption:

BACLB	19,100 kg at Rs 2.55 per kg
SHCL	2,800 kg at Rs 10 per kg
BASH	980 kg at Rs 16.50 per kg

Fixed overheads during the period were Rs 5,00,000.

You are required to reconcile standard and actual costs in January using a full variance analysis.

- (b). The following details have been extracted from the standard cost sheet for product X:

	Rs/Unit
Variable overhead:	
4 machine hours @Rs 8.00/hour	32.00
2 labour hours @ Rs 4.00 /hour	8.00
Fixed overhead	20.00

During October 2004, 5,450 units of the product were made compared to a budgeted production target of 5,500 units. The actual overhead costs incurred were:

Machine related variable overhead	Rs 1,76,000
Labour related variable overhead	Rs 42,000
Fixed overhead	Rs 1,09,000

The actual number of machine hours was 22,000 and the actual number of labour hours was 10,800.

Requirements

- (a) Calculate the overhead cost variances in as much detail as possible from the data provided.
- (b) Explain the meaning of, and give possible reasons for, the variable overhead variances which you have calculated.
- (c) Explain the benefits of using multiple activity bases for variable overhead absorption.

15. (a) ABC Ltd assembles PCBs , the process requiring a special raw material which needs to be imported from Germany. The vendor has quoted a FOB price of 10DM per unit . The CIF value shall be 40 % over the FOB over which a 20% Custom Duty is applicable. The local insurance and freight are estimated to be 10% of the CIF value. Another 2% over the CIF may be added towards local duties to be paid for bringing the material to the factory premises from the Indian port. You are required to estimate the Standard Cost of this Raw Material assuming a DM equivalent to Rs 50 .
- (b) Discuss briefly the advantages and disadvantages of Standard Costing.
16. How is Marginal Costing different from Absorption Costing? What are its limitations? Discuss.
17. (a) What do you understand by Cost plus pricing? What are its advantages and disadvantages?
- (b) What should a firms pricing policy be in a period of recession?
18. L Ltd. and M Ltd. are subsidiaries of the same group of companies. L Ltd. produces a branded product sold in drums at a price of Rs. 20 per drum.
- Its direct product costs per drum are:*
- Raw material from M Ltd.: At a transfer price of Rs. 9 for 25 litres.
- Other products and services from outside the group: At a cost of Rs. 3.
- L Ltd.'s fixed costs are Rs. 40,000 per month. These costs include process labour whose costs will not alter until L Ltd.'s output reaches twice its present level.
- A market research study has indicated that L Ltd.'s market could increase by 80% in volume if it were to reduce its price by 20%.
- M Ltd. produces a fairly basic product which can be converted into a wide range of end products. It sells one third of its output to L Ltd. and the remainder to customers outside the group.
- M Ltd.'s production capacity is 10,00,000 kilolitres per month, but competition is keen and it budgets to sell no more than 7,50,000 kilolitres per month for the year ending 31 December.
- Its variable costs are Rs. 0.20 per Kilolitre and its fixed costs are Rs. 60,000 per month.
- The current policy of the group is to use market prices, where known, as the transfer price between its subsidiaries. This is the basis of the transfer prices between M Ltd. and L Ltd.
- You are required:
- (a) to calculate the monthly profit position for each of L Ltd. and M Ltd. if the sales of L Ltd. are
- at their present level, and
 - at the higher potential level indicated by the market research, subject to a cut in price of 20%.
- (b) (i) to explain why the use of a market price as the transfer price produces difficulties under the conditions outlined in (a) (ii) above;
- (ii) to explain briefly, as Chief Accountant of the group, what factors you would consider in arriving at a proposal to overcome these difficulties;
19. An airline company operates a single aircraft from station A to Station B. It is licensed to operate 3 flights in a week each way thereby making a total of 312 flights in a year. While the seating capacity of the aircraft is 160 passengers, the average number of passengers actually caused per flight is 120 only. The fare charged per passenger for one way flight is Rs.8000. The cost data are as under:

- Variable fuel costs per flight Rs.1,60,000
- Food served on board the flight (not charged to passengers) Rs.200 per passenger
- Commission paid to travel agents (on an average 80% of the seats are booked through travel agents 5% if fare
- Fixed annual lease costs allocated to each flight Rs.400000 per flight
- Fixed ground and landing charges Rs.100000 per flight
- Fixed salaries of flight crew allocated to each flight Rs.60000 per flight

Required:

- (i) Compute the operating income on each one-way flight between stations A and B.
 - (ii) The company has been advised that in case the fare is reduced to Rs.7500 per flight per passenger, the average number of passengers per flight will increase to 132. Should this proposal be implemented? Show your calculations.
20. ABC Co. Ltd. has an annual turnover of Rs.6,00,00,000 from a range of products. Material costs and conversion costs account for 30% and 25% of annual turnover respectively.

Other information relating to the company is as follows:

- (i) Stock values are currently at a constant level, being:
 - (a) *Raw material stock*: 10% of the material element of annual turnover.
 - (b) *Work-in-progress*: 15% of the material element of annual turnover together with a proportionate element of conversion costs allowing for 60% completion of work-in-progress as to conversion costs and 100% completion as to material cost. The material cost: conversion cost ratio is constant for all products.
 - (c) *Finished goods stock*: 12% of the material element of annual turnover together with a proportionate element of conversion cost.
- (ii) Holding and acquisition costs of materials comprise of fixed costs of Rs.2,00,000 plus variable costs of Rs. 0.10 per Re. of stock held.
- (iii) Movement and control costs of work-in-progress comprise of fixed costs of Rs.2,80,000 per annum plus variable costs of Rs.0.05 per Re. of material value of work-in –progress.
- (iv) Holding and control costs of finished goods comprise fixed costs of Rs.3,60,000 per annum plus variable costs of Rs.0.02 per Re. of finished goods (material cost +conversion cost).
- (v) Financial charges due to the impact of stock holding on working capital requirement are incurred at 20% per annum on the value of stocks held.

ABC Co. Ltd., is considering a number of changes which is estimated to affect stock levels and costs as follows:

1. *Raw material stock*: Negotiate delivery from suppliers on a just-in-time basis. Stock levels will be reduced to 20% of the present level. Fixed costs of holding and acquiring stock will be reduced to 20% of the present level and variable costs to Rs.0.07 per Rs. of stock held.
2. *Work-in-progress*: Convert the layout of the production area into a 'dedicated cell' format for each product type instead of the existing system which comprises groups of similar machines to which each product type must be taken. Work-in-progress volume will be reduced to 20% of the present level with the same stage of completion as at present. Fixed costs of movement and control will be reduced to 40% of the present level and variable costs to Rs.0.03 per Rs. of material value of work-in-progress.
3. *Finished goods stock*: Improvement control of the flow of each product type from the production area will enable stocks to be reduced to 25% of the present level. Fixed costs of

holding and control will be reduced to 40% of the present level and variable costs to Rs.0.01 per Rs. of finished goods held.

Required:

Calculate the annual estimated financial savings from the proposed changes in each of raw material stock, work-in-progress and finished goods stock.

21. . (a) Define Material Requirement Planning (MRP). What are its purposes.
- (b) What is Enterprise Resource Planning (ERP). Mention its main features.
22. (a) Advocates of traditional Costing argue that ABC simply provides a different picture , rather than a more accurate picture, of product costs . Discuss.
- (b) Some advocates of ABC claim that it provides information suitable for decision making . Discuss.
23. (a) What are the benefits of operating a transfer pricing system within a divisionalised company?
- (b) What are the benefits of Activity Based Management?
24. G. Ltd. produces four products. A conventional product costing system is used at present. Now, use of activity based costing (ABC) system is being considered. Details of the four products and relevant information are given below for one period:

Product	A	B	C	D
Output in units	240	200	160	240
Costs per unit:	Rs.	Rs.	Rs.	Rs.
Direct material	80	100	60	120
Direct labour	56	42	28	42
Machine hours (per unit)	8	6	4	6

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

The production overhead is currently absorbed by using a machine hour rate, and the total of the production overhead for the period has been analysed as follows:

	Rs.
Machine department costs (rent, depreciation and supervision)	20,860
Set-up costs	10,500
Stores receiving	7,200
Inspection / Quality control	4,200
Output handling and despatch	9,240
	52,000

The `cost drivers` to be used for the overhead costs are as listed below:

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

The number of requisitions raised on the stores was 20 for each product and the number of orders executed was 84, each order being for a batch of 10 of a product. You are required:

- (a) to calculate the total costs for each product if all overhead costs are absorbed on a machine hour basis;
 - (b) to calculate the total costs for each product, using activity-based costing system;
 - (c) to calculate and list the unit product costs 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.
25. (a) Distinguish between fixed budget and flexible budget.
(b) State the advantages of target costing.
 26. (a) List and define four types of product quality cost.
(b) Define Total Quality Management (TQM). Explain in brief six C_s of T.Q.M. for its successful implementation.
 27. (a) Define the Term Value Chain .
(b) How can Value Chain Analysis be used to assess competitive advantage.
 28. Amar and Naveen architects, have been using a simplified costing system in which all professional labour costs are included in a single direct cost category professional labour and all overhead costs are included in a single indirect cost category, professional support, and allocated to jobs by using professional labour hours as the allocation base. Consider two clients: Host Restaurant, which required 25 hours of design work for a new addition, and Pizza Hut, which required plans for a new floor that took 40 hours to draw. The firm has two partners, who each earn a salary of Rs.1,50,000 a year, and four associates, who each earn Rs. 60,000 per year. Each professional has 1,500 billable hours per year. The professional support is Rs. 10,80,000, which consists of Rs.7,00,000 of design support and Rs.3,80,000 of staff support. Host Restaurant job required five hours of partner time and 20 hours of associate time. Pizza Hut job required 30 hours of partner time and 10 hours of associate time.

Required:

- (i) Prepare job cost sheets for Host Restaurant and Pizza Hut using a simplified costing system with one direct and one indirect cost pool.
 - (ii) Prepare job cost sheets for the two clients, using an activity based costing system with two direct cost categories – partner labour and associate labour – and two indirect cost categories – design support and staff support. Use professional labour in Rupees as the cost allocation base for design support and professional labour hours for staff support.
 - (iii) Determine the amount by which each job was under – or overcosted, using the simplified costing system.
29. IBM manufactures and sells computers and computer peripherals to several nationwide retail chains. Amar is the manager of the printer division. Its two largest-selling printers are P₁ and P₂.
(a) The manufacturing cost of each printer is calculated using IBM's activity based costing system. IBM has one direct manufacturing cost category (direct materials) and the following five indirect manufacturing cost pools:

<i>Indirect Manufacturing Cost Pool</i>	<i>Allocation Base</i>	<i>Allocation Rate</i>
		<i>Rs.</i>
1. Materials handling	Number of parts	1.20 per part
2. Assembly management	Hours of assembly time	40 per hour of assembly

		time
3. Machine insertion of parts	Number of machine inserted parts	0.70 per machine inserted part
4. Manual insertion of parts	Number of manually inserted parts	2.10 per manually inserted part
5. Quality testing	Hours of quality testing time	25 per testing hour

Product characteristics of P_1 and P_2 are as follows:

	P_1	P_2
	Rs.	Rs.
Direct materials costs	407.50	292.10
Number of parts	85	46
Hours of assembly time	3.2	1.9
Number of machine-inserted parts	49	31
Number of manually inserted parts	36	15
Hours of quality testing time	1.4	1.1

Required:

What is the manufacturing cost of products P_1 and P_2 ?

- (b) Assume all the information in part (a). Amar has just received some bad news. A foreign competitor has introduced products very similar to P_1 and P_2 . Given their announced selling prices, Amar estimated the P_1 to have a manufacturing cost of approximately Rs.680 and the P_2 clone to have a manufacturing cost of approximately Rs. 390. He calls a meeting of product designers and manufacturing personnel at the printer division. They all agree to have the Rs.680 and Rs. 390 figures become target costs for redesigned versions of P_1 and P_2 respectively. Product designers examine alternative ways of designing printers with comparable performance but lower cost. They come up with the following revised designs for P_1 and P_2 (termed P_1 REV and P_2 REV, respectively):

	P_1 -REV	P_2 -REV
	Rs.	Rs.
Direct materials cost	381.20	263.10
Number of parts	71	39
Hours of assembly time	2.1	1.6
Number of machine-inserted parts	59	29
Number of manually inserted parts	12	10
Hours of quality testing time	1.2	0.9

Required:

- Define what is target costing?
- Using an activity based costing system compute the manufacturing costs of P_1 REV and P_2 REV. How do they compare with the Rs.680 and Rs.390 target costs?
- Assume now that Amar has achieved major cost reductions in one of the activity areas. As a consequence, the allocation rate in the assembly management activity area will be reduced from Rs. 40 to Rs.28 per assembly hour. How will this activity area cost

reduction affect the manufacturing costs of P_1 REV and P_2 REV? Comment on the results.

30. The performance of a company at two levels of operations during 2002-03 is as under:

<i>Capacity utilisation</i>	<i>50%</i>	<i>60%</i>
Direct materials	Rs.1,00,000	1,20,000
Direct wages	Rs.1,60,000	1,92,000
Production overheads	Rs.6,00,000	6,50,000
Adm. overheads	Rs.1,20,000	1,20,000
Selling overheads	Rs.2,20,000	2,40,000

The company produced 12,000 units at 60% capacity utilisation. The profit margin is 20% on sales.

During the next year 2003-04, the company is poised for increasing the capacity utilisation to 75%. The company desires to have the same profit margin as in 2002-03. The following percentage changes in costs are expected to be applicable in the next year.

- Direct material prices will increase by 5%
- Direct wage rates will increase by 3%.
- Direct labour efficiency will fall by 4%.
- Variable production overheads will increase by 6%.
- Fixed production overheads will increase by 10% upto 80% capacity utilisation and by 22% thereafter.
- Variable selling expenses will increase by 10%.
- Fixed selling expense will increase by 80%.
- Administrative Overheads will increase by 15%.

The company expects to receive an export order for 3000 units while operating at 75% capacity utilisation. The anticipated export price offer is Rs.92 per unit.

Required:

- Prepare a flexible budget for 2003-04 and determine the cost per unit of output at the capacity utilisation levels of 75% and 90%.
 - Calculate the sales value and profit for 2003-04 at 75% capacity.
 - Advise the management as to whether or not the export order at the price of Rs.92 per unit should be accepted.
31. (a) What are the pre-requisites for successful Benchmarking.
- (b) Explain in brief advantages of Balanced Score Card.
32. Write short notes on:
- Advantages of Zero Based Budgeting
 - Key measures of Theory of constraints
 - Applications of Pareto Analysis.
 - Efficiency Ratio

33. (a) The management accountant of Atul Enterprises Ltd. has suggested that a linear programming model might be used for selecting the best mix of five possible products, A, B, C, D and E.

(i) The following information is available:

	Per unit of product				
	A	B	C	D	E
	Rs.	Rs.	Rs.	Rs.	Rs.
Selling price	48	42	38	31	27
Costs:					
Materials	15	14	16	15	16
Direct labour	18	16	6	4	4
Fixed overheads*	9	8	3	2	2
Total costs	42	38	25	21	22
Net profits	6	4	13	10	5

*based on 50% of direct labour cost.

(ii) Expected maximum unit demand per week for each product at the prices indicated:

A	B	C	D	E
1,500	1,200	900	600	600

(iii) Cost of materials includes a special component, which is in short supply; it costs Rs.3 a unit. Only 5,800 units will be available to the company during the week. The number of units of the special component needed for a unit of each product is:

A	B	C	D	E
1	1	3	4	5

(iv) Labour is paid at a rate of Rs.1.50 per hour and only 20,000 hours will be available in a week.

(v) The management of Atul Enterprises Ltd. has ruled that expenditure on materials must not exceed a sum of Rs.30,000.

(vi) All other resources are freely available in sufficient quantities for planned needs.

Formulate a linear programming model stating clearly the criterion you use.

(b) The simplex tableau for a maximisation problem of linear programming is given below:

Product mix. (x_i)	x_1	x_2	s_1	s_2	Quantity (b_i)
x_2	1	1	1	0	10
s_2	1	0	-1	1	3
c_j	4	5	0	0	
z_j	5	5	5	0	50
$z_j - c_j$	1	0	5	0	

Answer the following questions, giving reasons in brief:

- (i) Is the above solution optimal?
- (ii) Are there more than one optimal solution ?

- (iii) Is this solution degenerate?
 - (iv) Is this solution feasible?
 - (v) 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?
 - (vi) 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 profit?
 - (vii) Machine A (associated with slack s_1 , in hours/week) has to be shut down for repairs for 2 hours next week. What will be the effect on profits?
 - (viii) How many units of the two-product x_1 and x_2 are being produced according to this solution and what is the total profit?
34. A company manufactures two products each of which is processed in the same two production departments. The capacity in each department is measured by the number of machine hours which are limited to 9,000 hours in Department 'X' and 15,000 hours in Department 'Y' per annum.

Details relating to the two products are as under:

	<i>Product AXE</i>	<i>Product BXE</i>
Selling Price per unit	Rs. 300	Rs. 100
Variable Cost per unit	240	60
Machine Hours per unit		
Department X	4	1
Department Y	2	3

The order book analysis shows that the company has received sales orders for 2,000 units of AXE and 5,000 of BXE. The fixed overheads of the two departments are as under:

Department X Rs. 18,000 per annum

Department Y Rs. 60,000 per annum

Required:

- (i) Find the profitability if the company executes the order for the supply in the following manner:
 - (a) 2,000 units of AXE and 1,000 units of BXE.
 - (b) 5,000 units of BXE alone.
 - (ii) Indicate the cost of idle time arising out of the execution of the aforesaid two orders separately.
 - (iii) Set an optimal product mix and evaluate its profitability.
35. A company has just completed the manufacture of 40 units of a new product. The manufacturing costs are as under:

	<i>Rs.</i>
Direct materials	2,00,000
Direct Labour: 8000 hours @ Rs.20 per hour	1,60,000
Variable overheads	80,000

Special tools (re-usable)	10,000
Fixed overheads apportioned	1,00,000
Total	5,50,000

The company's policy is to add a profit of 12% on selling price.

The company received another order for 120 units of this product for which the company quoted, based on its policy on absorption cost basis, a price of Rs.15,625 per unit. The customer struck the order to Rs.11,000 per unit. The company is short of work and so is keen to take up more orders but it is reluctant to accept this order price because it is against the policy to accept any price before its cost. The company experiences is learning curve of 90%.

Required:

- (i) Compute the gain or loss arising from acceptance of the order at Rs.11,000 per unit.
 - (ii) Advise whether the company should accept this order for 120 units or not.
36. 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 the 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 manages 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 rooms so that their total preference ranking is a minimum.

37. (a) Distinguish between PERT & CPM
- (b) A project consists of activities, A, B, C, DH, I. The notation X< Y means that the activity X must be completed before Y can start and X, Y < W means that W will start only after the completion of the activities X and Y. With this notation:
- (i) Construct the network diagram for the following constraints
- A< D; A< E; B< F; C< G; D< H; E, F< I

The Project has the following time schedules of the above activities.

Time	A	B	C	D	E	F	G	H	I
Least time (t ₀)	5	18	26	16	15	6	7	7	3
Greatest time(t _p)	10	22	40	20	25	12	12	9	5
Most likely time (t _m)	8	20	33	18	20	9	10	8	4

(II) Determine the following:

- (i) Expected task times and their variance.
- (ii) The earliest and latest expected times to reach each node.
- (iii) The critical path, and
- (iv) The probability of a node occurring at the proposed completion date if the original contract time of completing the project is 41.5 weeks.

38. The following activities, preceding activities, normal time and cost and crash time and cost have been estimated from data accumulated for similar activities which have been completed in the past.

Activity	Preceding activity	Normal		Crash	
		time	cost	time	cost
		Days	Rs.	Days	Rs.
A	—	10	250	3	750
B	A	9	260	3	600
C	A	7	240	3	500
D	B	5	280	4	400
E	C	3	300	2	450
F	D,E	2	350	1	400
G	E	4	320	3	350
H	F,G	6	280	5	300
K	G,H	8	400	6	500

Site costs have been estimated at Rs. 80 per day. Activities must be completed either in normal time and cost or crash time and cost.

You are required to

- (I) Calculate and state the critical path using normal time, the associated time of completion and the associated cost;
 - (II) Calculate and state the minimum time for completion and the associated minimum cost;
 - (III) Calculate and state the minimum cost for completion and the associated time;
 - (IV) Discuss three significantly different factors which would be taken into consideration before deciding upon using normal time, minimum time or minimum cost.
39. A manufacturing company has four zones A, B, C and D four sales engineers P, Q, R and S respectively for assignment. Since the zones are not equally rich in sales potential. It is estimated that a particular engineer operating in a particular zone will bring the following sales:
Zone A: 4, 20,000, Zone B: 3,36,000, Zone C: 2,94,000, Zone D: 4,62,000
- The engineers are having different sales ability. Working under the same conditions their yearly sales are proportional to 14, 9, 11 and 8 respectively. The criteria of maximum expected total sales is to be met by assigning the best engineer to the richest zone, the next best to be second richest zone, and so on.
- Find the optimum assignment and the maximum sales.
40. (a) Enumerate the principles which are relevant to the development of database systems.
- (b) State the requirements of the implementation of Total Quality Management (TQM).

SUGGESTED ANSWERS / HINTS

1.

Client Analysis

a. <i>Computation of selling price per unit</i>	<i>Amount</i>	<i>Ratio</i>
Material	Rs. 4.00	
Direct labor	.60	
Overhead	1.00	
Administrative expense	1.20	
Profit	1.02	
	Rs. 7.82	85%
Selling expense at 15% of selling price (Rs. 7.82 ÷ 85% = Rs. 9.20)	1.38	15%
Selling price	Rs. 9.20	100%
b. Projected profit and loss statement (using 24,000 units)		
Sales		Rs. 2,20,800
<u>Cost of sales</u>		
Material	Rs. 96,000	
Labour	14,400	
Overhead	24,000	
Total cost of sales		134,400
Manufacturing profit		Rs. 86,400
Operating expenses:		
Selling	Rs. 33,120	
Administrative	28,800	
Total operating expenses		61,920
Net Income		Rs. 24,480
c. Computation of break-even point	<i>Amount</i>	<i>Percentages</i>
Sales	Rs. 220,800	100%
Variable costs:		
Material	Rs. 96,000	
Labor	14,400	
Selling	33,120	
Total variable costs	143,520	65%
Contribution margin	Rs. 77,280	35%
Fixed costs:		
Overhead	Rs. 24,000	
Administrative	Rs. 28,800	
	52,800	

Break-even: Fixed cost/contribution margin ratio : $52,800/.35 = \text{Rs. } 150,857$. In units: $\text{Rs. } 150,857/\text{Rs. } 9.20 = 16,398$ units.

2. (1) The fixed overhead volume variance shows the amount of over- or under absorption of fixed overheads based upon the actual level of output compared with the budgeted level of output. The capacity utilisation component arises because of the change in the level of output at a fixed (budgeted) overhead rate of absorption. The efficiency component occurs when the actual rate of overhead absorption is greater or less than that budgeted for a given level of output. This may be illustrated by the following example.

<i>XYZ Ltd</i>	<i>Budget</i>	<i>Actual</i>
Fixed overheads	Rs 1,00,000	Rs 1,01,000
Level of output	500 units	520 units
Labour used	2,000 hours	2,020 hours

The fixed overhead volume variance is Rs 4,000 favourable , i.e. $20 \text{ units} \times 4 \text{ hours per unit} \times \text{Rs } 50 \text{ per hour}$.

The capacity component is Rs 1,000 favourable , i.e. $20 \text{ hours} \times \text{Rs } 50 \text{ per hour}$.

The efficiency component is Rs 3,000 favourable , i.e. $60 \text{ hours} \times \text{Rs } 50 \text{ per hour}$.

The purpose of this subdivision of the variance is to aid management's understanding of the causes of the variance to enable management by exception.

Investigation of the capacity variance would look at the level of customer orders and any capacity constraints within the organisation. The efficiency variance investigation would look at the control and utilisation of labour. The limitations of this subdivision are:

- it is only possible for an absorption costing system;
- it may be difficult to decide which costs are truly fixed in nature;
- the use of labour hours as a driver of fixed costs may not be meaningful in modern manufacturing environments.

- (2) The materials usage variance shows the standard cost of the variation in quantity of materials used from the standard for a given level of output. The mixture component arises from the standard for a given level of output. The mixture component arises from using different relative proportions of the constituent raw materials from the budget. The yield component reflects any difference between the actual output achieved and that expected based upon the standard operation. For example :

	<i>Standard</i>	<i>Actual</i>
Input for 100 kg of product XY	• 60 kg of X at Rs 100 per kg. • 40 kg of Y at Rs 130 per kg.	• 64 kg of X at Rs 100 per kg • 38 kg of Y at Rs 125 per kg.

The material usage variance is Rs 140 adverse , i.e. $2 \text{ kg Y} \times \text{Rs } 130 - 4 \text{ kg X} \times \text{Rs } 100$.

The material mixture component is Rs 84 favourable , i.e. $2.8 \text{ kg X} \times \text{Rs } 130 - 2.8 \text{ kg X} \times \text{Rs } 100$.

The material yield component is Rs 224 adverse , i.e. $2 \text{ kg of XY at standard cost of } (0.6 \times 100 + 0.4 \times 130)$.

The purpose is the same for part (a). The limitation is that this model assumes that there is no change in the quality of the product XY produced from different proportions of X and Y .

This is not likely to be true in actual practice where side chemical reactions may become more prevalent which may render the product unsuitable for its intended purpose. Investigation of the variances would consider:

- Mixture variance: ingredients used , material control and wastage;
- Yield variance: efficiency of equipment and the quality of materials used.

- (3) The labour rate variance is the difference between the actual cost incurred for the actual hours worked and the cost for working the actual amount of hours using the budgeted labour rate. The operational component arises from any changes in the rate of pay , which were a consequence of the way labour was operated, e.g. allowing a discretionary extra payment for poor working conditions. The planning component shows the change in labour rate due to inadequacies or inaccuracies in the preparation of the original budget. For example, the anticipated annual pay rise may have been different from that obtained from the workforce:

Actual hours worked	100
Actual wages paid	Rs 500
Original standard wage rate	Rs 4 per hor
Revised standard wage rate for the period	Rs 5.20 per hour

The labour rate variance is Rs 100 adverse i.e. $(500 - (4 \times 100))$

The operational component is Rs 20 favourable , i.e. $(500 - (5.20 \times 100))$

The planning component is Rs 120 adverse , i.e. (100×1.20)

Again, the purpose is the same as for part (a). The limitation for this subdivision is that it is rare for there to be a controllable (operational) reason for the labour rate variance. In general labour rates are fixed by the market place , i.e. they are uncontrollable (planning) variances.

Thus, this subdivision is an unnecessary complication that will rarely provide an insight which is an improvement on that provided by the labour rate variance. However, any investigation would focus on the establishment of wage rates and labour recruitment, whereas investigation of the operational variance would look at the actual payment of wages and control of payroll.

3. The Dearborn Company

Material: $\frac{AQ \times AP}{13,000 \times Rs.4.70} = Rs.61,1000$

$\frac{AQ \times SP}{13,000 \times Rs.4.50} = Rs.58,500$

$\frac{SQ \times SP}{12,600 \times Rs.4.50} = Rs.56,700$

} Price(Rs 2,600)
Usage(Rs 1,800)

Labor:

$\frac{AQ \times AR}{7,920 \times Rs.8.45} = Rs.66,924$

$\frac{AQ \times SR}{7,920 \times Rs.8.25} = Rs.65,340$

$\frac{SQ \times SR}{7,560 \times Rs.8.25} = Rs.62,370$

} Rate (Rs 1,584) Efficiency (Rs 2,970)

Factory overhead:

Incurred	Rs. 36,000	}	(Rs 90)
$\frac{SQ \times SR}{7,560 \times Rs.4.75}$			
	= Rs.35,910		

- a Material cost was above standard for two reasons:
- (1) The purchase of 13,000 kgs at 20 paise per kg over standard price, adding Rs. 2,600.
 - (2) The waste in production, of 400 kgs, worth Rs. 4.50 per kg, adding Rs. 1,800
- b Labor was paid an average of Rs. 8.45 per hour, 20 paise more than standard, for 7,920 hours, adding Rs. 1,584; 360 hours were wasted in production, adding Rs. 2,970 at Rs. 8.25 standard rate per hour.
- c. Overhead, applied at standard rate of Rs. 4.75 per hour for 7,560 standard hours, was Rs. 35,910. Overhead incurred was Rs. 36,000, resulting in underapplied overhead of Rs. 90.
4. (a) Costs incurred in the past, or revenue received in the past are not relevant because they cannot affect a decision about what is best for the future. Costs incurred to date of Rs. 50,000 and revenue received of Rs. 15,000 are 'sunk' and should be ignored.
- (b) Similarly, the price paid in the past for the materials is irrelevant. The only relevant cost of materials affecting the decision is the opportunity cost of the revenue from scrap which would be forgone – Rs. 2,000.

(c) Labour Costs

	<i>Rs.</i>
Labour costs required to complete work	8,000
Opportunity costs : contribution forgone by losing other work Rs. (30,000 – 12,000)	18,000
Relevant cost of labour	26,000

- (d) The incremental cost of consultancy from completing the work is Rs. 2,500

	<i>Rs.</i>
Cost of completing work	4,000
Cost of cancelling contract	1,500
Incremental cost of completing work	2,500

- (e) Absorbed overhead is a notional accounting cost and should be ignored. Actual overhead incurred is the only overhead cost to consider. General overhead costs (and the absorbed overhead of the alternative work for the labour force) should be ignored.
- (f) Relevant costs may be summarised as follows.

	<i>Rs.</i>	<i>Rs.</i>
Revenue from completing work		34,000
Relevant costs		
Materials: Opportunity cost	2,000	
Labour: basic pay	8,000	
opportunity cost	18,000	
Incremental cost of consultant	2,500	

	30,500
Extra profit to be earned by accepting the order	3,500
5. (a) Relevant cost of operating machine for six months:	
	Rs.
Variable operating costs	60,000
Reduction in saleable value during use (Rs. 4,000 – Rs. 2,500)	15,000
Total relevant cost	75,000

The original cost of Rs. 90,000 and the net book value are irrelevant **sunk costs**.

- (b) Material required = 20,000 units × (Rs. 12/Rs. 3) = 80,000 kg
Material is therefore a limiting factor, since only 75,000 kg are available.
Labour required = 20,000 units × (Rs. 72/Rs. 8) = 180,000 hours.
Labour is not a limiting factor, since 1,90,000 labour hours are available.

6. Working notes:

1. Total machine hours required to produce the required units

	AA	BB	CC	DD	Total hrs.
Direct expenses per unit (Rs.)	5.00	10.00	5.00	30.00	
Direct expense rate per machine hour	5	5	5	5	
Machine hours per unit of component	1	2	1	6	
Total machine hours required	2,000	7,000	1,500	16,800	27,300
	(2,000 units × 1 hour)	(3,500 units × 2 hours)	(1,500 units × 1 hour)	(2,800 units × 6 hours)	

2. Advantage per hour and ranking:

Variable cost per component: Rs. (A)	28.50	27.50	28.50	72.00
Purchase price per component: Rs. (B)	30.00	29.50	26.00	84.00
Advantage in making Rs.	1.50	2.00	(2.50)	12.00
Advantage per machine hour per component (B – A)	1.50	1.00	—	2.00
Ranking	2	3	—	1

- (i) Ranking clearly shows that the entire requirement of component CC (1,500 units) should be purchased from outside

(i)Rank	Component	Maximum units	Machine hrs. / unit	Production units	Machine hours utilised	Balance machine hrs.
1	DD	2,800	6	2,800	16,800	3,200
2	AA	2,000	1	2,000	2,000	1,200
3	BB	3,500	2	600	1,200	Nil

- (ii) **Balance to be manufactured by second shift:** Component: BB = 2,900 units
Machine hours required = 2,900 hours × 2 units = 5,800 hours

Slab of 6,000 hours of second shift is necessary

Economics of second shift working:

		<i>Per unit</i>	<i>For 2,900 units</i>
Advantage in making	Rs.	2.00	5,800
Additional cost:			
Wages 25% of Rs.4 per unit	Rs.	1.00	2,900
Fixed overheads			
@ Rs.250 per 1,000 hrs. (250 × 6)	Rs.	<u>0.52</u>	<u>1,500</u>
Total additional costs	Rs.	<u>1.52</u>	<u>4,400</u>
Net advantage	Rs.	0.48	1,400

Component BB should be manufactured by introducing second shift.

7. Working notes

(1) *Hours required to meet maximum demand:*

	<i>External sales</i>	<i>Hours required per unit</i>	<i>Total hours</i>
	<i>(a)</i>	<i>(b)</i>	<i>(a) × (b)</i>
X	800 Units	3	2,400
Y	500 Units	4	2,000
Z	300 Units	2	600
			5,000

(2) *Contribution per unit:*

	X	Y	Z
Selling price	Rs 48	Rs 46	Rs 40
Variable cost	33	24	28
Contribution per unit	15	22	12
Labour hours required per unit	3	4	2
Contribution per hour	5	5.5	6
Ranking	111	11	1

(a) If only 3,800 hours are available in Division A

300 units of Z (maximum) which will take*	600 hours
500 units of Y (maximum) , which will take	2,000 hours
400 units of X to use remaining hours	1,200 hours
	3,800 hours

***Note:** Labour hours required per unit are given in the question . If 300 units of Y are to be transferred to Division B then 1,200 hours will have to be used for production of Y instead of X. It means Division A will sacrifice production of 400 units of X , which are yielding Rs 5 per hour. Given above is the optimum mix for Division A for 3,800 hours. If 300 units of Y are to be transferred to Division B with time constraint of 3,800 hours, then additional 300 units of Y will have to be produced sacrificing the production of 400 units of X, which is yielding contribution.

(1) Variable cost of Y Rs 24.00

(2) Contribution related to 'X' foregone for producing additional units of X : 4 hrs × Rs 5*

Transfer Price Rs44.00

* Y takes 4 hours and in each hour production of X would have generated contribution of Rs 5.

(b) If 5,600 hours are available:

Maximum time required to meet external sales(Working note 1) =5,000 hrs

Hours now available =5,600 hrs

(1) It means 600 hours can be easily used for production of Y and transfer price will be Rs 3,600*

Note. Y takes 4 hours per unit

(2) For producing additional 150 units, production of X will be disturbed

(1) i.e. 150 units of X @Rs 24 =3,600

Opportunity cost

(2) Contribution of X units foregone 600 hrs × Rs 5 =3,000*
6,600

*(600 hrs ÷ 4 hrs) × Rs 24 = 3,600

Total price for 300 units Rs 10,200

∴ Average transfer price should be Rs 34 per unit

* Contribution per hour of X foregone

8. (a) The shortfall in available machine hours for next period is 26,000 hours.

Workings

Machine hours required to satisfy annual sales demand

		Hours
Product X	5,000 units × 20 hrs.	1,00,000
Product Y	7,500 units × 21 hrs.	1,57,500
Product Z	2,500 units × 26 hrs.	65,000
Total machine hours required		322, 500
Machine hours available		2,96,500
Shortfall in available machine hours		26,000

(b) The contribution earned per machine hour used on product X is Rs. 2.50.

Workings

	X Rs. '000
Sales revenue	1,000
Prime costs	(500)
Variable overheads	(250)
Contribution	250
Contribution per unit	(÷5,000) Rs. 50
Contribution per machine hours	(÷20) Rs. 2.50

- (c) (i) Product X 5,000 units
 (ii) Product Y 7,500 units
 (iii) Product Z 1,500 units

Working

<i>Ranking</i>	<i>Product</i>	<i>Demand</i>	<i>Hours required</i>	<i>Hours available</i>	<i>Production units</i>
1 st	X	5,000(×20)	1,00,000	100,000	5,000
2 nd	Y	7,500(×21)	1,57,500	157,500	7,500
3 rd	Z	2,500(×26)	65,000	39,000*	1,500
				2,96,500	

* Balance (2,96,500 – 1,00,000 – 1,57,500)

9. (a) The purpose of a make or buy exercise often involves the choice between buying-in a component from an outside supplier or producing it within the firm. If there is spare capacity the choice is simple; it is worth buying a component only if the marginal costs incurred in production are greater than the buying –in-price.

If however there is no spare capacity then to the marginal cost we must add the contribution lost from the product displaced(i.e. the internal opportunity cost)

Other qualitative factors which may influence decisions are as follows:

- I. Supplier reliability – unforeseen delivery problems or supplier bankruptcy could lead to production difficulties
- II. Quality of buying in component- inferior quality may lead to high wastage.
- III. Price stability of buying in component – the management must carefully define the costs and the consequences of any policy change must be investigated before change is initiated.

- (b) (1)

	X	Y	Z
<u>Marginal cost</u>	Rs	Rs	Rs
Direct material	0.80	1.00	0.40
Direct labour	1.60	1.80	0.80
Direct expense	0.40	0.60	0.20
	2.80	3.40	1.40
Buying-in price	2.75	4.20	2.00
Extra cost saved/(incurred)	(0.05)	0.80	0.60

Therefore recommend buying component X.

- (2)

Profit statement

	X	Y	Z	Total
	Rs	Rs	Rs	Rs
Sales revenue	80,000	2,00,000	1,60,000	4,40,000
Variable cost	56,000	1,36,000	1,12,000	3,04,000
Fixed cost	16,000	40,000	32,000	88,000
Total cost	72,000	1,76,000	1,44,000	3,92,000
Profit	8,000	24,000	16,000	48,000

(3)

Profit statement: buying-in component X

	X	Y	Z	Total
	Rs	Rs	Rs	Rs
Selling price per unit	4.00	5.00	2.00	
Variable cost per unit	2.75	3.40	1.40	
Contribution per unit	1.25	1.60	0.60	
Contribution	25,000	64,000	48,000	1,37,000
Fixed cost				88,000
Profit				49,000

The profit increases by Rs 1,000 which is the cost saved by buying –in rather than making component X (20,000 units × Rs0.05).

(4) **Factors that should be considered include the following:**

- quality of component
- price stability
- investigate why supplier's price is lower
- supplier stability
- delivery reliability
- spare capacity may open new opportunities
- labour redundancy or rescheduling.

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

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

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

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

(e) Summary of relevant costs

	Rs.
Material A (1,000×Rs. 6)	6,000
Material B (1,000×Rs. 5)	5,000
Material C (300×Rs. 4) plus (700×Rs. 2.50)	2,950
Material D	1,500
Total	15,450

11. (a) Preliminary calculations

Variable costs are quoted per acre, but selling prices are quoted per tonne.

Therefore, it is necessary to calculate the planned sales revenue per acre. The calculation of the selling price and contribution per acre is as follows:

	Potatoes	Turnips	Parsnips	Carrots
(a) Yield per acre in tonnes	10	8	9	12
(b) Selling price per tonne	Rs. 100	Rs. 125	Rs. 150	Rs. 135
(c) Sales revenue per acre, (a)×(b)	Rs. 1000	Rs. 1000	Rs. 1350	Rs. 1620
(d) Variable cost per acre	Rs. 470	Rs. 510	Rs. 595	Rs. 660
(e) Contribution per acre	Rs. 530	Rs. 490	Rs. 755	Rs. 960
(a) (i)				

(i) Profit statement for current year

	Potatoes	Turnips	Parsnips	Carrots	Total
(a) Acres	25	20	30	25	
(b) Contribution per acre	Rs. 530	Rs. 490	Rs. 755	Rs. 960	
(c) Total contribution (a×b)	Rs. 13250	Rs. 9800	Rs. 22650	Rs. 24000	Rs. 69700
				Less fixed costs	Rs. 54000
				Profit	Rs. 15700

(ii) Profit statement for recommended mix

	Area A (45 acres)		Area B (55 acres)		Total
	Potatoes	Turnips	Parsnips	Carrots	
(a) Contribution per acre	Rs. 530	Rs. 490	Rs. 755	Rs. 960	
(b) Ranking	1	2	2	1	
(c) Minimum sales requirements in acres ¹		5	4		
(d) Acres allocated ²	40			51	

Comment:

¹ The minimum sales requirement for turnips is 40 tonnes, and this will require the allocation of 5 acres (40 tonnes/8 tonnes yield per acre). The minimum sales requirement for parsnips is 36 tonnes, requiring the allocation of 4 acres (36 tonnes/9 tonnes yield per acre).

² Allocation of available acres to products on basis of a ranking that assumes that acres are the key factor.

(e)	Recommended mix (acres)	40	5	4	51	
(f)	Total contribution, (a)×(e)	Rs. 21200	Rs. 2450	Rs. 3020	Rs. 48960	Rs. 75630
					Less fixed costs	Rs. 54000
					Profit	Rs. 21630

- (b) (i) Production should be concentrated on carrots, which have the highest contribution per acre (Rs. 960).

	Rs.
(ii) Contribution from 100 acres of carrots (100×Rs. 960)	96000
Fixed overhead	54000
Profit from carrots	42000

- (iii) Break-even point in acres for carrots =

$$\frac{\text{fixed costs (Rs. 54000)}}{\text{contribution per acre (Rs. 960)}}$$
= 56.25 acres

Contribution in sales value for carrots

= Rs. 91125 (56.25 acres at Rs. 1620 sales revenue per acre).

12. (a) (i) It is apparent that Components division profit will be maximized by a mix of:

10,000 d/X

10,000 e/Y

30,000 f/Z

- (ii) It is apparent that Products division profit will be maximized by a mix of:

10,000 d/X

30,000 e/Y

10,000 f/Z

- (iii) It is apparent that CD's aggregate profit will be maximized by a mix of:

30,000 d/X

10,000 e/Y

10,000 f/Z

The rankings of the products can be determined in each case simply by calculating the contributions of the products from the three alternative points of view. For example, in (ii) the ranking will be determined by the contribution generated by X, Y, and Z with the transfer prices of d, e, and f being perceived as variable costs. Thus X is perceived by the Products division to generate Rs.26 contribution (Rs.56 selling price – Rs.20 d transfer price – Rs.10 division variable cost), Y Rs.30 and Z Rs.14.

- (b) A perfect transfer pricing system has to satisfy three criteria. First, it has to give a 'fair' impression of divisional profit. Second, it has to avoid distorting the decision-making processes in the business. Third, it has to be cheap and simple to operate. In practice, almost no system of transfer pricing is capable of meeting all three of these criteria.

The transfer pricing system used by CD Ltd involves transfers at 'market selling price' accompanied by an obligation to supply all components internally. This system possibly meets the first and third criteria but it certainly does not meet the second. For one thing, who decides which components are to be prioritized? If the decision is left to the Components division, then it is likely that a pattern of output will emerge (see (i) above) that gives an aggregate profit to the two divisions of Rs.11,65,000 – Rs.1,00,000 less than the maximum possible (see (iii) above).

One possibility – if 'outside' sales are allowed, then the production of Z could be discontinued and all the output of component f be sold to outside customers. This would increase aggregate profit by Rs.60,000 over the maximum otherwise possible – by foregoing Rs.3,00,000 net revenue but avoiding Rs.1,60,000 of variable costs and Rs.2,00,000 of fixed costs.

13. General Workings

Present Output

General Purpose Machinery:

Capacity 4,752 hours

M/c hours per batch of 10 Turret lathes:

A 10 hours

B 14 hours

C 12 hours 36 hours

Present output 132 batches

+50% increase in demand 66 batches

Projected output 198 batches

Present and Projected Fixed Costs

TFC per batch Rs.316

× 132 batches

TFC Rs.41,712

Expected Price

Probability	A		B		C	
	Rs	Rs	Rs	Rs	Rs	Rs
0.25	96	24.00	176.00	44	149	37.25
0.50	85	42.50	158.00	79	127	63.50
0.25	54	13.50	148.00	37	97	24.25
Expected price		80.00		160.00		125.00

Present Contribution

Per batch	Rs.	Rs.
Selling price		600
Less:		
Variable production costs	160	

Variable assembly costs 40

200

400

Present output $\times$ 132 batches

Present contribution Rs.52,800

(a) Increased Production Availability

Present capacity 4,752 hours 132 batches

(1) Buy A — hours

Make B 14 hours

Make C 12 hours

= 26 hours

No. of batches – $4,752 \div 26$ = 182.8

Increase = 50.8 batches = 38.5%

(2) Buy B — hours

Make A 10 hours

Make C 12 hours

= 22 hours

No. of batches – $4,752 \div 22$ = 216

Increase = 84 batches = 63.6%

(3) Buy C — hours

Make A 10 hours

Make B 14 hours

— 24 hours

No. of batches – $4,752 \div 24$ = 198

Increase = 66 batches = 50%

Note: Increase in market demand = 66 batches = 50%

Market demand = 198 batches

(b) Financial Implications

	<i>A</i>	<i>B</i>	<i>C</i>
	<i>Rs</i>	<i>Rs</i>	<i>Rs</i>
T.V.C. per batch	32	54	58
Expected purchase price	80	160	125
Increase in VC per batc	48	106	67
Present contribution per batch	400	400	400
Revised contribution per batch	352	294	333
Revised no. of batches	182.8	198*	198
Revised contribution	64,346	58,212	65,934

* Limited to 50% increase

Decision - Buy out C; this offers the greatest revised contribution.

(c) Revised Profit Statement

		<i>Per batch</i>	<i>Total (per 198 batches)</i>
		<i>Rs</i>	<i>Rs</i>
Sales		600	1,18,800
Variable costs	Rs		
— Production	A	32	
	B	54	
	C	125	
	D	12	
	E	4	
Sub total		227	
Assembly	40	267	52,886
Contribution		333	65,934
Fixed Costs			41,712
Profit			24,222

14. (a) Standard material cost of 1 kg of PCM 30 is :

		<i>Rs</i>
BACLB	0.9 kg @ Rs 2.50	2.25
SHCL	0.1 kg @ Rs 10.50	1.05
BASH	0.05 kg @ Rs 14.50	0.725
	1.05 kg	4.025

Standard overhead cost of 1 kg of PCM30 is:

0.9 kg of BACLB @ Rs 27.77 = Rs 25.

Standard cost of output is:

	<i>Rs</i>
Materials	86,538
Overheads	5,37,500
	6,24,038
Variances	
Material price	1,515 adv
Material yield	1,169 adv
Material mix	3,652 adv
Capacity usage	30,556 fav
Overhead efficiency	6,944

Actual cost of output is:

	<i>Rs</i>
Materials	92,850
Overheads	5,00,000
	5,92,850

Working notes

Material yield variance

Standard output from actual inputs

$$\frac{22,880}{1.05} = 21,790 \text{ kg}$$

Actual output is 21,500 , therefore yield variance is 290 kg, having a cost impact of Rs 1,169..

Capacity usage variance

Budgeted BACLB usage is 18,000 kg and actual usage is 19,100 kg, giving a capacity usage variance of 1,100 kg. This has a cost impact of Rs 30,556(1,100 × Rs 27.77).

(b) (a) Machine related variable overhead

Expenditure variance = (std rate per hour – actual rate per hr)×actual hrs

$$= (\text{Rs } 8 - (\text{Rs } 1,76,000 / 22,000)) \times 22,000$$

= nil

Efficiency variance = (std hrs for actual prod – actual hrs) × std rate /hr

$$= ((5,450 \times 4) - 22,000) \times \text{Rs } 8.$$

= Rs 1,600 adv

Labour related variable overhead

$$\text{Expenditure variance} = (\text{Rs } 4 - (\text{Rs } 42,000 / 10,800)) \times 10,800$$

= Rs 1,200 fav

$$\text{Efficiency variance} = ((5,450 \times 2) - 10,800) \times \text{Rs } 4$$

= Rs 400 fav

Fixed overhead

Expenditure variance = budgeted expenditure – actual expenditure

$$= (5,500 \times \text{Rs } 20) - \text{Rs } 1,09,000$$

= Rs 1,000 fav

$$\text{Volume variance} = (\text{actual output} - \text{budgeted output}) \times \text{fixed overhead/unit}$$

$$= (5,450 - 5,500) \times \text{Rs } 20$$

= Rs 1,000 adv

(b)

<i>Variance</i>	<i>Meaning</i>	<i>Cause</i>
<i>Machine related</i>		
Expenditure	The variable overhead costs incurred are exactly in line with those which would have been budgeted for the machine hours worked.	Nil
Efficiency	The output from the machines is lower than would have been budgeted based on the machine hours worked, therefore less variable overhead has been absorbed.	Necessary maintenance has been deferred, causing operational difficulties and reduced output
<i>Labour related</i>		
Expenditure	The actual variable overhead cost incurred is lower than the standard cost allowance for the hours worked by the employees.	Some substitution of lower paid employees has taken place.
Efficiency	The output produced was higher than would have been expected from the number of labour hours worked and therefore more variable overhead has been absorbed.	The employees were anxious to finish a large order on time to maximise the organisations chances of receiving significant follow up work. They therefore worked faster..

(c) The use of multiple activity bases for variable overhead absorption can have the following benefits:

- More realistic product costs may be produced, resulting in improved pricing and decision making in general;
- management will be more aware of the link between activity and cost behaviour, and will have more incentive to focus on the relationships between these two variables;
- cost reduction activities within this area are more likely to be successful;
- it may become apparent that costs are not driven solely by output volumes, and therefore the focus on managerial attention may be significantly broadened. This may encourage managers to adopt a 'holistic' view of the organisation.

15. (a) Computation of Standard Cost

<i>Cost Component</i>	<i>Value in DM/Ut</i>	<i>Value in Rs</i>
FOB	10	500
Insurance and Freight	$10 \times 40\% = 4$	200
CIF	14	700
Custom Duty	2.8	140
Local Insurance and Freight	1.4	70
Local duties	0.28	14
Standard Cost		924

(b) Advantages and disadvantages of Standard Costing**Advantages**

- Carefully planned standards are of aid to more accurate budgeting.
- Standard costs provide a yardstick against which the actual performance may be measured.
- The establishment of standards involves the use of best material and methods which leads to economies.
- A target of efficiency to reach is set for employees and cost – consciousness is stimulated.
- Variances can be calculated which promote the concept of management by exception. Only the variances which exceed the tolerance level are investigated.

Disadvantages

- It is difficult to set accurate standards.
- The collection and analysis of necessary data may be very time consuming.
- Standards may be seen as pressure device.

16. Marginal Costing vs Absorption Costing

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

Limitations of Marginal Costing

- The use of Marginal Costing necessitates the need to classify expenses as fixed and variable. Frequently most of the expenses are semi-variable and so need to be divided amongst their variable and fixed components. This is difficult in practical situations.
- Contribution by itself is not a guide towards attaining optimum profitability. It needs to be interpreted along with the key factor.
- It is not practical to exclude overheads of fixed nature for valuing work-in-progress of large contracts. The use of Marginal Costing does not provide with useful results for decision making purposes nor does it give a correct valuation of the work-in-progress in such cases.

- Marginal Costing ignores the time factor as well as the investment involved for decision making purposes. For example two products may have the same Marginal Cost, however one of them can be produced in a shorter time and hence it should be the preferable produce. However, Marginal Costing ignores this time factor. Similarly the quantum of investment involved for alternative uses available are not considered in Marginal Costing.
17. (a) Cost plus Pricing refers to a pricing technique in which selling prices of a product are determined based on its estimated cost plus a fixed profit margin. For purposes of Cost plus Pricing, 'cost' means full cost at current level of production/operation and wage levels since these are regarded as most appropriate for price determination purposes.

The following are the various advantages and disadvantages of Cost plus Pricing method,

Advantages

- The use of Cost plus Pricing technique ensures a guaranteed contribution to a firm. This contribution is suffice to recover all the fixed costs and provides positive profits.
- Since the use of Cost plus Pricing assures that the price is more than the cost of a product, there are lesser risks and uncertainties involved in the adoption of this method.
- This pricing method is most suited for the long run since there are no permanent opportunity costs involved. The prices are based on the normal long run costs. This ensures that the seasonal fluctuations are taken care of.
- The mark up considered in Cost plus Pricing is normally the cost of capital of the firm. The cost of capital is arrived at by considering the market forces being exerted in the business environment. Hence it can be said that Cost plus Pricing technique takes into account various market forces while arriving at the desired selling price.
- Prices when fixed on a Cost plus basis provide stability in the long run. This facilitates planning.
- The use of Cost plus formulae does not require costs to be segregated into fixed and variable. This makes the formulae simple and easy to use.

Disadvantages

- The concept of Cost plus Pricing does not take into account the buyers needs and willingness to pay.
 - Cost plus Pricing assumes that costs have been estimated and allocated with accuracy. This may not be true in cases of multi product firms.
 - In specific circumstances, incremental costs play an important role for decision making purposes. The concept of Cost plus may not be of any help in such situations. It may lead a firm towards ignoring opportunity costs which may result in a wrong price fixation.
 - Cost plus Pricing gives undue importance to the concept of capacity utilisation. During times of short product life cycles and frequent innovation, the absorption of fixed overheads on the basis of capacity may be erroneous and detrimental for an organisation.
- (b) During a period of recession a firm may be advised to sell its products at prices between the Marginal Cost and the Absorption Cost. This should be done for short term purposes only. When conditions improve in the long run, the firm may gradually increase its prices. Such a policy shall have the following advantages;

- Plant and Machinery shall continue working and hence may be protected from deterioration due to idleness.
- Skilled employees who may be difficult to replace during future periods shall continue working with the firm.
- The firm will be ready to take advantages of favourable conditions at a later date.
- The firm shall remain in the market , so as to maintain its Goodwill amongst customers and reduce loss of market to its competitors.

18. (a) (i) Monthly profits at present level of L & M Ltd.

	(Rs. ' 000)
L Ltd.: Sales (10,000 drums* @ Rs.20 per drum)	200
Less : Costs: Raw materials @ Rs. 9 per drum	90
Other costs @ Rs.3	<u>30</u>
Contribution	80
Less : Fixed costs	<u>40</u>
Profit	<u>40</u>
M Ltd.: Sales (7,50,000 kilolitres at Rs. 9 per 25 litres)	270
Less: Costs: Variable (@Rs.0.20 per Kilolitre)	<u>150</u>
Contribution	120
Less : Fixed costs	<u>60</u>
Profit	<u>60</u>

Note:

* Sales of L Ltd. = 2,50,000 kilolitres internal transfers / 25 litres per drum
=10000 drums

(ii) Monthly profits at higher sales level

	(Rs. ' 000)
L Ltd.: Sales (18,000 drums* at Rs.16 per drum)	288
Less: Costs: Raw materials (Rs. 9 per drum)	162
Other expenses (Rs.3 per drum)	<u>54</u>
Contribution	72
Less: Fixed costs	<u>40</u>
Profit	<u>32</u>
M Ltd. Sales (9,50,000 kilolitres* at Rs. 9 per 25 litres)	342
Costs: Variable (@ Rs.0.20 per kilolitre)	<u>190</u>
Contribution	152
Less : Fixed costs	<u>60</u>
Profit	<u>92</u>

Note:

* Internal transfers (18,000) drums at 25 litres per drum) plus 500 000 kilolitres external sales.

- (b) (i)** The use of a market price as the transfer price produces difficulties because L Ltd. is not motivated to reduce the selling price, in order to increase volume, because its profit declines from Rs. 40,000 to Rs. 32,000. However, the profits of M Ltd. increases from Rs. 60,000 to Rs. 92,000. Thus, the profits for the company as a whole increase by Rs.

24,000. Hence the transfer price does not encourage goal congruence in this particular situation.

- (ii) In order to overcome the above difficulties, there is a need to offer some inducement to L Ltd. such that its profits will increase as a result of lowering the selling price in order to increase volume. Factors to consider are the following:

1. The significance of the loss in profits arising from the difference between profits at the optimum output level and profits based on the output using the current transfer pricing system.
2. Savings in selling and distribution costs arising from internal transfers compared with external sales. The savings per unit should be deducted from the market price.

19. Per flight basis:

		<i>Rs</i>
Fare collection		9,60,000
120 × Rs.8000		
Commission 80% of 9,60,000=7,68,000		
5% commission on 7,68,000		38,400
Net fare		9,21,600
Expenses:		
Fuel		1,60,000
Food 120 × Rs.200		24000
Total variable		184000
Contribution		737600
Fixed costs		
Annual lease apportioned	4,00,000	
Ground handling charges	1,00,000	
Crew salaries	60,000	5,60,000
Operating income		1,77,600
Fare collections		9,90,000
132 × Rs.7,500		
Commission		39,600
5% of 80% of 9,90,000 = 7,92,000		
Net fare		9,50,400
Fuel		1,60,000
Food 132 × Rs.200		26,400
		1,86,400
Contribution		7,64,000
Fixed costs		5,60,000
Profit		2,04,000

Excess of income is 2,04,000 – 1,77,600 = Rs.26,400

Hence reduction in fare is recommended.

20. **Statement showing the annual estimated financial savings
from the proposed changes**

	<i>Existing</i>	<i>Revised</i>
	<i>Rs.</i>	<i>Rs.</i>
<i>Raw material stock:</i>		
Fixed holding and acquisition costs	2,00,000	40,000 (20% of Rs.2,00,000)
Variable holding and acquisition costs (Refer to working note 1)	1,80,000	25,200
Financial charges	3,60,000 (20% × Rs.18,00,000)	72,000 20% × (20% of Rs.18,00,000)
	<u>7,40,000</u>	<u>1,37,200</u>
<i>Work-in-Progress</i>		
Fixed movement and control cost	2,80,000	1,12,000 (40% × Rs.2,80,000)
Variable movement and control cost (Refer working note 2)	1,35,000	16,200
Financial charges (Refer to working note 3)	<u>8,10,000</u>	<u>1,62,000</u>
	<u>12,25,000</u>	<u>2,90,200</u>
<i>Finished goods:</i>	<i>Rs.</i>	<i>Rs.</i>
Fixed holding & control costs	3,60,000	1,44,000
Variable holding & control costs (Refer to working note 4)	79,200	9,900
Financial charges (Refer to working note 4)	7,92,000 (20% of Rs.39,60,000)	1,98,000 (20% of Rs.9,90,000)
	<u>12,31,200</u>	<u>3,51,900</u>
<i>Summary of cost savings:</i>		
	<i>Existing</i>	<i>Revised</i>
	<i>situation</i>	<i>situation</i>
	<i>Rs.</i>	<i>Rs.</i>
Raw material stock	7,40,000	1,37,200
Work-in-progress	12,25,000	2,90,200
Finished goods	<u>12,31,200</u>	<u>3,51,900</u>
	<u>31,96,200</u>	<u>7,79,300</u>
		<u>24,16,900</u>

Working notes:1. *Variable holding and acquisition costs*

	<i>Existing (Rs.)</i>	<i>Revised (Rs.)</i>
Raw material stock: (i)	18,00,000	3,60,000
	(10% of 30%	(20% of
	×	Rs.18,00,000
	Rs.6,00,00,000)	)
Variable holding & acquisition cost per Rs. of stock (ii)	0.10	0.07
Variable holding & acquisition costs (i) × (ii)	1,80,000	25,200

2. *Variable movement and control cost*

Work-in-progress: (i)	27,00,000	5,40,000
	(15% of 30%	(20% of
	× Rs.6,00,00,000)	Rs.27,00,000)
Variable movement and control cost per Rs.:(ii)	0.05	0.03
Variable movement and control cost: (i) × (ii)	1,35,000	16,200

3. *Financial charges for WIP:*

	<i>Existing Rs.</i>	<i>Revised Rs.</i>
<i>Investment in WIP</i>		
Material	27,00,000	540000
	(15% of 30% × Rs.6,0000,000)	(20% of Rs.27,00,000)
Conversion cost	13,50,000	2,70,000
	(60% of 15%× 25% ×Rs.6,00,00,000)	(20% of Rs.13,50,000)
	40,50,000	8,10,000
Financial charges	20%	20%
Financial charges for WIP	8,10,000	1,62,000

4. *Variable holding & control cost for finished goods:*

	<i>Existing</i>	<i>Revised</i>
<i>Finished goods:</i>		
Material	21,60,000	5,40,000
	(12% of 30% × Rs.6,00,00,000)	(25% of Rs.21,60,000)
Conversion cost	18,00,000	4,50,000
	(12% of 25% × Rs.6,00,00,000)	(25% of Rs.18,00,000)
Investment in finished goods: (i)	39,60,000	9,90,000

Variable cost per (Rs.): (ii)	0.02	0.01
Variable holding & control cost: (i) × (ii):	79,200	9,900

21. (a) Refer to Chapter 10 of Institute's book of "Cost Management"

(b) Refer to Chapter 10 of Institute's book of "Cost Management"

22. (a) There is a very high probability of an Activity Based Costing system providing a different picture of Product Costs than what is provided by the Traditional system. However, since both methods make assumptions about the behaviour and cause of costs it cannot be said with certainty that ABC shall always produce more precise results than Traditional Costing. Nevertheless, since there are usually more activities than cost centers and often cost driver rates are more justifiable than the rates used by absorption costing, an Activity Based Costing System, most of the times, produces more accurate results.

(b) Usually, Marginal Costing is attributed as a tool for decision making. However, as you have seen in Question No 16, Marginal Costing has its own limitations. It does not consider the quantum of investment which may affect a firm in the long run. It also needs to segregate expenses into fixed or variable, which has its own practical limitations.

In contrast, ABC uses a number of absorption bases to spread costs across products or other cost units.. Such a analysis frequently results in the identification of certain expensive activities carried out for one or two specific products/services out of the many which are being manufactured /serviced by a company. Costs of such expensive activities tend to be spread over the many products produced in case of Traditional Costing, thus hiding the fact that the products/services using this activity may be loss making. If these costs are not completely variable costs but are, for example, batch costs, marginal costing would not have related them to the products at all. Therefore, ABC can be used for various decisions eg pricing, discontinuing products etc.

23. (a) The following are the potential benefits of operating a transfer pricing system within a divisionalised company :

1. It can lead to goal congruence by motivating divisional managers to make decisions, which improve divisional profit and improve profit of the organization as a whole.
2. It can prevent dysfunctional decision making so that decisions taken by a divisional manager are in the best interests of his own part of the business, other divisions and the organization as a whole.
3. Transfer prices can be set at a level that enables divisional performance to be measured 'commercially'.
4. A well run transfer pricing system ensures that a balance is kept between divisional autonomy to provide incentives and motivation, and centralized authority to ensure that the divisions are all working towards the same target

(b) The various benefits derived by the use of ABM technique are as follows,

- Activity Based Management helps to focus on cost reduction.
- It facilitates the preparation of an Activity Based Budget by providing the management with a clear view on the details of various activities.
- It provides a clear understanding of the underlying causes of the various business processing costs.
- It helps decision making.
- Identification of non value adding activities helps management control cost.

24. (a) Statement showing the total cost for each products (if all overhead costs are absorbed on a machine hour basis)

Product	A	B	C	D
Output in units: (i)	240	200	160	240
Cost per unit				
Direct material	80	100	60	120
Direct labour	56	42	28	42
Overheads	80	60	40	60
(Refer to working note 1)				
Total cost per unit: (ii)	216	202	128	222
Total cost per product (i) × (ii)	51,840	40,400	20,480	53,280

(b) Statement showing total costs for each product by using Activity Based Costing

Product	A	B	C	D
No. of units (i)	240	200	160	240
Direct material	19,200	20,000	9,600	28,800
Direct labour	13,440	8,400	4,480	10,080
Overheads				
Machine department cost	7702.15	4813.85	2567.38	5776.62
	(240 units × 8 hours × 4.11)	(200 units × 6 hours × 4.11)	(160 units × 4 hours × 4.11)	(240 units × 6 hours × 4.11)
Set up costs	3,000	2,500	2,000	3,000
	(240/20 × Rs.250)	(200/20 × Rs.250)	(160/20 × Rs.250)	(240/20 × Rs.250)
Stores receiving	1,800	1,800	1,800	1,800
	(20 × Rs.90)	(20 × Rs.90)	(20 × Rs.90)	(20 × Rs.90)
Inspection / quality control	1,200	1,000	800	1,200
	(240/20 × Rs.100)	(200/20 × Rs.100)	(160/20 × Rs.100)	(240/20 × Rs.100)
Output handling & despatch	2,640	2,200	1,760	2,640
(Refer to working note 2)	(240/10 × Rs.110)	(200/10 × Rs.110)	(160/10 × Rs.110)	(240/10 × Rs.110)
Total cost (ii)	48982.15	40713.85	23007.38	53296.62
Cost per unit (i) / ii)	204.09	203.57	143.80	222.07

Working note:

1. Computation of machine hour rate

Product	A	B	C	D	Total
Output in units	240	200	160	240	
Machine hours (per unit)	8	6	4	6	
Total machine hours	1,920	1,200	640	1,440	5,200

Machine hour rate = $\frac{\text{Total overheads}}{\text{Total machines hours}}$
= $\frac{\text{Rs.52,000}}{5,200 \text{ hours}}$
= Rs.10 per hour

2. Computation of overhead rate

Costs	(Rs.)	Cost driver	Cost driver transaction	Cost per unit
	(a)		(b)	(c)= (a)/ (b)
Machine department cost	20,860	Machine hours	5,200 hours	4.011538
Set up costs	10,500	No. of production runs	42*	250
Stores receiving	7,200	Requisition raised	80 (20 × 4)	90
Inspection / quality control	4,200	No. of production runs	42*	100
Output handling & despatch	9,240	Orders executed	84**	110
	52,000			

* No. of production runs = Total output / units per production run
= 840/20
= 42

** No. of orders executed = Total output / units per order
= 840 / 10
= 84

(c) Computation of product cost per unit [computed in part (a) + (b)]

	A	B	C	D
Cost per unit (a) (Rs.)	216	202	128	222
Cost per unit (b) (Rs.)	204.09	203.57	143.80	222.07
Difference (Rs.)	(11.91)	1.57	15.80	(06.07)

Product A and D are over costed with the traditional system and Product B & C are under-costed.

25 (a)

Fixed budget	Flexible budget
(i) It does not change with the actual activity achieved	(i) It changes in accordance with the activity attained
(ii) It operates under one level of activity	(ii) It consists of various budget for different levels of activities.
(iii) The costs whatever fixed variable or semi variable are related to one level of activity and hence variance analysis is not meaningful.	(iii) Variance analysis provides useful information as cost is analysed according to behaviour in relation to output.
(iv) If the budgeted and actual output levels	(iv) It facilitates ascertainment of

differ considerably, cost ascertainment and price fixation will not correct correct cost for price fixation purposes.

(v) Comparison of actual performance inter-budgeted targets will be meaningless

(v) It provides a meaningful comparison by flexing the budget in accordance with the level of activity attained.

(b) Advantages of target costing

- It reinforces top to bottom commitment to process and product innovation and aims at identifying issues to be resolved to achieve competitive advantage.
- It helps to create a company's competitive future with market driven management for designing and manufacturing products which meet the price required for market success.
- It uses management control systems to support, and reinforce manufacturing strategies and to identify market opportunities that can be converted into real savings to achieve the best value.

26. (a) The four types of products quality cost are:

- (i) *Prevention costs*: These are the costs incurred in preventing the production of products that do not conform to specification. They include quality of preventing maintenance, quality planning and training & extra costs of acquiring higher quality raw materials.
- (ii) *Appraisal costs*: These are the costs incurred to ensure that materials and products meet quality conformance standard. They include the cost of inspecting purchased parts, work in process and finished goods, quality audits & field tests.
- (iii) *Internal failure cost*: These are the costs associated with materials and products that fail to meet quality standards. They include costs incurred before the product is despatched to customer, such as the cost of scrap, repair, downtime caused by defects.
- (iv) *External failure costs*: These are the costs incurred when inferior products are delivered to customer. They include the costs of handling customer complaints, repairs of returned products & the costs arising from a damaged company reputation

(b) Total Quality Management:

Traditional focus was primarily on the financial performance of an organisation. Now a days it is crucial for organisation to monitor performance in many non financial areas as well. For many companies, quality is at the forefront of the area in which non financial performance is critically important. Monitoring product quality coupled with measuring and reporting quality costs helps companies program of total quality management (TQM) . TQM refers to the broad set of management and control processes designed to focus the entire organisation and all of its employees on providing products or services that do the best possible job of satisfying the customers.

Refer to Chapter 12 of Institute Cost Management Book for answer of six C_s of T.Q.M.

27. (a) Value chain may be defined as a series of internal processes or activities a company performs, “ to design, produce, market, deliver and support its product.” “ A firms value chain and the way it performs individual activities are a reflection of its history, its strategy, its approach of implementing strategy , and the underlying economics of the activities themselves.” For further details refer to Chapter 13 of Cost Management Book of the Institute

(b) In order to gain a competitive advantage over its competitors , a company needs to profitably satisfy or even exceed the needs and expectations of its various customers. This can be

done by the use of Value Chain Analysis . This analysis can be used to better understand which segments, distribution channels, price points, product differentiation , selling propositions and value chain configurations will yield the firm its greatest competitive advantage. The use of VCA to assess competitive advantage involves the following analyses'

- Internal cost analysis
- Internal differential analysis
- Vertical linkage analysis

For further details refer to Chapter 13 of Cost Management Book of the Institute

28. (i) Job cost sheet for Host Restaurant and Pizza Hut (using a simplified costing system)

	Host Restaurant (Rs.)	Pizza Hut (Rs.)
Professional labour cost:		
25 hours @ Rs.60 per hour	1,500	
40 hours @ Rs.60 per hour (Refer to working note 1)		2,400
Professional Support staff		
25 hours @ Rs.120per hour	3,000	
40 hours @ Rs.120 per hour (Refer to working note 2)		4,800
Total	4,500	7,200

(ii) Job cost sheet using an Activity based costing

	Host Restaurant (Rs.)	Pizza Hut (Rs.)
Professional labour cost	500	
5 hours @ Rs.100 per hour		3,000
30 hours @ Rs.100 per hour (Refer to working note 3)		
Associate labour cost	800	
20 hours @ Rs.40		400
10 hours @ Rs.40 (Refer to working note 4)		
Design support	1,690	
Rs.1.30 × Rs.1,300		4,420
Rs.1.30 × Rs.3,400 (Refer to working note 5)		
Staff support	1,056	
25 hours @ Rs.42.22		1,689
40 hours @ Rs.42.22 (Refer to working note 6)		
	4,046	9,509

(iii) Determining the amount by which each job was under or overcosted using a simplified costing system.

	Host Restaurant	Pizza Hut
	(Rs.)	(Rs.)
Cost using simplified system	4,500	7,200
Cost using Activity Based system	4,046	9,509
Difference	454	(2,309)

The simplified costing system overcosted Host Restaurant job by Rs.454 and undercosted Pizza Hut job by Rs.2,309.

Working notes:

1. Professional labour cost per hour

$$\begin{aligned} \text{Professional labour cost per hour} &= \frac{\text{Professional salaries}}{\text{Professional labour hours}} \\ &= \frac{(2 \times \text{Rs.1,50,000}) + (4 \times \text{Rs.60,000})}{6 \times 1,500 \text{ hours}} \\ &= \frac{\text{Rs.3,00,000} + \text{Rs.2,40,000}}{9,000 \text{ hours}} \\ &= \text{Rs.60 per hour} \end{aligned}$$

2. Professional support cost per hour

$$\begin{aligned} \text{Professional support cost per hour} &= \frac{\text{Total support cost}}{\text{Professional labour hours}} \\ &= \frac{\text{Rs.10,80,000}}{9,000 \text{ hours}} \\ &= \text{Rs.120 per hour} \end{aligned}$$

3. Partner wage rate per hour

$$\begin{aligned} \text{Partner rate per hour} &= \frac{\text{Partner salaries}}{\text{Partner billable hours}} \\ &= \frac{\text{Rs.3,00,000}}{3,000 \text{ hours}} \\ &= \text{Rs.100 per hour} \end{aligned}$$

4. Associate wage rate per hour

$$\begin{aligned} &= \frac{\text{Associate salaries}}{\text{Associate billable hours}} \\ &= \frac{4 \times \text{Rs.60,000}}{4 \times 1,500 \text{ hours}} \\ &= \text{Rs.40 per hour} \end{aligned}$$

5. Design support per Re. of professional labour

$$\begin{aligned} &= \frac{\text{Budgeted design support costs}}{\text{Budgeted professional labour cost}} \\ &= \frac{\text{Rs.7,00,000}}{\text{Rs.5,40,000}} \end{aligned}$$

= Rs.1.30 per Re. of professional labour

6. Staff support per professional labour hour

= $\frac{\text{Budgeted staff support costs}}{\text{Budgeted professional labour hours}}$

= $\frac{\text{Rs.3,80,000}}{9,000 \text{ hours}}$

= Rs.42..22 per professional hour

29. (a) Statement showing manufacturing cost of product P₁ and P₂

<i>Product</i>	<i>P₁</i>	<i>P₂</i>
	<i>Rs.</i>	<i>Rs.</i>
<i>Direct cost</i>		
Direct material cost	407.50	292.10
<i>Indirect cost</i>		
Material handling cost	102.00	55.20
	(Rs.1.20 × 85 parts)	(Rs.1.20 × 46 parts)
Assembly Management	128.00	76.00
	(Rs.40 × 3.2)	(Rs.40 × 1.9)
Machine insertion of parts	34.30	21.70
	(Rs.0.70 × 49)	(Rs.0.70 × 31)
Manual insertion of parts	75.60	31.50
	(Rs.2.10 × 36)	(Rs.2.10 × 15)
Quality testing	35.00	27.50
	(Rs.25 × 1.4)	(Rs.25 × 1.10)
	782.40	504.00

- (b) (i) Target costing is defined as “ a structural approach to determining the cost at which a proposed product with specified functionality & quality must be produced, to generate a desired level of profitability at its anticipated selling price.”

(ii) **Statement showing the revised cost of products P₁ & P₂**

	<i>P₁ REV</i>	<i>P₂ REV</i>
	<i>Rs.</i>	<i>Rs.</i>
<i>Direct cost</i>		
Direct material cost	381.20	263.10
<i>Indirect cost</i>		
Material handling cost	85.20	46.80
	(Rs.1.20 × 71)	(Rs.1.20 × 39)
Assembly Management	84.00	64.00
	(Rs.40 × 2.1)	(Rs.40 × 1.6)
Machine insertion of parts	41.30	20.30

	(Rs.0.70 × 59)	(Rs.0.70 × 29)
Manual insertion of parts	25.20	21.00
	(Rs.2.10 × 12)	(Rs.2.10 × 10)
Quality testing	30.00	22.50
	(Rs.25 × 1.2)	(Rs.25 × 0.9)
	646.90	437.70

The cost of P₁ REV is within the target set i.e. Rs.680 but the product cost of P₂ REV is more than the target set i.e. Rs.380.

- (iii) Statement showing the effect of cost reduction on the manufacturing costs of product P₁ REV and P₂ REV.

	<i>P₁ REV</i> Rs.	<i>P₂ REV</i> Rs.
<i>Direct cost</i>		
Direct material cost	381.20	263.10
<i>Indirect cost</i>		
Material handling cost	85.20	46.80
	(Rs.1.20 × 71)	(Rs.1.20 × 39)
Assembly Management	58.80	44.80
	(Rs.28 × 2.10)	(Rs.28 × 1.6)
Machine insertion of parts	41.30	20.30
	(Rs.0.70 × 59)	(Rs.0.70 × 29)
Manual insertion of parts	25.20	21.00
	(Rs.2.10 × 12)	(Rs.2.10 × 10)
Quality testing	30.00	22.50
	(Rs.25 × 1.2)	(Rs.25 × 0.9)
	621.70	418.50

The cost of product P₁ REV reduce by cost reduction effort by Rs.25.20 (Rs.646.90 – Rs.621.70) The cost of product P₂ REV reduce by cost reduction effort by Rs.19.20 (Rs.437.70 – 418.50)

The target cost of P₂ REV is Rs. 390. Further, cost reduction efforts are required to reduce cost of product P₂ REV from present Rs. 418.50 to Rs. 390 i.e. by Rs. 28.50 (Rs. 418.50 – Rs.390)

30. Year 2002-2003

At 60% production 12,000 units

At 50% production 10,000 units

Production overheads:

	Rs.		
12,000 units	6,50,000	Total cost of 12,000 units	6,50,000
<u>10,000 units</u>	<u>6,00,000</u>	Variable cost @ Rs. 25/- per unit	<u>3,00,000</u>
2,000 units	50,000	Fixed costs	3,50,000

Selling overheads:

Units	Rs.		
12,000	2,40,000	Total cost of 12,000 units	2,40,000
<u>10,000</u>	<u>2,20,000</u>	Variable cost @ Rs.10/- per unit	<u>1,20,000</u>
2,000	20,000	Fixed costs	1,20,000

Flexible budget for 2003-04:

Account		Cost @ 60%	Increase	Revised @ 60%	75%	90%
Units					1,50,000	1,80,000
Materials		1,20,000	5%	1,26,000	1,57,500	1,89,000
Labour		1,92,000	3%	1,97,760	1,97,760	
		Efficiency fall	4%	2,06,000	2,57,500	3,09,000
Production						
Overheads	V	3,00,000	6%	3,18,000	3,97,000	4,77,000
	F	3,50,000	10%	3,85,000	3,85,000	4,27,000
Admn. overheads	F	1,20,000	15%	1,38,000	1,38,000	1,38,000
Selling overheads	V	1,20,000	10%	1,32,000	1,65,000	198,000
	F	1,20,000	8%	1,29,600	<u>1,29,600</u>	<u>1,29,600</u>
Total					16,30,100	18,67,600
					108.67	103.67

Cost per unit

At 75% capacity : Profit 20%

$$\therefore \text{Sales} = \frac{16,30,100 \times 100}{80} = 20,37,625$$

$$\text{Profit} = 20,37,625 - 16,30,100 = \text{Rs.} 4,07,525$$

$$\text{Incremental cost of 3,000 units} = (16,30,100 - 18,67,600) = \text{Rs.} 2,37,500$$

$$\text{Incremental cost per unit} = 79.17 \text{ S.P offered is Rs.} 92$$

Hence the export order is acceptable.

31. Refer to Chapter 14 of Institute's Cost Management Book
32. Refer to Chapters 6, 9 and 14 of Institute's Cost Management Book
33. (a) To formulate a linear programming model based on the given data, an objective function in contribution terms is required. (The "net profit" figures per unit of product include an arbitrary absorption of fixed overheads. This will lead to a distortion of the appropriate product mix.)

Let the decision variable x_1 , x_2 , x_3 , x_4 and x_5 represent the units of products A, B, C, D and E to be produced.

Then, the objective function is to maximise the contribution i.e.

$$\text{Maximise } C = 15x_1 + 12x_2 + 16x_3 + 12x_4 + 7x_5$$

subject to the following constraints:

$$\left. \begin{array}{l} x_1 \leq 1,500 \\ x_2 \leq 1,200 \\ x_3 \leq 900 \\ x_4 \leq 600 \\ x_5 \leq 600 \end{array} \right\} \text{ (expected maximum demand constraints)}$$

$$x_1 + x_2 + 3x_3 + 4x_4 + 5x_5 \leq 5,800 \quad (\text{special component constraint})$$

$$12x_1 + 10\frac{2}{3}x_2 + 4x_3 + 2\frac{2}{3}x_4 + 2\frac{2}{3}x_5 \leq 20,000 \quad (\text{labour hours constraint})$$

$$15x_1 + 14x_2 + 16x_3 + 15x_4 + 16x_5 \leq 30,000 \quad (\text{material expenditure constraint})$$

$$x_1, x_2, x_3, x_4, x_5 \geq 0 \quad (\text{non-negativity conditions})$$

- (b) (i) The solution is optimal, since all the elements in the last row are non-negative.
- (ii) No, because the elements in the last row under non-basic variables x_1 and s_1 are strictly positive.
- (iii) No, because none of the basic variables x_2 or s_2 is zero.
- (iv) Yes, because the values of basic variable x_2 and s_2 are non-negative.
- (v) Machine A is being used to the full capacity because the value of slack variable s_1 is zero in the optimum simplex table. This indicates that the entire time (in hours/week) is consumed by the activities of the model.
- (vi) From the given table, the element in the last row under x_1 is 1; therefore, an increase of x_1 from its current zero level to a positive level will mean the reduction in the total profit at the rate of unity per week. Hence in order to ensure that there should not be any reduction, price of x_1 should be increased by Re. one.
- (vii) There will be no effect on the profits as s_1 is not in the final basis.
- (viii) $x_1=0$ and $x_2 = 10$ with total profit of Rs.50.

34. (i) **Statement showing contribution per unit**

	Product AXE	Product BXE
Selling Price per unit	Rs. 300	Rs. 100
Variable Cost per unit	<u>240</u>	<u>60</u>
Contribution per unit	<u>60</u>	<u>40</u>
(a) For 2,000 units of AXE, contribution will be $2,000 \times \text{Rs. } 60$		Rs. 1,20,000
For 1,000 units of BXE, contribution will be $1,000 \times \text{Rs. } 40$		<u>40,000</u>
Total Contribution		1,60,000
Less: Fixed Cost:		
Department X –	Rs. 18,000	
Department Y –	<u>Rs. 60,000</u>	<u>78,000</u>
Profit		<u>82,000</u>
(b) For 5,000 units of BXE, contribution will be $(5,000 \times \text{Rs. } 40)$		Rs. 2,00,000
Less: Fixed cost (as above)		<u>78,000</u>
Profit		<u>1,22,000</u>

(ii) **Statement showing the idle hours**

Situation 1(a)

	Output	Department X	Department Y
AXE	2,000 units	8,000 hours	4,000 hours
BXE	1,000 units	<u>1,000</u> hours	<u>3,000</u> hours

Hours utilized	9,000 hours	7,000 hours
Hours available	<u>9,000</u> hours	<u>15,000</u> hours
Idle hours	<u>—</u>	<u>8,000</u> hours

Situation 1(b)

	Output	Department X	Department Y
BXE	5,000 units	5,000 hours	15,000 hours
Hours available		<u>9,000</u> hours	<u>15,000</u> hours
Idle hours		<u>4,000</u> hours	<u>—</u>

	Fixed overhead recovery rate	Department X	Department Y
Hours available		9,000	15,000
Fixed Overhead		Rs. 18,000	Rs. 60,000
Fixed Overhead Recovery Rate		Rs. 2 per hour	Rs. 4 per hour

Cost of the idle hours in Department X in situation 1 (b) = 4,000 hours × 2 = Rs. 8,000

Cost of the idle hours in Department Y in situation 1 (a) = 8,000 hours × 4 = Rs. 32,000

(iii) Contribution per unit of AXE and BXE are respectively Rs. 60 and Rs. 40. For optimal product mix, we take x_1 and x_2 as production units of AXE and BXE respectively.

Thus, we have to maximize $Z = 60 x_1 + 40 x_2$

Subject to $4x_1 + x_2 \leq 9,000$
 $2x_1 + 3x_2 \leq 15,000$
 $x_1, x_2 \geq 0$

Introducing slack variables S_1 and S_2 and converting inequations to equations.

$4x_1 + x_2 + S_1 = 9,000$, $2x_1 + 3x_2 + S_2 = 15,000$

Simplex Table

			60	40	0	0
			x_1	x_2	S_1	S_2
0	S_1	9,000	4	1	1	0
0	S_2	15,000	2	3	0	1
60	x_1	2,250	1	$\frac{1}{4}$	$\frac{1}{4}$	0
0	S_2	10,500	0	$\frac{5}{2}$	$-\frac{1}{2}$	1
			60	15	15	0
	Δ_j		0	-25	15	0
60	x_1	1,200	1	0	$\frac{3}{10}$	$-\frac{1}{10}$
40	x_2	4,200	0	1	$-\frac{1}{5}$	$\frac{2}{5}$
			60	40	10	10
	Δ_j		0	0	10	10

∴ Optimum production is $x_1 = 1,200$ and $x_2 = 4,200$ which are within the sale limits of $x_1 \leq 20,000$, $x_2 \leq 5,000$.

35. First order for 40 units

Total costs	Rs.550000
No. of units	40
Cost per unit	Rs.13750
Profit 12% on price	

∴ Price quoted $\frac{13750}{88} \times 100 = \text{Rs.}15625$

Second order:

Learning curve 90%

No. of units	Tim	Cumulative Time	Per unit
40	8000		200
80	80×180	=14400 hours	200 × 0.9 = 180
160	160×162	=25920 hours	180 × 0.9 = 162

Time required for 120 units
25920 – 8000 = 17920 hours

Cost sheet:

Direct materials	
$\frac{200000}{40} = 5000 \times 120$	=600000
Direct labour	
17920 hours × 20	358400
Variable overheads	179200
17920 hours × 10	
Special tools – (re-usable) hence	Nil
Fixed overheads –idle capacity	Nil
No opportunity cost	
Total cost	11,37,600
Cost/ unit 1137 ÷ 120	=Rs.9480
Price offered	Rs.11000
Profit per unit	Rs.1520
Total profit 1520 × 120	=Rs.182400

The order should be accepted.

36. Let we first tabulate the preference ranking of different managers.

Room No.	Managers				
	M ₁	M ₂	M ₃	M ₄	M ₅
301	-	4	2	-	1
302	1	1	5	1	2
303	2	-	1	4	-
304	3	2	3	3	3
305	-	3	4	2	-

We have to find an assignment so that total preference ranking is minimum. In a cell having (-) indicate that no assignment is to be made in that cell. Let us assign a very large value, say M, to all such cells. Now applying the assignment algorithm, we subtract from each row minimum element of that row from all the elements of that row to get the following matrix:

Room No.	Managers				
	M_1	M_2	M_3	M_4	M_5
301	M	3	1	M	0
302	0	0	4	0	1
303	1	M	0	3	M
304	1	0	1	1	1
305	M	1	2	0	M

Thus, the assignment is as follows:

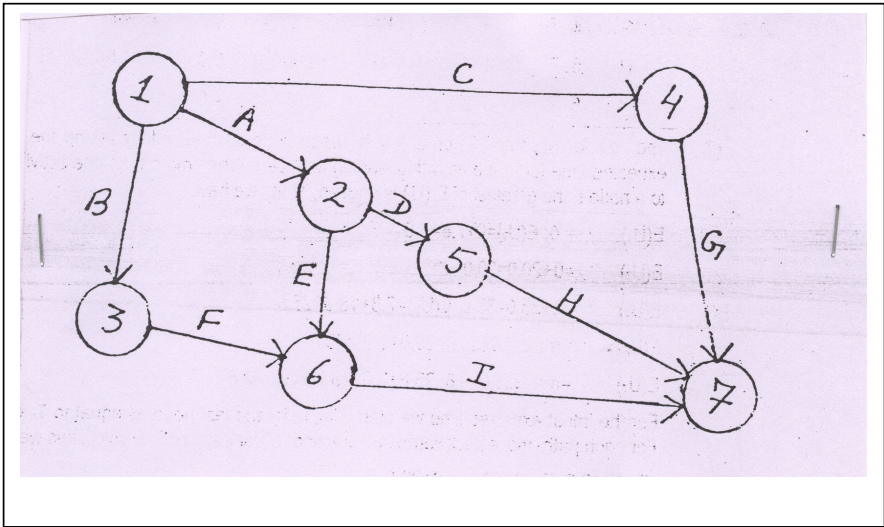
$M_1 \rightarrow 302$, $M_2 \rightarrow 304$, $M_3 \rightarrow 303$, $M_4 \rightarrow 305$, $M_5 \rightarrow 301$ and the total minimum ranking = $1+2+1+2+1=7$.

37. (a) Distinction between PERT and CPM

The PERT and CPM models are similar in terms of their basic structure, rationale and mode of analysis. However, there are certain distinctions between PERT and CPM networks which are enumerated below:

- (i) CPM is activity oriented i.e. CPM network is built on the basis of activities. Also results of various calculations are considered in terms of activities of the project. On the other hand, PERT is event oriented.
- (ii) CPM is a deterministic model i.e. it does not take into account the uncertainties involved in the estimation of time for the execution of a job or an activity. It completely ignores the probabilistic element of the problem. PERT, however, is a probabilistic model. It uses three estimates of the activity time; optimistic, pessimistic and most likely; with a view to take into account time uncertainty. Thus, the expected duration of each activity is probabilistic and expected duration indicates that there are fifty percent probability of getting the job done within that time.
- (iii) CPM places dual emphasis on time and cost and evaluates the trade-off between project cost and project time. By deploying additional resources, it allows the critical path project manager to manipulate project duration within certain limits so that project duration can be shortened at an optimal cost. On the other hand, PERT is primarily concerned with time. It helps the manager to schedule and coordinate various activities so that the project can be completed on scheduled time.
- (iv) CPM is commonly used for those projects which are repetitive in nature and where one has prior experience of handling similar projects. PERT is generally used for those projects where time required to complete various activities are not known. Thus, PERT is widely used for planning, scheduling research and development projects.

(b) (I) The network based on the given activities is as under:



(II) (i) The expected task time t_e is calculated by using three time estimates by using the following relation:

$$t_e = \frac{t_0 + 4t_m + t_p}{6}$$

The variance σ^2 , for the task is calculated by the following formula.

$$\sigma^2 = \left[\frac{t_p - t_0}{6} \right]^2$$

The following table provides the required information regarding t_e and σ^2 .

Activities		t_0	t_p	t_m	t_e	σ^2
A	1-2	5	10	8	7.8	0.694
B	1-3	18	22	20	20.0	0.444
C	1-4	26	40	33	33.0	5.443
D	2-5	16	20	18	18.0	0.443
E	2-6	15	25	20	20.0	2.780
F	3-6	6	12	9	9.0	1.000
G	4-7	7	12	10	9.8	0.694
H	5-7	7	9	8	8.0	0.111
I	6-7	3	5	4	4.0	0.111

(ii) The earlier expected T_e or $E [U_i]$ for each node is obtained by taking the sum of expected time for all the activities leading to node I. When more than one activity leads to a node I, the greatest of $E (U_i)$ is chosen. Thus, we have

$E(U_1) = 0, E(U_2)=0+7.8=7.8$
 $E(U_3) = 0+20.0=20.0$
 $E(U_4) = 0+33.0=33.0, E(U_5)=7.8+18.0=25.8$

$E(U_6) = \max.(7.8+20.0, 20.0+9.0)=29.0$
 $E(U_7) = \max.(33.0+9.8, 25.8+8.0, 29.0+4.0)=42.8$

For the latest expected time we start with T_L for the last node as equal to T_e or $E(U_i)$. For each path move backwards subtracting “ t_e ” for each activity link. Thus we have

$(EL_7)=42.8, E(L_6)=42.8-4.0=38.8$
 $(EL_5)=42.8-8.0=34.8, E(L_4)=42.8-9.8=33.0$
 $E(L_3)=38.8-9.0=29.8,$
 $E(L_2)=\min.(34.8-18.0, 38.8-20.0)=16.8$
 $E(L_1)=\min. (16.8-7.8, 29.8-20.0, 33.0-33.0)=0$

(iii) For the calculation of critical path, we first derive slack for each node, given by the following table

Node	t_e	T_e	T_L	T_s	σ^2
2	7.8	7.8	16.8	9.0	0.694
3	20.0	20.0	29.8	9.8	0.444
4	33.0	33.0	33.0	0.0	5.443
5	18.0	25.8	34.8	9.0	1.137
6	9.0	29.0	38.8	9.8	1.444
7	9.8	42.8	42.8	0.0	6.123

Hence, the critical path is 1–4–7

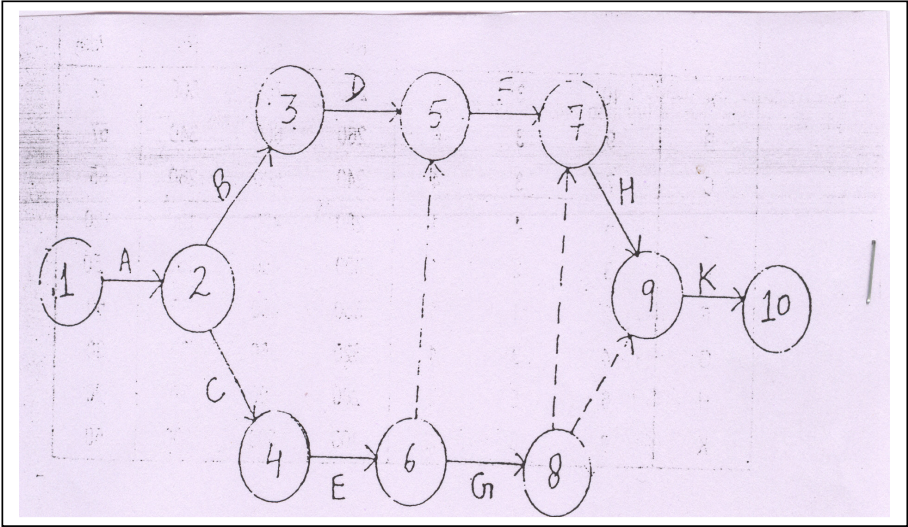
(iv) The schedule time of completing the project is 41.5 weeks. Therefore, the distance in standard deviations, is given by

$$D_i = \frac{ST_i - E\{U_i\}}{\sqrt{VAR\{U_i\}}} = \frac{41.5 \text{ weeks} - 42.8 \text{ weeks}}{\sqrt{6.123}} = \frac{-1.3}{\sqrt{2.474}}$$

Therefore, we have $P(Z < D_i) = 0.30$

Hence, the probability of completing the project within 41.5 weeks is 30%.

38. (i) The network based on the given activities is as follows:



There are four possible paths as below:

Possible paths							Normal time	Crash time
(i)	A	B	D	F	H	K	40	22
(ii)	A	C	E	F	H	K	36	20
(iii)	A	C	E	G	H	K	38	22
(iv)	A	C	E	G	K		32	17

The critical path using normal time is

A–B–D–F–H–K with duration 40 days.

Cost is the sum of the individual normal costs plus site cost for 40 days at Rs. 80 per day.

= Rs. 2,680 + 40 days × Rs. 80 = Rs. 2,680 + Rs. 3,200 = Rs. 5,880

(ii) There are two critical paths using minimum times:

A–B–D–F–H–K

and A–C–E–G–H–K with duration 22 days.

Combining the two critical paths it can be seen that all activities are critical and so all must be crashed. Hence, the cost is the sum of the individual crash costs plus site cost for 22 days at Rs. 80 per day.

= Rs. 4,250 + 22 days × Rs. 80 = Rs. 4,250 + Rs. 1,760 = Rs. 6,010

(iii) To evaluate the minimum cost for completion, the cost slopes as tabulated below are required:

Activity	Times		Cost		Cost	
	Normal	Crash	Saving	Normal	Crash	Extra
				Rs.	Rs.	Rs.
A	10	3	7	250	750	500
B	9	3	6	260	600	340
C	7	3	4	240	500	260
D	5	4	1	280	400	120
E	3	2	1	300	450	150
F	2	1	1	350	400	50
G	4	3	1	320	350	30
H	6	5	1	280	300	20
K	8	6	2	400	500	100

Activity	Path duration				Saving	Cost	Crash	Net	Net	Critical
	days				days	saved	cost	saved	cost	activities
	(i)	(ii)	(iii)	(iv)						not crashed
						Rs.	Rs.	Rs.	Rs.	
	40*	36	38	32					5,880	A B D F H K
H	39*	35	37	32	1	80	20	60	5,820	A B D F K
K	37*	33	35	30	2	160	100	60	5,760	A B D F
F	36*	32	35	30	1	80	50	30	5,730	A B D

(B has minimum slope but will only save 1 day)

B	35*	32	35	30	1	80	57	23	5,707	ABD
A	28*	25	28	23	7	560	500	60	5,647	B D
B,G	27	25	27	22	1	80	(57+30)	(-7)	5,654	BD

Hence, the minimum cost is Rs. 5,647 and the duration related with it is 27 days.

- (iv) Three factors are:
- (i) Working to minimum cost tends to result in multiple critical paths which makes the time sensitive to dalays.
 - (ii) Minimum time may be best if early completion is more important than is reflected in the cost.
 - (iii) Probability of achieving the target times needs to be considered in all cases.

39 It is given that yearly sales of four sales engineers are proportional to 14, 9, 11 and 8 respectively. The sum of proportion is 14+9+11+8 = 42. It is assumed that Rs. 1,000 is equivalent to one unit. The sales units of four engineers in four different zones have been calculated as follows:

		Zones			
Sales Engineers		A	B	C	D
P	$(14/42) \times 420 = 140$	$(14/42) \times 336 = 112$	$(14/42) \times 294 = 98$	$(14/42) \times 462 = 154$	
Q	$(9/42) \times 420 = 90$	$(9/42) \times 336 = 72$	$(9/42) \times 294 = 63$	$(9/42) \times 462 = 99$	
R	$(11/42) \times 420 = 110$	$(11/42) \times 336 = 88$	$(11/42) \times 294 = 77$	$(11/42) \times 462 = 121$	
S	$(8/42) \times 420 = 80$	$(8/42) \times 336 = 64$	$(8/42) \times 294 = 56$	$(8/42) \times 462 = 88$	

The problem here is to find the optimum assignment in the following sales table so as to maximise the total sales of the company

		Zones			
Sales Engineers		A	B	C	D
	P	140	112	98	154
	Q	90	72	63	99
	R	110	88	77	121
	S	80	64	56	88

In order to apply the assignment algorithm it is necessary to first convert this maximisation problem into a minimisation problem by subtracting all elements of the above matrix from the highest element, i.e., 154. The resultant loss matrix will be as follows:

		Zones			
Sales Engineers		A	B	C	D
	P	14	42	56	0
	Q	64	82	91	55
	R	44	66	77	33
	S	74	90	98	66

Now row operations should be performed with each of the row as i.e., from all elements of a row subtract the minimum element of that row. The reduced matrix is as given below:

Zones				
Sales Engineers	A	B	C	D
P	14	42	56	0
Q	9	27	36	0
R	11	33	44	0
S	8	24	32	0

Now from all the elements of a column, minimum element of that column has been subtracted and this operation has been repeated in all columns to get the following table:

Zones				
Sales Engineers	A	B	C	D
P	6	18	24	0
Q	1	3	4	0
R	3	9	12	0
S	0	0	0	0

The minimum number of lines drawn to cover all zeros is 2 which is less than the order of the matrix (i.e., 4). Hence assignment cannot be made at this stage. Now next operation is to subtract the minimum uncovered element from all the uncovered elements and add it to the elements lying at the intersection of two lines to get the following table:

Zones				
Sales Engineers	A	B	C	D
P	5	17	23	0
Q	0	2	3	0
R	2	8	11	0
S	0	0	0	1

The minimum number of lines drawn again to cover all the zeros is 3, which is one less than the order of the matrix (i.e., 4). Therefore the above step has been repeated to get the following table:

Zones				
Sales Engineers	A	B	C	D
P	5	15	21	0
Q	0	0	1	0
R	2	6	9	0
S	2	0	0	3

The minimum number of lines to cover all zeros is 3, which is still one less than the order of the matrix (i.e., 4). Therefore, the above step has been repeated to get the following table:

Zones				
Sales Engineers	A	B	C	D
P	3	13	19	0
Q	0	0	1	2
R	0	4	7	0
S	2	0	0	5

The minimum number of lines drawn to cover all the zeros is 4, which equal to the order of the matrix. Hence the above table will give the optimum assignment. The assignments are as follows:

Sales Engineers	Zones			
	A	B	C	D
P	3	13	19	0
Q	0	0	1	2
R	0	4	7	0
S	2	0	0	5
Engineers		Zones	Sales (in Rs.)	
P		D	1,54,000	
Q		B	72,000	
R		A	1,10,000	
S		C	56,000	
			3,92,000	

It can be seen from the above assignments that the best engineer P is assigned to the richest zone D. The next best engineer is assigned to second richest zone A, the next best engineer Q is assigned to zone B, and so on. Hence optimum assignment matches the company criteria of achieving the maximum expected total sales.

40. (a) The principles which are relevant to the development of data base systems are:
- Global perspective should be considered
 - Use of top down design approach, which recognises the management needs
 - The database should be designed to provide for selective information reporting.
 - Provide for different and multiple data bases to cater to the needs of different levels of management
 - Databases should not be confined to mere conversion of existing files.
- (b) The fundamental requirements of the implementation of TQM are:
- The focus should be on customer needs
 - Everyone in the organisation should be involved in TQM
 - Appropriate training and education should be given
 - Senior management should promote the culture of change for continuous improvement
 - The aim should be to design quality into the product and production process
 - The focus should be on continuous improvement.
 - An effective performance measurement system should be introduced.

