FINAL EXAMINATION

(REVISED SYLLABUS - 2008)

GROUP - IV

Paper-15 : MANAGEMENT ACCOUNTING–ENTERPRISE PERFORMANCE MANAGEMENT

Q. 1. (a) Expand the following abbreviations :

(i) BM
(ii) DBR
(iii) DRP
(iv) PLCM
(v) SQC
(vi) EFQM
(vii) DMAIC
(viii) JUSE
(ix) ALM
(x) SCP
(xi) QFD
(xii) ISO
(xiii) TQC
(xiv) CWTQM
(xv) CMS
(xvi) CRP
(xvi) FAST
(xvii) VAM
(xviii) PDSA

Q. 1. (b) Define the following terms :

(i) V in VAT Analysis
(ii) Matrix Organizational Structure
(iii) Bench Marking
(iv) Contribution Approach
(v) Talent Drain

Q. 1. (c) State if each of the following statements is *True* or *False*.

(i) Value Analysis process is a less important tool than Function Analysis System Technique

(ii) The term value has four different meanings-exchange value,cost value,use value, wealth value

(iii) Internal Quality costs consists of Preventive Costs,Appraisal Costs and Failure Cost

(iv) The phrases – right first time or zero defects-were promoted by the Japanese quality expert Kaoru Ishikawa.

(v) The Balance Score Card (BSC) puts more stress on financial parameters than on non financial parameters since its objective is the growth of the organization.

(vi) Theory Y style of management is a highly autocratic style.

(vii) The matrix organization structure is suitable for large projects.

(viii) The key factors of Theory of Constraints are contribution and profit.

(ix) Life Costing is a technique to establish the total cost of ownership.

(x) One of the goals JIT seeks to achieve is batch sizes of one.

(xi) Theory Y style of Mnagement is a highly autocratic style.

(xii) EVA encourage short term performance.

(xiii) Black Flash Accounting COMPARES PROFIT WITH THE COST OF PRODUCING A PRODUCT.

(xiv) The key factors ' Theory of Constraints" are Contribution & Profit.

(xv) Life Costing is a techniqueto establish the total cost of ownership.

(xvi) The experience curve effect is broader in scope than the learning curve.

(xvii) The concept of quality Circle is primarily based upon recognition of the value of the worker.

(xviii) Akio Morita is credited with pioneering the cost approach of target costing.

Answer 1. (a)

(i) Buffer Management
(ii) Drum Buffer Rope
(iii) Distribution Requirement Planning
(iv) Product Life Cycle Management
(v) Statistical Quality Control
(vi) European Foundation for Quality Control
(vii) Define, Measure, Analyze, Improve, Control
(viii) Japanese Union of Scientists and Engineers
(ix) Asset Life Cycle Management
(x) Supply Chain Planning
(xi) Quality Function Deployment
(xii) International Organization for Standardization
(xiii) Total Quality Control
(xiv) Company Wide Total Quality Management
(xv) Capacity Management Strategy
(xvi) Capacity Requirement Planning
(xvi) Functional Analysis System Technique
(xvii) Value Analysis method
(xviii) Plan- Do- Study- Act

Answer 1. (b)

(i) A logical structure starts with one or few raw materials and the product expands into a number of different products as it flows through its routings.

(ii) Matrix Organization Structure combines the coordination and control of the decentralized structure with the technical excellence of econimies of scaleof the functional structures to reap the benefits of both.

(iii) Benchmarking is a prosess of continuously comparing and measuring an organizations business process against business leader anywhere in the wotld to gain information that will help the organization take action to improve performance.

(iv) Contribution Approach IS AMETHOD OF PREPARING INCOME STATEMENT THAT SEPARATES Variable cost from Fixed Cost to emphasize cost behavour patternfor the purpose of planning and control.

(v) Talent Drain is the second potential problem in succession planning. Because upper management must identify a small group of managers to receive training and development for promotion, those managers who are not assigned to development activities may feel overlooked leave the organizations. This turnover may reduce the number of talented managers of lower and middle levels of the organization.

Answer 1. (c)

(i) True
(ii) False
(iii) True
(iv) False
(v) False
(vi) False
(vii) False
(viii) False
(ix) True
(x) True
(xi) False
(xii) False
(xiii) False
(xiv) False
(xv) True
(xvi) True
(xvii) True
(xviii) True

Q. 2. (a) What is life Cyle Costing? Explain the stages in product life cycle?

(b) What is Intranet? What are its advantages?

Answer 2. (a)

Life cycle costing is a technique which takes account of the total cost of owning a physical asset, or making a product, during its economic life. It includes the costs associated with acquiring, using, caring

for and disposing of physical assets, including the feasibility studies, research, design, development, production, maintenance, replacement and disposal, as well as support, training and operating costs generated by the acquisition, use, maintenance and replacement of permanent physical assets.

Stages in Product Life Cycle :

There are five distinct stages in the life cycle of a product as follows :

Introduction stage – Research and engineering skill leads to product development. The product is put on the market and its awareness and acceptance are minimal. Promotional costs will be high, sales revenue low and profits probably negative. The skill that is exhibited in testing and launching the product will rank high in this phase as critical factor in securing success and initial market acceptance. Sales of new products usually rise slowly at first.

Growth Stage – In the growth stage product penetration into the market and sales will increase because of the cumulative effects of introductory promotion, distribution. Since costs will be lower than in the earlier stage, the product will start to make a profit contribution. Following the consumer acceptance in the launch stage it now becomes vital or secure wholesaler / retailer support. But to sustain growth, consumer satisfaction must be ensured at this stage. If the product is successful, growth usually accelerates at some point, often catching the innovator by surprise.

Maturity Stage – This stage begins after sales cease to rise exponentially. The causes of the declining percentage growth rate the market saturation – eventually most potential customers have tried the product and sales settle at a rate governed by population growth and the replacement rate of satisfied buyers. In addition there were no new distribution channels to fill. This is usually the longest stage in the cycle, and most existing products are in this stage. The period over which sales are maintained depends upon the firm's ability to stretch the cycle by means of market segmentation and finding new uses for it.

Saturation stage – As the market becomes saturated, pressure is exerted for a new product and sales along with profit begin to fall. Intensified marketing effort may prolong the period of maturity, but only by increasing costs disproportionately.

Declining Stage – Eventually most products and brands enter a period of declining sales. This may be caused by the following factors :

- Technical advances leading to product substitution
- Fashion and changing tastes
- Exogenous cost factors will reduce profitability until it reaches zero at which point the product's life is commercially complete.

Answer 2. (b)

An intranet is a private computer network that uses Internet protocols and network connectivity to securely share part of an organization's information or operations with its employees. Sometimes the term refers only to the most visible service, the internal website. Briefly, an intranet can be understood as "a private version of an Internet," or as a version of the Internet confined to an organization. Through such devices and systems off-site employees can access company information, computing resources and internal communications.

Advantages of intranets :

1. **Workforce productivity** – Intranets can help users to locate and view information faster and use applications relevant to their roles and responsibilities. Users can access data held in any database the organization wants to make available, anytime and - subject to security provisions - from anywhere within the company workstations.

2. **Time** – With intranets, organizations can make more information available to employees on a "pull" basis (i.e.: employees can link to relevant information at a time which suits them) rather than being deluged indiscriminately by emails.
3. **Communication –** Intranets can serve as powerful tools for communication within an organization, vertically and horizontally. From a communications standpoint, intranets are useful to communicate strategic initiatives that have a global reach throughout the organization. The type of information that can easily be conveyed is the purpose of the initiative and what the initiative is aiming to achieve, who is driving the initiative, results achieved to date, and who to speak to for more information. By providing this information on the intranet, staff have the opportunity to keep up-to-date with the strategic focus of the organization.
4. **Knowledge Management –** Web publishing allows 'cumbersome' corporate knowledge to be maintained and easily accessed throughout the company using hypermedia and Web technologies. Examples include: employee manuals, benefits documents, company policies, business standards, news feeds, and even training, can be accessed using common Internet standards (Acrobat files, Flash files, CGI applications). Because each business unit can update the online copy of a document, the most recent version is always available to employees using the intranet.
5. **Business operations and management –** Intranets are also being used as a platform for developing and deploying applications to support business operations and decisions across the internetworked enterprise.
6. **Cost-effective** – Users can view information and data via web-browser rather than maintaining physical documents such as procedure manuals, internal phone list and requisition forms.
7. **Promote common corporate culture –** Every user is viewing the same information within the Intranet.
8. **Enhance Collaboration** – With information easily accessible by all authorised users, teamwork is enabled.

Q. 3. The operating result of Sona Ltd. For the previous year was as under :

Product	*% of Sales Mix*	*P. V. Ratio*
A	40	20
B	10	6
C	30	12
D	20	10
	100%	

Total sales value of the product was Rs. 80 lakhs.

Total fixed overhead amounted to Rs. 10 lakhs. The raw material content, which is entirely imported, is 50% of the respective variable cost of the item.

The forecast of the year just started are as under :

(i) The raw material cost will go up by 10%.
(ii) The raw material availability will be restricted to Rs.35 lakhs from the imported source.
(iii) The maximum potential sales of any of the four products in the current year is 40% of the total sale value of the previous year.
(iv) In the sale price of the products there will be an uniform 5% increase.

You are required to :

(a) Prepare statement of probability for the previous year.

(b) Set a product mix with maximize profit for the current year and prepare a statement showing forecast profitability for the current year.

Answer 3.

(a) Statement showing profitability of previous year

Product	Sales mix	Sales value (Rs.)	P.V. Ratio (%)	Contribution (Rs.)
A	40	32,00,000	20	6,40,000
B	10	8,00,000	6	48,000
C	30	24,00,000	12	2,88,000
D	20	16,00,000	10	1,60,000
	100	80,00,000		11,36,000
Less: Fixed expenses:				10,00,000
Profit				1,36,000

(b) Statement Showing Contribution as Percentage of Raw material

Products	Sales (Rs.)	Percentage of Variable cost* (%)	Variable Cost (Rs.)	Raw material 50% of v.cost (Rs.)	Contribution (Rs.)	Contribution as % of raw
A	32,00,000	80	25,60,000	12,80,000	6,40,000	50.00
B	8,00,000	94	7,52,000	3,76,000	48,000	12.76
C	24,00,000	88	21,12,000	10,56,000	2,88,000	27.27
D	16,00,000	90	14,40,000	7,20,000	1,60,000	22.22
	80,00,000					

* 100 – P.V. ratio

Therefore Ranking for selection should be as follows :

I	II	III	IV
A	C	D	B

Optimum Product Mix at Previous Year Costs

Product	Sales mix (%)	Sales (Rs.)	Variable cost* (Rs.)	Raw material (50% of v.cost) (Rs.)	Raw material With 10% incr. (Rs.)
A	40	32,00,000	25,60,000	12,80,000	14,08,000
B	–	–	–	–	–
C	40	32,00,000	28,16,000	14,08,000	15,48,800
D	20	16,00,000	14,40,000	7,20,000	7,92,000
		80,00,000			37,48,000

* 80%, 88% and 90% of sales value for products A, C and D respectively.

But the company can import material of Rs. 35 lakhs only.

Product	Raw Materials (%)	Raw material before 10% (Rs.)	Variable cost (Rs.)	Sales value at previous price (Rs.)	Sales after 5% increase (Rs.)
A	14,08,000	12,80,000	25,60,000	32,00,000	33,60,000
C	15,48,800	14,08,000	28,16,000	32,00,000	33,60,000
D	5,43,200	4,93,818	9,87,636	10,97,373*	11,52,243
	35,00,000				78,72,243

* 9,87,636 × 100/90 = Rs. 10,97,373

(c) Statement Showing Profitability of Current Year.

Product	Sales	Raw material	Other variable Cost (Note)	Total variable cost	Contribution
A	33,60,000	14,08,000	12,80,000	26,88,000	6,72,000
B	–	–	–	–	–
C	33,60,000	15,48,800	14,08,000	29,56,800	4,03,200
D	11,52,243	5,43,200	4,93,818	10,37,018	1,15,225
	78,72,243		31,81,818	66,81,818	11,90,425
Fixed cost					10,00,000
Profit					1,90,425

Working Note : 1

Product A	(Rs.)
Total variable cost	25,60,000
Less: Material cost before revision	12,80,000
	12,80,000

Product C	(Rs.)
Total variable cost	28,16,000
Less: Material cost before revision	14,08,000
	14,08,000

Product D Raw material cost after revision of material price = Rs. 5,43,200

Corresponding material price before price increase of 10%

= Rs. 5,43,200 x 100/110 = Rs.4,93,818

Since material cost is 50% of variable cost, remaining variable cost will be = Rs.4,93,818

Q. 4. (a) What are the benefits of Activity Based Management?

(b) What is Value Chain Analysis?

Answer 4. (a)

Activity Based Management :

ABM currently being used for a variety of business applications. Such as :

1. Cost Reduction.
2. Activity Based Budgeting.
3. Business process re-engineering.
4. Benchmarking
5. Performance measurement.

1. **Cost reduction :**

ABCM helps the organization to identify cost against activities and to find opportunities to streamline or reduce the costs or eliminate the entire activity, especially if there is no value added. It is particularly useful in identifying and quantifying process waste and providing vehicle for continuous process improvement through continuous cost reduction.

2. **Activity Based Budgeting :**

Activity Based Budgeting analyse the resource input or cost for each activity. It provides a framework for estimating the amount of resources required in accordance with the budgeted level of activity. Actual results can be compared with budgeted results to highlight both in financial and non-financial terms those activities with major discrepancies from budget for potential reduction in supply of resources. It is a planning and control system which seeks to support the objectives of continuous improvement.

3. **Business process re-engineering :**

Business process re-engineering involves examining business processes and making substantial changes to how organization currently operates. ABCM is a powerful tool for measuring business performance, determining the cost of business output and is used as a means of identifying opportunities to improve process efficiency and effectiveness.

4. **Benchmarking :**

Determination of Benchmarking goal statement.

6. **Performance measurement :**

Many organizations are now focusing on activity performance as a means of facing competitors and managing costs. To monitor efficiency and effectiveness of activities performance measures are required. Activity performance measures consists of measures relating to costs, time, quality and innovation.

Answer 4. (b)

Value Chain Analysis : Value Chain depicts how customer value accumulates along a chain of activities that lead to an end product or service. It is described as the internal processes or activities a company performs to design, produce, market, deliver and support its product.

Value Chain Analysis requires a strategic framework or focus for organizing internal and external information and for summarizing findings and recommendations. It requires a team effort. Management accountants of today has to collaborate with engineering, production, marketing, distribution and service professionals to focus on the strength, weakness, opportunities and threats identified in the value chain analysis results. This helps the firms to better understand which segments, distribution channels, price points, product differentiation, selling propositions will yield them the greatest competitive advantage.

The analysis involves the following steps:

(a) *Internal cost analysis* – to determine the sources of profitability and relative cost positions of internal value-creating processes.

(b) *Internal differentiation analysis* - to understand the sources of differentiation within internal value creating processes.

(c) *Vertical linkage analysis* – to understand the relationship and associated costs among external suppliers and customers in order to maximize the value delivered to customers and to minimize cost.

Q. 5. P Ltd. has two divisions, S and T, S transfer all its output to T, which finishes to work. Cost and revenues at various levels of capacity are as follows :

Output (Units)	S. costs (Units)	T Net revenues (i.e., revenue minus costs incurred in T) (Rs.)	Profit (Rs.)
600	600	2,950	2,350
700	700	3,250	2,550
800	840	3,530	2,690
900	1,000	3,780	2,780
1,000	1,200	4,000	2,800
1,100	1,450	4,200	2,750
1,200	1,800	4,350	2,550

Company profits are maximised at Rs. 2,800 with output of 1,000 units. If P Ltd. wish to select a transfer price in order to establish S and T as profit centres, what transfer price would motivate the managers of S and T together to produce 1,000 units, no more and no less?

P Ltd. wants that the transfer price should be set at Rs. 2.10 per unit. Comment on this proposal.

Answer 5.

The transfer price will be notional revenue to S and notional costs to T.

(a) S will continue to produce more output until the costs of further production exceed the transfer price revenue.

(b) T will continue to want to receive more output from S until its net revenue from further processing is not sufficient to cover the incremental transfer price costs.

Output (Units)	Division S Incremental costs (Rs.)	Division T Incremental costs (Rs.)
600	–	–
700	100	300
800	140	280
900	160	250
1,000	200	220
1,100	250	200
1,200	350	150

Since S will continue to produce more output if the transfer price exceeds the incremental costs of production, a price of at least Rs.200 per units (Rs. 2 per unit) is required to 'Persuade' the manager of S to produce as many as 1,000 units, but a price in excess of Rs. 250 per 100 units would motivate the manager of S to produce 1,100 units (or more).

By a similar argument, T will continue to want more output from S if the incremental revenue exceed the transfer costs from S. If T wants 1,000 units the transfer price must be less than Rs.220 per 100 units. However, if the transfer price is lower than Rs. 200 per 100 units, t will ask for 1,100 units from S in order to improve its division profit further.

In summary :

(a) The total company profit is maximized at 1,000 units of output.

(b) Division S will, want to produce 1,000 units, no more and no less, if the transfer price is between Rs. 2 and Rs. 250 (i.e. Rs. 200 to Rs. 2.50 per 100 units).

(c) Division T will want to receive and process 1,000 units, no more and no less, if the transfer price is between Rs. 2 and Rs. 2.20

(d) A transfer price must, therefore, be selected in the range Rs. 2.00 to Rs. 2.20 per unit (exclusive).

Thus, if a price of Rs. 2.10 per unit is selected, profits at 1,000 units of output would be :

Particulars	Division S	Division T	Total
Sales/Net revenue	2,100	4,000	4,000
Costs	1,200	2,100	1,200
Profit	900	1,900	2,800

At a transfer Price of Rs. 2.10, any increase in output above 1,000 units, or shortfall in output below this amount, would reduce the profits of the company as a whole, but also the divisional profits of S and T.

Q. 6. (a) "Purpose of Sensitivity Analysis is to identify the critical variable in the project analysis." — Discuss.

(b) What are the major components of Balanced Score Card?

Answer 6. (a)

In management accounting parlance, all quantitative and financial figures are best estimates, made on the basis of experience and of the study of macro-economic factors and industry-specific matters. In actual practice, while executing the project, all factors are subject to variation.

Sensitivity Analysis is one of the objective methods to ascertain the impact on final probability by taking specific changes in each critical factor variable. Thus if a company is to operate in a highly competitive market, with many rivals, Sales volumes and Price will be critical variables and hence, one would like to assess how sensitive the project is to changes in Sales volume and price.

Sensitive Analysis, when applied to a capital project, will allow the margin of error in various parameters of a project which can be allowed before the project ceases to be profitable. Sensitivity Analysis does not directly measure risk and it is limited by being able to examine the effect of a change in one variable while the others, remaining constant, are unlikely occurrence in practice.

Answer 6. (b)

1. A well designed Balanced Score Card combines financial measures of past performance with measures of the Firm's drivers of future performance.
2. The specific objectives and measures of a Firm's BSC are derived from the Firm's vision and strategy.

3. Generally, the BSC has the following perspectives from which a Company's activity can be evaluated.

   (a) **Customer perspective i.e., How customers see us?** In order to translate effective internal processes into organizational success, customers/clients must be happy with the service they receive. The Customer perspective considers the business through the eyes of the customers, measuring and reflecting upon customer satisfaction.

   (b) **Internal business perspective i.e., in what processes must the Firm excel?** The Internal perspective focuses attention on the performance of the key internal processes, which drive the business. The nature of the processes is dependent on the nature of the organization.

   (c) **Innovation and learning perspective i.e. Can we continue to improve and create value?** The learning and Growth perspective is a measure of potential future performance – it directs attention to the basis of all future success – the organization's people and infrastructure. Adequate investment in these areas is critical to all long term success.

   (d) **Financial perspective i.e., How we look to our shareholders?** The Financial perspective measures the results that the organization delivers to its stakeholders.

Q. 7. B Ltd manufactures two types of bags-L & T Both bags are produced on the same equipment and use similar processes. The following budgeted data has been obtained for the year ended 31st December 2009.

Product	L	T
Production Quantity	**25,000**	**2,500**
Number of Purchase Orders	**400**	**200**
Number of Set ups	**150**	**100**
Resources required per unit		
Direct Material (Rs)	**25**	**62.5**
Direct Labour (hours)	**10**	**10**
Machine Time (hours)	**5**	**5**

Budgeted Production overheads for the year have been analyzed as follows :

	Rs.
Volume Related Overheads	**2,75,000**
Purchase Related Overheads	**3,00,000**
Set up Related Overheads	**5,25,000**

The budgeted wage rate is Rs. 20/- per hour.

The cost present system is to absorb overheads by product units using rates per labour hour.

However, the company is considering implementing a system of activity based costing. An activity baseinvestigation revealed that the cost drivers for the overhead costs are as follows :

Volume Related Overhead	**Machine Hours**
Purchase Related Overhead	**No of Purchase Orders**
Set up related Overheads	**No of Set ups**

Calculate the unit cost for each type of bag using

(i) The current absorption Costing method

(ii) The proposed activity based costing approach

Compare your results and briefly comment on your findings.

Answer 7.

	L	T	Total Rs.
Production Quantity	25,000	2,500	
Direct Labour hours required	250,000	25,000	275000
Total Production Overhead			1,1,00,000
Overhead absorption rate per labour hour			4.00
Machine hours required	125,000	12,500	1,37,500
Total Puchase Order	400	200	600
Total Set ups	150	100	250
Cost per cost driver			Rs.
Volume Related Overheads			2,75,000
Machine hours required			1,37,500
Volume related overheads/machine hour			2.00
Purchase related overhead			3,00,000
Total Purchase orders			600
Purchase related overheads/order			500
Set ups related overheads			5,25,000
Total Set ups			250
Set up related overheads per set up			2100

(a) (i) Unit cost using existing overhead absorption rate

Product	L Rs.	T Rs.
D. Material	25.00	62.50
D. Labour Cost	200.00	200.00
Overheads (10 lab hrs × Rs. 4)	40.00	40.00
	265.00	302.50

(a) (ii)

Product	L (Rs.)	T (Rs.)	
D. Material	25.00	62.50	
D. Labour Cost	200.00	200.00	
Overheads :			
Volume Related (Rs. 2 per machine hour)	10.00	10.00	
Purchase Related (Rs. 500 × 400 orders/25000)	8.00	40.00	(Rs. 500×200/2500)
Set up related (Rs. 2100 × 150 set ups/25000)	12.60	84.00	(Rs. 2100×100/2500)
	255.60	396.50	

(b)	Cost pu traditional method	Rs. 265.00	Rs. 302.50
	Cost pu ABC	Rs. 255.60	Rs. 396.50
	Difference	9.40	– 94.00
	% change	3.55%	31.07%

The ABC approach attributes the cost of resources to each product which those rsources on a more appropriate are basis than the traditional absorption costing method.the price of the t should be reviewed in the light of the new unit cost.

Q. 8. (a) What is lean manufacturing? Briefly describe the lean/JIT system.

(b) Explain how adoption of JIT affects profitability of an organization.

Answer 8. (a)

Just in time (JIT) philosophy was first developed in Japan. Toyota introduced it in 50's and later, other companies in Japan have adopted it.

The overriding feature of JIT is that materials or parts are generated in the exact quantity required and just at the time they are needed. A classic JIT system consists of a series of manufacturing units each delivering to one another in successive stages of production. The amount delivered by each unit to the next unit is exactly what the needs for the next production period (usually one day). There are no safety margins in the form of buffer stock, live storage or work-in-progress. JIT is a sophisticated approach in eliminating wastage in the process of manufacturing in different stages, say, from the production design stage to the stage of delivery of finished product. JIT is sometimes regarded as an inventory control technique or a purchasing method. It aims at eliminating all activities which do not add 'value' to the product.

JIT seeks to achieve the following goals :

- Elimination of non value added activities
- Zero inventory
- Zero defects
- Batch size of one
- Zero Breakdown
- A 100% on time delivery service

Schonberger defines JIT as being 'to produce and deliver finished goods just in time to be sold, sub assemblies just in time to be assembled into finished goods, fabricated parts just in time to go into sub assemblies and purchased materials just in time to be transformed into fabricated parts'.

Answer 8. (b)

The introduction of a JIT system can be expected to affect profit as follows :

- There will be a reduction in inventory holding costs since inventories of raw materials and finished goods will be eliminated.
- There will probably be an increase in the price paid for raw materials to compensate the supplier for the additional flexibility that they are required to offer.
- There may be cost increase as a result of peaks and troughs of demand which cause fluctuating production levels and results in high labour costs through overtime.
- More management time may be spent on planning the resource utilization rather than on making strategic decisions to improve the profitability.

Q. 9. A Ltd. is engaged in production of three types of ice-cream products: Coco, Strawberry and Vanilla. The Company presently sells 50,000 units of Coco at Rs. 25 per unit, Strawberry 20,000 at Rs. 20 per unit ad Vanilla 60,000 at Rs. 15 per unit. The demand is sensitive to selling price, and it has been observed that every reduction of Rs. 1 per unit in selling price increases the demand for each product by 10% to the previous level. The Company has the production capacity of 60,500 units of Coco, 24,200 units of Strawberry and 72,600 units of Vanilla. The Company marks up 25% on cost of the product.

The Company management decides to apply ABC analysis. For this purpose, it identifies four activities and the rate as follows :

Activity	Cost Rate
Ordering	Rs.800 per purchase Order
Delivery	Rs. 700 per Delivery
Shelf Stocking	Rs. 199 per Hour
Customer Support and Assistance	Rs. 1.10 p.u. sold

The other relevant information for the products are as follows:

Particulars	Coco	Strawberry	Vanilla
Direct Material p.u. (Rs.)	8	6	5
Direct Labour p.u. (Rs.)	5	4	3
No. of Purchase Orders	35	30	15
No. of Deliveries	112	66	48
Shelf Stocking Hours	130	150	160

Under the traditional costing system, Store Support Costs are changed at 30% of Prime Cost. In ABC these costs are coming under Customer Support and Assistance.

Required :

1. **Calculate Target Cost for each product after a reduction of selling price required to achieve the sales equal to the production capacity.**
2. **Calculate the Total Cost and Unit Cost of each product at the maximum level using Traditional Costing.**
3. **Calculate the Total Cost and Unit Cost of each product at the maximum level using Activity Based Costing.**
4. **Compare the Cost of each product calculated in (i) and (ii) with (iii) and comment on it.**

Answer 9.

1. Computation of New Selling Price to achieve 100% production Capacity.

Coco		Strawberry		Vanilla	
Price (Rs.)	Quantity (Units)	Price (Rs.)	Quantity (Units)	Price (Rs.)	Quantity (Units)
25	50,000	20	20,000	15	60,000
25-1 = 24	50,000 + 10% = 55,000	20-1 = 19	20,000 + 10% = 22,000	15-1 = 14	60,000 + 10% = 66,000
24-1 = 23	55,000 + 10% = **60,500**	19-1 = 18	22,000 + 10% = **24,200**	14-1 = 13	66,000 + 10% = **72,600**

2. Computation of Target Cost to achieve 100% Capacity

Particulars	Coco	Strawberry	Vanilla
(a) Total Production Capacity	60,500 Units	24,200 Units	72,600 Units
(b) Proposed Selling Price as per WN 1 above	Rs. 23.00	Rs. 18.00	Rs. 13.00
(c) Profit Margin at 20% on Cost (1/4th on Cost = 1/5th on Sales)	Rs. 4.60	Rs. 3.60	Rs.2.60
(d) **Target Cost p.u.**	**Rs. 18.40**	**Rs. 14.40**	**Rs. 10.40**

3. Computation of Cost under Traditional Costing

Particulars	Coco	Strawberry	Vanilla
(a) Direct Material p.u	Rs. 8.00	Rs. 6.00	Rs. 5.00
(b) Direct Labour p.u.	Rs. 5.00	Rs. 4.00	Rs. 3.00
(c) Prime Cost (a+b)	Rs. 13.00	Rs. 10.00	Rs. 8.00
(d) Store Support 30% pf Prime cost (c)	Rs. 3.90	Rs. 3.00	Rs. 2.40
(e) Total Cost p.u	**Rs. 16.90**	**Rs. 13.00**	**Rs. 10.40**
(f) 100% level Output Quantity	60,500 Units	24,200 Units	72,600 Units
(g) Total costs (e × f)	Rs. 10,22,450	Rs. 3,14,600	Rs. 7,55,040
(h) Target Cost p.u as per WN 2	Rs. 18.40	Rs. 14.40	Rs. 10.40
(i) Comments (e) vs (h)	Rs. 1.50 cost further saved when compared to Target Cost	Rs. 1.40 further cost saved when compared to Target Cost	Target Cost just achieved

4. Computation of Total cost & Unit cost using ABC

Particulars		Coco (Rs.)		Strawberry (Rs.)		Vanilla (Rs.)
	p.u.	Total	p.u	Total	p.u.	Total
Output quantity		60,500 Units		24,200 Units		72,600 Units
Direct Material	8.00	4,84,000	6.00	1,45,200	5.00	3,63,000
Direct Labour	5.00	3,02,500	4.00	96,800	3.00	2,17,800
Cost of purchase order	0.46	(800 × 35) 28,000	0.99	(800 × 30) 24,000	0.17	12,000 (800×15)
Cost of Delivery	1.30	(700 × 112) 78,400	1.91	(700 × 66) 46,200	0.46	33,600 (700×48)
Shelf Stocking	0.43	(199 × 130) 25,870	1.23	(199 × 150) 29,850	0.44	31,840 (199×160)
Customer Support & Assistant	1.10	66,550	1.10	26,620	1.10	79,860

Particulars		Coco (Rs.)		Strawberry (Rs.)		Vanilla (Rs.)
(a) ABC Cost p.u.	16.29	9,85,320	15.23	3,68,670	10.17	7,38,100
(b) Target Cost p.u.	18.40		14.40		10.40	
(c) Comments (a vs b)	Rs.2.10 cost further saved when compared to Target Cost		0.83 further cost reduction required.		0.23 cost further saved when compared to Target Cost	

Q. 10. A manufacturing Company has an installed capacity of 1,50,000 units p.a. Its cost structure is given below –

Variable Costs	**Rs. 10 per unit**
Labour (Minimum Rs.1,00,000 per month)	**Rs. 10 per unit**
Overheads	**Rs. 4 per unit**
Fixed Overheads	**Rs. 1,92,300 per annum.**

Semi-Variable overheads Rs. 60,000 per annum at 75% capacity, which increases by Rs. 4,000 per annum for every 5% increase in capacity utilization for the year as a whole.

The capacity utilization for the next year is estimated at 75% for three months, 80% for six months and 90% for the remaining part of the year. If the company is planning to have a profit of 20% on the selling price, calculate the selling price per unit.

Answer 10.

1. Production per month = 1,50,000 ÷ 12 = 12500 units
2. Statement of Costs and Revenues for the year

Particulars	First 3 months	Next 6 months	Last 3 months	Total
a. Capacity	75%	80%	90%	
b. Production	12500 × 75% × 3 = 28,125	12500 × 80% × 6 = 60,000	12500 × 90% × 3 = 33,750	1,21,875
c. Variable Costs at Rs. 10 p.u.	2,81,250	6,00,000	3,37,500	12,18,750
d. Labour at Rs. 10 p.u. (min. Rs. 1 Lakh per month)	3,00,000	6,00,000	3,37,500	12,37,500
e. Variable OH at Rs. 4 pu	1,12,500	2,40,000	1,35,000	4,87,500
f. Fixed Overheads (given)				1,92,300
g. Semi-Variable OH (Note 3)	15,000	32,000	18,000	65,000
h. **Total Costs**	1/5 on Revenue	= ¼ on Cost		**32,01,050**
i. Add: Profit				8,00,263
j. **Desired Revenue (h + i)**				**40,01,313**
k. **Selling Price unit (j ÷ b)**				**32.83**

3. Computation of Semi-variable OH :

First 3 months : 75%	Rs. 60,000 × 3/12	=	15,000
Next 6 months : 80%	[Rs. 60,000 + Rs. 4,000] × 6/12	=	32,000
Last 3 months : 90%	[Rs. 60,000 + Rs. 4,000 × 3] × 3/12	=	18,000

Note : In the above calculation, it is presumed that Semi-Variable OH arise uniformly during the year. Alternatively, the following treatment is also permissible –

- Since 90% is reached at some time during the year (i.e.during the last three months), the average SVOH for the entire year = 90% Capacity = Rs. 60,000 + Rs. 4,000 × 3 = Rs. 72,000.
- Average Capacity Utilisation during the entire year = 1,21,875 ÷ 1,50,000 units = 81.25%. Hence, SVOH for the entire year = Rs. 60,000 + Rs. 4,000 × 2 = Rs. 68,000.

Q. 11. Hudco Ltd. Requires its various operating divisions to meet the company's target return of 15% on investment, as specified by the board. Besides the ROI of 15% the board also requires an annual positive cash flow. The Steady Division has achieved the 15% target for many years. Steady's assets are mainly plant and equipment (its property rented), plus net current assets. The average age of its assets has increased by 10 months per year over the last four years. A recent benchmarking exercise has shown that Steady's productivity is below that of its competitors, although its financial performance appears very good. The divisional operations director has recently presented a proposal for a major investment in new plant and machinery. He argued that without substantial investment Steady would not be able to compete on either quantity or delivery time. The divisional sales director agreed that these factors had become the two most important features in winning new orders. The budgeted financial figures for 2010 are shown here :

	Steady Division- 2004 (Rs. Cr)
Sales	**168.60**
Operation profit before depreciation	**22.20**
Depreciation	**3.00**
Operating profit	**19.20**
Interest payable	**1.80**
Divisional net profit before tax	**17.40**
Plant and equipment	**60.00**
Net current assets	**36.00**
Total divisional assets	**96.00**

The proposal for new investment would lead to a net increase in plant and equipment of Rs.36 crore and a reduction in net current assets of Rs. 12 crore. Steady expects that the new assets would lead to an increase in operating profit before depreciation of Rs. 8.4 crore and a net increase in depreciation of Rs. 4.8 crore. Hudco charges 12% on all funds used by divisions.

You are required to :

(a) Calculate the return on investment for Steady Divisions for 2010, with and without the new investment proposal. Briefly comment on the expected performance of Steady Division for each option.

(b) Calculate the Residual Income (RI) for Steady Division for 2010, with or without the new investment proposal. Briefly comment on whether using RI would improve the measurement of Steady's performance.

(c) Outline the major features of Economic Value Added (EVA) and briefly discuss whether its use could improve divisional performance measurement for Hudco.

Answer 11. (a)

Hudco Ltd.-Steady Division
Return on Investment (ROI)

	Without investment Rs. *Cr.*		With investment Rs. *Cr.*
PBIT	19.20	(+8.4 - 4.8)	22.80
Total Assets	96.00	(36.00 – 12.00)	120.00
ROI	20%		19%

Comments :

Stedy's return is more than the company's target. However, the information of poor productivity and aged assets makes a discerning accountant wonder if the apparent better result were the products of low asset values rather than production efficiency.

With new additional investment the ROI is reduced. This might discourage the steady manjagement to undertake the proposed investment, though this will mean steady remains a weakling in respect of productivity, quality of goods and service in its market.

This measure, ROI, obstructs a clear vision of the merit of a project at times.

(b) Residual Income (RI)

	Without investment Rs. *Cr.*		With investment Rs. *Cr.*
PBIT	19.20		22.80
Imputed interest charge @ 12% (on 96.00)	(11.52)	(on 120.00)	(14.40)
RI	7.68		8.40

Comments :

As in ROI, RI also shows better results as the imputed interest on older assets gets smaller.

However, the RI measure here will encourage new investment. As against the current return, a target return is decided with a view to long term objective of the corporate management. Sometimes the target rate of return is used as the imputed interest charge; a positive RI in this case will indicate a project that earns in excess of the target ROI. Performance measures must be designed to reward decisions that are optimum for the company as a whole.

(c) Economic Value Added (EVA)

EVA, as a measure, follows the same principle as RI. Value addition by a project is measured by EVA. However, this measure looks at the impact on economic value of the business by the project. This requires a procedure which may deviate from the conventional accounting principles. For example, fully written off goodwill, research and development may be reinstated at their economic values with corresponding adjustments to the reported profit. The use of all the assets to generate economic benefits is thus highlighted. The emphasis on measuring value creating in the EVA should encourage managers to make decisions that are compatible with the objectives of the business as a whole.

Indeed, assets are often measured on a current cost basis within the EVA, which will eliminate the misleading benefit that appears to be gained from holding assets for longer than their economic value warrants. Divisional bonus schemes may be based on EVA for motivation of managers, which will attain corporate goal congruence at the same time.

Q. 12. (a) Write a note on Total Quality Management.

(b) Differentiate between Quality Planning, Quality Control & Quality Improvement.

Answer 12. (a)

Quality is considered a by-product of the manufacturing system, i.e. each individual process has some variation that will lead to the production of some defective units. If the resulting defective rate is too high, compared to the established quality standards, quality inspectors will identify and send them back for rework. The approach is expensive and does not guarantee the desired quality, because quality maintenance and ensuring it self can not be inspected into a product. This approach assigns the responsibility for quality to quality control managers.

A more unlighted approach to quality emphasizes building quality into the product by studying and improving activities that affect quality, from marketing through design to manufacturing. This new approach is referred to as Total Quality Management (TQM).

It is an active approach encompassing a company-wide operating philosophy and system for continuous improvement of quality. It demands co-operation from everyone in the company, from the top management down to workers.

The principles of TQM are as follows :

(i) Customer focus,

(ii) Managerial Leadership,

(iii) Belief in continious improvement.

(iv) The current thinking on TQM is moving from Quality of product and service to Quality of people to embrace also Quality of environment. ISO 14000 standard supports this.

Answer 12. (b)

Difference between Quality Planning, Quality Control & Quality Improvement :

Quality Planning	Quality Control	Quality Improvement
• Determine who are the Customers	• Choose control subjects what to control?	• Establish the infrastructure needed to secure annual quality improvement
• Determine the needs of the Customers	• Choose units of measurements-Evaluate Measurements	• Identify the specific needs for improvement - the improvement projects
• Develop product features that respond to the customer's needs.	• Establish standards of performance	• For each project establish a project team with clear responsibility for bringing the project to a successful conclusion
• Develop processes that areable to product feature	• Measure actual performance	• Provide the resources, motivation and training needed by the teams to :
• Transfer the resulting plans to the operating forces.	• Interpret the difference (actual versus standard) • Take action on difference	• Diagnose the causes • Stimulate establishment of a remedy • Establish controls to hold the gains

Q. 13. A company manufactures 3 lakhs units of product X and 2 lakh units of product Y per annum. The following figures are extracted from its cost books related to the costs of above products.

	(Rs. Lakhs)
Sale value	**38.00**
Direct material	**7.00**
Direct labour	**9.50**
Factory overheads	**9.50**
Administration and selling overheads	**6.00**

5% of factory overheads are variable and 50% of Administration and selling overheads are fixed.

The selling price of X is Rs.6 per unit and Y is Rs.10 per unit. The direct material and labour ratio for product X is 1:1.5 and for Y is 1:1.25. For both the products, the selling price is 400% of direct labour. The factory overheads are charged in the ratio of direct labour and administration and selling overheads are recovered at a flat rate of Re. 1 per unit of X and Rs. 1.50 per unit of Y.

Due to fall in demand of the above products, the company has a plan to diversify and make product Z using 40% of the present capacity. It has been estimated that for Z direct material and labour will be Rs. 1.25 and Rs. 1.50, respectively. Other variable costs will be same as applicable to Product X. The selling price of Z will be Rs. 7 per unit and production will be 3 lakh units.

Assuming that balance 60% capacity is used for manufacture of X and Y, (a) Calculate present costs and profits, (b) Costs and profits after the diversification is implemented, and (c) your recommendation as to whether to diversify or not.

Answer 13.

Working Notes :

(1) Per Unit Contribution from Products X and Y

Particulars			**X**	**Y**
Selling price		(a)	6.00	10.00
Variable costs:				
Direct labour	(1/4 of selling price)		1.50	2.50
Direct material	(1.5 × 1/1.5); (2.5 × 1/1.25)		1.00	2.00
Variable overheads:				
Factory	(50% of direct labour)		0.75	1.25
Administration and selling overheads			0.50	0.75
		(b)	3.75	6.50
		(a)-(b)	2.25	3.50

(2) Per Unit contribution from Product Z

Particulars	**(Rs.)**	
Selling Price		7.00
Variable costs :		
Direct material	1.25	
Direct labour	1.50	
Variable overheads :		
Factory	0.75	
Administration and selling	0.50	4.00
Contribution		3.00

(3) Fixed costs

Particulars	**(Rs. lakhs)**	
(a) Total factory overheads		9.50
Less : Variable factory overheads		
X (3 lakh units × Re. 0.75)	2.25	
Y (2 lakh units × Rs. 1.25)	2.50	4.75
		4.75
Fixed factory overheads		
(b) Total Administration and selling overheads		6.00
Less : Variable Administration and selling overheads		
(Re. 0.50 × 3 lakh units)	1.50	
(Re. 0.75 × 2 lakh units)	1.50	3.00
Fixed Selling and Administration overheads		3.00

(a) Statement of present Cost and Profits

Particulars		**X**	**Y**	**Total**
Production and sale (units in lakhs)		3.00	2.00	5.00
Sale value	(i)	18.00	20.00	38.00
Less : Variable costs				
Direct material		3.00	4.00	7.00
Direct labour		4.50	5.00	9.50
Factory overheads		2.25	2.50	4.75
Admn. and selling overheads		1.50	1.50	3.00
Total variable cost	(ii)	11.25	13.00	24.25
Contribution	(i)-(ii)	6.75	7.00	13.75
Less : Fixed costs :				
Factory overheads				4.75
Administration and selling overheads				3.00
				6.00

(b) Statement of Profits and Cost under Proposed Plan

Particulars		**X**	**Y**	**Z**	**Total**
Production and Sales (units in lakhs)		1.80	1.20	3.00	6.00
Sale value	(i)	10.80	12.00	21.00	43.80
Less : Variable costs					
Direct material		1.80	2.40	3.75	7.95
Direct labour		2.70	3.00	4.50	10.20
Factory overheads		1.35	1.50	2.25	5.10
Administration and selling overheads		0.90	0.90	1.50	3.30
Total variable costs	(ii)	6.75	7.80	12.00	26.55
Contribution	(i-ii)	4.05	4.20	9.00	17.25
Less : Fixed costs as above					7.75
Profit					9.50

(c) **Recommendations :**

(i) The diversification is justified since there will be full capacity utilization which will result in an increase in profit by Rs.3.5 lakhs.

(ii) Management can also reduce production of Product X and do more production of Products Y and Z in order to achieve a better product mix.

(iii) Product Y is giving the highest contribution per unit. Assuming no key factor, effect of Z on Y should be observed before diversification plan is followed.

(iv) Investment on Product Z should also be taken into consideration.

(v) Maximum demand of Product X, Y and Z should be studied for making better decision.

Working Note :

No. of units of Z, utilizing 40% capacity, is given as 3 lakhs units. The balance 60% capacity is utilized for manufacture of products X and Y. The revised quantities of Products X and Y have been calculated as 60% of the original production of Products X and Y assuming that previous production level is for 100% capacity.

Q. 14. Quick Progress Ltd. have been able to achieve remarkable improvement in their profits over the previous year and the figures are as under :

Particulars	Previous year	This year
Sales	**5,00,000**	**8,40,000**
Direct material	**1,50,000**	**1,99,500**
Direct labour	**1,00,000**	**1,54,000**
Variable overheads	**50,000**	**70,000**
Fixed costs	**1,50,000**	**1,80,000**
Profit	**50,000**	**2,36,500**

The improvement has been effected by increasing the sales volume and at the same time putting up the selling price by 20%. Labour have been paid more and administration strengthened. On account of increased purchases of material discounts in price have been obtained.

You are required to find out in terms of percentage over the previous year, the increase in sales volume, labour and administration costs as well as savings in material costs. You are also required to qualify in monetary terms the effect of each of these factors on the improvement in the profit made.

Answer 14.

Percentage Increase in Sales, Sales Volume, Labour and Administration Cost, as well as Savings in Material Cost :

Increase in Sales volume $= \frac{2,00,000}{5,00,000} \times 100$ = 40%

Increase in Labour Costs $= \frac{14,000}{1,00,000 + 40,000} \times 100$ = 10%

Increase in Administration Cost $= \frac{30,000}{1,50,000} \times 100$ = 20%

Savings in Material Costs $= \frac{10,500}{1,50,000 + 60,000} \times 100$ = 5%

Working Notes :

(1) Sales Volume (this year) at previous year's selling price:

= 8,40,000 × 100/120 = Rs.7,00,000

(2) Increase in Sales Volume = 7,00,000 – 5,00,000 = Rs. 2,00,000

(3) Percentage increase in sales volume 2,00,000/ 5,00,000 × 100 = 40%

(4) Variations in Sales and Costs due to change in Volume and Price etc. **(Rs.)**

Particulars	**Previous Year (1)**	**This year (2)**	**Change over the Previous Year (3)**	**Change due to volume at 40% (4)**	**change due to price & other causes (5) (3)-(4)**
Sales	5,00,000	8,40,000	3,40,000	2,00,000	1,40,000
Direct material	1,50,000	1,99,500	49,500	60,000	(-)10,500
Direct labour	1,00,000	1,54,000	54,000	40,000	14,000
Variable overheads	50,000	70,000	20,000	20,000	–
Fixed costs	1,50,000	1,80,000	30,000	–	30,000
Profits	50,000	2,36,000	1,86,500	80,000	1,06,500

Statement showing in Monetary Terms the effect of the various factors on the improvement in the profit

		(Rs.)
Improvement in Profits		1,86,500
Accounted by:		
Increase due to change in Sales Volume	(40% of Rs.2,00,000)	80,000
Increase due to change in Sale Price	(20% of Rs.7,00,000)	1,40,000
Increase due to decrease in Material Costs	(5% of Rs.2,10,000)	10,500
Decrease due to increase in Labour Costs	(10% of Rs.1,40,000)	(14,000)
Decrease due to increase in Fixed Costs		(30,000)
Total increase in Profits		1,86,500

Q. 15. A Company paid Rs.20,000 and acquired a machine on 1-10-2010. Its annual operation cost is Rs. 15,000 excluding depreciation. The machine will have a 5-year useful life with zero terminal value.

The machine was just put on trial and was used for one day when the supplier offered a different model to do the same job. The annual operating cost of the revised model is Rs. 9,000 exclusive of depreciation. The new machine will cost Rs. 24,000. The old machine can be sold for Rs. 10,000. The cost of removal; of the old machine is Rs. 2,000. The new machine will also have a five-year life with zero terminal value. Sales will be Rs. 2,50,000 per annum and all other cash costs will be Rs. 2,10,000 per annum regardless of the decision to change the machine. The machine is installed in a separate building and the written down value of the building is Rs. 5,00,000. If this building is sold now, it will fetch Rs. 10 lakhs but the company proposes to use the building for installing the machine.

You are required to explain whether each item of income or expense or cost stated above is relevant or not in deciding on the replacement of the machine.

Answer 15.

Statement showing relevancy of income or expenditure for replacement decision.

Item of Expenditure	Relevancy
(1) Cost of machine Rs.2,00,000.	It is a sunk cost and is not relevant for replacement decision.
(2) Operation costs Rs. 15,000 & Rs. 9,000	These will affect the future cash outflows and are relevant.
(3) Cost of new machine Rs. 24,000.	There is a cash outflow and is relevant for decision making.
(4) Sale proceeds of old machine Rs. 10,000.	This will lead to cash inflow and is relevant.
(5) Removal of old machine Rs. 2,000.	It will affect the future cash outflow and is relevant.
(6) Future sales of Rs. 2,50,000 p.a. and operating costs of Rs. 2,10,000 p.a.	It is common to both the machines and is not relevant.
(7) WDV of building of Rs. 5,00,000.	It is sunk cost is not relevant.
(8) Sale value of machine Rs. 10,00,000.	There is no intention to sell the machine and it is not relevant for replacement decision.

Q. 16. Company produces 4 products P, Q, R, S. The data relating to production activity are as under

Product	Quantity of Production	Material Cost per unit (Rs)	Direct Lab hrs./unit	Machine hours per unit	Direct Labour Cost per unit (Rs)
P	**1000**	**10**	**1**	**0.5**	**6**
Q	**10000**	**10**	**1**	**0.5**	**6**
R	**1200**	**32**	**4**	**2**	**24**
S	**14000**	**34**	**3**	**3**	**18**

Production Overhead as under	**Rs.**
(i) Overheads applicable to machine oriented activity	**1,49,700**
(ii) Overheads relating to ordering material	**7680**
(iii) Set up Costs	**17,400**
(iv) Administration overheads for spare parts	**34,380**
(v) Material Handling Cost	**30,294**

The following further information have been compiled :

Product	No of set up	No of material orders	No of times materials handled	No of Spare Parts
P	**3**	**3**	**6**	**6**
Q	**18**	**12**	**30**	**15**
R	**5**	**3**	**9**	**3**
S	24	12	36	12

Required :

(i) Select a suitable cost driver for each item of overhead expense and calculate the cost per unit of cost driver.

(ii) Using the concept of activity based costing,compute the factory cost per unit of each product.

Answer 16.

Computation of Cost Driver Rates.

Production Overhead	Cost Driver	Cost Driver Rates
Overheads applicable to machine oriented activity	Machine Hour Rate	149700/*49900 = Rs. 3 per hour
Overheads relating to ordering material	No of Material Order	7680/30 = Rs. 256 per order
Set up Costs	No of set up	17400/50 = Rs. 348 per set up
Administration overheads for spare parts	No of Spare Parts	34380/36 = Rs. 955 per spare part
Material Handling Cost	No of times materials handled	30294/81 = Rs. 374 per material handling

*Machine hours = 1000 × 0.5 + 10000 × 0.5 + 1200 × 2 + 14000 × 3

	P		Q		R		S	
Material		10.00		10.00		32.00		34.00
Labour		6.00		6.00		24.00		18.00
Overheads Machine oriented activity	1.500		1.50		6.00		9.00	
Ordering of material	0.768		0.31		0.64		0.22	
Set up Costs	1.044		0.63		1.45		0.60	
Administration overheads for spare parts	5.730		1.43		2.39		0.82	
Material Handling Cost	2.244	11.29	1.12	4.99	2.81	13.29	0.96	11.60
Factory Cost		**27.29**		**20.99**		**69.29**		**63.60**

Q. 17. The management of an engineering company manufacturing a range of products is considering next year's production, purchase and sales budgets. Shown below are the budgeted total unit costs for two of the components and two of the products manufactured by the company.

	Component 12 Per unit Rs.	Component 14 Per unit Rs.	Product VW Per unit Rs.	Product XY Per unit Rs.
Direct Material	18	26	12	28
Direct Labour	16	4	12	24
Variable Overhead	8	2	6	12
Fixed Overhead	20	5	15	30
	62	37	45	94

Components 12 and 14 are incorporated into other products manufactured and sold by the company, but not the two products shown above. It is possible to purchase. Components 12 and 14 from another company for Rs. 60 per unit and Rs. 30 per unit respectively.

The anticipated selling prices of Products VW and XY are Rs. 33 and Rs. 85 respectively.

Required :

a. Advise the management of the company whether it would be profitable to :

(I) Purchase either of the above components,

(II) Sell either of the above products.

b. Sate clearly, and where appropriate comment upon, the assumptions you have made in answering 1 above.

c. Consider how the following additional information would affect your advice in (a) above.

(I) Next Year's budgeted production requirements for the two Components are 7,000 units of Component 12 and 6,000 units of Component 14. Next year's budgeted sales for the two products are Product VW 5,000 units and Products XY 4,000 units.

(II) A special machine is used exclusively by the above two components and two products and for technical reason the machine can only be allowed to operate for 80,000 machine hours next year.

The budgeted usage of the machine is :

Component 12	**8 machine hours**	**Product VW**	**6 machine hours**
Component 14	**2 machine hours**	**Product XY**	**12 machine hours**

The operating costs of the machine have been included in the unit costs shown in (a) above.

Answer 17. (a)

	Component 12 Rs.	Component 14 Rs.	Product VW Rs.	Product XY Rs.
Variable cost	42	32	30	64
Purchase price	60	32		
Selling price			33	85

On the basis that fixed costs are apportionments of company costs, they have been omitted from the comparison data.

The above figures show that it would appear to be financially worthwhile to buy-in component 14 but not component 12. It would appear to be profitable to sell both product VW and product XY since both show a positive contribution per unit.

(b) In answering part (a) of the question, a number of assumptions have been made;

(i) Prime costs and variable overheads vary directly with units produced/sold. This may not be the case where, for example, labour is semi-fixed with a basic wage plus a bonus per unit.

(ii) No additional costs will be specifically incurred by either product or component. The purchase of component 14 may incur specific additional costs such as inspection on receipt or costs due to a higher than normal incidence of scrap components when they are used.

(iii) Fixed overheads are unaffected by the production level and mix of the components/products. If any fixed overhead is directly attributable to a component or product, it should be added to the variable cost for comparison with the purchase or selling price. For example, if more than Rs.3 per unit of fixed overhead is directly attributable to product VW it will not be worthwhile selling it at Rs.33 per unit.

(iv) There are no limitations to the capacity available to produce the components and products. If a capacity constrains exists, the choice of products/components which will make the most profitable use of the capacity available must be evaluated.

	Component 12	**Product VW**	**Product XY**	**Total**
Machine hours per unit	8	6	12	
Budgeted units	7,000	5,000	4,000	
Hours required	56,000	30,000	48,000	134,000
Hours available				80,000
Shortfall				54,000
Contribution per unit (Rs.)	18	3	21	
Contribution per machine hour (Rs.)	2.25	0.50	1.75	
Ranking	(1)	(3)	(2)	
Purchase / sales policy to Maximize profit (units)	7,000	Nil	2,000	

Notes :

(i) Component 14 is not considered since it is cheaper to buy than to produce even at variable cost.

(ii) Component 12 has an opportunity cost of Rs.18 per unit which represents the cash outflows if it has to be produced. This is directly comparable with the cash inflow from the contribution earned from sales of products VW and XY when deciding on the vest use of the scarce machine capacity.

(iii) Component 12 used 56,000 machine hours to produce its requirement of 7,000 units. The remaining 24,000 machine hours are used to produce product XY. This is sufficient for 2,000 units of product XY (24,000 ÷ 12).

This strategy eliminates product VW. It may be that management would wish to take a long term view and retain a spread of production to include some of product VW in order that its market is not lost.

Q. 18. (a) Next years forecasted trading results for Caribee Ltd. a small company manufacturing three different types of product, are shown below :

	Product A	Product B	Product C	Total
Selling price, per unit	Rs. 10	Rs. 12	Rs. 8	
Sales	100	96	32	Rs.228
Variable cost of sales			(Rs. '000)	
Prime cost	40	38	13	91
Variable overhead	20	18	11	49
Share of general fixed overhead	30	27	10	67
Profit/ (loss)	10	13	(2)	21

Required :

(i) Explain how the company's forecasted profits would be affected if product C were discontinued. It should be assumed that sales of the remaining products would not be affected; any other assumptions made should be included with your explanation.

(ii) Additional advertising for product B would cost Rs. 8,000 next year; this amount is not included in the forecasts shown above. Calculate the minimum extra sales, in units, or product B required to cover this additional cost.

(iii) Calculate the increase in sales volume of product A necessary to compensate for a 10% reduction in the selling price of the product. Carefully explain why the increase in volume is proportionately greater that the reduction in selling price.

(b) The production director of Caribee Ltd has just been informed that next year's supplies of a material used in the manufacture of each of the three products will be restricted to 92,000 kg; no substitute materials is available and the estimated consumption of this restricted material, per product is:

Product A	**8 kg per unit**
Product B	**4 kg per unit**
Product C	**1 kg per unit**

The sales director estimates that the maximum demand for each product is that which is shown in the original forecast (a) above; also he decides that advertising or adjustment to selling price are not possible.

Assume that stocks of materials, work in progress or finished goods cannot be carried.

Required : Calculate the optimum quantities of product A, B and C which should be manufactured next year in order to maximize company profits.

Answer 18. (a)

(i) The forecasted results show that product C makes a loss of Rs.2,000. However, if product C is discontinued, sales will decline by Rs.32,000 and cost, will decline by Rs.24,000 (prime cost ÷ variable overhead). It is assumed that fixed overheads will still continue to be incurred and that the fixed costs of Rs.10,000 will be borne by other products. Therefore the company will lose a contribution of Rs.8,000 towards fixed overheads and profit if product C is discontinued and company's profit would be reduced to Rs.13,000 as shown below :

		Rs. '000
Sales (product A & B)		196
Variable Cost of Sales:		
Prime Cost	78	
Variable O.H.	38	116
Total Contribution		80
Less : Fixed cost		67
		13

(ii) The minimum extra sales of B to cover the Rs.8,000 advertising is calculated as follows :

$$\frac{\text{Cost of Advertising}}{\text{Contribution per unit of B}} = \frac{\text{Rs. } 8,000}{\text{Rs. } 5} = 1,600 \text{ units}$$

For calculating contribution per unit of B

Total Sales of B	Rs. 96,000
Less : Variable cost	56,000
Total contribution of B	40,000

Units sold = Rs. 96,000 ÷ Rs. 12 = 8,000 units

Contribution per unit = Rs. 40,000 ÷ 8000 units = Rs. 5 per unit of B

(iii) Existing contribution per unit of product A :

Total sales of A	Rs. 1,00,000
Less : Variable cost (total)	60,000
Total contribution of A	40,000

Units of A sold = Rs. 1,00,000 ÷ Rs. 10 = 10,000 units.

Contribution per unit of A = Rs.40,000 ÷ 10,000 = Rs.4 per unit.

Contribution per unit after a 10% reduction in selling price Rs. 9.00 – Rs. 6.00 = Rs. 3.00

Reduction in product contribution due to decrease in selling price will be Rs. 10,000 (i.e. Rs.1 × 10,000)

Increased sales volume to obtain a contribution of Rs. 10,000 = Rs. 10,000 ÷ Rs. 3 = 3,333 units percentage increase in sales volume = 33-1/3%

Answer 18. (b)

	A	B	C
Total contribution	Rs. 40,000	Rs. 40,000	Rs.8,000
Unit contribution (Rs.)	4	5	2
Quantity used (kg)	8	4	1
Contribution per kg	0.50	1.25	2
Ranking	III	II	I

Optimal Production :

Product	Unit	Qty.used (kg)	Qty unused (kg)
C	4,000	4,000	88,000
B	8,000	32,000	56,000
A	7,000 *	56,000	–

* 56,000 ÷ 8 = 7000 units.

Q. 19. (Overall profitability of the company – optmising problem). A company has two divisions A and B sells two products B1 and B2 made of 3 materials A1, A2, and A3 produced by division A. Division A has no outside market for these 3 materials. The following details are relevant :

	A1	A2	A3
Variable cost per unit Rs.	**1.00**	**0.50**	**0.75**
Quantity used (units) per unit of			
B1	**2**	**0.5**	**1**
B2	**2**	**2**	**3**
Processing capacity (Unit/week in Division A)	**4,000**	**3,000**	**4,800**

The price and variable processing cost for products B1 and B2 are :

	B1	B2
Price	**Rs. 8**	**Rs. 14**
Processing cost in division B	**2**	**1.75**

The overall profitability of the company has to be maximized and with this end in view, formulate the optimization as a linear programming model.

Answer 19.

Let Y_1 and Y_2 be the amounts of B1 and B2 respectively

Let X_1, X_2, X_3, be the amounts of A1,A2, A3 produced.

The capacity constraints :

X_1 - 4,000 X_2 - 3,000 X_3 - 4,800

The demand for each of the 3 of the Division A Products in terms of the amounts of the 2 of the Division B Products to be produced is given by.

$$2Y_1 + 2Y_2 - X_1 \geq 0$$

$$0.5Y_1 + 2Y_2 - X_2 \geq 0$$

$$Y_1 + 3Y_2 - X_3 \geq 0$$

The model to be formulated

Maximize (8-2) Y_1 + (14–1.75) Y_2 – 1X_1 – 0.5X_2 – 0.75X_3

Subject to	$2Y_1 + 2Y_2 - X_1$	≥	0
	$0.5Y_1 + 2Y_2 - X_2$	≥	0
	$Y_1 + 3Y_2 - X_3$	≥	0
	X_1	≥	4,000
	X_2	≥	3,000
	X_3	≥	4,800
Where	Y_1, Y_2, X_1, X_2, X_3	≥	0

Q. 20. A Mutual Fund has cash resources of Rs.200 million for investment in a diversified portfolio. Table below shows the opportunities available, their estimated annual yields, risk factor and term period details.

Formulate a Linear Program Model to find the optimal portfolio that will maximize return, considering the following policy guidelines :

- **All the funds available may be invested.**
- **Weighted average period of at least five years as planning horizon.**
- **Weighted average risk factor not to exceed 0.20**
- **Investment in real estate and speculative stocks to be not more than 25% of the monies invested in total.**

Investment type	Annual yield (percentage)	Risk factor	Term period (years)
Bank deposit	**9.5**	**0.02**	**6**
Treasury notes	**8.5**	**0.01**	**4**
Corporate deposit	**12.0**	**0.08**	**3**
Blue-chip stock	**15.0**	**0.25**	**5**
Speculative stocks	**32.5**	**0.45**	**3**
Real estate	**35.0**	**0.40**	**10**

Answer 20.

Mathematical formulation :

Let x_1, x_2, x_3, x_4, x_5 and x_6 represent the six different investment alternatives, i.e., x_1 is bank deposit, $x_2$is treasury note. x_3 corporate deposit, x_4 blue chip stock, x_5 speculative stock and x_6 real estate. The objective is to maximize the annual yield of the investors (in number of units) given by the Linear expression.

Maximise $Z = 9.5x_1 + 8.5x_2 + 12.0x_3 + 15.0x_4 + 32.5x_5 + 35.0x_6$ subject to the constraints :

$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 \leq 1$ (Investment decision)

$0.02x_1 + 0.01x_2 + 0.08x_3 + 0.25x_4 + 0.45x_5 + 0.40x_6 \leq 0.20$(weighted average risk of the portfolio)

$6x_1 + 4x_2 + 3x_3 + 5x_4 + 3x_5 + 10x_6 \geq 5$(weighted average length of investment)

$x_5 + x_6 \leq 0.25$ (limit on investment in real estate and speculative stock)

$x_1, x_2, x_3, x_4, x_5, x_6 \geq 0$ [non-negativity condition].

Q. 21. Expected ROI

The frequency distribution of Contribution per Unit, Annual Demand and Investment requirement of a manufacturing Company were found as below –

Contribution per Unit (Rs.)	3	5	7	9	10
Relative frequency	0.1	0.2	0.4	0.2	0.1

Annual demand (in 1000 units)	20	25	30	35	40	45	50
Relative frequency	0.05	0.10	0.20	0.30	0.20	0.10	0.05

Required Investment (Rs. 000s)	17,50	20,00	25,00
Relative frequency	0.25	0.50	0.25

Consider the random number 93, 03, 51, 59, 77, 61, 71, 62, 99, 15 for simulating 10 run, to estimate the Percentage of Return on Investment (ROI = Cash inflow ÷ Investment 100) for each run. Find the average ROI.

Answer 21.

1. Random Number Allocation :

Table 1: Random Number for Demand

Event	Prob.	Cum Prob	Random Nos.
20	0.05	0.05	00-04
25	0.10	0.15	05-14
30	0.20	0.35	15-34
35	0.30	0.65	35-64
40	0.20	0.85	65-84
45	0.10	0.95	85-94
50	0.05	1.00	95-99

Table 2: Random Number for contribution

Event	Prob.	Cum Prob	Random Numbers
3	0.10	0.10	00-09
5	0.20	0.30	10-29
7	0.40	0.70	30-69
9	0.20	0.90	70-89
10	0.10	1.00	90-99

Table 3: Random number for Investment

Event	Prob.	Cum Prob	Random Numbers
1750	0.25	0.25	00-24
2000	0.50	0.75	25-74
2500	0.25	1.00	75-99

2. Simulation Table :

Trial (a)	Random No (b)	Demand (Rs.) (c)	Contribution p.u. (Rs.) (d)	Investment (Rs.) (e)	Cash inflow (Rs.) (f) = (C) × (d)	ROI (g) = (f) ÷ (e) ×100
1	93	45	10	2,500	450	18.00%
2	03	20	3	1,750	60	3.43%
3	51	35	7	2,000	245	12.25%
4	59	35	7	2,000	245	12.25%
5	77	40	9	2,500	360	14.40%
6	61	35	7	2,000	245	12.25%
7	71	40	9	2,000	360	18.00%
8	62	35	7	2,000	245	12.25%
9	99	50	10	2,500	500	20.00%
10	15	35	5	1,750	150	8.57%
Total				21,000	2,860	131.40

Result : Simple Average ROI = Total ROI 10 = 131.40 ÷ 10 = 13.14%

Weighted Average ROI = Total Cash Inflow Total Investment = 2860 ÷ 21000 = 13.62%.

Q. 22. X ltd.is considering the purchase of a new computer controlled packing machine to replace the two machines which are currently used to pack product y. The new machine would result in reduced labour costs because of more automated nature of the process and in addition, would permit production levels to be increased by creating greater capacity at the packing stage. With an anticipated rise in the demand for product y, it has been estimated that the new machine will lead to increased profits in each of the next three years. Due to uncertainty in demand, however, the annual cash flows (including savings) resulting from purchase of the new machine cannot be fixed with certainty and have therefore been estimated probabilistically as follows :

Annual Cash Flows (Rs. '000)

Year 1	Prob.	Year 2	Prob.	Year 3	Prob.
10	0.3	10	0.1	10	0.3
15	0.4	20	0.2	20	0.5
20	0.3	30	0.4	30	0.2
		40	0.3		

Because of the overall uncertainty in the sales of product y, it has been decided that only 3 years cash flows will be considered in deciding whether to purchase the new machine. After allowing for the scrap value of the existing machines, the net cost of the new machine will be Rs. 42,000. ignore tax.

Required :

(i) Ignoring time value of money, identify which combinations of annual cash flows will lead to an overall negative net cash flow and determine the total probability of this occurring.

(ii) On the basis of the average cash flow for each year, calculate the net present value of the new machine, given company's cost of capital is 15% and the present value of Re.1 at 15% discount rate are as follows :

Year	1	2	3	4	5
P. V	0.8696	0.7561	0.6575	0.5718	0.4972

Answer 22.

If the total cash flow in years 1,2 and 3 is less than Rs. 42,000, the net cash flow will be negative.

(i) The combination of cash flow which total less than Rs.42,000 are given below :

Year 1	Year 2	Year 3	Total	Jt. probability of combination
10	10	10	30	0.3 × 0.1 × .3 = 0.009
10	10	20	40	0.3 × 0.1 × 0.5 = 0.015
10	20	10	40	0.3 × 0.2 × 0.3 = 0.018
15	10	10	35	0.4 × 0.1 × 0.3 = 0.012
20	10	10	40	0.3 × 0.1 × 0.3 = 0.009
				Total 0.063

The probability of a negative cash flow is 0.063.

(ii) Expected cash flow.

Year 1 Expected cash flow= 10 × 0.3 + 15 × 0.4 + 20 × 0.3 = 15(000)

Year 2 Expected cash flow= 10 × 0.1 + 20 × 0.2 + 30 × 0.4 + 40 × 0.3 = 29(000)

Year 3 Expected cash flow= 10 × 0.3 + 20 × 0.5 + 30 × 0.2 = 19(000)

Present cash flow = 15 × 0.8696 + 29 × 0.7561 + 19 × 0.6575 = 47.4634 (Rs.000)

The NPV of the new machine = Rs. (47463 – 42000) = Rs. 5463.

Q. 23. A manufacturing co currently operating at 80% capacity has received an export order from Middle East,which will utilize 40% of the capacity of the factory. The order has to be either taken in full and executed at 10% below the current domestic prices or rejectrd totally.

The current sales and cost data given below :

Sales	**Rs. 16 lacs**
Direct Material	**Rs. 5.80 lacs**
Direct Labour	**Rs. 2.40 lacs**
Variable Overheads	**Rs. 0.60 lacs**
Fixed Overheads	**Rs. 5.20 lacs**

The following alternatives are available to the management :

a. Continue with the domestic sales and reject the export order.

b. Accept the export order and allow the domestic market to starve to the extent of excess of demand.

c. Increase capacity so as to accept the export order and maintain the domestic demand by —

I. Purchasing additional plant and increasing 10% capacity and thereby increasing fixed Overheads by Rs. 65,000 and

II. Working overtime at one and half time the normal rate to meet balance of the required capacity.

You are required to evaluate each of the above alternatives and suggest the best one.

Answer 23.

Statemenr showing computation of profit at different alternatives.

	Particulars	Present Sales 80%	40% Foreign 60% Domestic	40% Foreign 80% Domestic
I	Sales	16	19.2 (7.2+12)	23.2 (7.2+16)
II	Variable Cost			
	Direct Material	5.8	7.25	8.7
	Direct Labour	2.4	3.00	3.6
	Variable Overhead	0.6	0.75	0.90
	Overtime Premium	—	—	0.15
		8.8	11.00	13.35
III	Contribution	7.2	8.20	9.85
IV	Fixed Cost	5.2	5.20	5.85 (5.20+0.65)
V	Profit	2.00	3.00	4.00

From the above computation, it was found that the profit is more at the III alternative, i.e accepting the foreign order fully and maintaining the present domestic sales, it is the best alternative to be suggested.

Q. 24. Division A is a profit centre which produces four products K, L, M &N. Each product is sold in the external market also. Data for the period is

	K	L	M	N
Market Price per unit (Rs)	**150**	**146**	**140**	**130**
Variable Cost of Prodn p.u (Rs)	**130**	**100**	**90**	**85**
Labour hours required p.u	**3**	**4**	**2**	**3**

Product N can be transferred to Division B, but the maximum Quantity that may required for transfer is 2500 units of N.

The maximum sales in the external market are :

K	**2800 Units**
L	**2500 Units**
M	**2300 Units**
N	**1600 Units**

Division B can purchase the same product at a price of Rs. 125 per unit from outside instead of receiving transfer of Product N from Division A.

What would be the transfer price for each unit for 2500 units of N, if total lobour hours available in Division A are 20,000 hours?

Answer 24.

Ranking of products when availability of time is the key factor.

	K	L	M	N
Market Price	150	146	140	130
Less: Variable Cost	130	100	90	85
Contribution pu	20	46	50	45
Labour hours	3	4	2	3
Contribution/labour hours	6.67	11.5	25	15
Ranking	IV	III	I	II
Maximum Demand (units)	2800	2500	2300	1600
Total No of hours	8400	10,000	4600	4800
Allocation of 20,000 hrs on the basis Of ranking	600	10,000	4600	4800

Note : Time required for meeting the demand of 2500 units of product N is 7500 hours. This requirement of time viz.7500 hours for providing 2500 units of product N for Division B can be met by sacrificing 600 hours of product K (200 UNITS) AND 6900 hours of Product L (1725 UNITS)

OR, Rs. 85 + (6900 × 11.5 + 600 × 6.66/2500)

= Rs. 85 + (79,350 + 4000 /2500)

= Rs. 85 + 33.34 = Rs. 118.34

Q. 25. (a) What are the Options for Demand stimulation? How would you adjust capacity to match current demand?

(b) YIPPEE TEXTILE LTD. Monitors for quality of the woven coarse cotton cloth as it arrives to be rolled on to beam. Usually a metre of the cloth is taken as a SAMPLE and checked for defects of different kinds such as :

(i) Knots,

(ii) Oily or greasy Patches or spots,

(iii) Missed weave.

The SAMPLE may have a number of these defects. For instance, if it has one knot, two oil marks and one missed weave, then the number of defects are counted as (1+2+1 = 4). Next time during the first shift on Wednesday, 20 beams have been woven.

The quality control record is given in the following table:

Sample No	Number of Defects	Sample No.	Number of Defects
1	4	11	12
2	9	12	9
3	3	13	3
4	12	14	9
5	5	15	2
6	3	16	2
7	2	17	1
8	2	18	3
9	1	19	1
10	9	20	4

Required :

(i) Design and appropriate control chart. (use C-chart)

(ii) Was the process in control in the first shift on Wednesday?

Answer 25. (a)

Demand Stimulation Options:

Options for situations in which demand needs to be increased in order to match capacity include:

Pricing – Varying (lowering) pricing to increase demand in periods when demand is less than peak e.g., off season rates for hotels

Promotion – Advertising, direct marketing, bulk purchase discounts, bonus, free offers are used to shift demand

Back ordering – By postponing delivery on current orders, demand is shifted to period when capacity is not fully utilized.

New demand creation – A new, but complementary demand is created for a product or services – when restaurant customers have to wait, they are frequently diverted into a complementary service – the bar.

Options which can be used to increase or decrease capacity to match current demand are

(a) Hire or lay-off workers.
(b) Overtime.
(c) Part-time or casual workers.
(d) Inventory-build up in periods of slack demand and then used to fill demand during periods of high demand.
(e) Subcontracting work to an alternative source, additional capacity is temporarily obtained.
(f) Contract manufacturing: sub-letting spare or idle manufacturing facilities to other firms needing extra facilities:
(g) Cross-training: Cross trained employees may be able to perform tasks in several operations. Creating some flexibility when scheduling capacity.
(h) Other methods: while varying workforce size and utilization, inventory build-up/ back logging and sub contracting are well-know alternatives, there are other, more novel ways that find use in industry.

Answer 25. (b)

VIPEE TEXTILE LTD

The type of process control chart required here is the Number of Defects Chart, also known as c-chart, where 'c' denotes the number of defects.

The underlying sampling distribution is the poisson distribution.

$\therefore$ Standard deviation

Where $\sqrt{\bar{c}}$ = mean no. of defects

The 3-sigma control limits are:

UCL = $\bar{c} + 3\sqrt{\bar{c}}$ LCL = $\bar{c} - 3\sqrt{\bar{c}}$

In the case of the present problem,

$$\bar{C} = \frac{\text{Total number of defects}}{\text{Number of samples}} = \frac{96}{20} = 4.8 \text{ defects sample}$$

Hence, UCL = $4.8 + 3\sqrt{(4.8)} = 11.4$

LCL= $4.8 - 3\sqrt{(4.8)}$ = (–) 1.8 ≈ (zero)

Note that a negative number of defects have no meaning, and therefore the LCL is effectively Zero.

The control chart (C-chart) at this stage, looks as given below:

UCL	.....	11.4
C	.....	4.8
LCL	.....	0.0

$\sqrt{\bar{c}}$

$\bar{C}$ Chart (initial)

However, in order to use this as a control chart, it is necessary that the process is in control. Looking at our 20 sample readings we find the 4th and the 11th sample exceeding the UCL. So, in these two instances the process was not in control. For the construction of stable control chart, these two readings will have to be dropped from our computations.

Deleting, for the present, the 4th and 11th reading, we have :

$$\bar{C} = \frac{\sum C}{18} = \frac{72}{18} = 4.0 \text{ defects sample}$$

UCL = $4.0+3\sqrt{(4.0)} = 10.0$

LCL = $4.0-3\sqrt{(4.0)}$ = (-) 2.0 ≈ (zero)

The control chart is now as shown in FIG – A

UCL	.....	10.0
C	.....	4.0
LCL	.....	0.0

Fig. A-c Chart (final)

We observe that none of the 18 sample readings cross the control limit. Therefore, this is the final c-Chart to be used for the control of the cloth-making process.

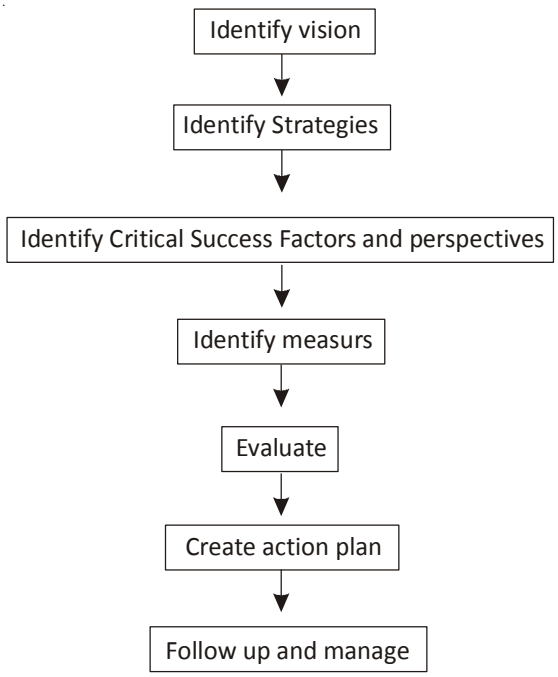
Q. 26. What are the stages involved in the creation of a Balanced Score Card?

Answer 26.

The stages involved in the creation of a balanced score card are enumerated below:

1. To Identify a vision i.e., where on organization is going
2. To Identify Organisation's strategies: i.e., how an Organization is planning to go there
3. Define Critical success factors and perspectives: i.e., what we have to do well in each Perspective Customer perspective, Internal perspective, Innovation and Learning perspective and Financial perspective.
4. Identify measures which will ensure that everything is going in the expected way.
5. Evaluation of Balanced score card i.e., ensuring what we are measuring is right.
6. Create action plans and plan reporting of the Balanced score Card.
7. Follow up and manage i.e., which person should have reports and what reports should look like.

The diagram given below depicts various stages involved to create a balanced score card :



Although the process to create Balanced Score cards is the same for all organization.

However, each organization must decide what its critical success factors are and what its performance measures are

Q. 27. XYZ Ltd., supports the concept of the Life Cycle Costing for new investment decisions, covering its engineering activities, XYZ LTD., is to replace a number of its machines and the Chief Engineer is to decide between the 'AB' machine, a more expensive machine, with a life of 10 years and the 'CD' machine with an estimated life of 5 years. If the 'CD' machine is chosen, it is likely that it would be replaced at the end of 5 years. If the 'CD' machine is chosen, it is likely that it would be replaced at the end of 5 years by another 'CD' machine.

The pattern of maintenance and running costs differs between two types of machine and the relevant data are as given below :

	Rs.	
	AB	**CD**
Purchase price	**19,000**	**13,000**
Trade-in-value	**3,000**	**3,000**
Annual repair cost	**2,000**	**2,600**
Overhaul cost (p.a.)	**4,000**	**2,000**
	(at year 8)	**(at year 4)**
Estimated financing cost averaged Over machine life (p.a.)	**10%**	**10%**

Required : Recommend, with supporting figures, which machine to be purchased, stating any assumptions made.

[Given PVIF (10,10) = 0.39
PVIF (10,5) = 0.62
PVIFA (10,10) = 6.15
PVIFA (10,5) = 3.80
PV factor @ 10% for 4 years = 0.68
PV factor @10% for 8 years = 0.47]
PVIF means present value interest factor.
PVIFA means present value interest factor for an Annuity.

Answer 27.

AB M/c- 10 yrs. Life.

	Year	Cost (Rs.)	P/V factor	Discounted Cost (Rs.)
Purchase Price	0	19,000	1.00	19,000
Overhaul Costs	8	4,000	0.47	1,880
Trade-in-value	10	(3,000)	0.39	(1,170)
Annual Repair Cost	1-10	2,000	6.15	12,300
				32,010

Annualized equivalent = Rs. 32,110/6.15 = Rs. 5,221

CD M/c– 5 yrs. Life.

	Year	Cost (Rs.)	P/V factor	Discounted Cost (Rs.)
Purchase Price	0	13,000	1.00	13,000
Overhaul Costs	4	2,000	0.68	1,360
Trade-in-value	5	(3,000)	0.62	(1,860)
Annual Repair Cost	1-5	2,600	3.80	9,880
				22,380

Annualized equivalent = Rs. 22,380/3.80 = Rs. 5,890.
Conclusion: AB M/c should be purchased.

Q. 28. Write Short Notes on :

(a) Value Analysis

(b) Supply Chain Management

(c) Decision Tree

(d) Theory of Constraint

(e) Value Chain Management

Answer 28. (a)

Value Analysis defines a basic function as anything that makes the products work or sell. A function that is defined as basic control change. Secondary functions, also called supporting functions, described the manner in which basic functions were implemented. Secondary function could be modified or eliminated to reduce product cost. The term value has four different meanings: Cost Value, use value, esteem value and exchange value. The first step in the value analysis process is to define the problem and its scope. Once this is done , the functions of the product and its items are derived. These functions are basic and secondary functions. A cost function matrix or value analysis matrix is prepared.. Improvement Opportunities are then brainstormed, analysed and selected.

Answer 28. (b)

Supply Chain Management- Supply Chain Management encompasses the planning and management of all activities involved in sourcing , procurement,conversion and logistics management activities. Supply Chain Management integrates supply and demand management within and across companies.

Five basic components of supply Chain Management are :

- Plan-Develop a strategy for managing all resources that go towards meeting customer demand.
- Source-Choose the supplier
- Make-Schedule activities for Production.
- Deliver- Coordinate receipt of order to delivery
- Return-Receive Defectives and excess

Answer 28. (c)

Decision Tree-Decision Tree is a tool which helps to choose between several courses of action. It provides a highly effective structure within which options can be laid out and the possible outcomes of choosing those options can be investigated. It also helps to form a balanced picture of the risks and rewards associated with each possible course of action.

Answer 28. (d)

Theory of Constraint :

It describes methods to maximize operating income when faced with some bottleneck and some non-bottleneck operations. It defines three measuremnts :

(a) Throughput contribution, equal to sales revenue minus direct materials cost.

(b) Investments (inventory), equal to the sum of materials cost of direct materials inventory, W.I.P inventory and finished good inventory; R & D costs and costs of equipment and buildings.

(c) Operating costs, equal to all operating costs (other than direct materials) incurred to earn throughput contribution. Operating costs include salaries and wages, rent, utilities and depreciation.

Increasing throughput and / or decreasing inventory or operating expenses should lead to the accomplishment of the firm's goal; to make money now and in future as well. Anything that prevents a firm from reaching this goal is labeled as a constraint (in the form of capacity, material, the market (demand), behaviour or even management policy).

Theory of Constraint thinking regards all progress toward the goal of making money as relating directly to management attention toward the constraint(s).

The five focusing steps are a tool developed to help systems deal with constraints: Step (i) Identify the system's constraints,

Step (ii) Decide how to exploit the system's constraints,

Step (iii) Subordinate everything else to the decisions made in step (ii), Step (iv) Elevate the system's constraints,

Step (v) If a constraint is broken in step (iv), go back to step (i), but do not allow inertia to cause a new constraints

Answer 28. (e)

Value Chain Management :

Value chain management (VCM) is a solution for smoothening the interaction between all partners of an enterprise, suppliers, dealers, bankers etc. VCM goes beyond supply chain management to bring synergy between business partner by way of providing business and knowledge information in the effective manner to help achieve business targets. There are three kinds of partners among whom a company try to build synergy.

- One is the normal supply chain management partners – suppliers, suppliers to suppliers, dealers, customers etc.
- The second important partner category is the transporter who transports raw material and finished goods. The transporters play an important role in value chain.

The third important category of partners are service providers and banks.

Q. 29. Write Short Notes on :

(i) Management Control System

(ii) Aggregate Planning

(iii) ERP

(iv) Quality Function Deployment

(v) Zero Defects and Right First Time-Philip Crosby

Answer 29. (i)

Management Control System – Joseph Maciariello & Calvin Kirby have defined M.C.S. as follows MCS is a set of inter-related communication structures that facilitates the processing of information for the purpose of assisting managers in coordinating the parts and attaining the purpose of an organization on a continuous basis.

They view "the entire organization as a control system. 'Control' is seen as a characteristic of a control system; it occurs when the organization is attaining its purpose. Purpose and attainment of purpose are central to the work of control system."

Purposes of MCS, according to them are :

1. Coordination of parts of organization
2. Steering those parts to achieve organizational goals.

Bring along unity out of the diverse activities of an organization

Answer 29. (ii)

Aggregate planning is an operational activity that does an aggregate plan for the production process, in advance of 2 to 18 months, to give an idea to management as to what quantity of materials and other resources are to be procured and when, so that the total cost of operations of the organization is kept to the minimum over that period.

The quantity of outsourcing, subcontracting of items, overtime of labour, numbers to be hired and fired in each period and the amount of inventory to be held in stock and to be backlogged for each period are decided. All of these activities are done within the framework of the company ethics, policies, and long term commitment to the society, community and the country of operation.

Aggregate planning has certain prerequired inputs which are inevitable. They include :

- Information about the resources and the facilities available.
- Demand forecast for the period for which the planning has to be done.
- Cost of various alternatives and resources. This includes cost of holding inventory, ordering cost, cost of production through various production alternatives like subcontracting, backordering and overtime.
- Organizational policies regarding the usage of above alternatives.

"Aggregate Planning is concerned with matching supply and demand of output over the medium time range, up to approximately 12 months into the future. Term aggregate implies that the planning is done for a single overall measure of output or, at the most, a few aggregated product categories. The aim of aggregate planning is to set overall output levels in the near to medium future in the face of fluctuating or uncertain demands.

The following procedure is generally adopted in the process of aggregate planning-

- Determine Demand for each period
- Determine Capacity for each period
- Identify company,departmental and union policy
- Determine Unit cost of production
- Develop alternative Plans
- If satisfactory plans emerge, select the one that best satisfies the objective.

Answer 29. (iii)

ERP- Enterprise resource planning (ERP) refers to a computer information system that integrates all the business activities and processes throughout an entire organization. ERP systems incorporate many of the features available in other types of manufacturing programs, such as project management, supplier management, product data management, and scheduling. The objective of ERP is to provide seamless, real-time information to all employees throughout the enterprise. Companies commonly use ERP systems to communicate the progress of orders and projects throughout the supply chain, and to track the costs and availability of value-added services.

ERP systems offer companies the potential to streamline operations, eliminate overlap and bottle-necks, and save money and resources. But ERP systems are very expensive and time-consuming to implement, and surveys have shown that not all companies achieve the desired benefits. According to the online business resource Darwin Executive Guides, it is "a tall order, building a single software program that

serves the needs of people in fi nance as well as it does the people in human resources and the warehouse... To do ERP right, the ways you do business will need to change and the ways people do their jobs will need to change too. And that kind of change doesn't come without pain."

Answer 29. (iv)

Quality Function Deployment- Quality Function Deployment (QFD) is a structured approach to defining customer needs or requirements and translating them into specific plans to produce products to meet those needs. The "voice of the customer" is the term to describe these stated and unstated customer needs or requirements. The voice of the customer is captured in a variety of ways : direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, etc. This understanding of the customer needs is then summarized in a product planning matrix or "house of quality". These matrices are used to translate higher level "what's" or needs into lower level "how's" — product requirements or technical characteristics to satisfy these needs.

While the Quality Function Deployment matrices are a good communication tool at each step in the process, the matrices are the means and not the end. The real value is in the process of communicating and decision-making with QFD. QFD is oriented toward involving a team of people representing the various functional departments that have involvement in product development: Marketing, Design Engineering, Quality Assurance, Manufacturing/ Manufacturing Engineering, Test Engineering, Finance, Product Support, etc.

The active involvement of these departments can lead to balanced consideration of the requirements or "what's" at each stage of this translation process and provide a mechanism to communicate hidden knowledge - knowledge that is known by one individual or department but may not otherwise be communicated through the organization. The structure of this methodology helps development personnel understand essential requirements, internal capabilities, and constraints and design the product so that everything is in place to achieve the desired outcome - a satisfied customer. Quality Function Deployment helps development personnel maintain a correct focus on true requirements and minimizes misinterpreting customer needs. As a result, QFD is an effective communications and a quality planning tool.

Answer 29. (v)

'Zero Defects' & "Right First Time" - Philip Crosby :

Philip Crosby prompted the phrases, "Zero Defects" does not mean mistakes never happen, rather than there is no allowable number of errors built into a product or process and that it is to be got right first time. He believes that management should take prime responsibility for quality and worker only follow their managers' example.

His four absolute quality management criteria are :

(i) Quality is conformance to requirements,

(ii) Quality prevention is preferable to quality inspection,

(iii) Zero defects is the quality performance standard,

(iv) Quality is measured in monetary terms—the price of non-conformance.

Steps to quality improvement :

Committed to quality,

Creation of quality improvement teams representing all the departments,

Measure processes to determine current and potential quality issues,

Calculate cost of (poor) quality,

Raise quality awareness of all employees, Take action to correct quality issues, Monitor progress of quality improvement, Train supervisors in quality improvement, Hold "Zero Defects" days,

Encourage employees to create their own quality improvement goals,

Encourage employee communication with management about obstacles to quality, Recognize participants' effort,

Create quality councils,

Do it all over again — quality improvement does not end.

Q. 30. Write Short Notes on :

(a) Distribution Requirement Planning

(b) KAIZEN Costing

(c) Five S Concept

(d) Six Sigma

(e) PDCA

Answer 30. (a)

Systematic process for determining which goods, in what quantity, at which location, and when are required in meeting anticipated demand. This inventory related information is then entered into a manufacturing requirements planning (MRP-I) system as gross requirements for estimating input flows and production schedules.

A supply channel is composed of three structures. At one end of the channel is the manufacturer. The manufacturer focuses on the development and production of products and originates the distribution process. The terminal point in the channel is the retailer who sells goods and services directly to the customer for their personal, non-business use. In between the two lies a process called distribution.

Distribution involves a number of activities centered around a physical flow of goods and information. At one time the term distribution applied only to the outbound side of supply chain management, but it now includes both inbound and outbound. Management of the inbound flow involves these elements :

- Material planning and control
- Purchasing
- Receiving
- Physical management of materials via warehousing and storage
- Materials handling

Management of the outbound flow involves these elements :

- Order processing
- Warehousing and storage
- Finished goods management
- Material handling and packaging
- Shipping
- Transportation

Distribution channels are formed to solve three critical distribution problems: functional performance, reduced complexity, and specialization.

Answer 30. (b)

Kaizen Costing :

Kaizen costing is a modification of standard costing which is essential to realize the planned cost reductions in continuous time. Kaizen costing is a Japanese contribution to cost accounting. Kaizen costing is

continuous improvement applied to cost reduction in the manufacturing stage of a product's life. Like that of standard costing programme, the aim of Kaizen costing is to remove inefficiencies from production processes.

Kaizen costing tracks the cost reduction plans on a monthly basis. The Kaizen costing targets are expressed in the physical resources terms. If the head of a group fails to achieve the Kaizen costing target by 1 percent, review by senior will start. Resource consumption is so tightly controlled in many Japanese firms. Thus the planned cost reductions are planned and monitored through Kaizen cost targets in terms of physical resources.

While implementing the concept of Kaizen, following few rules are to be remembered :

- List down your own problems.
- Grade your problems as to minor, difficult and major.
- Select the smallest minor problem and start with it. After tackling this, move on to next graded problem and so on.
- Know and always remember, improvement is a part of daily routine.
- Never accept status quo.
- Never reject any idea before trying it.
- Share the experiments with colleagues.
- Eliminate already tried but failed experiments, while sharing the problems with your colleagues.
- Never hide problems, always highlight them.

Answer 30. (c)

Five S Concept- Five 'S' are derived from the first letters of the words

SEIRI — means Organization or sorting

SEITON — means straighten or prepare correctly

SEISO — means Cleanup or Cleanliness

SEIKETSU — means Standardization

SHITSUKE — means Discipline

Advantages of 5S By thoroughly enforcing 5S in each work area.

1. Operations can be performed without error, proceeding in a well-regulated fashion, resulting in fewer defective items thereby increasing the overall quality of product.
2. Operations can be performed safely and comfortably, reducing the chances of accidents.
3. Machinery and equipment can be carefully maintained, reducing the number of breakdowns.
4. Operations can be performed efficiently, eliminating waste thereby incrasing the efficiency and productivity.

Answer 30. (d)

Six Sigma- Six Sigma is a rigorous and a systematic methodology that utilizes information (management by facts) and statistical analysis to measure and improve a company's operational performance, practices and systems by identifying and preventing 'defects' in manufacturing and service-related processes in order to anticipate and exceed expectations of all stakeholders to accomplish effectiveness.

Six Sigma is a business management strategy originally developed by Motorola, USA in 1981. As of 2010[update], it enjoys widespread application in many sectors of industry, although its application is not without controversy.

Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes.It uses a set of quality management methods, including statistical methods, and creates a special infrastructure of people within the organization ("Black Belts", "Green Belts", etc.) who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified targets. These targets can be financial (cost reduction or profit increase) or whatever is critical to the customer of that process (cycle time, safety, delivery, etc.).

The term *six sigma* originated from terminology associated with manufacturing, specifically terms associated with statistical modelling of manufacturing processes. The maturity of a manufacturing process can be described by a *sigma* rating indicating its yield, or the percentage of defect-free products it creates. A six-sigma process is one in which 99.99966% of the products manufactured are free of defects, compared to a one-sigma process in which only 31% are free of defects. Motorola set a goal of "six sigmas" for all of its manufacturing operations and this goal became a byword for the management and engineering practices used to achieve it.

Answer 30. (e)

PDCA-PDCA ("Plan-Do-Check-Act") is an iterative four-step problem-solving process typically used in quality control. PDCA was made popular by Dr. W. Edwards Father of modern quality control; however it was always referred to by him as the "Shewhart cycle." Later in Deming's career, he modified PDCA to "Plan, Do, Study, Act" (PDSA) so as to better describe his recommendations.

The concept of PDCA comes out of the Scientific Method. The scientific method can be written as "hypothesis" - "experiment" - "evaluation" or Plan, Do, and Check. Shewhart described manufacture under "control"- under statistical control - as a three step process of specification, production, and inspection. The also specifically related this to the Scientific Method of hypothesis, experiment and evaluation. Shewhart, says that the statistician "must help to change the demand [for goods] by showing... how to close up the tolerance range and to improve the quality of goods." Clearly, Shewhart intended the analyst to take action based on the conclusions of the evaluation. PDCA has an inherent circular paradigm, it assumes that everything starts with Planning. Plan has a limited range of meaning. Shewart intended that experiments and quality control should be planned to deliver results in accordance with the specifications, which is good advice. However, Planning was not intended to cover aspects such as creativity, innovation, invention. In these aspects particularly when based upon imagination, it is often impossible or counterproductive to plan. Hence, PDCA is inapplicable in these situations.