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IN THIS EDITION

Questions	Solutions
December - 2013 to June - 2026 Duly incorporated in chapters	December - 2013 to December - 2025 Duly incorporated in chapters
	June - 2026 on scanneradda.com ➡"My Books" for the Answers

SCANNER™ 1.5

Strategic Cost Management

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Study Material Based Contents
Paper - 16
Strategic Cost Management

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PYQ's: 2013 December to 2026 June (23 Exams)

Note: The weighted score is mapped as **A (Very Important), B (Moderately Important), C (Essential but Lower Priority), D (Lowest Priority)** to help you decide your study sequence.

This Importance Rating is derived from star ratings across 3 parameters - Attempts (Frequency), Maximum Marks (Weightage), and Compulsory Questions (Certainty). (See Page xii)

Syllabus

Paper - 16 **Strategic Cost Management (One Paper - Three Hours)** **(100 Marks)**

Syllabus Structure:

The syllabus in this paper comprises the following topics and study weightage:

Module No.	Module Description	Weight
Section A	**Strategic Cost Management for Decision Making**	**60%**
1.	Introduction to Strategic Cost Management	5%
2.	Quality Cost Management	5%
3.	Decision Making Techniques	25%
4.	Activity Based Management and Just in Time (JIT)	10%
5.	Evaluating Performance	15%
Section B	**Quantitative Techniques in Decision Making**	**40%**
6.	Linear Programming	15%
7.	Transportation	
8.	Assignment	
9.	Game Theory	15%
10.	Simulation	
11.	Network Analysis – PERT, CPM	
12.	Learning Curve	
13.	Business Application of Maxima and Minima	10%
14.	Business Forecasting Models – Time Series and Regression Analysis	
15.	Introduction to Tools for Data Analytics	

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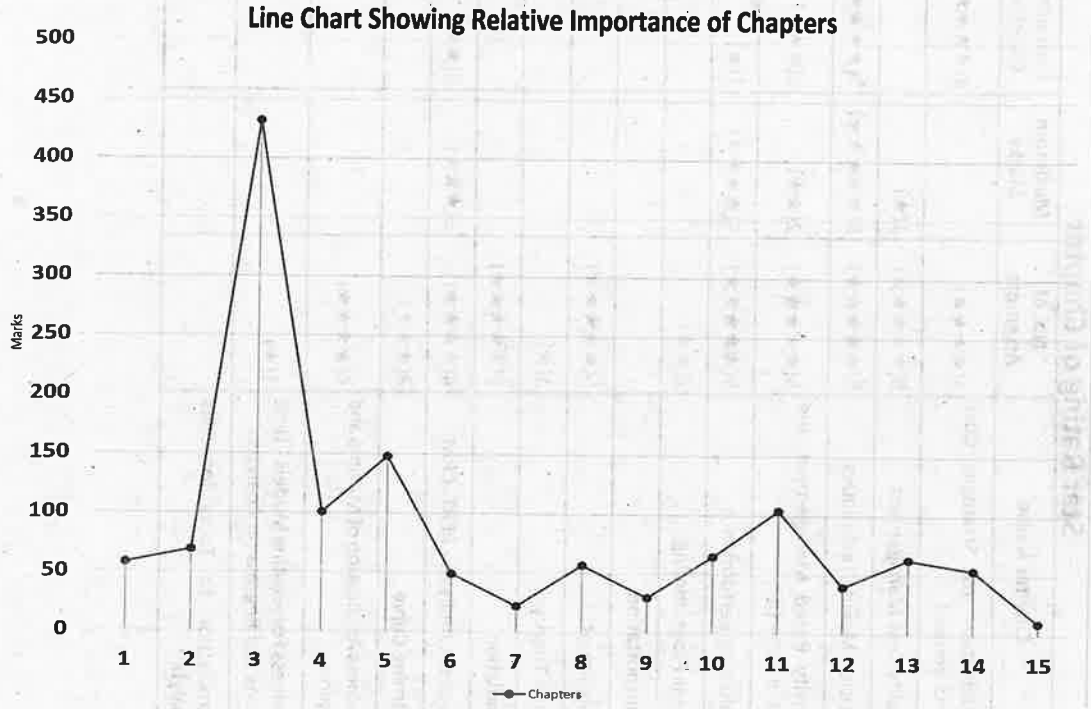
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Chapter Marks Trend Graph
Strategic Cost Management
Line Chart Showing Relative Importance of Chapters



Chapter-Wise Marks Analysis

Chap. No.	Chapter Name / Years	19 Jun	19 Dec	22 Dec	23 Jun	23 Dec	24 Jun	24 Dec	25 Jun	25 Dec	26 Jun	Total
1.	Introduction to Strategic Cost Management	2	-	12	12	11	2	9	2	4	4	58
2.	Quality Cost Management	4	4	10	15	2	9	2	9	7	7	69
3.	Decision Making Techniques	74	88	36	22	32	34	34	36	38	38	432
4.	Activity Based Management and Just in...	10	8	16	9	9	9	9	9	11	11	101
5.	Evaluating Performance	16	2	18	14	16	16	16	16	16	18	148
6.	Linear Programming	4	8	8	6	-	7	-	-	9	7	49
7.	Transportation	-	-	-	2	2	2	-	9	-	7	22
8.	Assignment	8	4	8	8	9	2	7	2	7	2	57
9.	Game Theory	-	-	-	8	2	2	9	-	2	7	30
10.	Simulation	8	2	8	2	9	9	9	9	7	2	65
11.	Network Analysis - PERT, CPM	2	18	12	8	9	16	16	16	-	7	104
12.	Learning Curve	8	-	-	8	7	2	2	2	9	2	40
13.	Business Application of Maxima and....	10	10	-	6	7	7	2	7	7	7	63
14.	Business Forecasting Models - Time...	-	-	-	-	9	11	11	9	7	7	54
15.	Introduction to Tools for Data Analytics	-	-	-	6	-	-	-	-	2	2	10

Chapter-Wise Compulsory Questions Analysis

Chap. No.	Years / Chapter Name	19 Jun	19 Dec	22 Dec	23 Jun	23 Dec	24 Jun	24 Dec	25 Jun	25 Dec	26 Jun	Total
1.	Introduction to Strategic Cost Management	2	-	2	6	4	2	2	2	4	4	28
2.	Quality Cost Management	-	-	2	2	2	2	2	2	-	-	12
3.	Decision Making Techniques	10	10	4	10	4	6	6	8	10	10	78
4.	Activity Based Management and Just in...	2	2	2	4	2	2	2	2	4	4	26
5.	Evaluating Performance	-	2	2	2	2	2	2	2	2	4	20
6.	Linear Programming	4	-	2	-	-	-	-	-	2	-	8
7.	Transportation	-	-	-	2	2	2	-	2	-	-	8
8.	Assignment	-	-	-	-	2	2	-	2	-	2	8
9.	Game Theory	-	-	-	-	2	2	2	-	2	-	8
10.	Simulation	-	2	-	2	2	2	2	2	-	2	14
11.	Network Analysis - PERT, CPM	2	2	2	8	2	2	2	2	-	-	22
12.	Learning Curve	-	-	-	-	-	2	2	2	2	2	10
13.	Business Application of Maxima and....	-	-	-	-	-	-	2	-	-	-	2
14.	Business Forecasting Models - Time...	-	-	-	-	2	4	4	2	-	-	12
15.	Introduction to Tools for Data Analytics	-	-	-	-	-	-	-	-	2	2	4

Star Rating of Chapter

No.	Chapter Name	No. of Attempts	Maximum Marks	Compulsory Questions
1.	Introduction to Strategic Cost Mana-gement	4(★★★★)		4(★★★★)
2.	Quality Cost Management	5(★★★★★)	1(★)	
3.	Decision Making Techniques	5(★★★★★)	5(★★★★★)	5(★★★★★)
4.	Activity Based Management and Just in Time (JIT)	5(★★★★★)	2(★★)	3(★★★)
5.	Evaluating Performance	5(★★★★★)	4(★★★★)	1(★)
6.	Linear Programming	2(★★)		
7.	Transportation			
8.	Assignment	5(★★★★★)		
9.	Game Theory	1(★)		
10.	Simulation	5(★★★★★)		
11.	Network Analysis - PERT, CPM	4(★★★★)	3(★★★)	2(★★)
12.	Learning Curve	3(★★★)		
13.	Business Application of Maxima and Minima	4(★★★★)		
14.	Business Forecasting Models - Time Series and Regression Analysis	1(★)		
15.	Introduction to Tools for Data Analytics			

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- Editoria Team

Paper Trend Analysis

Paper-16: Strategic Cost Management

Year	Q. No.	{C}	No.	Chapter Name	Topic	Mks.	Ctg.	Page No.
2026 June	1 (i)-(iii)	{C}	3	Decision Making Techn...		6	OQ	81
	(iv)	{C}	4	Activity Based Manage...		2	OQ	220
	(v)	{C}	5	Evaluating Performance		2	OQ	266
	(vi)	{C}	8	Assignment		2	OQ	347
	(vii)	{C}	10	Simulation		2	OQ	382
	(viii)	{C}	12	Learning Curve		2	OQ	443
	(ix)	{C}	15	Introduction to Tools ...		2	OQ	502
	(x)	{C}	1	Introduction to Strategic...		2	OQ	8
	(xi)	{C}	3	Decision Making Techn...		2	OQ	81
	(xii)	{C}	4	Activity Based Manage...		2	OQ	220
	(xiii)	{C}	5	Evaluating Performance		2	OQ	266
	(xiv)	{C}	1	Introduction to Strategic...		2	OQ	8
	(xv)	{C}	3	Decision Making Techn...		2	OQ	82
	2		3	Decision Making Techn...	1	14	CSQ	138
	3 a		3	Decision Making Techn...	3	7	CSQ	161
	b		3	Decision Making Techn...	5	7	CSQ	189
	4 a		4	Activity Based Manage...	1	7	CSQ	241
	b		2	Quality Cost Management	2	7	DQ	41
	5 a		5	Evaluating Performance	1	7	CSQ	303
	b		5	Evaluating Performance	1	7	CSQ	304
	6 a		6	Linear Programming	5	7	CSQ	324
	b		7	Transportation	2	7	CSQ	341
	7 a		9	Game Theory	1	7	CSQ	369
	b		11	Network Analysis -PERT...	5	7	CSQ	428
	8 a		13	Business Application of...	3	7	CSQ	475
	b		14	Business Forecasting M...	4	7	CSQ	500

Legend: **OQ:** Objective Question, **SN:** Short Notes, **DB:** Distinguish Between, **DQ:** Descriptive Questions, **CSQ:** Case-Scenario Questions

PYQ 2024-Dec [1] (i) {C} Choose the correct option from the four alternatives given:
Which of the following important pillars of Strategic Cost Management determines the company's comparative position in the industry in terms of performance?
(a) Cost Driver Analysis
(b) Value Chain Analysis
(c) Strategic Positioning Analysis
(d) Competitive Value Analysis **(2 Marks)**
Answer: (c) Strategic Positioning Analysis

PYQ 2025-Jun [1] (i) {C} Choose the correct option from the given alternatives:
Which of the following primary activities of Porter's Value Chain deliver the Product or Service to the Customer?
(a) Operations (b) Outbound Logistics
(c) Infrastructure (d) Services **(2 Marks)**
Answer: (b) Outbound Logistics

2025-Dec [1] {C} Choose the correct option from the given alternatives:
(x) Which one of the following, simply answers the question "What else will accomplish the purpose of the product, service or process we are studying?"
(a) Value Engineering
(b) Value Analysis
(c) Business Process Re-engineering
(d) Supply Chain Strategy **(2 Marks)**
Answer: (a) Value Engineering

(xiv) Which of the following is not a principle of Business Process Re-engineering?
(a) Organise work around outcomes, not tasks.
(b) Capture information once and at the source.

(c) Empower workers who use the process.
(d) Rely heavily on hierarchy and supervision. **(2 Marks)**
Answer: (d) Rely heavily on hierarchy and supervision.

PYQ 2026-Jun [1] {C} Choose the correct option from the four alternatives given:
(x) Which one of the following is true for a Blue Ocean Strategy?
(a) Exploit existing demand
(b) Beat the competition
(c) Make the competition irrelevant
(d) Make the value-cost trade off **(2 Marks)**

(xiv) A major risk in implementing Business Process Reengineering is
(a) over dependence on Information Technology.
(b) increase in product prices.
(c) reduced market share.
(d) employee resistance to change. **(2 Marks)**

SECTION-B

02 Cost Control and Cost Reduction

THEORY QUESTIONS

TQ 2.1	PYQ	2015-Jun [4] (b) (ii)	DB	7 Marks
Distinguish between Cost Reduction and Cost Control.				

Answer:

Difference between Cost Reduction and Cost Control:

Particulars	Cost Reduction	Cost Control
1. Permanence	Permanent, Real and reflects genuine savings in cost.	Represents efforts made towards achievement of pre-determined target or goal.
2. Nature of function	It is a corrective function. It can operate along with an efficient cost control system. This concept Believes that there is always a scope for further reduction in costs.	It is a preventive function, where costs are optimized before these are incurred.
3. Nature of process	It presumes the existence of concerned potential savings in norms or standards and therefore it is a corrective process.	It does not focus on costs independent of revenue nor considers product attributes as given. It is a holistic control process.

4. Performance evaluation	It is not concerned with maintenance of performance according to standards.	The process involves setting up a target, investigating variances and taking remedial measures to correct them.
5. Nature of Standards	Continuous process of critical examination includes analysis and challenge of standards. It assumes the existence of potential savings in the standards and aims at improving them by bringing out more savings.	It accepts the standards, once they have been fixed. In other words, standards shall remain, as it is.
6. Dynamism	Fully a dynamic approach.	It is a routine exercise and lacks dynamic approach.
7. Coverage	Universally applicable to all areas of business. Does not depend upon standards, though target amounts may be set.	Limited applicability to those items of cost for which standards can be set.
8. Basic approach	It is not concerned with maintenance of performance according to standards. It challenges the very standards set.	It involves setting up a target, ascertaining the actual performance and doing the variance analysis, followed by remedial actions.

TQ 2.2	PYQ	2017-Jun [2] (b) (i)	DB	1 Mark
What are the problems of Traditional Costing arising out of volume-based cost allocation to products?				

Answer:
Under traditional costing, overhead which occupies an important share of the total cost structure of the firm is generally allocated based on volume-based allocation rates viz. rates per labour hour, rate per machine hour, % of labour cost, etc. It does not take into consideration disproportionate consumption of service from service department. As a result, the product cost gets distorted i.e., some products are over costed while others are under costed. The basic assumption in cost allocation is; the higher the volume, the greater the share of indirect costs to the product or service. This simplistic assumption does not hold good in reality.

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2021-Dec [5]	1 Mark

A hand crafted product is produced in a factory taking 8 hours per unit against the standard set at 9 hours. The production manager is trying to find means of reducing the standard to lesser hours by improving material handling, etc. This measure is considered as (Cost Reduction/ Cost Control)

[Sec. B - SAQ]

Answer:
Cost Reduction

CSQ 2.2	PYQ	2022-Dec [2] (a)	10 Marks

ABC Enterprises has prepared a draft budget for the next year as follows:

Quantity	10,000 units
Sales price per unit (₹)	30
Variable costs per unit:	
Direct Materials (₹)	8
Direct Labour (₹)	6
Variable overhead (2hrs. × 1) (₹)	2
Contribution per unit (₹)	14

Budgeted Contribution (₹)	1,40,000
Budgeted Fixed Costs (₹)	1,25,000
Budgeted Profit (₹)	15,000

The Board of Directors are dissatisfied with this budget, and asks working party to come up with alternate budget with higher target profit figures. The working party reports back with the following suggestions that will lead to budgeted profit of ₹ 25,000. The company should spend ₹ 30,000 on advertising and set the target sales price up to ₹ 32 per unit. It is expected that the sales volume will also rise, in spite of the price rise to 12,000 units. In order to achieve the extra production capacity, however, the workforce must be able to reduce the time taken to make each unit of the product. It is proposed to offer a pay and productivity deal in which the wage rate per hour is increased to ₹ 4. The hourly rate for variable overhead will be unaffected.
Ascertain the target labour time required to achieve the target profit.

Answer:
Sales = 12,000 × 32 = 3,84,000
Less: Profit = 25,000
Total Cost = 3,59,000
Advertisement = 80,000
Material (8 × 12,000) = 96,000
F.C. = 1,25,000
Labour & OH Cost = 1,08,000
Therefore,
Labour Hours = 1,08,000 ÷ 5 = 21,600 hrs

03 Value Chain Analysis

THEORY QUESTIONS

TQ 3.1	PYQ	2017-Jun [2] (a)	DESC	2+4=6 Marks

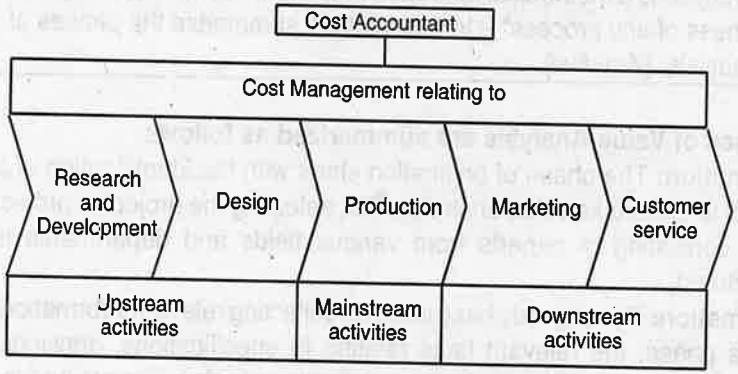
What is Value Chain ? How does it help modern cost management?

Answer:

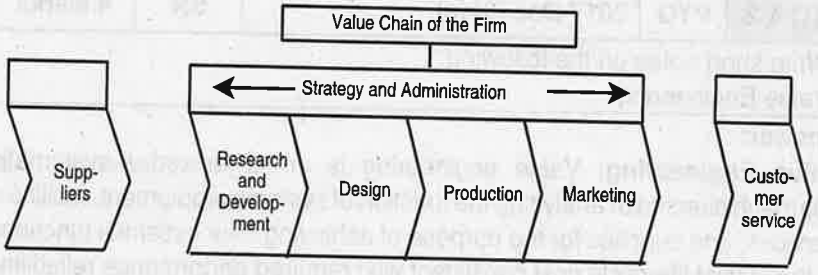
A value chain is the sequence of business functions in which utility (usefulness) is added to the products or services of the firm. Through proper analysis and management of each segment of the value chain, customer value is enhanced. Non- value creating activities are eliminated.

In value chain analysis, each of the business functions is treated as an essential and valued contributor and is constantly analyzed to enhance value relative to the cost incurred. Like business functions, in value chain approach also, it is important that the efforts of all functions are integrated and co-ordinated to increase the value of the products or services to the customers.

The following diagram shows the important functions or activities of a firm and the role of the cost accountant in cost management.



Michael Porter introduced the value chain concept in cost management in 1985. It was developed further by others subsequently. When the supplier and customers are included, the firm is viewed as an extended value chain as shown below:



The value chain approach is an integral part of strategic cost management, which is an approach to Management Accounting that explicitly highlights strategic issues and concerns. It sets cost analysis as a broader context in which cost information is used to develop superior strategies.

Modern cost accountant has an important role to play in analyzing cost information relating to each of the segments of the value chain and supplying the same to other functional managers for improved decisions.

04 *Value Engineering*

THEORY QUESTIONS

TQ 4.1	PYQ	2016-Jun [7] (b)	DESC	2 Marks

Define the term 'value engineering'.

Answer:

Value Engineering is a function oriented, systematic team approach and study to provide value in a product, system or service. Often, this improvement is focused on cost reduction; however other important areas such as customer perceived quality and performance are also of paramount importance in the value equation.

TQ 4.2	PYQ	2017-Dec [8] (e)	SN	4 Marks
Write short notes on the following: Value Engineering				

Answer:

Value Engineering: Value engineering is an organized / systematic approach directed at analyzing the function of systems, equipment, facilities, services, and supplies for the purpose of achieving their essential functions at the lowest life-cycle cost consistent with required performance reliability, quality and safety.

Society of Japanese Value Engineering defines VE as:

"A systematic approach to analyzing functional requirements of products or services for the purposes of achieving the essential functions at the lowest total cost".

Value Engineering is an effective problem solving technique. Value Engineering is essentially a process which uses function analysis, team-work and creativity to improve value. Value Engineering is not just "good engineering". It is not a suggestion program and it is not routine project or plan review. It is not typical cost reduction in that it doesn't "cheapen" the product or service, nor does it "cut corners".

TQ 4.3	PYQ	2018-Jun [8] d)	SN	4 Marks
Write short notes on the following: Value Engineering				

Answer:

Please refer 2017-Dec [8] (e)

TQ 4.4	PYQ	2021-Dec [2]	DESC	4 Marks
Define Value Engineering (VE).What are the issues considered during a VE review? *[Sec. C - Three LAQ]*				

Answer:

Meaning of Value engineering:

Value engineering involves searching for opportunities to modify the design of each component or part of a product to reduce cost, but without reducing the functionality and quality of the product.

Following Issues are given below:

1. Elimination of unnecessary functions from the production process.
2. Elimination of unnecessary product qualities
3. Design minimisation
4. Substitution of parts
5. Search for better way of doing things.

TQ 4.5	PYQ	2023-Dec [4] (b)	DESC	7 Marks
"Value Analysis is a methodical approach to sharpening the efficiency and effectiveness of any process" – In this context, summarize the phases of Value Analysis. (*Any five*)				

Answer:

The Phases of Value Analysis are summarized as follows:

1. **Origination:** The phase of origination starts with the identification of a project to undertake value analysis. After selecting the project, a project team consisting of experts from various fields and departments is constituted.
2. **Information:** The second phase is that of collecting relevant information. In this phase, the relevant facts relating to specifications, drawings, methods, materials, etc. are collected. Costs are, also, ascertained for each of the elements that are being studied.
3. **Functional Analysis:** Then follows the important phase of functional analysis. After familiarisation with the relevant facts & figures, a functional analysis is carried out to determine the functions and uses of the product and its components. The cost and importance of each function are identified. A value index is computed on the basis of cost benefit ratio for each of the functions.

4. **Innovation:** This is the creative phase concerned with the generation of new alternatives to replace or remove the existing ones. The objective is to produce ideas and to formulate alternative means and methods for accomplishing the essential functions and improving the value of the element under consideration.
5. **Evaluation:** During the stage of evaluation, each and every alternative is analysed and the most promising alternatives are selected. These alternatives are further examined for economic and technical feasibility. The alternatives finally selected must be capable of performing the desired functions satisfactorily.
6. **Choice:** In this phase, the decision makers choose the best of alternatives. The programs and action plans are then developed to implement the chosen alternative.
7. **Implementation:** The chosen alternative is put to the actual use with the help of the programs and action plans. The progress of implementation is continuously monitored and followed up to ensure that the desired results are achieved.

TQ 4.6	PYQ	2024-Dec [4] (b)	DESC	7 Marks
"Value Analysis enables people to contribute towards value addition by continuous focus on product design and services". - In this context, summarize the phases of Value Analysis.				

Answer:

Please refer 2023-Dec [4] (b)

CASE-SCENARIO QUESTIONS

CSQ 4.1	PYQ	2015-Jun [4] (a) (i)	8 Marks
Aadarsh Instruments, located in Ambala, is a medical instrument manufacturing company considered to apply Value Engineering in to the Focus Adjustment Knob in one of their model SL 250 for Slit Lamp in microscope. This microscope has found application in the field of eye inspection. The value engineering analysis may help company in running its export business of medical microscope. This firm is producing different types of microscopes which they export to various countries around the globe. All of the products manufactured here are conforming to the international standards. It is an ISO certified company. The total savings after the implementation of value engineering are as given below: • Cost before analysis — ₹ 29.99 • Total Cost of Nylon Knob — ₹ 18.40 • Saving per product — ₹ 11.59 • Percentage saving per product — ₹ 38.64% • Annual Demand of the product — 8,000 • Total Annual Saving — ₹ 92,720 • Value Improvement — ₹ 62.98% What are the steps to be followed for doing Value Engineering? How can you conclude the decision on the basis of the above Value Engineering?			

Answer:

The following are the steps to be used for carrying out the Value Engineering exercise by Aadarsh Instruments in their model SL 250 for Slit Lamp in Microscope for the Focus Adjustment Knob:

(i) Selection of the Product Plan.
(ii) Gathering Product Information
(iii) Functional Analysis
(iv) Creativity Phase and preparing the work-sheet
(v) Evaluation Sheet
(vi) Cost Analysis
(vii) Result and Conclusion
(viii) Implementation.

Conclusion:

Value Engineering methodology is a powerful tool for resolving system failures and designing improvements in performance of any process, product, service or organization. In the Case Study discussed under the question, we have used the concept of Value Engineering to analyze the

Focus Adjustment Knob of SL 250 Slit Lamp Microscope. With a critical evaluation of this study, we have been able to increase the value of the product by substituting another material in place of the one currently in use. The % value improvement is to the tune of 62.98% and the total annual saving has been ₹ 92,720.

The various advantages have been observed in terms of:

- Cost Reduction
- Increase in overall production
- Reduction in man-power
- Reduction in scrap.

Thus the cost has been brought down by a substantial margin and thereby the value of the product has been increased.

05 *Business Process Re-engineering*

THEORY QUESTIONS

TQ 5.1	PYQ	2017-Dec [8] (b)	SN	4 Marks
Write short notes on the following: Seven Principles of BPR				

Answer:

Seven Principles of BPR:

1. Processes should be designed to achieve a desired outcome rather than focusing on existing tasks,
2. Personnel who use the output from a process should perform the process,
3. Information processing should be included in the work, which produces the information,
4. Geographically dispersed resources should be treated, as if they are centralized,
5. Parallel activities should be linked rather than integrated,
6. Doers should be allowed to be self-managing,
7. Information should be captured once at source.

TQ 5.2	PYQ	2018-Dec [8] (a)	SN	4 Marks
Write short notes on the following: Business Process Re-engineering				

Answer:

Business Process Re-engineering (BPR) refers to fundamental rethinking and redesign of business processes to achieve improvement in critical measures of performance such as cost, quality, service, speed and customer satisfaction.

In contrast, the meaning of Kaizen, which involves small, incremental steps towards gradual improvement, re-engineering involves a giant leap.

It is the complete redesign of a process with an emphasis on finding creative new way to accomplish an objective.

It has been described as taking a blank piece of paper and starting from scratch to redesign a business process. Rather than searching continually for minute improvement, re-engineering involves a radical shift in thinking about how an objective should be met.

Re-engineering prescribes radical, quick and significant change.

Admittedly, it can entail high risks, but it can also bring big rewards.

These benefits are most dramatic, when new models are discovered for conducting business.

TQ 5.3	PYQ	2023-Jun [2] (a)	DESC	6 Marks
"Business Process Re-engineering involves the radical redesign of core business processes to achieve dramatic improvements in productivity, cycle times and quality." In this context, state what are the characteristics and principles of Business Process Re-engineering.				

Answer:

Characteristics and Principles of Business Process Re-engineering are enumerated below:

(i) Several jobs are combined into one

(ii) Often workers make decisions

(iii) The steps in the process are performed In a logical order
(iv) Work is performed, where it makes most sense
(v) Quality is built in
(vi) Manager provides a single point of contact
(vii) Centralized and decentralized operations are combined.

Seven Principles of BPR:

(i) Processes should be designed to achieve a desired outcome rather than focusing on existing tasks
(ii) Personnel who use the output from a process should perform the process
(iii) Information processing should be included in the work, which produces the information
(iv) Geographically dispersed resources should be treated, as if they are centralized
(v) Parallel activities should be linked rather than integrated
(vi) Doers should be allowed to be self-managing
(vii) Information should be captured once at source.

CASE-SCENARIO QUESTIONS

CSQ 5.1	PYQ	2016-Jun [5] (b) {C}	6 Marks

The public sector Bank of India (BOI), which targets to take its business to about ₹ 12 lakhs crore in next five years, mulls to implement Business Process Re-engineering (BPR) initiates to streamline its growing business. Seven consultants, including Ernst & Young, Boston Consulting Group (BCG) and McKinsey, have expressed interest to take up the job of evaluation and restructuring the organizational set-up by using 3Rs Model of BPR. What are the actions and resources to be considered for 3Rs Model of EPR for expecting the results to BOI?

Answer:

BPR is achieving dramatic performance improvements through radical changes in organizational process, re-architecting of business and management process. It involves the redrawing of organizational boundaries,

the reconsideration of jobs, tasks, knowledge and skills. This occurs with the creation and the use of models. In resuming the whole process of BPR in order to achieve the expected results is based on key steps- principles which include 3R (i.e., re-design, re-tool and re-orchestrate). Each step- principle embodies the actions and resources as presented in below:

Re-design	Re-tools	Re-orchestrate
Simplify	Networks	Synchronies
Standardize	Intranets	Processes
Empowering	Extranets	Information Technology
Employee-ship	Workflow	Human resources
Groupware		
Measurements		

06 Supply Chain Management

CASE-SCENARIO QUESTIONS

CSQ 6.1	PYQ	2015-Dec [1] {C}	20 Marks

This Case Study explains why Nestle Inc. needs a first class Supply Chain, with high quality linkages from where the coffee is grown in the field, to the way in which it reaches the consumer. For Nestle"s, the Supply Chain is a bit complex and includes:

- Growers of Coffee
- Intermediaries like dealers/brokers/roasters/retailers, etc., Some Intermediaries may buy Coffee and doing some of the primary processing.
- Growing and processing of Coffee. This includes activities like coffee picking, drying and hulling sorting, grading & picking.
- Price-Balancing Supply and Demand: Coffee prices are determined on day-to-day basis on the world commodity markets in London and New York. The price of Coffee is determined by the relationship between the amount of Coffee available to be sold (Supply) and the amount

which the company would like to buy (demand). If there is more Coffee available than what the company would desire to buy at current prices, the prices will fall. The market, thus, ultimately determines the price that the farmer receives.

- Nestle"s Trading Methods: Nestle is a pioneer in purchasing Coffee direct from growers. A growing % of the company"s Coffee is bought direct from the producer and it is now one of the world"s largest direct purchasers. In Countries, where this is not possible, Nestle operates in a way that takes it as close to the growers as possible.
- Buying from dealers: In countries like UK, it is impossible for Nestle to buy from the hundreds of thousands of farmers, who ultimately supply the Company and so the coffee is bought from dealers, using the international market.

Conclusion: Creating wonderful cups of Coffee is not only Nestle"s business, it is the business of everyone involved in the Supply Chain. It is in everyone"s interest the farmers" and Nestle"s – that farmers receive a fair income from their Coffee. This ensures that they will continue to grow Coffee and to invest in increasing their yield and quality and this in turn, guarantees the supply of quality Coffee, which companies like Nestle require.

In the context of the above case study, answer the following questions:

(i) What is Supply Chain Management? Explain clearly its basic concept?
(ii) What are the basic objectives of a Supply Chain?
(iii) State the way Nestle Inc., manages its Supply Chain?

Answer:

Supply Chain Management (SCM) is the active management of Supply Chain activities to maximize customer value and achieve a sustainable Competitive Advantage.

A Supply Chain is a network of facilities and distribution options that performs the functions of Procurement of materials, transformation of these materials into intermediate and finished goods and the distribution of these finished goods to the customers. Supply Chain exists in both Service and Manufacturing Organizations. The complexity of the chain may vary greatly from Industry to Industry and from firm to firm.

The concept of Supply Chain Management (SCM) is based on the core idea that every product that reaches an end user represents the cumulative effort of multiple organizations and collectively referred to as Supply Chain.

Supply Chain Management (SCM) represents a conscious effort by the Supply Chain firms to develop and run Supply Chains in the most effective and efficient ways possible.

In 1980s companies discovered new manufacturing technologies and strategies that allowed them to reduce costs and compete better in different markets. Strategies like JIT manufacturing, Lean Manufacturing, TQM etc., became very popular and vast amounts of resources were invested in implementing these strategies. Many companies have reduced manufacturing cost to the barest minimum.

Many companies are discovering that effective SCM is the next step that must be taken to increase Profit and market share.

SCM is a strategy/mechanism, through which different functions can be integrated.

SCM is not a new innovation in management philosophy. Rather it existed since the time of Napoleon, as he commended once "Army marches on its stomach." He did not explain his statement but the inner meaning is unquestionable i.e., to make a strategy successful, it should have a strong line of supply be it food, clothes, arms or anything else.

Thus, SCM is the management of upstream and downstream value-added flow of materials, final goods and related information among Suppliers, Company, Re-Sellers and final customers. It is a systematic and strategic co-ordination of the traditional business functions with a view to improving the long-term performance of the company. It encompasses the planning and management of all activities involved in Sourcing, Procurement, Conversions and Logistic Management.

In a nutshell, SCM implies all such activities by which the final product is delivered in the hands of customers.

Logistics is the logical way of transportation in a timely way so that Production and Distribution are not hampered.

But in SCM, we take into account all the aspects of the Product like:

- Sales demand analysis
- Production Planning
- Procurement of Raw-Material
- Ware-housing
- Production Process/Conversion
- Picking, Drying and hulling, sorting, grading & picking.
- **Price-Balancing Supply and Demand:** Coffee prices are determined on day-to-day basis on the world commodity markets in London and New York. The price of Coffee is determined by the relationship between the amount of Coffee available to be sold (Supply) and the amount which the company would like to buy (demand). If there is more Coffee available than what the company would desire to buy at current prices, the prices will fall. The market, thus, ultimately, determines the price that the farmer receives.
- **Nestle's Trading Methods:** Nestle is a pioneer in purchasing Coffee direct from growers. A growing % of the companies Coffee is bought direct from the producer and it is now one of the world's largest direct purchasers. in Countries, where this is not possible, Nestle operates in a way that takes it as close to the growers as possible.
- **Buying from dealers:** In countries like UK, it is impossible for Nestle to buy from the hundreds of thousands of farmers, who ultimately supply the Company and so the Coffee is bought from dealers, using the international market.

For Notes

For Notes

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 2 Quality Cost Management

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Managing Quality in Competitive Environment	2	-
2.	Cost of Quality	10	-
3.	Total Quality Management	4	-
4.	Lean Accounting	6	-
5.	Six Sigma	9	-

SECTION-A

PYQ 2016-Dec [1] (iv) (d) {C} In each of the case/statement given below, one of four alternatives is correct. Indicate the correct answer:
Following are included in the concept of the TQM philosophy, except
(a) Customer focus (b) Static improvement
(c) Employee empowerment (d) Use of quality tools **(1 Mark)**
Answer: (b) Static improvement

PYQ 2017-Dec [1] (viii) {C} Choose the most appropriate answer to the following questions giving justification.
Match the following:

(A)	Dr. Deming believes	(1)	Common causes
(B)	Ishikawa development	(2)	To prevent defect
(C)	Type of variation is due to	(3)	Cause & effect diagram
(D)	Crosby's objective of quality	(4)	Histogram

The correct order is
(a) A-3, B-2, C-1, D-4 (b) A-2, B-3, C-4, D-1
(c) A-2, B-3, C-1, D-4 (d) A-4, B-3, C-1, D-2 **(2 Marks)**
Answer: (c) A-2, B-3, C-1, D-4

PYQ 2021-Dec [3] A factory is setting up a special inspection at the supply point of raw materials at ₹ 80,000. Consequent to this, there is lesser number of returns from customers. These goods used to be sold for ₹ 1,00,000 and variable costs are ₹ 80,000. The change in quality costs are
(1) Decrease by ₹ 80,000 (2) Decrease by ₹ 60,000
(3) Decrease by ₹ 20,000 (4) No change
(1 Mark) [Sec. A - MCQ]

Answer:
(4) No change

PYQ 2021-Dec [16] Liability claims is an example of
(1) prevention costs. (2) appraisal costs.
(3) external failure costs. (4) internal failure costs.
(1 Mark) [Sec. A - MCQ]

Answer:
(3) external failure costs.

PYQ 2021-Dec [3] Spoilage is an example of _____ quality cost.
(1 Mark) [Sec. B - SAQ]

Answer:
Internal failure

PYQ 2022-Dec [1] (iv) {C} Choose the most appropriate answer to the following questions giving justification/reasonable workings:
Depreciation of product testing equipment is:
(a) Internal Failure Cost (b) Appraisal Cost
(c) Not a Quality Cost (d) Irrelevant, but Quality Cost
(2 Marks)

Answer: (b) Justification:
Appraisal costs are incurred in the process of uncovering defects. They include the cost of quality inspections, product testing, and performing audits to make sure that quality standards are being met. Also included in this category are the costs of worker time spent measuring quality and the cost of equipment used for quality appraisal. Example; testing and inspecting materials, final product testing and inspecting, WIP testing and inspecting, package inspection and depreciation of testing equipment.

PYQ 2023-Jun [1] (ii) {C} Choose the most appropriate answer to the following questions with justification.
Warranty period return of finished goods sold falls under the following quality cost:
(a) Prevention (b) Appraisal
(c) Internal failure (d) External failure. **(2 Marks)**
Answer: (d) External failure.

PYQ 2023-Dec [1] (i) {C} Choose the correct option.
Down time due to defect in quality is an example of:
(a) Internal failure cost (b) Prevention cost
(c) Appraisal cost (d) External failure cost **(2 Marks)**
Answer: (a) Internal failure cost

PYQ 2024-Jun [1] (ii) {C} Choose the correct option from the four alternatives given:
Which of the following Quality Cost is incurred in the process of uncovering defects?
(a) Appraisal Costs (b) Prevention Costs
(c) Internal Failure Costs (d) External Failure Costs **(2 Marks)**
Answer: (a) Appraisal Costs

PYQ 2024-Dec [1] (iii) {C} Choose the correct option from the four alternatives given:
Which of the following quality costs is incurred when inferior products are delivered to customers?

(a) Prevention Costs (b) Appraisal Costs
(c) External Failure Costs (d) Internal Failure Costs **(2 Marks)**
Answer: (c) External Failure Costs

PYQ 2025-Jun [1] (ii) {C} Choose the correct option from the given alternatives:
Which of the following is/are not the quality parameter(s) for manufacturing organisations?
(a) Reliability (b) Durability
(c) Service ability (d) Courtesy/Friendliness **(2 Marks)**
Answer: (d) Courtesy/Friendliness

SECTION-B

01 Managing Quality in Competitive Environment

THEORY QUESTIONS

TQ 1.1	PYQ	2016-Jun [7] (a)	DB	2 Marks
Write the basic difference between 'quality assurance' and 'quality control'.				

Answer:
The term 'quality assurance' and 'quality control' are often used interchangeably to refer to ways of ensuring the quality of services or products. The two terms, however, have different meanings.
Quality assurance refers the planned and systematic activities (i.e. engineering activities) implemented in a quality system so that the quality requirements for a product or service will be fulfilled. It is the act of giving confidence or the state being certain.
Quality control refers the operational techniques and activities used to fulfill requirements for quality and needed for corrective responses.

TQ 1.2	PYQ	2017-Dec [2] (a)	DESC	8 Marks
What do you understand by 'quality' in the context of Quality Cost Management? Explain.				

Answer:
Quality is defined (by the American Society) as the total features and characteristics of a product or service made or rendered according to specifications to satisfy customers at the time of purchase and during use. There are two basic aspects of quality: (a) design quality, and (b) conformance quality. Quality of product or service is decided by the customer and is built into the service on product through the design for it. A customer has certain needs or requirements for product or service. It is the design of product or service which builds these requirements as product or service

specifications into the product or service–including the way the product or service would be delivered to the customer. The way the product is made or the service is delivered is according to a set of processes which are in sequence. This set of processes, their sequence and interdependence gets defined while the design activity is performed and the design of process has a direct impact on the outcome, that is, the extent to which the outcome meets the specifications developed during design. Process design also contributes to quality. Conformance to specifications measures how well the product or service meets the targets and tolerances determined by its designers. **For example**, the dimensions of a machine part may be specified by its design engineers as 3 + .05 inches. This would mean that the target dimension is 3 inches but the dimensions can vary between 2.95 and 3.05 inches. Similarly, the wait for hotel room service may be specified as 20 minutes, but there may be an acceptable delay of an additional 10 minutes. Also, consider the amount of light delivered by a 60 watt light bulb. If the bulb delivers 50 watts it does not conform to specifications. As these examples illustrate, conformance to specification is directly measurable, though it may not be directly related to the consumer's idea of quality.

Thus, actual performance (quality) of a product or service may fall short of customer expectation either due to design quality failure and/or due to conformance quality failure.

Quality has both financial and non-financial perspectives. Financially, it, represents costs of quality where as non-financial measures are the number of customer complaints, defectives to good production (%), employee empowerment and training, etc. Quality affects all aspects of the organization and has dramatic cost implications. The most obvious consequence occurs when poor quality creates dissatisfied customers and eventually leads to loss of business. However, quality has many other costs, which can be divided into two categories. The first category consists of costs necessary for achieving high quality, which are called quality control costs. These are of two types: prevention costs and appraisal costs. The second category consists of the cost consequences of poor quality, which are called quality failure costs. These include external failure costs and internal failure costs. The first two costs are incurred in the hope of preventing the second two.

02 Cost of Quality

THEORY QUESTIONS

TQ 2.1	PYQ	2017-Dec [8] (a)	SN	4 Marks
Write short notes on the following: Usefulness of Pareto Analysis				

Answer:

Pareto analysis is useful to: 1. Prioritize problems, goals, and objectives to Identify root causes, 2. Select and define key quality improvement programs, 3. Select key customer relations and service programs, 4. Select key employee relations improvement programs, 5. Select and define key performance improvement programs, 6. Maximize research and product development time, 7. Verify operating procedures and manufacturing processes, 8. Product or services sales and distribution, 9. Allocate physical, financial and human resources.

TQ 2.2	PYQ	2022-Dec [8] (b)	SN	4 Marks
Write Short Note on: Pareto Analysis in Quality Management				

Answer:

Pareto analysis in Quality Management:

Pareto analysis is based on the principle that 80% of the volume relates to 20 % value and vice - versa. In the context of problem solving, it says that 80% of the problems can be solved by taking 20% effort.

The 80 - 20 rule can be modified to 70 - 30 or 75 - 25, etc., but the essence is that larger volumes are concentrated on a smaller area of attention.

When resources are limited and the problems seem very large, this approach gives a good analysis for an action plan that could be effective.

TQ 2.3	PYQ	2017-Dec [2] (b)	DESC	4+4 = 8 Marks
Why would you classify costs of quality into different groups? Enumerate them and give suitable examples where possible.				

Answer:

Costs of quality can be classified into the following groups for better quality costs management: (1) Prevention costs, (2) Appraisal costs, (3) Internal failure costs, (4) External failure costs, (5) opportunity costs (e.g. loss of contribution).

Prevention costs are all costs incurred in the process of preventing poor quality from occurring. They include quality planning costs, such as the costs of developing and implementing a quality plan. Also included are the costs of product and process design, from collecting customer information to designing processes that achieve conformance to specifications. **Example;** Quality training, Quality circles, Statistical process control activities, System Development for prevention, Quality improvement.

Appraisal costs are incurred in the process of uncovering defects. They include the cost of quality inspections, product testing, and performing audits to make sure that quality standards are being met. Also included in this category are the costs of worker time spent measuring quality and the cost of equipment used for quality appraisal. **Example;** testing and inspecting materials, final product testing and inspecting, WIP testing and inspecting, package inspection and depreciation of testing equipment.

Internal failure costs are associated with discovering poor product quality before the product reaches the customer site. One type of internal failure cost is rework, which is the cost of correcting the defective item. Sometimes the item is so defective that it cannot be corrected and must be thrown away.

This is called scrap, and its costs include all the material, labor, and machine cost spent in producing the defective product. **Example;** cost of scrap (net of realization), cost of spoilage, cost of rework, down time due to defect in quality and retesting.

External failure costs are incurred when inferior products are delivered to customers. They include cost of handling customer complaints, warranty replacements, repairs of returned products and cost arising from a damaged company reputation. **Example;** cost of field servicing, cost of handling complaints, warranty repairs, lost sales, warranty replacements.

For better management, quality costs may be classified into direct (e.g. employees and inspectors involved in defect rectification) and indirect costs. Indirect costs are incurred in each of the costs-of-quality activities.

TQ 2.4	PYQ	2018-Jun [6] (a)	DESC	3+5 = 8 Marks
Explain the concept of 'quality' and enumerate 'cost of quality' under different groups.				

Answer:

The term quality is a perception which is personal to an individual. In plain terms, quality is "features" or "worth" or "value".

Conformance to specifications measures how well the product or service meets the targets and tolerances determined by its designers.

Fitness for use focuses on how well the product performs its intended function or use.

Value for price paid is a definition of quality that consumers often use for product or service usefulness. **Support services** provided are often how the quality of a product or service is judged. Quality does not apply only to the product or service itself; it also applies to the people, processes, and organizational environment associated with it.

Psychological criteria is a subjective definition that focuses on the judgmental evaluation of what constitutes product or service quality.

Quality has many other costs, which can be divided into two categories. The first category consists of costs necessary for achieving high quality, which are called quality control costs. These are of two types:

Prevention Costs and Appraisal Costs. The second category consists of the cost consequences of poor quality, which are called quality failure costs. These include external failure costs and internal failure costs.

Prevention Costs are all costs incurred in the process of preventing poor quality from occurring. They include quality planning costs, such as the costs of developing and implementing a quality plan. Also included are the costs of product and process design, from collecting customer information to designing processes that achieve conformance to specifications. Employee

training in quality measurement is included as part of this cost, as well as the costs of maintaining records of information and data related to quality.

Appraisal Costs are incurred in the process of uncovering defects. They include the cost of quality inspections, product testing, and performing audits to make sure that quality standards are being met. Also included in this category are the costs of worker time spent measuring quality and the cost of equipment used for quality appraisal.

Internal Failure Costs are associated with discovering poor product quality before the product reaches the customer site. One type of internal failure cost is rework, which is the cost of correcting the defective item. Sometimes the item is so defective that it cannot be corrected and must be thrown away. This is called scrap, and its costs include all the material, labour, and machine cost spent in producing the defective product.

External Failure Costs are incurred when inferior products are delivered to customers. They include cost of handling customer complaints, warranty replacements, repairs of returned products and cost arising from a damaged company reputation.

TQ 2.5	PYQ	2025-Jun [4] (b)	DESC	7 Marks
"Quality is the degree to which a set of inherent characteristics fulfils requirements." – In this context, explain the concept of quality and append the cost of quality under different categories briefly explaining them.				

Answer:

The term quality is a perception that varies from person to person. In simple terms, it refers to the features, worth, or value of a product or service. Today, there is no universally accepted definition of quality. However, some common definitions include:

Conformance to specifications: This measures how effectively a product or service meets the targets and tolerances set by its designers.

Fitness for use: This refers to how well a product performs its intended purpose or function.

Value for price paid: Consumers often use this definition to evaluate how useful a product or service is in relation to its cost.

Support services: The quality of the services provided alongside a product often influences how its overall quality is perceived.

Psychological criteria: This subjective definition depends on personal judgment and perception of what constitutes quality in a product or service.

The costs of quality are classified into four categories for effective quality cost management:

(i) Prevention costs, (ii) Appraisal costs, (iii) Internal failure costs, and (iv) External failure costs.

(i) **Prevention Costs:** Prevention costs are incurred to prevent poor quality from arising. These include the costs of developing and implementing quality plans, designing products and processes, collecting customer feedback, and ensuring conformance to specifications.

Examples: Quality training, quality circles, statistical process control activities, system development for prevention, and quality improvement initiatives.

(ii) **Appraisal Costs:** Appraisal costs are incurred to identify defects. They cover expenses related to quality inspections, product testing, and audits to verify adherence to quality standards. These also include labor time spent measuring quality and the depreciation of testing equipment.

Examples: Testing and inspecting materials, inspecting work-in-progress (WIP) and final products, package inspection, and depreciation of testing instruments.

(iii) **Internal Failure Costs:** Internal failure costs arise when defects are detected before products reach customers. These include costs of reworking defective items or scrapping unusable ones, as well as losses from downtime and retesting.

Examples: Cost of scrap (net of realization), spoilage, rework, downtime due to quality defects, and retesting.

(iv) External Failure Costs: External failure costs occur when defective products reach customers. They include expenses related to customer complaints, warranty claims, product replacements, repairs, and the loss of reputation or sales.

Examples: Field servicing costs, complaint handling, warranty repairs, lost sales, and warranty replacements.

TQ 2.6	PYQ	2026-Jun [4] (b)	DESC	7 Marks

Apply the classification of Cost of Quality to assess the following items under appropriate categories of quality costs, viz., Prevention Costs (PC), Appraisal Costs (AC), Internal Failure Costs (IFC) and External Failure Costs (EFC):

1. Product acceptance
2. Design review
3. Discount due to defects
4. Re-inspection
5. Statistical process control activities
6. Cost of field servicing
7. Depreciation of testing equipment

[**Note:** Write only the Roman numbers of the items given against appropriate categories]

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2017-Jun [6] (a)	6+2=8 Marks

Nikee Ltd. manufactures and sells one variety of sports-shirt in India. Noted football clubs and supporters of these clubs are the main customers. Nikee's products show some rectifiable defects. These problems can generally be detected and repaired during internal inspection at a cost of ₹ 15 per unit.

During 2016, 50,000 shirts were produced and sold. After inspection defect was detected in respect of 5% of output. Inspection cost is ₹ 25 per shirt. After sales, customers reported defects in respect of 6% of output. These shirts were received back from customers at a transportation cost of ₹ 8 per unit. Because of negative publicity due to defects, there would be loss of sales in 2017 to the extent of 5% of external failures.

Required:

(i) Analyse costs of quality showing separately (with workings) the:
- (I) Inspection or appraisal cost
- (II) Internal failure cost
- (III) External failure cost
- (IV) Opportunity cost due to external failure, and
- (V) Total costs of quality

(ii) If the selling price per shirt is ₹ 250 and variable cost is 60% of sales, fixed cost ₹ 5,50,000 p.a., prepare a statement showing profitability of the product during 2016.

Answer:

Statement of Costs of Quality

		₹
(a)	Inspection or Appraisal cost (₹ 25 × 50,000 shirts)	12,50,000
(b)	Internal failure (re-work) cost (5% × 50,000 × ₹ 15)	37,500
(c)	External failure cost (i.e., transportation + re-work cost) [6% × 50,000 × (₹ 8 + 15)]	69,000
(d)	Opportunity cost (i.e., loss of contribution) [10% × (5% × 50,000) × (₹ 250 × 40%)]	25,000
	Total Quality Cost	13,81,500

Profitability Statement

	₹
Sales (50,000 × ₹ 250)	1,25,00,000
Less: Variable Cost (60%)	75,00,000
Contribution	50,00,000
Less: Quality Cost (as above)	13,81,500
Contribution, net of quality costs	36,18,500
Less: Fixed Cost	5,50,000
Net Profit	30,68,500

CSQ 2.2	PYQ	2018-Dec [6] (a)	8 Marks

The following is the information regarding turnover and quality cost of a company:

(i) Sales revenue ₹ 1,00,00,000; net income ₹ 10,00,000

(ii) During the year, customers returned 30,000 units needing repair. Repair cost averages ₹ 7 per unit.

(iii) Six inspectors are employed each earning an annual salary of ₹ 25,000. These six inspectors are involved only with final inspection (Product acceptance).

(iv) Total scrap is 30,000 units. All scrap is quality related. The cost of scrap is about ₹ 15 per unit.

(v) Each year, approximately 1,50,000 units are rejected in final inspection. Of these units, 80 per cent can be recovered through rework. The cost of rework is ₹ 3.00 per unit.

(vi) A customer cancelled an order that would have increased the profits by ₹ 2,50,000. The customer's reason for cancellation was poor product performance. The accounting and marketing departments agree that the company loses at least this much during the year for the same reason.

(vii) The company employs five full time employees in its complaint department. Each earns ₹ 20,000 a year.

(viii) The company gave sales allowances totalling ₹ 1,30,000 due to substandard products being sent to the customer.

(ix) The company requires all new employees to take in three hour Quality-Training programme. The estimated cost for the programme is ₹ 80,000.

(x) Inspection of the final product requires testing equipment. The annual cost operating and manufacturing this equipment is ₹ 1,20,000.

Required:

Prepare a simple quality cost report classifying costs by rational category.

Answer:

Quality Cost Report:

		Quality Costs	Percentage of sales
(i)	**Prevention costs:**		
	Quality training	80,000	0.8%
(ii)	**Appraisal costs:**		
	Product inspection	1,50,000	
	Test equipment	1,20,000	
		2,70,000	2.7%
(iii)	**Internal failure costs:**		
	Scrap	4,50,000	
	Rework	3,60,000	
		8,10,000	8.1%
(iv)	**External failure costs:**		
	Repair	2,10,000	
	Order cancellation	2,50,000	
	Customer complaints	1,00,000	
	Sales allowance	1,30,000	
		6,90,000	6.9%
Total quality costs (i to iv)		18,50,000	18.5%

CSQ 2.3	PYQ	2021-Dec [2]	4 Marks

The following data of manufacture and sale is obtained from AEC Ltd. for the year ending 31st March, 2021

Product	A	B	C	D	E	F	Total
Contributicn (₹)	500	200	1500	75	100	125	2,500

Prepare a Pareto product contribution chart and comment on the sales.

[Sec. C - Two LAQ]

Answer:

Rearrange the products in descending order of contribution and find out the cumulative contribution percentage.

Product	Contribution ₹	Cumulative Contribution ₹	Cumulative Contribution (%)
C	1,500	1,500	60%
A	500	2,000	80%
B	200	2,200	88%
F	125	2,325	93%
E	100	2,425	97%
D	75	2,500	100%
Total	**2,500**		

On analysis it is found that 80% of the total contribution is earned by C and A. Hence these two products should be carefully monitored and nurtured. The other products should be investigated for improvement of contribution.

CSQ 2.4	PYQ	2023-Jun [3] (a)	4+3=7 Marks

The following financial information has been extracted from the records of ASHREEN LTD. for analyzing the cost of quality for the year 2022-2023:

(i) Sales Revenue for the year: ₹ 400 lakhs

(ii) During the year, customers returned 40,000 units needing repair, repair cost averages ₹ 8 per unit.

(iii) Six Inspectors are employed each earning an annual salary of ₹ 2,00,000. These six inspectors are involved only with final inspection (Product acceptance).

(iv) Total Scrap is 30,000 units. All scraps are quality related. The cost of scrap is about ₹ 20 per unit.

(v) During the year, approximate 1,20,000 units are rejected in final inspection. Of these units, 90 per cent can be recovered through rework. The cost of rework is ₹ 8 per unit.

(vi) The company employs 5 full time employees in the complaint department. Each earns ₹ 1,00,000 for this year.

(vii) The company requires all new employees to take three hour quality training programme. The estimated cost for the programme is ₹ 1,50,000.

(viii) Inspection of the final products requires testing equipment. The annual cost of operating and maintaining this equipment is ₹ 1,80,000.

Required:

(I) Analyse the costs of quality showing its elements separately with workings.

(II) If the selling price per unit is ₹ 50 and variable cost is 60% of the sales and fixed costs ₹ 70 lakhs per annum, determine what will be the profit (Net of quality costs) of the Company for the year 2022-2023.

Answer:

Cost of Quality Analysis

1. **External Failure Costs**
   (a) Repair Costs for Returned Units:
   - Customers returned 40,000 units needing repair.
   - Repair cost per unit: 8
   - Total Repair Cost = 40,000 units × 8 = 3,20,000

   (b) Scrap Costs:
   - Total Scrap: 30,000 units.
   - Cost per unit: 20
   - Total Scrap Cost = 30,000 units × 20 = 6,00,000

2. **Internal Failure Costs**
   Rework Costs:
   - Units rejected in final inspection: 1,20,000
   - Units recoverable through rework (90%): 1,20,000 × 90% = 1,08,000

- Cost of rework per unit: 8
- Total Rework Cost = 1,08,000 units × 8 = 8,64,000

3. **Appraisal Costs**
   (a) Salary of Inspectors:
   - Number of inspectors: 6
   - Annual salary per inspector: 2,00,000
   - Total Salary of Inspectors = 6 × 2,00,000 = 12,00,000

   (b) Testing Equipment Costs:
   - Annual cost of operating and maintaining the testing equipment: 1,80,000

4. **Prevention Costs**
   (a) Complaint Department Salaries:
   - Number of employees: 5
   - Annual salary per employee: 1,00,000
   - Total Complaint Department Salary = 5 × 1,00,000 = 5,00,000

   (b) Quality Training Program Costs:
   - Cost of quality training program: 1,50,000

   Total Cost of Quality = 3,20,000 (Repair Costs) + 6,00,000 (Scrap Costs) + 8,64,000 (Rework Costs) + 12,00,000 (Salary of Inspectors) + 1,80,000 (Testing Equipment Costs) + 5,00,000 (Complaint Department Salary) + 1,50,000 (Quality Training Program Costs) = 38,14,000

Profit Calculation (Net of Quality Costs)

1. Sales Revenue:
   - Total Sales Revenue: 4,00,00,000
2. Variable Costs:
   - Variable cost percentage: 60%
   - Variable Cost = Sales Revenue × 60% = 4,00,00,000 × 60% = 2,40,00,000
3. Fixed Costs:
   - Fixed Costs: 70,00,000
4. Quality Costs:
   - Total Cost of Quality: 38,14,000

5. Total Costs:
   - Total Variable Cost: 2,40,00,000
   - Total Fixed Cost: 70,00,000
   - Total Quality Cost: 38,14,000
   - Total Costs = 2,40,00,000 + 70,00,000 + 38,14,000 = 3,48,14,000
6. Profit Calculation:
   - Profit Before Quality Costs = Sales Revenue - Variable Cost - Fixed Cost = 4,00,00,000 - 2,40,00,000 - 70,00,000 = 90,00,000
   - Net Profit (after Quality Costs) = Profit Before Quality Costs - Quality Costs = 90,00,000 - 38,14,000 = 51,86,000

Net Profit = 51,86,000

03 Total Quality Management

THEORY QUESTIONS

TQ 3.1	PYQ	2015-Jun [4] (c) (ii)	DESC	9 Marks
What are the various stages/steps to be taken in the implementation of TQM?				

Answer:

The following are the various stages/steps to be taken in the implementation of TQM process:

Stage 1: Identification of customers/customer groups: Through a team approach, the firm should identify major customer groups. This helps in generating priorities in the identification of customers and critical issues in the provision of decision-support information.

Stage 2: Identifying customer expectations: Once the major customer groups are identified, their expectations are then listed.

Stage 3: Identifying customer decision-making requirements and product utilities: BY identifying the need to stay close to the customers and follow their suggestions, a decision-support system can be developed, incorporating both financial as well as non-financial information.

Stage 4: Identifying perceived problems in decision-making process and product utilities: Using participative processes such as brain-storming, the firm seeks to list out its perception of problem areas and the shortcomings in meeting customer requirements.

Stage 5: Comparison with other firms and benchmarking: Detailed and systematic internal deliberations allow the firm to develop a clear idea of their own strengths and weaknesses and of the areas of most significant deficiency.

Stage 6: Customer feedback: Interaction with the customers and obtaining their views helps the firm in correcting its own perceptions and refining its process.

Stage 7: Identification of improvement opportunities and implementation of Quality improvement Process: The outcomes of the customer survey, benchmarking and internal analysis.

TQ 3.2	PYQ	2017-Jun [8] (c)	SN	4 Marks
Write a short note on the following: Principles of Total Quality Management (TQM).				

Answer:

Principles of Total Quality Management (TQM):

The philosophy of TQM rest on the following principles, which are enlisted below:

(i) Clear exposition of the benefits of a project.
(ii) Total Employee Involvement (TEI).
(iii) Process measurement.
(iv) Involvement of all customers and contributors.
(v) Elimination of irrelevant data.
(vi) Understanding the needs of the whole process.
(vii) Use of errors to prompt continuous improvement.
(viii) Use of statistics to tell people how well they are doing.

TQ 3.3	PYQ	2017-Dec [8] (c)	SN	4 Marks
Write short notes on the following: Four P's of TQM				

Answer:

Four P's of TQM

	The 4P's
People	To avoid misdirection, TQM teams should consist of team spirited individuals who have a flair for accepting and meeting challenges Individuals who are not ideally suited to the participatory process of TQM. Should not be involved at all. e.g. lack of enthusiasm, non- attendance at TQM meetings, failure to complete delegated work, remaining a "Mute Spectator" at TQM meetings, etc.
Process	It is essential to approach problem-solving practically and to regard the formal process as a system designed to prevent participants from jumping to conclusions. As such, it will provide a means to facilitate the generation of alternatives while ensuring that important discussion stages are not omitted.
Problem	Problems need to be approached in a systematic manner, with teams tackling solvable problems with a direct economic impact, allowing for immediate feedback together with recognition of the contribution made by individual participants.
Preparation	Additional training on creative thinking and statistical processes are needed in order to give participants a greater appreciation of the diversity of the process. This training must quickly be extended beyond the immediate accounting circle to include employees at supervisory levels and also who are involved at the data input strategy.

TQ 3.4	PYQ	2023-Jun [2] (b)	DESC	6 Marks
Summarize the essential steps to be taken in the implementation of Total Quantity Management (TQM) (Any Six)				

Answer:

The required steps to be taken in the implementation of Total Quality Management are summarized below:

Step 1: Identification of customers / customer groups:

Through a team approach (a technique called Multi-Voting), the Firm should identify major customer groups. This helps in generating priorities in the identification of customers and critical issues in the provision of decision-support information.

Step 2: Identifying customer expectations:

Once the major customer groups are identified, their expectations are listed. The question to be answered is - What does the customer expect from the Firm?

Step 3: Identifying customer decision-making requirements and product utilities:

By identifying the need to stay close to the customers and follow their suggestions, a decision support system can be developed, incorporating both financial and non-financial and non-financial information, which seeks to satisfy user requirements.

Step 4: Identifying perceived problems in decision-making process and product utilities:

Using participative processes such as brainstorming and multi-voting, the Firm seeks to list out its perception of problem areas and shortcomings in meeting customer requirements.

Step 5: Comparison with other Firms and benchmarking:

Detailed and systematic internal deliberations allow the Firm to develop a clear idea of their own strengths and weaknesses and of the areas of most significant deficiency. Benchmarking exercise allows the Firm to see how other Companies are coping with similar problems and opportunities?

Step 6: Customer Feedback:

Steps 1 to 5 provide an information base developed without reference to the customer. This is rectified at **Steps 6** with a survey of representative customers, which embraces their views on perceived problem areas. Interaction with the customers and obtaining their views helps the Firm in correcting its own perceptions and refining its processes.

Steps 7 & 8: Identification of Improvement opportunities and Implementation of Quality Improvement Process:

The outcomes of the customer survey, benchmarking and Internal analysis, provides the inputs for **Steps 7 and 8**, i.e. the identification of improvement opportunities and the implementation of a formal improvement process. This is done through a six-step process called PRAISE, for short.

04 *Lean Accounting*

THEORY QUESTIONS

TQ 4.1	PYQ	2017-Dec [8] (d)	SN	4 Marks
Write short notes on the following: Lean Accounting				

Answer:

Lean Accounting

- It refers to the application of lean principles in day to day accounting process by eliminating 3Ms (muda-waste, mura-variation, and muri-strain on resources) by looking at it from eyes of the customer/user/beneficiary group.
- Lean accounting highlights the importance of the lean performance measurements and reporting in the general accounting for lean application process.
- There are basically three aspects to measure lean performance as given under:
  - (i) Development of strategy which supports, company level measurement,

(ii) Continuous improvement through value stream level measurements, and
(iii) Process and cell design measurements driving the muda, mura, muri Process.

TQ 4.2	PYQ	2019-Jun [8] (b)	SN	4 Marks
Write short notes of the following: Lean Accounting				

Answer:

Please refer 2017-Dec [8] (d)

TQ 4.3	PYQ	2021-Dec [3]	SN	3 Marks
Write short note on Lean Accounting *[Sec. C - Six LAQ]*				

Answer:

Please refer 2017-Dec [8] (d)

TQ 4.4	PYQ	2021-Dec [4]	DESC	1 Mark
During the lockdown days, a hospital that was running to capacity in terms of medical staff available on regular shifts proposes to share profits with staff that are willing to work extra time. Can this be termed lean management? *[Sec. B - SAQ]*				

Answer:

Yes. Planning from a lean perspective-invest in people.

TQ 4.5	PYQ	2022-Dec [8] (a)	SN	4 Marks
Write Short Note on the following question: Lean Accounting				

Answer:

Please refer 2017-Dec [8] (d)

TQ 4.6	PYQ	2024-Jun [4] (b)	DESC	7 Marks
What is Lean Accounting? Append the Principles and Practices of Lean Accounting.				

Answer:

Lean Accounting:

Lean Accounting is the application of Lean thinking to all accounting and finance processes and systems. It is an essential component of a successful Lean transformation for any organization. Lean accounting uses a method that categorizes costs by value stream rather than by department. This approach "provides the basis for sound management decisions". Lean accounting groups together costs that fall outside of the value stream as "business sustaining costs" that do not get included in value stream costs. This, in turn, helps the businesses to find better price points for products and do further research into high-cost areas. The bottom line is that Lean accounting can help business leaders quickly know if they are heading in the right direction or need to make a change.

The principles and Practices of Lean Accounting are appended in the following table:

Sr. No.	Principles	Practices
1.	Lean & Simple Business Accounting	Continuously eliminates waste from the transactions, processes, reports and other accounting methods.
2.	Accounting process that supports lean transformation	Management Control & Continuous improvement. Cost Management. Customer & supplier value and Cost Management.
3.	Clear & Timely Communication of information	Financial reporting. Visual reporting of financial & non-financial performance measurements. Decision making.

4.	Planning from a lean perspective	Planning & Budgeting. Impact of lean improvement. Capital planning. Invest in people.
5.	Strengthen internal accounting control	Internal control based on Lean Operational Controls. Inventory Valuation.

TQ 4.7	PYQ	2025-Dec [4] (b)	DESC	7 Marks
"Lean Accounting is the application of Lean Philosophy to all accounting and finance processes and systems" - In this context, Align the Principles and Practices of Lean Accounting.				

Answer:

Please refer 2024-Jun [4] (b)

05 *Six Sigma*

THEORY QUESTIONS

TQ 5.1	PYQ	2019-Dec [8] (d)	SN	4 Marks
Write short note on the following: Six sigma in quality control process				

Answer:

Six Sigma is a set of practices originally developed by Motorola to systematically improve processes by eliminating defects. A defect is defined as non-conformity of a product or service to its specifications. While the particulars of the methodology were originally formulated by Bill Smith at Motorola in 1986, Six Sigma was heavily inspired by six preceding decades of quality improvement methodologies such as quality control, TQM, and Zero Defects.

Six Sigma asserts the following:

(a) Continuous efforts to reduce variation in process outputs is key to business success

(b) Manufacturing and business processes can be measured, analyzed, improved and controlled

(c) Succeeding at achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

The term "Six Sigma" refers to the ability of highly capable processes to produce output within specification. In particular, processes that operate with six sigma quality produce at defect levels below 3.4 defects per (one) million opportunities (DPMO). Six Sigma's implicit goal is to improve all processes to that level of quality or make them ever better.

Chapter Trend Analysis

THE GRAPH

Marks of Objective, short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER	
3	**Decision Making Techniques**

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Decisions involving Alternative Choice	42	-
2.	Pricing Decisions and Strategies	8	-
3.	Transfer Pricing	10	-
4.	Relevant Cost Analysis	9	-
5.	Target Costing	10	-
6.	Product Life Cycle Costing	8	-
7.	Asset Life Cycle Costing	3	-
8.	Decision Making using Probability	3	-

SECTION-A

PYQ 2013-Jun [1] (a) (viii) {C} In each of the cases/statements given below, one of four alternatives is correct. Indicate the correct answer:
IBM found, after analyzing computer processing time that 80% of processing time was concerned with executing 20% of software operating code. As a result, its programmes rewrote the code to make the most frequently used parts of it as streamlined as possible. This is possible because of

(a) GE Matrix
(b) Pareto Analysis
(c) Value Engineering
(d) Benchmarking **(1 mark)**

Answer: (b) Pareto Analysis

PYQ 2017-Jun [1] {C} Choose the most appropriate answer to the following questions giving justification.

(i) Stock Control data for Material P are:
Annual usage: 3600 units; Cost per unit: ₹ 100/-; Cost of placing an order: ₹ 40;
Stockholding Cost: 20% of the overall stock volume; Lead time: One month
The EOQ based on the above data is:
(a) 210 units (b) 175 units
(c) 90 units (d) 120 units **(2 Marks)**
Answer: (d) Explanation: 120 units as per the following computation:
EOQ = $\sqrt{2AB/C}$, where
A = Annual Requirement of the material = 3,600 units.
B = Buying or Ordering Cost /Order = ₹ 40.
C = Carrying or Stockholding Cost per unit per annum = ₹ 100× 20%
EOQ = $\sqrt{2}$ x 3,600 x 40/20 =120 units.

(ii) Which of the following would take place if a company is able to reduce its variable cost?

	Contribution Margin	Break-Even Point
(a)	Increase	Increase
(b)	Decrease	Decrease
(c)	Increase	Decrease
(d)	Decrease	Increase

(2 Marks)
Answer: (c) Explanation: Contribution margin = Sales Less Variable Cost
So, reduction in variable cost will increase contribution.
BEP = FC/Contribution Margin
Hence, increase in contribution will reduce BEP.

(iii) The following details relate to Product P-1 of a manufacturing company:

Level of activity (units)	1,000	2,000
Cost per unit (₹):		
Direct materials	4.00	4.00
Direct labour	3.00	3.00
Production Overheads	3.50	2.50
Selling Overheads	1.00	0.50
	11.50	**10.00**

The total fixed cost and variable cost per unit are:

	Total Fixed Cost (₹)	Variable Cost per unit (₹)
(a)	2,000	7.00
(b)	2,000	8.50
(c)	3,000	7.00
(d)	3,000	8.50

(2 Marks)
Answer: (d) Explanation: Variable Cost per unit = 4.00 + 3.00 = ₹ 7.00
Total FC (included in Production Overheads and Selling Overheads) is as follows:
Units 1,000 2,000
Total OH4.50 × 1,000 = 4,500 3.00 × 2,000 = 6,000
Difference in Overhead = ₹ 1,500
Difference in Volume = 1,000
∴ Variable per unit = ₹1.50
Add: This to variable cost per unit of ₹ 7.00.
Total variable cost = ₹ 1.50 + ₹ 7.00 = ₹ 8.50
Fixed Cost = ₹4,500 - (1,000 × 1.50) = ₹ 4,500 - ₹ 1,500 = ₹ 3,000.

(iv) A company makes a single product which it sells at ₹ 10 per unit. Fixed costs are ₹ 48,000 per month and the product has a contribution to sales ratio of 40%. In a period when actual sales were ₹ 1,40,000, the company's margin of safety in units was:
(a) 2,000 (b) 3,000
(c) 3,500 (d) 4,000 **(2 Marks)**

Answer: (a) Explanation: BEP = $\frac{FC}{C/S\ Ratio} = \frac{₹48,000}{0.4} = ₹1,20,000$ or 12,000 units.

When sells are ₹ 1,40,000, the volume is ₹ 1,40,000 ÷ 10 = ₹ 14,000 units.

∴ Margin of Safety is 14,000 – 12,000 = 2,000 units.

(vi) A company has the capacity of production of 80,000 units and presently it sells 20,000 units at ₹ 100 each. The demand is sensitive to selling price and it has been observed that every reduction of ₹ 10 in selling price the demand is doubled. What should be the target cost at full capacity it profit margin on sales is taken at 25%?

(a) ₹ 58 lakhs(b)₹ 52 lakhs

(c) ₹ 48 lakhs(d)₹ 50 lakhs **(2 Marks)**

Answer: (c) Explanation:

Maximum Capacity	80,000 Units
Present Sale	20,000 Units @ ₹ 100/-per unit
Selling Price/Unit	Demand
100	20,000
90	40,000
80	80,000
Target Price	₹ 80
Target Cost/Unit	80 - 25% of Sales = 80 - 20 = ₹ 60/- per unit
Total Target Cost	80,000 Units × ₹60/- per unit = ₹ 48 lakhs.

(vii) The information relating to the direct material cost of a company is as follows:

Standard price per unit	₹ 7.20
Actual quantity purchased in units	1,600
Standard quantity allowed for actual production in units	1,450
Material price variance on purchase (Favourable)	₹ 480

What is the actual purchase price per unit?

(a) ₹ 7.50 (b) ₹ 6.40

(c) ₹ 6.50 (d) ₹ 6.90 **(2 Marks)**

Answer: (d) Explanation:

Material Price Variance (MPV) = Standard cost of Actual Quantity - Actual Cost

480 = 7.20 × 1,600 - Actual Cost

or, Actual Cost = 11,520 - 480 = 11,040

Actual Price / Unit = 11,040 ÷ 1,600 = ₹ 6.90.

(ix) The preparation and use of standard cost, their comparison with actual costs and the measurement and analysis of variances to originating causes is defined as:

(a) Marginal Costing (b) Standard Costing

(c) Throughput Costing (d) Kaizen Costing **(2 Marks)**

Answer: (b) Explanation: Because standard costing only involves the process described.

(x) The following are cost data for two alternative ways of processing the clerical work for legal cases brought before the district court:

	Semi automatic	Fully automatic
Monthly fixed costs (₹):		
Occupancy	15,000	15,000
Maintenance contract	5,000	10,000
Equipment lease	25,000	1,00,000
Unit variable cost (per report) (₹) Supplies Labour	8,060	2,020

The cost indifference point will be:

(a) 800 cases (b) 850 cases

(c) 750 cases (d) 700 cases **(2 Marks)**

Answer: (a) Explanation: Cost Indifference Point is calculated as follows:

$$\frac{\text{Difference in monthly FC}}{\text{Difference in unit VC}} = \frac{₹1,25,000 - ₹45,000}{₹140 - ₹40} = \frac{₹80,000}{₹100} = 800 \text{ Cases.}$$

PYQ 2017-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification.

(i) The following figures are extracted from the books of a company:
Budgeted O/H ₹ 10,000 (Fixed ₹ 6,000, Variable ₹ 4,000)
Budgeted Hours 2,000
Actual O/H ₹ 10,400 (Fixed ₹ 6,100, Variable ₹ 4,300)
Actual Hours 2,100
Variable O/H cost variance and Fixed O/H cost variance will be:
(a) 100 (A) and 200 (A) (b) 100 (F) and 200 (F)
(c) 100 (A) and 200 (F) (d) 200 (A) and 100 (F) **(2 Marks)**
Answer: (c) Variable O/H Cost variance = Recovered O/H - Actual O/H
= 4,200 – 4,300 = 100(A)
Fixed O/H Cost variance = 6,300 – 6,100 = 200 (F).

(ii) A company produces a product which is sold at a price of ₹ 80. Its Variable cost is ₹ 32. The company's Fixed cost is ₹ 11,52,000 p.a. The company operates at a margin of safety of 40%. The total sales of the company is:
(a) 4,000 units (b) 40,000 units
(c) 30,000 units (d) 20,000 units **(2 Marks)**
Answer: (b) SP 80 – VC 32 = Contribution 48
F.C. 11,52,000
B.E.P. = 11,52,000/48 – 24,000 units
MOS = 40%; B.E.P. = 60%
∴ Total sales = $\frac{24,000 \times 100}{60}$ = 40,000 units

(iii) The P/V ratio of a firm dealing in Electrical equipment is 50% and the margin of safety is 40%. BEP of the firm at a sales volume of ₹ 50,00,000 will be
(a) ₹ 25,00,000 (b) ₹ 35,00,000
(c) ₹ 30,00,000 (d) ₹ 36,00,000 **(2 Marks)**
Answer: (c) Actual Sales - M.O.S. = BEP Sales
Sales = ₹ 50,00,000

Less: Margin of safety 40% on sales = ₹ 20,00,000
Break even sales = ₹ 30,00,000

(vi) Marketing department of an organisation estimates that 40,000 of new mixers could be sold annually at a price of ₹ 60 each. To design, develop and produce these new mixers an investment of ₹ 40,00,000 would be required. The company desires a 15% return on investment (ROI). Given these data, the target cost of manufacture, sell, distribute and service one mixer will be
(a) ₹ 37.50 (b) ₹ 40.00
(c) ₹ 45.00 (d) ₹ 48.60 **(2 Marks)**
Answer: (c)

Projected sales (40,000 mixers X ₹ 60 per mixer) (A)	= ₹ 24,00,000
Less: Desired profit (15% of ₹ 40,00,000) (B)	= ₹ 6,00,000
Target Cost for 40,000 mixers (A - B)	= ₹ 18,00,000
Target Cost per mixer (₹ 18,00,000 / 40,000 mixer	= ₹ 45.00 per unit

PYQ 2018-Jun [1] Choose the most appropriate answer to the following questions giving justification:

(i) A Company requires ₹ 85,00,000 in sales to meet its target net profit. Its contribution margin is 30% and the fixed costs are ₹ 15,00,000. What is the target net profit?
(a) ₹ 10,50,000 (b) ₹ 19,50,000
(c) ₹ 25,50,000 (d) ₹ 35,00,000 **(2 Marks)**
Answer: (a) Explanation:
₹ 10,50,000
= (85,00,000 × 30%) – 15,00,000 = 10,50,000
Or
Sales × Contribution Margin Ratio or P.V. Ratio – Fixed Cost

(ii) In a factory where standard costing system is followed, the production department consumed 1,100 kgs of a material @ ₹ 8 per kg for product X resulting in material price variance of ₹ 2,200 (Fav) and material usage variance of ₹ 1,000 (Adv). What is the standard material cost of actual production of product X?

(a) 11,000 (b) 20,000
(c) 14,000 (d) 10,000 **(2 Marks)**

Answer: (d) Explanation:
Actual Cost + Favourable Cost Variance = Standard Cost
1,100 × 8 + 2,200 – 1,000 = 8,800 + 1,200 = 10,000

(iii) The following information relate to ABC company for two activity levels:

Activity level	60%	80%
Variable costs (₹)	12,000	16,000
Fixed costs (₹)	20,000	22,000

The differential cost for 20% capacity is
(a) ₹ 4,000 (b) ₹ 2,000
(c) ₹ 6,000 (d) ₹ 5,000 **(2 Marks)**

Answer: (c) Explanation:
Differential Costs = Differences in Fixed and Variable Cost = 4,000 + 2,000 = 6,000.

(iv) By making and selling 9,000 units of a product, a company makes a profit of ₹ 10,000, whereas in the case of 7,000 units, it would lose ₹ 10,000 instead. The number of units to break-even is
(a) 7,500 units (b) 8,000 units
(c) 7,750 units (d) 8,200 units **(2 Marks)**

Answer: (b) Explanation:
Contribution for 2,000 units = 20,000 (difference in profits for two output levels)
Hence, contribution per unit = 10.
Substituting in equation 1,00,000 = F + 10,000. Or F = 80,000.
BEP = 80,000 / 10 = 8,000.

(v) 1,200 units of microchips are required to be sold to earn a profit of ₹ 1,06,000 in a monopoly market. The fixed cost for the period is ₹ 74,000. The contribution in the monopoly market is as high as 3/4th of its variable cost. Determine the target selling price per unit.

(a) 450 (b) 325
(c) 400 (d) 350 **(2 Marks)**

Answer: (d) Explanation:
Contribution = 1,06,000 + 74,000 = 1,80,000
Contribution/Unit = 1,80,000/1,200 = 150
Variable Cost/Unit = 150 ÷ ¾ = ₹ 200
Selling price = 350

(vii) If project A has a net present value (NPV) of ₹ 30,00,000 and project B has an NPV of ₹ 50,00,000, what is the opportunity cost if project B is selected?
(a) ₹ 23,00,000 (b) ₹ 30,00,000
(c) ₹ 20,00,000 (d) ₹ 50,00,000 **(2 Marks)**

Answer: (b) Explanation:
Opportunity cost represents the next best alternative foregone.
If B is chosen, only A is being foregone and hence the NPV of 30,00,000 is the present value of the opportunity lost.

(ix) Empire Hotel has a capacity of 100 single rooms and 20 double rooms. Average occupancy is 70% for 365 days of the year. The rent for a double room is kept at 130% of a single room. The total room *occupancy days* in a year in terms of single room is
(a) 32,193 (b) 30,660
(c) 31,660 (d) 30,993 **(2 Marks)**

Answer: (a) Explanation:
1 double room = 1.3 single in terms of revenue.
Capacity = 100 + 1.3 × 20 = 100 + 26 = 126 equivalent single rooms.
Total Room Occupancy p.a. = 126 × 365 × 70% = 32,193 days.
Note: This can be arrived at by other ways also, taking for example 70% of only single rooms and then double rooms, etc.

PYQ 2018-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification:

(i) A company has a break even point when sales are ₹ 3,20,000 and variable cost at that level of sales are ₹ 2,00,000. How much would contribution margin increase or decrease if variable expenses are dropped by ₹ 30,000?

(a) Increase by 27.5% (b) Increase by 9.375%
(c) Decrease by 9.375% (d) Increase by 37.5% **(2 Marks)**

Answer: (b) S – V = C = ₹ 3,20,000 – ₹ 2,00,000 = ₹ 1,20,000

$c/s\ ratio = \frac{1,20,000}{3,20,000} \times 100 = 37.5\%$

New VC = ₹ 1,70,000,

∴ C = ₹ 1,50,000

$c/s\ ratio = \frac{1,50,000}{3,20,000} \times 100 = 46.875\%$

∴ % increase in c = 46.875 – 37.5% = 9.375%

(iii) A company operates a standard absorption costing system. The budgeted fixed production overheads for the company for last year were ₹ 3,30,000 and budgeted output was 2,20,000 units. At the end of the company's financial year, the total of the fixed production overheads debited to the Fixed Production Overhead Control Account was ₹ 2,60,000 and the actual output achieved was 2,00,000 units. The under/over absorption of overhead was

(a) ₹ 40,000 over absorbed (b) ₹ 40,000 under absorbed
(c) ₹ 50,000 over absorbed (d) ₹ 50,000 under absorbed **(2 Marks)**

Answer: (a) Overhead Absorption Rate = $\frac{₹3,30,000}{2,20,000\ units}$ = ₹ 1.50/unit

Overhead Absorbed: 2,00,000 @ ₹ 1.50 =	₹ 3,00,000
Actual overhead	₹ 2,60,000
Over absorbed overhead	₹ 40,000

(iv) A company has the capacity of producing 80,000 units and presently sells 20,000 units at ₹ 100 each. The demand is sensitive to selling price and it has been observed that with every reduction of ₹ 10 in selling price the demand is doubled. What should be the target cost in selling price if the demand is doubled at full capacity and profit margin on sale is taken at 25%?

(a) ₹ 75 (b) ₹ 90
(c) ₹ 25 (d) ₹ 60 **(2 Marks)**

Answer: (d) as per following:

Demand	price (₹)
20,000	100
40,000	90
80,000	80

∴ Target cost = ₹ 80 – (25% of 80) = ₹ 60/-

(v) A factory can make only one of the three products X, Y or Z in a given production period. The following information are given:

Per unit ₹	X	Y	Z
Selling Price	1,500	1,800	2,000
Variable Cost	700	950	1000

Assume that there is no constraint on resource utilization or demand and similar resources are consumed by X, Y and Z. The opportunity cost of making one unit of Z is

(a) ₹ 850 (b) ₹ 800
(c) ₹ 1,800 (d) ₹ 1,500 **(2 Marks)**

Answer: (a) Opportunity cost is the cost of next best alternative foregone. Between X and Y, Y has a better contribution i.e. ₹ 850 as against X (₹ 1,500 – 700) = ₹ 800.

PYQ 2019-Jun [1] Choose the most appropriate answer the to following questions giving justification:

(i) XYZ Ltd. has the following alternative planned activity levels.

Level	E	F	G
Total cost	₹ 1,00,000	₹ 1,50,000	₹ 2,00,000
No. of units produced	5,000	10,000	15,000

If fixed overhead remains constant, then fixed overhead cost per unit at Level E is

(a) ₹ 20 (b) ₹ 15
(c) ₹ 13.33 (d) ₹ 10 **(2 Marks)**

Answer: (d) Change in Costs (F – E) ₹ 50,000
Change in Units (F – E) ₹ 5,000
VC per unit = ₹ 50, 000 ÷ 5,000 = ₹ 10
Total Cost at E ₹ 1,00,000
VC: 5,000 × ₹ 10 = 50,000
Total FC ₹ 50,000 ÷ 5,000 units
= ₹ 10 per unit

(ii) T Ltd. produces and sells a product. The company expects the following revenues and costs in 2018:

Revenues (400 sets sold @ ₹ 600 per product)	₹ 2,40,000
Variable costs	₹ 1,60,000
Fixed costs	₹ 50,000

What amount of sales must T Ltd. have to earn a target net income of ₹ 63,000 if they have a tax rate of 30%?

(a) ₹ 4,20,000 (b) ₹ 4,29,000
(c) ₹ 3,00,000 (d) ₹ 4,89,000 **(2 Marks)**

Answer: (a) Required Sales $= \frac{FC + \frac{\text{Desired Profit}}{1 - \text{tax rate}}}{\frac{\text{Contribution}}{\text{Sales}}}$

$= \frac{₹50,000 + 90,000}{1/3}$

= ₹ 4,20,000

(iii) Excel Products Ltd. manufactures four products e.g. Product E, Product F, Product G and Product H using same raw materials. The input requirements for Products E, F, G and H are 1kg, 2kgs, 5kgs and 7kgs, respectively. Product-wise Selling Price and Variable Cost data are given hereunder:

Products	E	F	G	H
Selling Price (₹)	100	150	200	300
Variable Cost (₹)	50	70	100	125

Assuming raw material availability is a limiting factor, the correct ranking of the products would be:

(a) E, F, G & H (b) E, F, H & G
(c) F, E, G & H (d) F, E, H & G **(2 Marks)**

Answer: (b) Ranking of products would in order of contribution per limiting factor, in relative value.

	E	F	G	H
SP (₹)	100	150	200	300
VC (₹)	50	70	100	125
Contribution per unit	50	80	100	175
RM/unit (kg)	1	2	5	7
Contribution per kg of RM (₹)	50	40	20	25
Rank	1	2	4	3

Correct Order of ranking: E, F, H and G

(vi) AB Ltd. uses standard cost system. The following information pertains to direct labour for Product X for the month of March, 2019:

Standard rate per hour	₹ 8
Actual rate per hour	₹ 8.40
Standard hours allowed for actual production	2,000 hours
Labour Efficiency variance	₹ 1,600 (Adverse)

What were the actual hours worked?

(a) 1,800 (b) 1,810
(c) 2,200 (d) 2,190 **(2 Marks)**

Answer: (c) Labour Efficiency Variance = (ST – AT) × SR
or, (2,000 – AT) × ₹ 8 = (–) ₹ 1,600
or, AT = 17,600 ÷ 8 = 2,200 hours

(vii) X Ltd. has 1,000 units of an obsolete item which are carried in inventory at the original price of ₹ 50,000. If these items are reworked for ₹ 20,000, they can be sold for ₹ 36,000. Alternatively, they can be sold as a scrap for ₹ 6,000 in the market. In a decision model used to analyse the reworking proposal, the opportunity cost should be taken as

(a) ₹ 16,000 (b) ₹ 6,000
(c) ₹ 30,000 (d) ₹ 20,000 **(2 Marks)**

Answer: (b) Original price is not relevant

Rework income	₹ 36,000
Less: Cost of rework	₹ 20,000
Net inflow	₹ 16,000, it is relevant

The other alternative relevant cash flow is from sale as scrap = ₹ 6,000
Hence, the opportunity cost is ₹ 6,000

PYQ 2019-Dec [1] Choose the most appropriate answer to the following questions giving justification/reasonable workings:

(i) The break-even point of a manufacturing company is ₹1,60,000. Fixed cost is ₹48,000. Variable cost is ₹12 per unit. The PV ratio will be:
(a) 20% (b) 40%
(c) 30% (d) 25% **(2 Marks)**

Answer: (c) BEP = $\frac{FC}{P/V\ ratio}$ = P/V Ratio = $\frac{FC}{BEP}$ = $\frac{₹48,000}{1,60,000}$ = 30%

(ii) A factory has a key resource (bottleneck) of Facility A which is available for 31,300 minutes per week. The time taken by per unit of Product X and Y in Facility A are 5 minutes and 10 minutes respectively. Last week's actual output was 4,750 units of product X and 650 units of Product Y. Actual factory cost was ₹78,250. The throughout cost for the week would be:
(a) ₹75,625 (b) ₹76,225
(c) ₹77,875 (d) ₹79,375 **(2 Marks)**

Answer: (a) Cost per Factory Minute = Total Factory Cost/Minutes Available = ₹78,250/31,300 = ₹2.50
Standard Minutes of throughput for the week = (4,750 × 5) + (650 × 10) = 30,250 minutes
Therefore, throughput Cost for the week = 30,250 × ₹2.50 = ₹75,625

(iv) The higher the actual hours worked,
(a) The lower the capacity usage ratio.
(b) The higher the capacity usage ratio.
(c) The lower the capacity utilization ratio.
(d) The higher the capacity utilization ratio. **(2 Marks)**

Answer: (d) Capacity utilization ratio = $\frac{Actual\ Hours}{Budgeted\ Hours}$

(vi) What is the opportunity cost of making a component part in a factory given no alternative use of the capacity?
(a) The variable manufacturing cost of the component
(b) The total manufacturing cost of the component
(c) The total variable cost of the component **(2 Marks)**
(d) Zero

Answer: (d) Opportunity cost is not an out of pocket cost. It is the benefit given up by not selecting the next best alternative. Therefore, answers A, B and C are incorrect and D is correct.

(vii) The product of XYZ company is sold at a fixed price of ₹1,500 per unit. As per company's estimate, 500 units of the product is expected to be sold in the coming year. If the value of investments of the company is 15 Lakh and it has a target ROI of ₹15%, the target cost would be:
(a) ₹930 (b) ₹950
(c) ₹1,050 (d) ₹1,130 **(2 Marks)**

Answer: (c) ROI at 15% of total investment ₹15 lakhs = ₹15,00,000 × 0.15 = ₹2,25,000.
Profit per unit of future output = ₹2,25,000/500 = ₹450 per unit.
Therefore, target cost per unit = Selling Price – Profit per unit = ₹1,500 – ₹450 = ₹1,050 per unit.

PYQ 2021-Dec [9] When there is excess capacity, it makes sense to accept a one-time-only special order for less than the current selling price when
(1) incremental revenues exceed incremental costs.

(2) additional fixed costs need not be incurred to accommodate the order.
(3) there is a positive contribution per unit of the product under normal capacity and spare capacity
(4) the special order is from a normal customer. **(1 Mark) [Sec. A - MCQ]**

Answer:
(1) incremental revenues exceed incremental costs.

PYQ 2021-Dec [18] NM paid ₹ 5,30,000 for a machine used to powder wheat. The machine can be sold for ₹ 1,30,000. The sale value of wheat is ₹ 8,00,000 and its variable cost is ₹ 4,50,000. The opportunity cost of producing wheat flour is
(1) ₹ 5,30,000
(2) ₹ 3,50,000
(3) ₹ 8,00,000
(4) ₹ 1,30,000 **(1 Mark) [Sec. A - MCQ]**

Answers:
(4) ₹ 1,30,000

PYQ 2021-Dec [19] Which of the following will always be a relevant cost?
(1) Fixed cost
(2) Opportunity cost
(3) Variable cost
(4) Sunk cost **(1 Mark) [Sec. A - MCQ]**

Answers:
(2) Opportunity cost

PYQ 2021-Dec [10] At the breakeven point of 200 units, variable costs total ₹ 400 and fixed costs total ₹ 600. The 201st unit sold will contribute _____ to profits. **(1 Mark) [Sec. B - SAQ]**

Answer:
₹ 3

PYQ 2022-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification/reasonable workings:
(i) The Income statement of BOMA Ltd. is summarized as below:

	(₹ in Lakh)
Net Revenue	120
Less: Expenses (including ₹ 60 lakh of fixed cost)	132
Net Loss	12

The Manager (F&A) believes that an increase of ₹ 30 lakhs as fixed expenditure in advertising outlays will increase the sales substantially. At what sales volume will the company have break even?
(a) ₹ 250 lakhs (b) ₹ 225 lakhs
(c) ₹ 200 lakhs (d) None of the above **(2 Marks)**

Answer: (b) Justification:

Particulars	Amount
Sales	120
Less: Variable Cost (132-60)	72
Contribution	48
Less: Fixed Cost	60
Profit/loss	(12)

PVR = Contribution/sales
= 48/120*100 = 40%
BEP = Fixed cost/PVR
= 90/40% = 225 lakhs

(ix) MN Ltd. sales for the years 2018 and 2019 were ₹ 8,00,000 and ₹ 7,92,000. The cost of goods sold correspondingly were ₹ 4,80,000 and ₹ 4,64,000. In the year 2019 selling price was reduced by 10% as compared to 2018. What was the decrease in gross profit caused by the change in selling price?
(a) ₹ 8,000 (b) ₹ 72,000
(c) ₹ 79,200 (d) ₹ 88,000 **(2 Marks)**

Answer: (d) Gross Profit = Sales - COGS
= 7,92,000/90% - 4,64,000 = 4,16,000
= GP at 90% selling price
= 7,92,000 - 4,64,000 = 3,28,000

Decrease in GP
= 4,16,000 - 3,28,000
= 88,000

(x) The Holiday Card Company, a producer of specialty cards, has asked you to complete several calculations based upon the following information:

Income tax rate	30%
Selling price per unit	₹ 6.60
Variable cost per unit	₹ 5.28
Total fixed costs	₹ 46,200

How many cards must be sold to earn an after-tax net income of ₹ 18,480?

(a) 60,000 units
(b) 45,000 units
(c) 75,000 units
(d) 55,000 units **(2 Marks)**

Answer: (d) For after tax profit of 18,480 PBT required is 18,480/70% = 26,400

PVR = 20% ((6.60 - 5.28)/6.60)*100
Sales = FC + 26,400/20% = 3,63,000/6.6 = 55,000 units

PYQ 2023-Jun [1] (vi) {C} Choose the most appropriate answer to the following questions with justification.

SINT Ltd. determine its selling price by marking up the variable cost 50%. In addition, the company uses frequent selling price mark down to stimulate sales. If the mark down average is 20%, what is the company's contribution margin Ratio?

(a) 16.67% (b) 18.50%
(c) 20.30% (d) None of the above **(2 Marks)**

Answer: (a) 16.67%

PYQ 2023-Dec [1] {C} Choose the correct option.

(iii) A production of ZON Ltd. has the capacity to produce either 4,000 units of A, or 3,500 units of B or 5,000 units of C. Only one product can be made in a production period. The contributions per unit of A,B and C are ₹ 10, ₹ 11 and ₹ 8 respectively. The opportunity cost of A would be:

(a) ₹ 44,000 (b) ₹ 38,500
(c) ₹ 50,000 (d) ₹ 40,000 **(2 Marks)**

Answer: (d) ₹ 40,000

(iv) ROBINSON Ltd., a manufacturing company has a break-even point, when sales are ₹ 10 lakh and fixed costs of ₹ 4 lakh. To realize profits of ₹ 2 lakh from sales of 3,00,000 units, the selling price per unit will be:

(a) ₹ 6 (b) ₹ 5
(c) ₹ 4 (d) ₹ 2 **(2 Marks)**

Answer: (b) ₹ 5

PYQ 2024-Jun [1] {C} Choose the correct option from the four alternatives given:

(iv) The Break Even Sales of GXT Ltd., a manufacturing company, is ₹ 3,75,000, while its fixed cost is ₹ 1,12,500. If the Margin of Safety is 40%, what will be its Profit?

(a) ₹ 80,000 (b) ₹ 75,000
(c) ₹ 64,000 (d) Insufficient information **(2 Marks)**

Answer: (b) ₹ 75,000

(vi) BENT Ltd., a manufacturer of components for VCD, has a capacity to produce 4 Lakh units. The market demand is sensitive to the sale price and the company could sell 1 Lakh units at a price of ₹ 5,000 each. The demand thereafter would double for each ₹ 500 per unit fall in the selling price. If the company expects a minimum margin of 25%, what would be the Target Cost per unit for the company to sell at full capacity utilization?

(a) ₹ 4,000 (b) ₹ 3,200
(c) ₹ 3,000 (d) ₹ 2,900 **(2 Marks)**
Answer: (c) ₹ 3,000

(xi) A particular job MB requires 800 kgs. of a material. 500 kgs. of the particular material is currently in stock. The original price of the material as ₹ 300 but current resale value of the same has been determined as ₹ 200. The current replacement price of the material is Re. 0.80 per kg., what will be the relevant cost of material for job MB?
(a) ₹ 640 (b) ₹ 440
(c) ₹ 300 (d) None of the above **(2 Marks)**
Answer: (b) ₹ 440

PYQ 2024-Dec [1] {C} Choose the correct option from the four alternatives given:
(ii) ROTIZ Ltd., a manufacturing company has a break-even point when sales are ₹ 12,00,000 and fixed costs at that level of sales are ₹ 4,80,000.
If the margin of safety (MOS) and sales of the company are 40% and 5,00,000 units respectively, what will be the sale price per unit?
(a) ₹ 6 (b) ₹ 5
(c) ₹ 4 (d) None of the above **(2 Marks)**
Answer: (c) ₹ 4

(iv) DASN Ltd., operates a throughput accounting system. The details of product MB per unit are as under:

	₹
Selling Price	50
Material Cost	20
Conversion Cost	15

If time on bottleneck resource is 10 minutes, what will be the return per hour for product MB?
(a) ₹ 300 (b) ₹ 270
(c) ₹ 180 (d) ₹ 150 **(2 Marks)**
Answer: (c) ₹ 180

(iii) 120 units of semi-conductors are required to be sold to earn a profit of ₹ 1,00,000 in a monopoly market. The fixed cost for the period is ₹ 80,000. The contribution in the monopoly market is as high as 3/4th of its variable cost. Determine the target selling price per unit.
(a) ₹ 4,500 (b) ₹ 3,250
(c) ₹ 4,000 (d) ₹ 3,500 **(2 Marks)**
Answer: (d) ₹ 3,500

PYQ 2025-Jun [1] {C} Choose the correct option from the given alternatives:
(iv) AON Ltd., a manufacturer of doors using a Throughput Costing System, is experiencing a bottleneck in its plant. Set up time at one of its Work Stations has been identified as the offender. The Manager (Finance) has proposed a plan to reduce the set up time at a cost of ₹ 5,24,000. The change will result in 500 additional doors. The Direct Labour costs are ₹ 2,400 per door and the cost of Direct Materials is ₹ 8,000 per door. All units produced can be sold. If the change will result in an increase in the Throughput Contribution of ₹ 56,50,000, what will be the selling price per door?
(a) ₹ 19,300 (b) ₹ 18,500
(c) ₹ 13,700 (d) ₹ 21,700 **(2 Marks)**
Answer: (a) ₹19,300

(ix) The break-even point of a manufacturing company is ₹ 1,60,000. Fixed cost is ₹ 48,000. Variable cost is ₹ 12 per unit. The PV ratio will be
(a) 20% (b) 40%
(c) 30% (d) 25% **(2 Marks)**
Answer: (c) 30%

(xii) A factory of MONZ Ltd., can make only one of the three products A, B or C in a given production period. The following informations are given:

Per Unit (₹)	A	B	C
Selling price	1,500	2,000	2,500
Variable Cost	700	1,100	1,500

Assume that there is no constraint on resource utilization or demand and similar resources are consumed by A, B and C. The opportunity cost of making one unit of C is

(a) ₹ 900 (b) ₹ 800
(c) ₹ 1,800 (d) ₹ 1,500 **(2 Marks)**

Answer: (a) ₹900

(xv) SONT Ltd., has fixed costs of ₹ 5,00,000 and variable costs are 70% of the selling price. To realize profits of ₹ 1,00,000 from sales of 4,00,000 units, the selling price per unit must be

(a) ₹ 5 (b) ₹ 6
(c) ₹ 7 (d) ₹ 4 **(2 Marks)**

Answer: (a) ₹5

2025-Dec [1] {C} Choose the correct option from the given alternatives:

(i) RIM Ltd. has estimated the demand level of its product:

Sales (units)	5,000	10,000	15,000	20,000
Probability	0.10	0.20	0.40	0.30

It has estimated contribution of ₹4 per unit and total fixed costs of ₹60,000. What is the probability that the company will make a profit of at least ₹15,000?

(a) 40 %
(b) 30 %
(c) 20 %
(d) None of the above **(2 Marks)**

Answer:
(b) 30 %

(ii) SM Ltd., a manufacturing company produces a product which is sold at a price of ₹80 p.u. Its break even sales is ₹15 lakhs, while its fixed cost is ₹6 lakhs. What will be its desired quantity of sales to earn a profit of ₹4 lakhs?

(a) 18,750 units
(b) 31,250 units

(c) 32,320 units
(d) None of the above **(2 Marks)**

Answer: (b) 31,250 units

(iii) BOS Ltd., a manufacturing company, requires ₹90 lakhs in sales to meet target net profit of ₹15 lakhs. The company's contribution margin is 30%. What will be its fixed cost?

(a) ₹15 lakhs
(b) ₹12 lakhs
(c) ₹10 lakhs
(d) ₹20 lakhs **(2 Marks)**

Answer: (b) ₹12 lakhs

(xi) The shadow price of skilled labour for SD Ltd. is currently ₹10 per hour. What does this mean?

(a) The cost of obtaining additional skilled labour is ₹10 per hour.
(b) There is a hidden cost of ₹10 for each hour of skilled labour actively worked.
(c) Contribution will be increased by ₹10 per hour for each extra hour of skilled labour that can be obtained.
(d) The total costs will be reduced by ₹10 for each additional hour of skilled labour that can be obtained. **(2 Marks)**

Answer: (c) Contribution will be increased by ₹10 per hour for each extra hour of skilled labour that can be obtained.

(xv) The product of XYZ company is sold at a fixed price of ₹1,500 per unit. As per company's estimate, 500 units of the product are expected to be sold in the coming year. If the value of investments of the company is ₹15 lakhs and it has a target ROI of 15%, the target cost would be

(a) ₹930
(b) ₹950
(c) ₹1,050
(d) ₹1,130 **(2 Marks)**

Answer: (c) ₹1,050

PYQ 2026-Jun [1] {C} Choose the correct option from the four alternatives given:

(i) LDT Manufacturers is evaluating its research and development programs for the upcoming year. The four products under consideration all appear to offer favourable profitability if they can be carried out successfully. But, due to budget constraint one product can be launched. The following information is relevant:

Product	Probability of Success		Expected Profit
	Commercially	Technically	₹(in Crore)
P01	0.7	0.4	10
P02	0.8	0.5	12
P03	0.5	0.9	9
P04	0.4	0.8	14

Which product should be launched?

(a) P01 (b) P02
(c) P03 (d) P04 **(2 Marks)**

(ii) A company has a break-even point when sales are ₹3,20,000 and variable cost at that level of sales are ₹2,00,000. How much would P/V ratio increase or decrease if variable expenses are dropped by ₹30,000?

(a) Increase by 27.5% (b) Increase by 9.375%
(c) Decrease by 9.375% (d) Increase by 37.5% **(2 Marks)**

(iii) A firm has a fixed cost of ₹1,00,000 and a break-even sale of ₹8,00,000. What is its projected profit at ₹12,00,000 sales?

(a) ₹50,000 (b) ₹1,50,000
(c) ₹2,00,000 (d) None of the above **(2 Marks)**

(xi) The higher the actual hours worked

(a) the lower is the capacity usage ratio.
(b) the higher is the capacity usage ratio.
(c) the lower is the capacity utilisation ratio.
(d) the higher is the capacity utilisation ratio. **(2 Marks)**

(xv) Marketing department of Axis Ltd. estimates that 40,000 of new mixers could be sold annually at a price of ₹60 each. To design, develop and produce these new mixers, an investment of ₹40,00,000 would be required. The company desires a 15% return on investment (ROI). Given these data, the target cost to manufacture and sell one mixer will be

(a) ₹37.50 (b) ₹40.00
(c) ₹45.00 (d) ₹48.60 **(2 Marks)**

SECTION-B

01 Decisions involving Alternative Choice

THEORY QUESTIONS

TQ 1.1	PYQ	2017-Jun [2] (c) (ii)	DESC	4 Marks
In making repetitive decisions using relevant costs and benefits, should a decision maker be aware of several pitfalls? If so, mention a few and briefly explain them.				

Answer:

In such decision making, the decision maker must be aware of some pitfalls. Examples are:

1. **Sunk cost** should be ignored as not relevant.
2. **Fixed costs** if they change for the decision at hand, the changed portion only becomes relevant.
3. **Opportunity costs:** They need not be overlooked (e.g., to outsource an activity when there is no idle capacity). An opportunity cost is the cost of an opportunity foregone by not using a limited resource in its next best alternative use.

TQ 1.2	PYQ	2018-Dec [3] (b)	DESC	4 Marks
A company is producing and selling three products. How would you determine relative profitability of products in each of the following independent situation? (i) Total sales potential in unit is limited, (ii) Total sales potential in value is limited. (iii) Raw materials are in short supply. (iv) Production capacity (machine hours) is limited.				

Answer:

The Selection process will be based on optimization of contribution in relation to constraint.

(i) Unit contribution
(ii) P/V or C/S ratio
(iii) Contribution per Kg of RM
(iv) Contribution per machine hour.

TQ 1.3	PYQ	2019-Jun [6] (b)	DESC	4 Marks
Briefly state the significance of Margin of Safety in management decisions.				

Answer:

Significance of Margin of Safety in Management Decisions:

Margin of Safety (MOS) is the excess sales over and above the break-even sales. It is generally expressed in % form. The size of margin of safety is a very important indicator of the soundness of a business. It shows how much sales may decrease before the firms will suffer a loss. If the size of margin of safety is high, chances of incurring loss by the business will be remote but if it is low, a small reduction in sales may lead to loss. The common cause of lower margin of safety is higher fixed costs. In such a business, a high level of activity is required. A low margin of safety is a matter of concern and so the following steps may be taken to improve an unsatisfactory margin of safety:

1. Increase the selling price.
2. Reduce the fixed or variable costs or the both.
3. Increase the volume of output by utilizing the unutilized production capacity.
4. Stop production of unprofitable products and concentrate only on the profitable products.

TQ 1.4	PYQ	2019-Jun [8] (c)	SN	4 Marks
Write Short Note on the following question: Differential Costs				

Answer:

Differential Costs:

The essential features of differential costs are as follows:

(i) The basis data used for differential cost analysis are costs, revenue and the investment factors which are relevant in the problem for which the analysis is undertaken.

(ii) Total differential costs rather than the costs per unit are considered.

(iii) Differential cost analysis is made outside the accounting records.

(iv) As the differences in the costs at two levels are considered, absolute costs at each level are not as relevant as the difference between the two. Thus, items of costs which do not change but are identical for the alternatives under consideration, are ignored.

(v) The differentials are measured from a common base point or position.

(vi) The stage at which the difference between the revenue and the cost is the highest, measured from the common base point, determines the choice from amongst a number of alternative actions.

(vii) In computing differential costs, historical or standard costs may be used but they should be adjusted to the requirements of future conditions.

(viii) The elements and items of cost to be considered in differential cost analysis will depend upon the nature of the problem and the alternatives being considered.

TQ 1.5	PYQ	2019-Dec [3] (b)	DESC	4 Marks
What do you mean by Incremental cost? Is it always variable?				

Answer:

Incremental costs are incurred for the additional cost object with reference to the base. It could be for any additional resource or for any decision that is over and above the current scenario. It includes all costs that are incurred in addition to the existing base level. It could be fixed or variable or both.

TQ 1.6	PYQ	2019-Dec [5] (a) (i)	DESC	4 Marks
Discuss briefly on the significance of Margin of Safety in the context of a business.				

Answer:

The expression Margin of Safety (MOS) represents the difference between actual sales and break even sales. In other words, all sales revenue above the breakeven point represents the margin of safety. For example, if actual sales for the month of December 2019 are ₹50,00,000 and the break-even sales are ₹35,00,000, the difference of ₹15,00,000 is margin of safety. It can be expressed in percentage also.

Margin of safety is an important concept for any business because it tells management how much reduction in revenue will result in break-even. A higher MOS reduces the risk of business losses. Generally, the higher the margin of safety, the better the strength of business.

The formula or equation for arriving at MOS is stated as below:

Margin of safety = Actual or budgeted sales – Sales required to break-even

Margin of safety is also expressed in the form of ratio or percentage that is calculated by using the following formulae:

$$M/S = \frac{\text{Profit}}{\text{Contribution}}$$ or Sales over BEP/Total Sales.

MOS ratio = MOS/Actual or budgeted sales

MOS percentage = (MOS/Actual or budgeted sales) × 100

TQ 1.7	PYQ	2022-Dec [8] (d)	SN	4 Marks
Write Short Note on the following question: Enumerate the situations where Fixed Costs become relevant for Decision Making				

Answer:

Enumerate the situations where fixed costs become relevant for decision making:

In the following circumstances, fixed costs become relevant for decision making:

(i) When Fixed Costs are specifically incurred for any contract.

(ii) When fixed costs are incremental in nature.
(iii) When the fixed portion of semi variable cost whereas due to change in level of activity consequent to acceptance of a contract.
(iv) When fixed costs are avoidable or discretionary.
(v) When fixed costs are such that one cost is incurred in lieu of another.

CASE-SCENARIO QUESTIONS

CSQ 1.1	PYQ	2016-Jun [6] (b)	4+4=8 Marks

The income statement of Ashok Gears Ltd. is summarized as below:

Net Revenue.....	₹ 80,00,000
Less: Expenses (including ₹ 40,00,000 of Fixed Cost).....	₹ 88,00,000
Net Loss.....	₹ 8,00,000

The manager believes that an increase of ₹ 20,00,000 as fixed expenditure in advertising outlays will increase the sales substantially. His plan was approved by the Board.
You are required to calculate:
(i) At what sales volume will the company have Break Even?
(ii) What sales volume will result in a Net Profit of ₹ 4,00,000?

Answer:

(i) Variable Expenses = ₹ (88,00,000 - 40,00,000) = ₹ 48,00,000
The Ratio of Variable Expenses and Total Revenue = 48,00,000/ 80,00,000 = 0.60
The Contribution Margin Ratio = (1 - 0.60) = 0.40
Let, Break Even Sales = S
Therefore, S = Variable Expenses + Fixed Expenses + Net Profit
= 0.60S + (₹40,00,000 + ₹ 20,00,000) + 0
Or, S - 0.60S + = ₹ 60,00,000
Or,0.40S = ₹ 60,00,000
Therefore, S = ₹ (60,00,000 / 0.40 = ₹ 150,00,000
Alternative Method: PV ratio = 40%
BE point = F. Cost/PV ratio

Therefore, Break Even Sales = 60,00,000 / 40%
= ₹ 1,50,00,000

(ii) Computation of sales level to earn a Net Profit of ₹ 4,00,000
Required Sales = (Fixed Expenses + Target Net Profit) / Contribution Margin Ratio
= ₹ (60,00,000 + 4,00,000) / 0.40 = ₹ 1,60,00,000

CSQ 1.2	PYQ	2017-Jun [3] (a)	8 Marks

Accelerate Co. Ltd., manufactures and sells four types of products under the brand names of A, B, C $8\frac{1}{3}$% and D. The sales mix in value comprises $33\frac{1}{3}$%, $41\frac{2}{3}$%, $16\frac{2}{3}$% and of products A, B, C and D, respectively. The total budgeted sales (100%) are ₹ 60,000 p.m. Operating Costs are - Variable costs: Product A 60% of selling price, Product B 68% of selling price, Product C 80% of selling price, Product D 40% of selling price, Fixed costs:₹ 14,700 p.m.
Required:
Calculate the break - even - point for the products on overall basis.

Answer:

Computation of overall breakeven point

			A	B	C	D	Total
a	Sales	(₹)	20,000	25,000	10,000	5,000	60,000
b	Variable cost	(₹)	12,000	17,000	8,000	2,000	39,000
c	Contribution	(₹)	8,000	8,000	2,000	3,000	21,000
d	Fixed cost	(₹)					14,700
e	Profit	(₹)					6,300
f	P/V ratio	(%)	40%	32%	20%	60%	35%
g	Break even sales	(₹)	14,700/35% =				42,000

CSQ 1.3	PYQ	2017-Jun [5] (a)	6 Marks

A manufacturing company currently operating at 80% capacity has received an export order from Middle East, which will utilise 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 rejected totally.
The current sales and cost data are given below:

Sales	₹ 16.00 lakhs
Direct Material	₹ 5.80 lakhs
Direct Labour	₹ 2.40 lakhs
Variable Overheads	₹ 0.60 lakhs
Fixed Overheads	₹ 5.20 lakhs

The following alternatives are available to the management.

(I) Continue with domestic sales and reject the export order.

(II) Accept the export order and allow the domestic market to starve to the extent of excess of demand.

(III) 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 ₹ 65,000, and

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

Required:

Evaluate each of the above alternatives and suggest the best one.

Answer:

	Present Sales 80%	40% - Foreign 60% - Domestic	40% - Foreign 80% - Domestic
1. Sales	16.00	(7.20 + 12.00) = 19.20	(7.20 + 16.00) = 23.20
2. Variable Cost			
Direct Material	5.80	7.25	8.70
Direct Labour	2.40	3.00	3.60
Variable Overheads	0.60	0.75	0.90
Overtime Premium	--	---	0.15
	8.80	11.00	13.35
3. Contribution	7.20	8.20	9.85
4. Fixed Cost	5.20	5.20	(5.20 + 0.65) = 5.85
5. Profit	2.00	3.00	4.00

As per the above calculations, it is evident that the profit is maximum in Alternative III i.e., accepting the foreign order fully and monitoring the present domestic sales. It is the best alternative to be pursued by the management.

CSQ 1.4	PYQ	2017-Jun [5] (b)	4+6=10 Marks

The following particulars are extracted from the records of Ajanta Works Limited:

Particulars	Product A	Product B
Selling price per unit	₹ 1,000.00	₹ 1,200.00
Consumption of Material	Kg. 20	Kg. 30
Material cost	₹ 100.00	₹ 150.00
Direct wages	₹ 150.00	₹ 100.00
Direct expenses	₹ 50.00	₹ 60.00
Machine Hours used	3	2
Overhead Expenses:		
Fixed	₹ 50.00	₹ 100.00
Variable	₹ 150.00	₹ 200.00

Note: Direct wages per hour is ₹ 50.00.

Required:

(i) Comment on the profitability of each product (both use the same raw material) when:

(I) Total sales potential in units is limited

(II) Total sales potential in value is limited

(III) Raw Material is in short supply, and

(IV) Production Capacity (in terms of Machine Hours) is the limiting factor.

(ii) Assuming raw material as the key factor, availability of which is 10000 Kg., and maximum sales potential of each product being 3500 units, find out the product mix which will yield the maximum profit.

Answer:

Marginal Cost Statement of Ajanta Works Limited

Particulars	Cost Per Unit (₹)	
	A	B
Selling Price	1,000	1,200
Direct Materials	100	150
Direct Wages	150	100
Direct Expenses	50	60
Variable Overheads	150	200
Marginal Cost	450	510
Contribution Margin	550	690
P/V Ratio	55%	57.50%
Contribution per Kg of material	27.5	23.0
Contribution per Machine Hour	183.33	345

(i) The comments based on the above statement are as follows:

(i) When total sales potential in units is a limiting factor, Product B is more profitable, as it is making a larger contribution margin per unit as compared to A.

(ii) When total sales potential in value is a limiting factor, Product B is still more profitable, as its P/V ratio is more than that of A.

(iii) When Raw Material is in short supply, A is more profitable as its contribution per kg of material is more than that of Product B.

(iv) When production capacity is limited, B is more profitable as it makes larger contribution per machine hour than A.

(**Note:** Best position is reached when contribution per unit of key factor is maximum.)

(ii) As contribution of A is more than that of B, hence, 10,000/20 = 500 units of A will only be produced and sold.

Notes: It appears there might be a minor discrepancy in the calculation presented in the ICMAI'S Suggested Answer for the above Question. Our solution, derived from a strict application, provides different answer which we believe to the correct interpretation. Answer as per Suggested Answer is Contribution per Kg of material A 275 and B 230.

CSQ 1.5	PYQ	2017-Dec [3] (b)	3+3=6 Marks

The management of W Ltd., which is now operating at 50% capacity, expects that the volume of sales will drop below the present level of 5,000 units per month. The operating statement prepared for monthly sales shows:

	₹	₹
Sales (5,000 units at ₹ 3 per unit)		15,000
Less: Variable Costs at ₹ 2 per unit	10,000	
Fixed Overheads	5,000	15,000
Net Profit		Nil

It is proposed that the company should suspend production until market conditions improve. The General Manager estimated that a minimum of fixed cost (shut down costs) amounting to ₹ 2,000 would be necessary in any event.

Required:

(i) Advise Management at what level of sales it could think of suspending production.

(ii) If the sales price is ₹ 2.80, what should be the level of sales for shut down decision?

Answer:

(i) If selling price is ₹ 3 per unit

$$\text{Shutdown Point} = \frac{\text{F. Cost - Shutdown cost}}{\text{Contribution p.u.}} \times \text{SP}$$

$$= \frac{5,000 - 2,000}{(₹3 - ₹2)} \times ₹3$$

$$= 3,000 \times 3 = ₹\ 9,000$$

or, 3,000 units

Verification of the above is as under:

	₹
Sales 3,000 units @ ₹ 3	9,000
Less: Variable Cost 3,000 units @ ₹ 2	6,000
Contribution	3,000
Less: Fixed Cost	5,000

Operating Loss 2,000

Operating Loss = Loss at Shutdown Point

(ii) If selling price is reduced to ₹ 2.80

$$\left(\frac{5,000-2,000}{2.80-2.00}\right) \times ₹2.80$$

= ₹ 10,500

or 3,750 units

CSQ 1.6	PYQ	2017-Dec [4] (a)	8 Marks

The following data are obtained from the records of a company:

	Year 1 (₹)	Year 2 (₹)
Sales	80,000	1,00,000
Profit	10,000	15,000

Required:

(i) Calculate Break-even Point

(ii) Profit or Loss when sales amount to ₹ 60,000, and

(iii) Required sales for level of profit of ₹ 20,000.

Answer:

$$\text{P/V ratio} = \frac{\text{Change in profit}}{\text{Change in sales}} = \frac{5,000}{20,000} = \frac{1}{4}\text{th or } 25\%$$

C = F + P

or, F = C – P = 25% of 80,000 – 10,000

= ₹ 10,000

[or, 25% of 1,00,000 – 15,000 = ₹ 10,000]

(i) $\therefore \text{BEP} = \frac{\text{FC}}{\text{P/V ratio}} = \frac{₹10,000}{.25} = ₹40,000$

(ii) S = ₹ 60,000

P = C – F = 25% of 60,000 – 10,000 = ₹ 5,000

(iii) Required Sales for (P) = ₹ 20,000

C = F + P = ₹ 10,000 + 20,000 = ₹ 30,000

$\therefore$ Required Sales = $\frac{₹30,000}{.25} = ₹1,20,000$

CSQ 1.7	PYQ	2017-Dec [4] (b)	4+4=8 Marks

Your company wants to buy one machine. Two alternative models are available – A and B.

The following information are available with respect to them:

	Model A	Model B
Output p.a.	10,000	10,000
Fixed costs p.a. (₹)	30,000	16,000
Profit at 100% capacity (₹)	30,000	24,000

Both the machines will produce identical products. The annual market demand for the product is 10,000 units @ ₹ 10 Per unit.

Required:

(i) The level of sales at which both are equally profitable;

(ii) The range of sales at which one is more profitable than the other.

Answer:

[C = F + P]

	A ₹	B ₹
Sales @ ₹ 10	1,00,000	1,00,000
Contribution	60,000	40,000
P/V ratio	60%	40%
Contribution/unit	6	4
Variable cost/unit	4	6
BEP	5,000 units	4,000 units

(i) For A : 4x + 30,000

B : 6x + 16,000

$\therefore$ 4x + 30,000 = 6x + 16,000 ; Solving X = 7,000 units

(ii) At 7,000 units both are equally profitable. BEP of A and B being 5,000 units and 4,000 units, Machine B is more profitable below 7,000 units, and A will be more profitable above 7,000 units.

A : Range of production 7,000 to 10,000 units

B : Range of production 4,000 to 6,999 units

CSQ 1.8	PYQ	2017-Dec [5] (b)	2+3+2+3=10 Marks

Force Ltd. is a manufacturer of a fire fighting equipment which consists of five components three of which are made using general purpose machines and two by manual labour. The data for the manufacture of the equipment are as follows:

Components	F	O	R	C	E	Total
Machine hours required per unit	20	28	24			72 hrs
Labour hours required per unit				2	1	3 hrs
Variable cost per unit ₹	64	108	116	24	8	320
Fixed cost per unit (apportioned) ₹	96	204	232	48	52	632
Total component cost ₹	160	312	348	72	60	952
Assembly cost/unit (all variable) ₹						80
Selling price/unit ₹						1,200

The marketing department of the company anticipates 50% increase in demand during the next period. General purpose machinery used to manufacture. F, O and R are already working to the maximum capacity of 9,504 hours and there is no possibility of increasing this capacity during the next period. But labour is available for making components C and E and also for assembly according to demand. The management is considering the purchase of one of the components F, O or R from the market to meet the increase in demand. These components are available in the market at the following prices:

Component F : ₹ 160
Component O : ₹ 320
Component R : ₹ 250

Required:

(i) Profit made by the company from current operations.
(ii) If the company buys any one of the components F, O or R, what is the extent of additional capacity that can be created?
(iii) Assuming 50% increase in demand during the next period, which component should the company buy from the market?
(iv) The increase in profit, if any, if the component suggested in (iii) is purchased from the market.

Answer:

(i) Statement showing profit at current operations:

		(₹)
SP		1,200
Variable cost	320+80	400
Contribution		800
Number of units	9,504/72	Units 132
Total contribution		1,05,600
Fixed cost		83,424
Profit		22,176

(ii)

	F	O	R
	₹	₹	₹
Buying cost	160	320	250
Variable cost	64	108	116
Extra buying cost	96	212	134
Excess buying cost per hour	4.8	7.571	5.583

It is better to buy component F from the market because excess buying cost per machine hour is less. Computation of additional capacity created if components are bought from outside:

If F is bought:

Number of units that can be manufactured (9,504/52)	182.76 units
Increase in capacity (182.76 - 132/132 x 100)	38.46%
If O is bought:	
Number of units (9,504/44)	216
Increase in capacity (216 - 132 / 132 x 100)	63.64%
If R is bought:	
Number of units 9,504/48	198
Increase in capacity (198 - 132 /132 x 100)	50%

(iii) F is cheaper to buy. But the increase in capacity will not be sufficient to meet the expected demand for next year. Therefore, we shall try to buy the next cheaper component, i.e., R and by buying it the increase in capacity will be exactly equal to the demand for our product during the next year. Hence, component 'R' should be bought from the market.

(iv) Statement showing computation of profit by buying R from outside:

(i) No. of units	(9,504 / 48)	Units 198
(ii) Selling price		₹ 1,200
(iii) Variable cost	(400-116 + 250)	₹ 534
(iv) Contribution		₹ 666
(v) Total contribution		₹ 1,31,868
(vi) Fixed cost		₹ 83,424
(vii) Profit		₹ 48,444
Less: Existing profit		₹ 22,176
Increase in profit		₹ 26,268

CSQ 1.9 | PYQ | 2017-Dec [6] (b) | 6 Marks

A practicing Cost and Management Accountant now spends ₹ 0.90 per K.M. on taxi fares for his client's work. He is considering two other alternatives – the purchase of a new small car or an old bigger car.

Item	New Small Car	Old Bigger Car
	(₹)	(₹)
Purchase Price	35,000	20,000
Sale Price after 5 years	19,000	12,000
Repairs and servicing per annum	1,000	1,200
Taxes and insurance p.a.	1,700	700
Petrol consumption per litre (k.m.)	10	7
Petrol price per litre	3.5	3.5

He estimates that he will travel 10,000 K.M. annually.

Required:

Which of the three alternatives will be cheaper? If his practice expands and he has to travel 19,000 K.M. per annum will the cost of the two cars break even and why? Ignore interest and Income tax.

Answer:

Statement showing computation of break-even point for three alternatives:

	Taxi (₹)	New smaller car (₹)	Old bigger car (₹)
Fixed Cost: Depreciation		16,000/5 = 3,200	8,000/5 = 1,600
Repairs		1,000	1,200
Taxes		1,700	700
		5,900	3,500
Variable cost per KM	0.9	0.35	0.5
Total cost per 10,000 KMS	9,000	3,500 + 5,900 = 9,400	5,000 + 3,500 = 8,500
Cost per 19,000 KMS	17,100	12,550	13,000

(a) At 10,000 KMS old bigger car is cheaper than the other two alternatives.

(b) At 19,000 KMS it is better and cheaper to purchase the new smaller car. Indifference point = (difference in fixed cost/difference in variable cost per unit) = (2,400/0.15) = 16,000 kms.

CSQ 1.10 | PYQ | 2018-Jun [4] (a) | 4+4+4=12 Marks

A company manufactures two types of herbal product, A and B. Its budget shows profit figures after apportioning the fixed joint cost of ₹ 15 lakhs in the proportion of the numbers of units sold. The budget for 2018 indicates:

Particulars	A	B
Profit (₹)	1,50,000	30,000
Selling price per unit (₹)	200	120
P/V Ratio (%)	40	50

Required to advise on the best option among the following, if the company expects that the number of units to be sold would be equal.

(i) Due to change in manufacturing process, the joint fixed cost would be reduced by 15% and the variable cost would be increased by 7%.

(ii) Price of A could be increased by 20% as it is expected that the price elasticity of demand would be unity over the range of price.

(iii) Simultaneous introduction of both the options, viz (i) and (ii) above.

Answer:

Contribution of A = 40% x 200 = 80

Contribution of B = 50% x 120 = 60.

Average contribution per unit, considering equal units of both = (80 + 60)/2 = 70

Total units of production = (Total fixed costs + Profits)/70

$$= \frac{15,00,000 + 1,80,000}{70}$$

$$= \frac{16,80,000}{70}$$

$$= 24,000$$

Of which 12,000 of A and 12,000 of B

Evaluation of Option:

(i)

	A		B	
Selling Price/u	200	200	120	120
Variable Cost /u	120	128.4	60	64.20
Contribution/u	80	71.6	60	55.80
Contribution for 12,000 units		8,59,200		6,69,600
Total Contribution				15,28,800
Fixed Cost				15,00,000 x 85% = 12,75,000
Profits				15,28,800-12,75,000 = 2,53,800

(ii) Volume for A originally = 12,000.

Since price elasticity of demand = 1, for 20 % increase in unit selling price, there will be a drop in demand by 20 %, i.e. 20% of 12,000 = 2,400.

Revised sales quantity for A at increased price = 12,000 - 2,400 = 9,600

	A		B
Selling Price/u	200	240	120
Variable Cost /u	120	120	60
Contribution/u	80	120	60
Contribution for 9,600 units for 12,000 units		11,52,000	7,20,000
Total Contribution			18,72,000
Fixed Cost			15,00,000
Profits			18,72,000 - 15,00,000 = 3,72,000

(iii) Simultaneous introduction of both:

	A		B	
Selling price/u	200	240	120	120
Variable Cost /u	120	128.4	60	64.20
Contribution/u	80	111.6	60	55.80
Contribution for 9,600 units for 12,000 units		10,71,360		
Units				6,69,600
Total Contribution				17,40,960
Fixed Cost				15,00,000×85% = 12,75,000
Profits				17,40,960 - 12,75,000 = 4,65,960

Decision: Option (iii) has the maximum profits and should be chosen.

CSQ 1.11 | PYQ | 2018-Jun [5] | 12+4=16 Marks

A regional audit firm offers audit, tax and consulting services. The segmented profit and loss position for the next year shows the following position:

	Audit	Tax	Consulting
	₹	₹	₹
1. Revenues	60,000	1,00,000	1,20,000
2. Costs:			
Service-level	50,000	60,000	70,000
Facility-level (apportioned)	10,000	12,000	16,000
Total	60,000	72,000	86,000
3. Operating Profit (1-2)	Nil	28,000	34,000

Partners are concerned about the profitability of their audit business and contemplate to close it down. In the event of closure of audit service, it might do more tax work . If audit service is discontinued, 50 per cent of the facility costs associated with auditing would be saved. More tax work would increase tax revenues by 45 per cent, but tax service-level costs would also increase by 45 per cent.

Required:

(a) Determine whether the firm should drop auditing service and the impact on its closure on profit. Assume that audit centre facility level costs can be allocated to two other centres based on revenues. Compare Profitability of Tax and Consulting Services before and after closure of Audit Centre.

(b) What other considerations are important to drop auditing service?

Answer:

(a) Whether to drop auditing service and the impact on profits:

Item of Cost/ Revenue	Incremental impact
Revenue Loss from Audit	- 60,000
Savings in facility Level Costs	+ 5,000
Decrease in Service Level Cost (Audit), considered avoidable	+ 50,000
Increase in Tax Service Revenue by 45%	+ 45,000
Increase in Service Level Cost for Tax Service	- 27,000
Cumulative Impact	+13,000

Decision: Close the Audit function and improve Tax Service.

	Tax		Consulting	
	Before	After	Before	After
Revenue	1,00,000	1,45,000	1,20,000	1,20,000
Costs:				
Service- level	60,000	87,000	70,000	70,000
Facility -level	12,000	14,736	16,000	18,264
Total Costs	72,000	1,01,736	86,000	88,264
Operating Profits	28,000	43,264	34,000	31,736

Total operating profits before dropping: 28,000+34,000 = 62,000

Total operating profits after dropping Audit function: 43,264+31,736 = 75,000 Impact = 13,000

(b) Other important considerations for dropping Audit function:

(i) The Audit function is not unprofitable or with Nil profit as shown in the question. Its revenues less its service level costs and avoidable facility level costs are 60,000 – 50,000 – 5,000 = 5,000. Hence, it is only due to allocated overhead that Audit function appears to be a non contributor.

(ii) While the release of Audit function strengthens the Tax Service, the overall impact being ₹ 13,000 increase in profits, it is a major risk that the firm will be taking, since it is an audit firm.

(iii) In the medium to long term, it could lose other potential clients who may go elsewhere to have more diversified services.

(iv) The firm should try to improve its costs and increase its fees to have more comfortable profits.

CSQ 1.12	PYQ	2018-Dec [2] (b)	8 Marks

The profit for The Forward Look Ltd. works out to 12.5% of the capital employed and the relevant figures are as under:

	₹
Sales	5,00,000
Direct Materials	2,50,000
Direct Labour	1,00,000
Variable Overheads	40,000
Capital employed	4,00,000

The new Sales Manager who has recently joined the Company estimates for the next year a profit of about 23% on the capital employed provided the volume of Sales in increased by 10% and simultaneously there is an increase in Selling Price of 4% and an overall cost reduction in all the elements of cost by 2%.

Verify the contention of the Sale Manager by computing in detail the cost and profit for the next year and state whether his proposal can be adopted by the management.

Answer:

Computation of Fixed Cost:

		₹
Annual Sales		5,00,000
Less: Profit: ₹ 4,00,000 x 12.5%		50,000
Total Cost		4,50,000
Less: Variable Cost: Direct Material	₹ 2,50,000	

Direct Labour	₹ 1,00,000
Variable Overhead	₹ 40,000
	3,90,000
	60,000

Statement showing Profit obtained upon adopting the Sales Manager's proposal:

		₹
(i)	Revised Sales: ₹ 5,00,000 x 110% x 104%	5,72,000
(ii)	Variable Cost: ₹ 3,90,000 x 110% x 98%	4,20,420
(iii)	Contribution	1,51,580
(iv)	Fixed Cost ₹ 60,000 x 98%	58,800
(v)	Profit	92,780

Percentage of Profit on Capital Employed = (₹ 92,780 /4,00,000) × 100 = 23.195 > 23%

Conclusion: The Sales Manager's proposal can be adopted.

CSQ 1.13	PYQ	2018-Dec [3] (a)	6+6=12 Marks

XYZ Ltd. produces three products. The cost data are as under:

Particulars	X	Y	Z
Direct Materials	₹ 64	₹ 152	₹ 117
Direct Labour:			

Dept.	Rate per hour (₹)	Hrs.	Hrs.	Hrs.
1	5	18	10	20
2	6	5	4	6.5
3	4	10	5	20
Variable overheads		₹ 16	₹ 9	₹ 24

Fixed overheads ₹ 4,00,000 per annum.

The budget was prepared at a time, when market was sluggish. The budgeted quantities and selling prices are as under:

Product	Budgeted Quantity	Selling price (₹)/ unit
X	9,750	270
Y	7,800	280
Z	7,800	400

Later the market improved and the sales quantities could be increased by 20% for product X and 25% each for products Y and Z. The Sales Manager confirmed that the increased quantities could be achieved at the prices originally budgeted. The Production Manager has stated that the output cannot be increased beyond the budgeted level due to limitation of direct labour hours in Department 2.

Required:

(i) Set optimal product mix.

(ii) State profit under optimal product mix,

Answer:

Products:		X	Y	Z
Budged Quantity (units):		9,750	7,800	7,800
Selling price (p.u.):	(i)	270	280	400
Variable cost (p.u.):				
Direct materials		64	152	117
Direct labour		160	94	219
Variable overheads		16	9	24
Total variable cost (p.u.)	(ii)	240	255	360
Contribution (p.u.) (₹)	(i) – (ii)	30	25	40

Statement of optima product mix and profit.

Products:		X	Y	Z	Total
Contribution (p.u.): (₹)	(a)	30	25	40	
Direct labour hours in Dept.2	(b)	5	4	6.5	
Contribution per hr:	(a)/(b)	6	6.25	6.15	
Ranking		III	I	II	
Optimal product mix units	(c)	5,655 (28,275 hrs.)	9,750 (39,000 hrs)	9,750 (63,375 hrs)	
Total contribution (₹)	(a)x(c)	1,69,650	2,43,750	3,90,000	8,03,400
Less: Fixed cost (₹)					4,00,000
Optimal profit					4,03,400

Working Notes

(1) **Total hours available in Department 2:**

Products (a)	Units (b)	Hrs.(p.u.) (c)	Total hrs. (d) = (b) x (c)
X	9,750	5	48,750
Y	7,800	4	31,200
Z	7,800	6.5	50,700
Total available hrs. for budgeted production			1,30,650

(2) **Maximum Sales Quantities of Products (under improved market conditions)**

Products	Units	Increase in percentage	Total number of units
X	9,750	20	11,700
Y	7,800	25	9,750 x 4 = 39,000
Z	7,800	25	9,750 x 6.5= 63,375
		Required hours for Y+ Z	1,02,375
	Hours available for X: 1,30,650 –1,02,375		= 28,275
		∴ Production for X 28,275 ÷ 5	= 5,655 units

CSQ 1.14 | PYQ | 2019-Jun [2] (a) | 6 Marks

A toy manufacturing company produces different models of toy. The budget in respect of a model for the month of March, 2019 is as under:

			(₹ lakhs)
Budgeted output	40,000 units		
Variable costs:			
	Materials	528	
	Labour	104	
	Direct expenses	248	880
Fixed costs:			
	Specific fixed costs	180	
	Allocated fixed costs	225	405
Total costs			1,285
Add: Profit			115
Sales			1,400

Required:

(i) Calculate profit with 10% increase in selling price with a 10% reduction in sales volume.

(ii) Determine volume to be achieved to maintain the original profit after a 10% rise in material costs, at the originally budgeted selling price per unit.

Answer:

(i) Present selling price ₹ 1,400 lakhs/40,000 units3,500

Add: 10% Increase	350
Revised selling price	₹ 3,850
Present sales volume	40,000units
Less: 10% Decrease	4,000
Revised sales volume	36,000units

Revised sales revenue = 36,000 × ₹ 3,850 = ₹ 1,386 lakhs

Total variable cost/unit: Material + Labour + Direct expense

1,320 + 260 + 620 = ₹ 2,200

Profitability statement:

Sales	1,386
Less: Variable costs (36,000 units × ₹ 2,200)	792
Contribution	594
Less: Fixed costs	405
Profit	₹ 189 lakhs

(ii) Total variable cost/unit: Material + Labour + Direct expense

1,452 + 260 + 620 = ₹ 2,332

Calculation of sales to be achieved to maintain the original profit of ₹ 115 lakhs:

Selling price	3,500
Less: Variable costs	2,332
Contribution per unit	1,168

Desired sales = (Fixed cost + Desired profit)/Contribution p.u.

= (405 lakhs +115 lakhs)/1168 p.u. = 44,521 units

CSQ 1.15	PYQ	2019-Jun [2] (b)	10 Marks

SRM Ltd. manufactures and sells a single product X whose selling price is ₹ 80 per unit and the variable cost is ₹ 32 per unit.

(i) Assume that for first year fixed costs are ₹ 9,60,000 and the annual sales are at 60% margin of safety.

(ii) For second year, it is proposed to add another product line Y whose selling price would be ₹ 100 per unit and the variable cost ₹ 20 per unit. The total fixed cost are estimated at ₹ 13,33,200. The sales mix of X : Y would be 7 : 3 based on value.

Required:

(I) For the first year, calculate the rate of net return on sales, assuming an income tax level of 30%.

(II) For second year, at what level of sales would SRM Ltd. break even? Give separately for both X and Y the break even sales in rupees and quantities.

Answer:

(i) Contribution per unit = SP-VC = ₹ (80 - 32) = ₹ 48

Break-even Point = 9,60,000/48 = 20,000 units

Percentage Margin of Safety = (Actual Sales – Break-even Sales) / Actual Sales Or, 60%

= (Actual Sales – 20,000 units)/Actual Sales

Actual Sales = 50,000 units

	₹
Sales value (50,000 units x ₹ 80)	40,00,000
Less: Variable costs (50,000 units x ₹ 32)	16,00,000
Contribution	24,00,000
Less: Fixed cost	9,60,000
Profit	14,40,000
Less: Income Tax @30%	4,32,000
Net Return	10,08,000

Rate of net return on sales = (10,08,000/40,00,000) x 100 = 25.2%

(ii) Products

	X (₹)	Y (₹)
Selling price per unit	80	100
Variable cost per unit	32	20
Contribution per unit	48	80 -
Individual products contribution margin	60% (48/80) x 100	80% (80/100) x 100

Contribution margin (X and Y)

60% x 7/10 + 80% x 3/10 = 66%

Break even sales = ₹ 20,20,000 (₹13,33,200/66%)

Break even sales mix

X - 70% of 20,20,000 = ₹14,14,000 i.e. 17,675 units

Y - 30% of 20,20,000 = ₹ 6,06,000 i.e. 6,060 units

CSQ 1.16	PYQ	2019-Jun [3] (b)	8 Marks

AB Ltd. produces a variety of products, each having a number of component parts. Product X takes 5 hours to produce on machine no. 55 which is working at full capacity. X has a selling price of ₹ 50 and a marginal cost of ₹ 30 per unit, Y-5, a component part, could be made on the same machine in 2 hours for a marginal cost of ₹ 5 per unit. The supplier's price is ₹ 13.50 per unit.

Required:

Should AB Ltd., make or buy Y-5?

Answer:

Selling Price of product X	₹ 50
Marginal cost	30
Contribution per unit	20

Contribution per machine hr. = ₹ 20 ÷ 5 = ₹ 4

For Component Y-5:	₹
Marginal cost	5 per unit
Opportunity cost: ₹ 4 x 2 =	8
Total (to make)	13

Supplier's price ₹ 13.50

So, AB Ltd. should make Y-5 for gain of (₹ 13.50 – 13.00) = Re 0.50 per unit.

CSQ 1.17	PYQ	2019-Jun [5] (a)	8 Marks

X Ltd. manufactures and sells a special component. It follows a Standard Marginal Costing system. For the year ended 31.03.2019, it produced 1,500 components against a budgeted capacity of 2,000 components. Out of the production 100 components were scrapped. Due to a computer virus most of the financials could not be retrieved.

However, the Chief Cost Accountant gave the following information:

Particulars	(₹)
Selling Price per component	213
Direct materials total cost	84,000
Direct labour cost per component (Actual efficiency 80%)	?
Variable Manufacturing overhead per component	15
Variable Selling overhead per component	8
Fixed Selling and Administration overheads	48,000
Fixed overhead manufacturing absorption rate per component (on the basis of budgeted capacity)	30
Closing stock (200 units) (Valued at prime cost for financial purpose)	18,000

Required:

(i) Prepare the Profitability statements as per Marginal Costing, Absorption Costing and the actual Profit & Loss Account.

(ii) Reconcile the actual profit with that of the Break-even profit under Marginal Costing.

Answer:

(i)

1. Fixed Manufacturing Overheads = 60,000
   Budgeted Capacity x Absorption Rate (2000 x 30)
   Fixed administrative Overheads = 48,000
   Total Fixed cost = 1,08,000
2. Contribution per Unit
   Selling Price 213
   Prime Cost (Material + Labour)(18000/200) 90
   Variable Manufacturing Overhead 15
   Variable Selling Overhead 8
   Contribution/Unit 100

3. Break Even volume (108000/100 Units) = 1,080 Units
4. Total Absorption Cost / Unit (60 + 30 + 15) = 105
   (Materials + Labour + Variable Manufacturing OH)

Profit under Marginal Costing:

Contribution (1200 x100)	=	1,20,000
Less: Fixed Cost		1,08,000
Profit under Marginal Costing		12,000

Particulars	Profit under Absorption Costing	Actual P&L A/c
Sales (1,200 Units x ₹213)	2,55,600	2,55,600
Cost of Goods Manufactured		
Production (1,500 Units x ₹105)	2,02,500	2,02,500
Additional Labour cost	-	12,750
Less: Closing Stock(200 units x 135 p.u.) (18,000 given in the question)	27,000	18,000
Less: Scrap 100 units x 135	13,500	
Add: Under absorption of OH (500x30)	15,000	15,000
Add: Manufacturing Fixed OH	-	-
Total Cost of Manufacture	1,77,000	2,12,250
Gross Profit	78,600	43,350
Less: Fixed Administrative OH	48,000	48,000
Less: Variable Selling OH	9,600	9,600
Profit/(Loss)	21,000	(14,250)

(ii) Reconciliation (actual P& L with Marginal Costing)

Profit at Break Even point		0
Margin of Safety		+12,000
Stock Valuation		-3,000
(at variable cost under marginal costing 105 x 200 = 21,000 and at 90 as per actual P and L given = 18,000)		
Less: Scrap (variable mfg cost 105 x 100) =		-10,500
Less: Labour	- 12,750	
Actual Loss		-14,250

CSQ 1.18	PYQ	2019-Dec [2] (b)	6+4=10 Marks

Following is the operating results of Premier hospital for the year ended 31 March 2019:

Particulars	₹
Revenue	1,13,88,000
Cost: Variable	26,28,000
Bed capacity cost (fixed) but varies with number of beds	45,30,000
Staff cost	35,10,000
Profit	7,20,000

The hospital charged each patient and average of ₹650 per day, had a capacity of 60 beds operated 24 hours per day for 365 days. The hospital has minimum departmental personnel requirements based on totals annual patient days and following table gives the Salary to be paid.

Annual patient days	Salary (₹ in 000s)
10,000 – 14,000	32,00
14,001 – 17,000	33,80
17,001 – 23,725	35,10

Required:

(i) Compute the Break even patient days for the year ended 31 March, 2019.

(ii) Compute the Break even patient days for the year ended 31 March, 2020 if the hospital capacity is raised to 80 beds. Patient demand is unknown but assume that revenue per patient and cost per patient day, cost per bed, and employee salary will remain the same as for the year ended 31 March, 2019.

Answer:

(i)

No of patient days operated	1,13,88,000/650	17,520
Variable Cost per patient day	26,28,000/17,520	150
Contribution per patient day	650 – 150	500
Fixed Cost		
Bed Capacity cost	45,30,000	
Staff Cost – Salary	35,10,000	80,40,000
Break Even Patient days	80,40,000/ 500	16,080
Since it falls in the previous range revised fixed cost will be		
Fixed Cost		
Bed Capacity cost	45,30,000	
Staff Cost – Salary	33,80,000	79,10,000
Break Even Patient days	79,10,000/500	15,820

(ii)

Expected patient demand with 80 beds	80 × 365 × 17,520/365 × 60	23,360
Existing Staff salary will return unchanged		
Fixed Cost		
Bed Capacity cost (80/60 × 45,30,000)	60,40,000	
Staff Cost – Salary	35,10,000	95,50,000
Break Even Patient days	95,50,000/500	19,100

Since it is in the same range there is no change in the breakeven.

CSQ 1.19	PYQ	2019-Dec [5] (a) (ii)	4 Marks

The following are the data for two business units, P and Q. You are required to find out which of the two units has a better Margin of Safety.

	Unit P	Unit Q
	₹	₹
Sales Price per unit	100.00	250.00
Variable Cost per unit	80.00	150.00
Total Fixed Cost	1,75,000	2,25,000
Budget Sales	1,00,000	2,50,000

Answer:

The following table shows calculation of margin of safety in units and rupees and the margin of safety ratio:

Particulars	Unit P	Unit Q
Sales Price p.u. (₹) (1)	100	250*
Variable Cost p.u. (₹)(2)	80	150
Contribution p.u. (₹) (3) = (1 – 2)	20	100
Fixed Cost (₹) (4)	1,75,000	2,25,000

Budgeted Sales (₹) (5)	1,00,000	2,50,000
Budgeted Sales in units (6) = (5/1)	1,000	1,000
B.E.P in units (7) = 4/3	8,750	2,250
Margin of Safety in units (8) = (6 – 7)	–7750	–1250
Margin of Safety Ratio (9) = 8/6 x 100	–775%	–125%

CSQ 1.20 | PYQ | 2019-Dec [5] (b) | 8 Marks

Company XYZ produces two components (M and N) and is planning the allocation of its available resources for the next period.
75 units of component M and 60 units of component N are required to be produced but machine hour capacity is restricted to a total of 300 hours. Any deficit of components produced in-house can be made up by the purchase of any quantity of either component from an outside supplier. The objective of company XYZ is to satisfy the requirement for components at minimum total cost. The following information is available concerning each component:

Cost (₹ per unit)	M	N
Direct materials	6.20	8.70
Direct labour	5.10	7.50
Variable production overheads	1.20	1.30
Fixed production overheads	4.80	6.40
Total	17.30	23.90
Machine hours (per unit)	2.00	3.00
Price from outside supplier (₹ per unit)	18.50	25.90

Required:
For the next period:
(i) Calculate the variable costs of producing each component in-house.
(ii) Calculate the extra costs of buying-in each component.
(iii) Determine which component should have production priority. Show workings clearly and justify your conclusion.
(iv) Calculate the number of units of each component that should be manufactured by company XYZ.

Answer:

(i) **Calculation for variable cost of producing in-house**

Products	M (₹)	N (₹)
Variable Cost:		
Direct material	6.20	8.70
Direct labour	5.10	7.50
Variable production cost in-house	1.20	1.30
Total	12.50	17.50

(ii) **Calculation of Extra Cost of Buying–in each component**

Products	M	N
Price to be charged by outside Supplier	18.50	25.90
Variable cost of producing in-house [as per (a)]	12.50	17.50
Extra cost of buying – in	6.00	8.40

(iii) **Machine hour cost per unit**

Products	M	N
Machine Hours per unit	2.00	3.00
Extra cost of buying – in per unit (₹)	6.00	8.40
Extra cost of buying (per machine hour) (₹)	3.00	2.80

Priority should be given to the In-house production of component M in order to minimize the extra cost of buying-in.

(iv) Components to be manufactured by XYZ
M = 75 units (75 units x 2 hours) = 150 machine hours
N = 50 units [(300 – 150 machine hours)/3

CSQ 1.21 | PYQ | 2019-Dec [6] (a) | 8 Marks

An agro-based farm is planning its production for next year. The following is relating to the current year:

Product/Crops	M	N	O	P
Area occupied (acres)	125	100	150	125
Yield per acre (ton)	50	40	45	60
Selling price per ton (₹)	100	125	150	135
Variable cost per acre (₹):				

Seeds	150	125	225	200
Pesticides	75	100	150	125
Fertilizers	62.50	37.50	50	62.50
Cultivations	62.50	37.50	50	62.50
Direct wages	2,000	2,250	2,500	2,850

Fixed overhead per annum ₹13,44,000.

The land that is being used for the production of O and P can be used for either crop, but not for M and N. The land that is being used for the production of M and N can be used for either crop, but not for O and P. In order to provide adequate market service, the company must produce each year at least 1,000 tons of each of M and N and 900 tons each of O and P.

Required:

(i) Determine the profit for the production mix fulfilling market commitment.

(ii) Assuming the land could be cultivated to produce any of the four products and there was no market commitment, calculate the profit amount of most profitable crop and break-even point of most profitable crop in terms of acres and sales value.

Answer:

(i) **Profit Statement of Recommended mix:**

Product	**M**	**N**	**O**	**P**
Yield per acre (tons)	50	40	45	60
Selling price per ton	100	125	150	135
Sales revenue per acre	5,000	5,000	6,750	8,100
Variable cost per acre	2,350	2,550	2,975	3,300
Contribution per acre	2,650	2,450	3,775	4,800

Rank	1	2	2	1
Minimum sales requirement in acre		25	20	
		(1,000/40)	(900/45)	

Recommended mix in acre	200	25	20	255	
Total Contribution	5,30,000	61,250	75,500	12,24,000	18,90,750

Less: Fixed cost					13,44,000
Profit					5,46,750

(ii) Most profitable crop. Production should be concentrated on P which gives highest contribution per acre of ₹4,800.

Overall contribution if complete land is used for P = (500 × 4,800) = ₹24,00,000

Less: Fixed cost = ₹13,44,000

Profit = ₹10,56,000

Break-even point in acres for P = 13,44,000/48,000 = 280 acres

Break-even point in sales value = 280 × 135 × 60 = ₹22,68,000

CSQ 1.22	PYQ	2021-Dec [1]	1 Marks

MK Company incurred the following costs for 60,000 units: Variable costs ₹ 18,00,000 Fixed costs ₹ 24,00,000 MK has received a special order from a foreign company for 5,000 units. There is sufficient capacity to fulfill the order without jeopardizing regular sales. Filling the order will require spending an additional ₹ 85000 for shipping.

If MK wants to break even on the order, what should the unit sales price be?

[Sec. B - SAQ]

Answer:

Variable Cost per Unit:

Total Variable Costs for 60,000 units: 18,00,000

Variable Cost per Unit = Total Variable Costs / Number of Units

Variable Cost per Unit = 18,00,000 / 60,000

Variable Cost per Unit = 30

Total Variable Cost for Special Order:

Variable Cost per Unit: 30

Number of Units in Special Order: 5,000

Total Variable Cost for Special Order = Variable Cost per Unit × Number of Units

Total Variable Cost for Special Order = 30 × 5,000

Total Variable Cost for Special Order = 1,50,000

Additional Shipping Cost:
Additional Shipping Cost for Special Order: 85,000
Calculate Total Cost for Special Order:
Total Variable Cost for Special Order: 1,50,000
Additional Shipping Cost: 85,000
Total Cost for Special Order = Total Variable Cost for Special Order + Additional Shipping Cost
Total Cost for Special Order = 1,50,000 + 85,000
Total Cost for Special Order = 2,35,000
Calculate Break-Even Unit Sales Price:
Total Cost for Special Order: 2,35,000
Number of Units in Special Order: 5,000
Break-Even Unit Sales Price = Total Cost for Special Order / Number of Units
Break-Even Unit Sales Price = 2,35,000 / 5,000
Break-Even Unit Sales Price = 47

CSQ 1.23	PYQ	2021-Dec [6]	1 Mark
Hardware Company reported the following results from the sale of 5,000 hammers in May: sales ₹ 200,000, variable costs ₹120,000, fixed costs ₹60,000, and net income ₹ 20,000. Assume that Hardware increases the selling price of hammers by 10% on June 1. How many hammers will have to be sold in June to maintain the same level of net income? *[Sec. B - SAQ]*			

Answer:
Current Selling Price per Hammer:
Total Sales for May: 2,00,000
Number of Hammers Sold: 5,000
Selling Price per Hammer = Total Sales / Number of Hammers Sold
Selling Price per Hammer = 2,00,000 / 5,000
Selling Price per Hammer = 40
New Selling Price per Hammer (After 10% Increase):
Current Selling Price per Hammer: 40

Increase in Selling Price = 10% of 40
Increase in Selling Price = 4
New Selling Price per Hammer = 40 + 4
New Selling Price per Hammer = 44
Contribution Margin per Hammer:
Total Variable Costs for May: 1,20,000
Variable Cost per Hammer = Total Variable Costs / Number of Hammers Sold
Variable Cost per Hammer = 1,20,000 / 5,000
Variable Cost per Hammer = 24
Contribution Margin per Hammer = New Selling Price per Hammer - Variable Cost per Hammer
Contribution Margin per Hammer = 44 - 24
Contribution Margin per Hammer = 20
Number of Hammers to be Sold in June:
Desired Net Income: 20,000
Fixed Costs: 60,000
Total Contribution Margin Needed = Desired Net Income + Fixed Costs
Total Contribution Margin Needed = 20,000 + 60,000
Total Contribution Margin Needed = 80,000
Number of Hammers to be Sold = Total Contribution Margin Needed / Contribution Margin per Hammer
Number of Hammers to be Sold = 80,000 / 20
Number of Hammers to be Sold = 4,000

CSQ 1.24	PYQ	2021-Dec [12]	1 Mark
Kraft Kay sells a single product. 7,000 units were sold resulting in ₹ 70,000 of sales revenue, ₹ 28,000 of variable costs and ₹ 12,000 of fixed costs. Contribution margin per unit is? *[Sec. B - SAQ]*			

Answer:
Sales Price per Unit:
Total Sales Revenue: 70,000
Number of Units Sold: 7,000

Sales Price per Unit = Total Sales Revenue / Number of Units Sold
Sales Price per Unit = 70,000 / 7,000
Sales Price per Unit = 10
Variable Cost per Unit:
Total Variable Costs: 28,000
Number of Units Sold: 7,000
Variable Cost per Unit = Total Variable Costs / Number of Units Sold
Variable Cost per Unit = 28,000 / 7,000
Variable Cost per Unit = 4
Contribution Margin per Unit:
Sales Price per Unit: 10
Variable Cost per Unit: 4
Contribution Margin per Unit = Sales Price per Unit - Variable Cost per Unit
Contribution Margin per Unit = 10 - 4
Contribution Margin per Unit = 6

CSQ 1.25	PYQ	2021-Dec [15]	1 Mark
If there were 60,000 kgs of raw materials on hand on January 1,120,000 kgs are desired for inventory at January 31, and 3,60,000 kgs are required for production in January after a normal loss of 10% of input, how many kgs of raw materials should be purchased in January? *[Sec. B - SAQ]*			

Answer:
Total Requirement for Production:
Required for production: 3,60,000 kgs
Normal loss of 10% of input means 90% of the input will be used.
To find the input needed, we need to consider the 10% loss.
Input Required Considering the Loss:
Total requirement (output) = 3,60,000 kgs
Since this is 90% of the input, input = Total requirement / 90%
Input = 3,60,000 / 0.90
Input = 4,00,000 kgs

Total Raw Materials Needed:
Raw materials needed for production (input): 4,00,000 kgs
Desired inventory at the end of January: 1,20,000 kgs
Total Raw Materials Needed = Raw materials for production + Desired ending inventory
Total Raw Materials Needed = 4,00,000 + 1,20,000
Total Raw Materials Needed = 5,20,000 kgs
Raw Materials to be purchased:
Raw materials on hand on January 1: 60,000 kgs
Raw Materials to be Purchased = Total Raw Materials Needed - Raw materials on hand
Raw Materials to be Purchased = 5,20,000 - 60,000
Raw Materials to be Purchased = 4,60,000 kgs

CSQ 1.26	PYQ	2021-Dec [19]	1 Marks
GI can produce 100 units of a necessary component part with the following costs: Direct Materials ₹ 40,000 Direct Labor ₹18,000 Variable Overhead ₹ 42,000 Fixed Overhead ₹16,000 If GI purchases the component externally, ₹ 4,000 of the fixed costs can be avoided. Below what external price for the 100 units would GI choose to buy instead of make? *[Sec. B - SAQ]*			

Answer:
Total Cost of Producing 100 Units Internally:
Direct Materials: 40,000
Direct Labor: 18,000
Variable Overhead: 42,000
Fixed Overhead: 16,000
Avoidable Fixed Overhead if Purchased Externally:
Avoidable Fixed Overhead: 4,000
Remaining Fixed Overhead if Purchased: 16,000 - 4,000 = 12,000

Relevant Cost of Making the Component Internally:
Direct Materials: 40,000
Direct Labor: 18,000
Variable Overhead: 42,000
Avoidable Fixed Overhead: 4,000
Total Relevant Cost = Direct Materials + Direct Labor + Variable Overhead + Avoidable Fixed Overhead
Total Relevant Cost = 40,000 + 18,000 + 42,000 + 4,000
Total Relevant Cost = 1,04,000
GI would choose to buy the component if the external price is less than or equal to the total relevant cost of making it internally.
Therefore, the external price should be below 1,04,000.

CSQ 1.27	PYQ	2021-Dec [1]	9 Marks

Manton Moulders is operating at 70% capacity and presents the following information:
BEP = ₹ 200 lakhs, PV Ratio = 40% and Margin of Safety = ₹ 50 lakhs
The management has decided to increase production to 95% capacity level with the following changes:
Selling price will be reduced by 8%
Variable cost will be reduced by 5% on sales
Fixed cost will increase by ₹ 20 lakhs, including depreciation on additions but excluding interest on additional capital.
Additional capital of ₹ 50 lakhs will be needed for capital expenditure and working capital

(i) Calculate the present profit at 70% capacity
(ii) Calculate the sales that will be required to earn ₹10 lakhs over and above the present profit and also meet 20% interest on the additional capital.
(iii) What will be the revised Break Even Point?
(iv) What will be the new Margin of Safety?

[Sec. C - One LAQ]

Answer:

(i) Total Sale = 250 lakhs
Contribution = 250 × 40% = 100 lakhs
FC = 200 × 40% = 80 lakhs
Profit = 100 - 80 = ₹ 20 lakhs

(ii) New Fixed Cost = 80 + 20 + (50 × 20%) = ₹ 110 lakhs
New Profit = 20 + 10 = ₹ 30 lakhs
New Contribution = 110 + 30 = ₹ 140 lakhs
Let original selling price per unit = 100
Then, Original Variable Cost per unit = 60
Original Contribution per unit = 40
Then, New S.P. per unit will be 100 – 8 = 92
New V.C. per unit will be 92 × 55% = 50.6
New Contribution per unit will be = 41.4

$$\text{New P/V Ratio} = \frac{41.4}{92} = 45\%$$

$$\text{New Sales} = 140 \times \frac{100}{45} = ₹\ 311.11 \text{ lakhs}$$

(iii) $\text{New BEP} = \frac{110}{45\%} = ₹\ 244.44$ lakhs.

(iv) New MOS = 311.11 – 244.44 = ₹ 66.67 lakhs

CSQ 1.28	PYQ	2021-Dec [1]	4+2+2+4=12 Marks

Getwell Hospitals is a recently constructed multi speciality hospital and has been operating for the last three years quite successfully. A group of doctors who were founders of this hospital could not use the entire facility by itself to recover costs and make profits. They rented out the hospital facilities to different expert groups like pediatrics, cardiology etc. and collected amounts consisting of two elements- the variable portion relating to the number of patient days and a fixed portion irrespective of the number of beds occupied. Apart from common facilities, the respective expert groups had to engage its own nurses, aides and supervisory nurses on a full time basis. This is being done carefully after assessing the ability to attend on the requirements of patients.

During COVID, the number of patients who came for regular check-ups and undertook consequent preventive medical treatments dwindled drastically and therefore the whole hospital saw the necessity and opportunity to function as a COVID Care hospital. Now the facilities were rented to Covid treatment groups and all groups had a hundred per cent occupancy.

One such group called Covid Sure Cure (CSC) that rented this facility had the following figures for the past year:

It had taken up 60 beds for 365 days. It was charged by Getwell a sum of ₹ 9,31,80,000 as the fixed charge and ₹ 9,000 per patient day as the variable charge. CSC in turn charged its patients ₹ 15,000 per bed per day.

The range of requirements beginning from the minimum relating to nursing staff is given below:

Annual patient days	Aides (A)	Nurses (N)	Supervising Nurses (SN)
10,000 - 14,000	20	10	3
14,001 - 17,000	21	11	3
17,001 - 20,000	21	12	3
20,001 - 23,000	22	13	4
23,001 - 25,000	23	14	5
25,001 - 27,000	24	15	7

Salaries that had to be paid annually to each person under these categories was the following:

	₹ 3,60,000	₹ 4,80,000	₹ 5,40,000

CSC was comfortable during the pandemic as all the beds were occupied all the time and there was a growing demand for more. But in the coming year, as the number of patients has come down and some beds are now being given for post- covid complication care patients, CSC wants to look at its cost structure to be able to negotiate a different pricing with Getwell.

(i) Under the given conditions of outflows to salaries and to Getwell, how many patient days will be required by CSC for the earliest break-even?

(ii) How many beds does this figure translate to, on an average?

(iii) Will it be substantially worthwhile for CSC to consider trimming its requirement on the number of nursing staff?

(iv) If CSC expects an 80 % level of occupancy during the current period, what should be the amount to be paid to Getwell with a 25% margin of safety? It feels it cannot increase the charge to patients.

[Sec. D - CSQ]

Answer:

(i) BEP patient days = 18,020.

(ii) This translates to about 49.36, say 50 beds occupancy. (18,020 ÷ 365).

(iii) The staffing cost is very low considering the huge bulk of fixed cost to Getwell. As seen above, one level of pruning will only save 230 patient days, which is not even one bed occupancy. Hence it is not worthwhile for CSC to trim its staff. Another aspect is that trimmed workforce may be stressed and may not render adequate quality. Further, it is stated that the staffing is already done carefully. Hence there is no likelihood of a substantial reduction in nursing staff cost.

(iv) Amount to be paid to Getwell towards fixed and variable component = ₹ 18,21,60,000.

CSQ 1.29	PYQ	2022-Dec [3]	3+3+3+7 = 16 Marks

TOCON Ltd. manufactures plastic cans of a standard size. The variable cost per can is ₹ 4 and the selling price is ₹ 10 each. The factory of the company has eight machines of identical size. Any individual machine can produce 30 cans per hour. The factory works on 300 days per annum basic and the actual available hour per machine per day is 7.5. The company has an order of 4,20,000 cans from an oil company, to supply. The yearly fixed cost of the company is ₹ 20 lakhs. TOCON Ltd. has received an order from another firm for supplying 60,000 nos. of plastic moulded toys. The price of the toys is ₹60 each and the variable cost is ₹50 each. While this order would be acceptable for supplying for total quantities only on acceptance, a special mould costing ₹ 2,25,000 would be required to be acquired to manufacture the toys. The time study exercise has revealed that 15 nos. of toys can be produced per hour by any of the machines.

Required:

Advise the company, with reasons in the following situations:

(i) Whether to accept the order of manufacturing moulded toys, in addition to supplying 4,20,000 nos. of cans or not;

(ii) Whether to accept the order of manufacturing moulded toys, if order of cans increases to 5,40,000 nos. or not;

(iii) While a sub-contractor is willing to supply the toys, either whole or part of the required quantities at an all-inclusive rate of 57.50 each, what would be the minimum excess capacity needed to justify the manufacturing of any portion of the toys order, instead of sub-contracting?

(iv) The company had an understanding that the orders of the cans will be increased during the year on negotiations and planned and manufactured 4,50,000 cans during the year. For utilizing the excess capacity, they also accepted the toys order and sub-contracted only 15,000 nos. of toys. At the year's end, however, it was revealed that the order of the cans could be for 4,80,000 nos., if it was properly negotiated. How much loss has been suffered by the company due to improper prediction of demand and negotiation?

Answer:

(i) Increase in Net Profit = ₹ 3,75,000

Decision: It is advisable for the company to accept the order of 60,000 moulded toys as it will increase its profit by ₹ 3,75,000.

(ii)

	₹ (Lacs)
Profit from 5,40,000 cans	12.40
Alternatively, the production would be 4,20,000 cans and 60,000 moulded toys	
Profit from 4,20,000 cans	5.20
Profit from 60,000 moulded toys	3.75
Total profit	**8.95**

Decision:

The production of 1,20,000 additional cans instead of 60,000 moulded toys will result an additional profit of ₹ 3.45 lacs (₹ 12.40 lacs - ₹ 8.95 lacs). Therefore, the company is advised not to accept the order of manufacturing moulded toys.

(iii) Let the minimum excess capacity needed to justify the manufacturing of any portion of the moulded toys order be A.

If toys are manufactured, the profit is = (₹ 60 – ₹ 50) A – ₹ 2,25,000 and, if toys are subcontracted, the profit is = (₹ 60 – ₹ 57.50) A indifference point would be 10A - ₹ 2,25,000 = 2.5 A

or A = 30,000 moulded toys

Toys produced per hour = 15 toys

Therefore, 2,000 (30,000 toys/15 toys) excess machine hours are required to justify manufacturing of toys by the company, instead of sub-contracting.

(iv) Profit under existing production plan:

	₹ (Lacs)
Contribution from 4,50,000 Cans	27.00
Contribution from 45,000 Toys	4.50
Total contribution	31.50
Less: Fixed cost	22.25
Profit	9.25
Profit from 15,000 sub-contracted toys	0.375
Total profit	9.625

If demand was accurately forecasted and 4,80,000 cans were manufactured, excess machine hour capacity available was 2,000 hrs. such excess being the point of indifference i.e. profit from toys order would be the same by either manufacturing 30,000 toys or sub-contracting them along with the rest of 30,000 toys.

Profit under properly negotiated production plan:

	(₹ Lacs)
Contribution from 4,80,000 Cans	28.80
Less: Fixed cost	20.00
Profit	8.80
Profit from toys	1.50
Total profit	**10.30**

Therefore, the loss for improper prediction and negotiation is ₹ 10,30,000 – ₹ 9,62,500 = ₹ 67,500.

CSQ 1.30	PYQ	2023-Jun [3] (b)	5 Marks

SUNRISE PRAKASHAN LTD. is in the business of publishing a leading news paper which has a wide customer base. It measures quality of service in terms of:

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

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

To purchase the equipment, the company is planning to utilize the proceeds of an investment fetching an income @ 9%. Details regarding the present and future performance are given as under:

	Present	Expected
On time delivery	80%	95%
Variable cost per lot of newspaper damaged and unsold (₹)	40	40
Fixed Cost (₹)	60,000	60,000
No. of lots of newspaper damaged and unsold	6,000	1,000

It is expected that each percentage increases in on time performance will result in revenue increase of ₹ 35,000 per annum. Required contribution margin is 40%.

Required:

Draw inference from the information given above and evaluate, whether Sunrise Prakashan Ltd. should install the new system.

Answer:

Costs and Benefits for installation of the New System:

	₹
Total Cost for the New System	3,36,000
Total Benefits from the New System	4,10,000
Net Benefits	74,000

Decision: By installation the Scheduling and Tracking System, the Company (Sunrise Prakashan Ltd.) will be able to save ₹ 74,000 per annum. Hence, the Company should install the New System.

CSQ 1.31	PYQ	2023-Jun [6] {C}	8 Marks

You have been approached by a friend who is seeking your advice as to whether he should give up his job as an engineer, with a current salary of ₹ 14,800 per month and go into business on his own, assembling and selling a component which he has invented. He can procure the parts required to manufacture the component from a supplier.

It is very difficult to forecast the sales potential of the component, but after some research, your friend has estimated the sales as follows:

(i) Between 600 to 900 components per month at a selling price of ₹ 250 per component.
(ii) Between 901 to 1,250 components per month at a selling price of ₹ 220 per component for the entire lot.

The costs of the parts required would be ₹ 140 for each completed component. However, if more than 1,000 components are produced in each month, a discount of 5% would be received from the supplier of parts on all purchases.

Assembly costs would be ₹ 60,000 per month upto 750 components. Beyond this level of activity assembly costs would increase to ₹ 70,000 per month.

Your friend has already spent ₹ 30,000 on development, which he would write off over the first five years of the venture.

Required:

(I) Analyse the information stated supra and formulate by way of calculating for each of the possible sales levels at which your friend could expect to benefit by going into the venture on his own.
(II) Formulate by way of calculating the breakeven point of the venture for each of the selling price and suggest your friend on each level of break-even point.
(III) Advise your friend as to the viability of the venture.

Answer:

I. The salary of ₹ 14,800 per month is a benefit foregone by going into business. It should therefore be considered as a minimum profit which must be earned p.m. from the new venture in order to be not worse-off than before.

II. Sum of ₹ 30,000 spent on the development work of the new venture cannot be recovered irrespective of the decision and thus it should be ignored.

III. Advise on the viability of the venture:

(a) At a selling price of ₹ 250 he will not be at a loss if the demand of the component exceeds 680 units to 749 units and 770.909 units to 900 units.

(b) At a selling price of ₹ 220, it is not worthwhile to sell if the demand is less than 1,000 components without availing a discount of 5%.

CSQ 1.32	PYQ	2024-Jun [2]	14 Marks

ZOYAN Limited is currently manufacturing 5,000 units of the product 'ZN 100' annually making full use of its machine capacity. The selling price and total costs per unit associated with 'ZN 100' are as follows:

	₹	₹
Selling price per unit		900
Costs per unit:		
Direct material	200	
Variable machine operating cost	150	
(₹ 100 per machine hour)		
Manufacturing overhead cost	180	
Marketing and administrative cost	200	730
Operating income per unit of 'ZN 100'		170

ZOYAN Limited can sell additional 3,000 units of 'ZN 100', if it can outsource those additional units.

AOB Limited, a supplier of quality products, has agreed to supply up to 6,000 units of 'ZN 100' per year at a price of ₹ 650 per unit delivered at ZOYAN's factory.

ZOYAN Limited can use its facility to produce an alternative product 'ZN 200'. It can sell up to 12,000 units of 'ZN 200' annually. Estimated selling price and total costs per unit to manufacture and sell 12,000 units of 'ZN 200' are as follows:

	₹	₹
Selling price per unit		600
Costs per unit:		
Direct material	200	
Variable machine operating cost	50	
(₹ 100 per machine hour)		
Manufacturing overhead cost	60	
Marketing and administrative cost	110	420
Operating income per unit of 'ZN 200'		180

Other information pertaining to the operation of Zoyan Limited is as follows:

(i) ZOYAN Ltd., use machine hours as the basis for assigning fixed manufacturing overhead. The fixed manufacturing overhead for the current year is ₹ 3,00,000. These costs will not be affected by the product-mix decision.

(ii) Variable marketing and administrative cost per unit for various products are as follows:

Manufactured	'ZN 100'	₹ 80
Purchased	'ZN 100'	₹ 40
Manufactured	'ZN 200'	₹ 60

Fixed marketing and administrative costs for the current year is ₹ 6,00,000. These costs will be affected by the product mix decision.

Required:

(a) Analyse the Contribution per unit between manufactured 'ZN 100' and manufactured 'ZN 200'.

(b) Analyse the Contribution per unit between manufactured 'ZN 100' and purchased 'ZN 100'.

(c) Calculate the quantity of each product that ZOYAN Limited should manufacture and/or purchase to maximize operating income.

Answer:

(a) **Statement for Calculation of Contribution**

Particulars	ZN 100	ZN 200
Selling Price	900	600
Less: Variable Cost:		
Material	200	200
Machine Operating Cost	150	50
Variable Factory OH	120	40

Variable Selling and Distribution OH	80	60
Contribution per Unit	350	250
Machine Hours per Unit	1.5	0.5
Contribution per Hour	233.33	500
Ranking	II	I

Contribution per unit

Manufactured "ZN 100" = ₹ 350

Manufactured "ZN 200" = ₹ 250

(b) **If ZN 100 is purchased from outside**

Selling Price	=	900
— Purchase Cost	=	650
— Variable Marketing and Administration Cost	=	40
Contribution per unit		₹ 210

Contribution per unit

Manufactured "ZN 100" = ₹ 350

Purchased "ZN 100" = ₹ 210

(c) **Statement of Optimum Product Mix**

	Product	Units	Hours p.u.	Total Hours.
I	ZN 200	12,000	0.5	6,000
II	ZN 100	1,000	1.5	1,500
			Total	7,500

6,000 units of ZN 100 should be purchased from outside.

Working Notes:

Product ZN 100 → Hours p.u. = $\frac{150}{100}$ = 1.5 hours p.u.

Total Hours (Capacity) → 1.5 x 5,000 = 7,500 hours

Product ZN 200 → Hours p.u. = $\frac{50}{100}$ = 0.5 hours/unit

Fixed Manufacturing OH per machine hour = $\frac{3,00,000}{7,500}$ = ₹ 40 per machine hour

Quantity of each product that ZOYAN Limited should manufacture and / or purchase to maximize operating income.

Manufactured "ZN 200"	12,000 units
Manufactured "ZN 100"	1,000 units
Purchased "ZN 100"	6,000 units

CSQ 1.33 | PYQ | 2024-Dec [2] | 14 Marks

GREEN SINE (C) Ltd., a cement manufacturing company, produces '50 grade' cement for which the company has an assured market. The output for 2024 has been budgeted at 1,80,000 units at 90% capacity utilization. The cost sheet based on output (per unit) is as follows:

	(₹)
Selling Price	130
Direct Material	30
Component "EX"	9.40
Direct Wages @ ₹ 7 per hour	28
Factory Overheads (50% fixed)	24
Selling and distribution Overheads (75% variable)	16
Administrative Overheads (Fixed)	5

The factory overheads are applied on the basis of direct labour hours.

To utilize the idle capacity and to improve the profitability of the company, the following proposal was put up before the Board of Directors for consideration:

An order has been received from abroad for 6,000 units of product '53 grade' cement at ₹ 175 per unit. The cost data are:

Direct material ₹ 56 per unit, direct labour 10 hours per unit, selling and distribution overheads applicable to this product order is ₹ 14 per unit and variable factory overheads are chargeable on the basis of direct labour hours.

The company at present manufactures component 'EX' one unit of which is required for each unit of product '50 grade' cement. The cost details for 15,000 units of component 'EX' are as follows:

	(₹)
Direct Material	30,000
Direct Labour	52,500
Variable Overheads	25,500
Fixed Overheads	33,000
Total	1,41,000

The component "EX" however is available for purchase at the market at ₹ 7.90 per unit.

Required:

(i) Prepare a statement showing profitability of the company as envisaged in the Budget.

(ii) Evaluate the export order and state whether it is acceptable or not.

(iii) Make an appraisal of proposal to manufacture component "EX" and state whether component "EX" should be manufactured in the factory or purchased from the market. Assume that no alternative use of spare capacity is available.

Answer:

Segregation of Variable Costs and Fixed Costs:

Particulars		Cost/per unit (₹)	Variable Cost (₹/ unit)	Fixed Cost (₹)
Direct Material		30.00	30.00	-
Component EX		9.40	7.20	3,96,000
Direct Wages		28.00	28.00	-
Factory Overhead	50% fixed	24.00	12.00	21,60,000
Selling and Distribution Overhead	75% variable	16.00	12.00	7,20,000
Administration Overhead	Fixed	5.00	0.00	9,00,000
Total		112.40	89.20	41,76,000

(i) Statement showing Profitability as envisaged in the Budget:

Units sold	1,80,000
	Amount (₹)
Selling Price per unit	130.00
Less: Variable cost per unit	89.20
Contribution per unit	40.80
Total Contribution	73,44,000
Less: Fixed Cost	41,76,000
Profit	31,68,000

(ii) Evaluation of Export Order:

Particulars	₹ per Unit	₹ per Unit
Direct material	56	
Direct labour	70	
Variable factory overhead	30	
Selling and distribution overheads	14	
Total variable cost		170
Selling price (export)		175
Contribution		5
Total units		6,000
Additional contribution from export order (6,000 units X ₹5)		30,000

Verification of availability of Capacity to fulfill the export order:

Total labour Hours on Product 50 grade	7,20,000
Total labour Hours on component EX	90,000
Total hours utilised at 90% capacity	8,10,000
Total Hours at 100% capacity	9,00,000
Balance Hours available	90,000
Hours required for export order	60,000

Conclusion:

As export order gives an additional contribution of ₹ 30,000 and availability of capacity also exists to fulfill the export order, the same is acceptable.

(iii) Appraisal of Make or Buy Decision:

(per 15,000 units)	Make (₹)	Buy (₹)
Direct material	30,000	
Direct labour	52,500	
Variable factory overhead	25,500	
Total	1,08,000	1,18,500
Per unit	7.20	7.90

Judgement:

If the company makes the component, the out-of-pocket cost is ₹ 7.20 per unit whereas if the component is bought, the out-of-pocket cost is ₹ 7.90. As no alternative use of spare capacity is available, it is profitable to make.

CSQ 1.34	PYQ	2025-Jun [2]	14 Marks

AIRWAY Ltd. has hired an aircraft to specially operate between cities A and B. All the seats are economy class. The following information is available:

Seating capacity of the aircraft	:	260 passengers
Average number of passengers per flight	:	240 passengers
Average one-way fare from A to B	:	₹ 5,000 per passenger
Fuel costs per flight from A to B	:	₹ 90,000
Food cost (A to B sector) (no charge to passenger)	:	₹ 300 per passenger
Commission to travel agents (All tickets are through agents)	:	10% of the fare
Annual lease costs allocated to each flight		₹ 2,00,000
Ground services, baggage handling/ checking in service costs per flight A to B		₹ 40,000
Flight crew salaries per flight A to B		₹ 48,000

There is an offer from another airlines operator, ZOMB Ltd. for a stop-over at destination D, which is on the way from A to B. Due to this, the flight will operate from A to D, then from D to B.

The following terms are considered for the stop-over:

50 seats from D to B will be booked by ZOMB Ltd. at ₹ 2,700 per ticket, whether or not ZOMB Ltd. is able to sell them to its customers. No agents' commission is payable on these tickets. However, snacks must be provided to these passengers also by Airway Ltd. at no further charge to the passengers.

A maximum of 60 tickets can be sold by Airway's travel agents for A to D sector at a fare of ₹ 3,000 per passenger.

Since the stop-over wastes more time, 25 of Airway's original passengers in the A to B sector will voluntarily drop out in favour of other airlines offering direct flights between A and B.

Due to the stop-over, fuel costs will increase from ₹ 90,000 to ₹ 1,35,000. Additional airport landing/baggage, handling charges of ₹ 19,000 per stop-over will have to be incurred by Airway Ltd.

Airway Ltd. will have to serve snacks to all the passengers in the D to B sector at no charge to passengers. Each snack will cost Airway ₹ 200. This will be in addition to the original food at ₹ 300 served in the A to D sector.

(Assume that fuel costs are not affected by the actual number of passengers in the flight, ignore non-financial considerations, additional wear and tear to aircraft due to extra landing/take-off.)

Required:

(a) Without considering ZOMB Ltd.'s offer:
   (i) Analyze the Profit earned by AIRWAY Ltd., per flight from city A to B.
   (ii) Assess the Break–even number of passengers for each flight from city A to B.

(b) Considering the effects of ZOMB Ltd.'s offer:
   (i) Analyze the additional Profit earned by AIRWAY Ltd., from ZOMB Ltd.'s offer.
   (ii) Advise with the justification whether the AIRWAY Ltd. should accept the offer of ZOMB Ltd. or not.

[NOTE: A detailed Profitability Statement is not essential. Only figures relevant to the cost-revenue analysis are required.]

Answer:

(a) Statement Showing Allocation of Seats in the Aircraft:

Existing Situation for Destination A to B:	
Seating Capacity of the Aircraft	260 passengers
Average Number of Passengers per flight	240 passengers
Proposed Situation for Destination D to B	
Seat Booked by ZOMB Ltd.	50 Seats
For Destination A to B	
Seats Available {260 (Capacity) - 50 (booked by ZOMB Ltd. for Destination D to B)}	210 Seats
Requirement of Regular Passengers {240 (original no. of passengers) - 25 (no. of passengers drop out due to wastage of time)}	215 Seats
Possible Allocation of Seats to Regular Passengers	210 Seats
For Destination A to D	
Seats Available {260 (capacity) - 210 (seats allocated to regular passengers of destination A to B)}	50 Seats
Requirement of Agents (tickets can be sold by Airway's Travel Agents)	60 Seats
Possible Allocation to Agents of Airways Ltd.	50 Sets

(i) Analysis of Profit Per flight

Particulars	Amt. ₹	Amt. ₹
Revenue per passenger (Gross Fare)		5,000
Less: Total variable Cost per passenger		
10 % Commission on Fare	500	
Food	300	800
Contribution per passenger		4,200
Contribution per flight (Contribution for 240 Passengers)		10,08,000
Less: Fixed Costs per Flight		
Fuel Cost	90,000	
Annual Lease Cost	2,00,000	
Group Service, Baggage Handling / Checking in	40,000	
Flight Crew Salaries	48,000	3,78,000
Profit per Flight		6,30,000

(ii) Break-even number of Passengers for each flight from A to B

Break-even number of Passengers = Total Fixed cost per flight/Contribution per Passenger

Break-even number of Passengers @ (₹3,78,000 / ₹4,200) = 90 Passengers

(b) Proposed Situation:

Contribution per Passenger (A to D)

	₹	₹
Revenue per passenger (Gross Fare)		3,000
Less: Total Variable Cost per Passenger:		
10 % Commission on Fare	300	
Food #	300	600
Contribution per Passenger		2,400

(#) All the passengers booked for destination A to D are also served food.

(i) Analysis of Additional Profit Per Flight earned by Airway Ltd. from the offer of ZOMB Ltd.

	Additional	
	Cost (₹)	Revenue (₹)
Revenue from Destination D to B (50 Seats x ₹2,700)		1,35,000
Contribution from Destination A to D (50 Sets x ₹2,400)		1,20,000
Contribution Lost for Destination A to B (30 Seats x ₹4,200)*	1,26,000	
Snacks (260 Passengers x ₹200)	52,000	
Fuel Cost	45,000	
Airport Landing / Baggage Handling Charges	19,000	
Total	2,42,000	2,55,000
Profit (Additional) Per Flight (2,55,000 - 2,42,000)		13,000

(*) 240 Seats (existing) Less 210 Seats (Proposed)

(ii) **Advice:**

As Airway Ltd. will gain of ₹13,000 per flight, it should accept the ZOMB Ltd 's Offer.

CSQ 1.35 | PYQ | 2026-Jun [2] | 14 Marks

MHT Limited is currently manufacturing 5000 units of the product 'MH 100' annually making full use of its machine capacity. The selling price and total costs per unit associated with 'MH 100' are as follows :

	₹	₹
Selling price per unit		900
Costs per unit :		
Direct materials	200	
Variable machine operating costs (₹100 per machine hour)	150	
Manufacturing overhead costs	180	
Marketing and administrative costs	200	730
Operating income per unit of 'MH 100'		170

MHT Limited can sell additional 3,000 units of 'MH 100', if it can outsource those additional units.

Rex Limited, a supplier of quality products, has agreed to supply upto 6,000 units of 'MH 100' per year at a price of ₹650 per unit delivered at MHT's factory.

MHT Limited can use its facility to produce an alternative product 'MH 200'. It can sell up to 12,000 units of 'MH 200' annually. Estimated selling price and total costs per unit to manufacture and sell 12,000 units of 'MH 200' are as follows :

	₹	₹
Selling price per unit		600
Costs per units:		
Direct materials	200	
Variable machine operating costs (₹100 per machine hour)	50	
Manufacturing overheads costs	60	
Marketing and administrative costs	110	420
Operating income per unit of 'MH 200'		180

Other information pertaining to the operation of MHT Limited is as follows:

(1) MHT Limited use machine hours as the basis for assigning fixed manufacturing overhead. The fixed manufacturing overhead for the current year is ₹3,00,000. These costs will not be affected by the product-mix decision.

(2) Variable marketing and administrative costs per unit for various products are as follows :

Manufactured	'MH 100'	₹80
Purchased	'MH100'	₹40
Manufactured	'MH200'	₹60

Fixed marketing and administrative costs for the current year is ₹6,00,000.

Required :

(1) Assess the contribution per unit of manufactured 'MH 100' and manufactured 'MH 200'.

(2) Assess the contribution per unit between manufactured 'MH 100' and purchased 'MH 100'.

(3) Calculate the quantity of each product that MHT Limited should manufacture and/or purchase to maximize operating income.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

02 Pricing Decisions and Strategies

THEORY QUESTIONS

TQ 2.1	PYQ	2019-Dec [8] (b)	SN	4 Marks

Write short notes on the following:
Price sensitivity

Answer:

Price sensitivity is the degree to which the price of a product affects consumers' purchasing behavior. It may also be said that through price sensitivity analysis, any organization measures how it's demand changes with the change in the cost of it's products. Price sensitivity is generally used to measure the change in demand based on price change.

For example, some consumers are not willing to pay a few extra paise per litre for petrol, especially if a lower priced station is nearby.

When they study and analyze price sensitivity, companies and product manufacturers can make sound decisions about products and services.

Price sensitivity can be defined as the extent to which demand changes when the cost of a product or service changes. The price sensitivity of a product varies with the level of importance consumers place on price relative to other purchasing criteria. Some people may value quality over price, making them less susceptible to price sensitivity. For example, customers seeking top-quality goods are typically less price sensitive than bargainers, so they're willing to pay more for a high-quality product. By contrast, people who are more sensitive to price may be willing to sacrifice quality. These individuals will not spend more for something like a brand name, even if it has a higher quality over a generic store brand product.

Price sensitivity also varies from person to person, or from one consumer to another. Some people are able and willing to pay more for goods and services than others. Companies and governments are also able to pay more compared to individuals.

Consumers are less sensitive to price when the total cost is low compared to their total income. Likewise, the total expenditure compared to the total cost of the end product affects price sensitivity.

TQ 2.2	PYQ	2021-Dec [2]	SN	3 Marks
Write short note on Rate of return pricing. What are the issues that may arise due to adoption of this pricing? *[Sec. C - Six LAQ]*				

Answer:

Rate of Return Pricing:

Determination of return on capital employed is one of the most crucial aspects of price fixation process. In this process instead of arbitrarily adding a percentage on cost of profit, the firm determines an average mark up on cost necessary to produce a desired rate of return on its investment.

Under this method three issues arise:

(a) The basis on which the capital employed is computed.
(b) Which items should be covered on the return on capital.
(c) What rate of return can be regarded as fair?

TQ 2.3	PYQ	2021-Dec [2]	DESC	3 Marks
Write a brief note on Pricing in Service sector. *[Sec. C - One LAQ]*				

Answer:

Pricing in the Service Sector means determining the amount charged for services such as education, banking, healthcare, transport, and consultancy. Since services are intangible and cannot be stored, pricing is influenced by factors like cost of providing the service, customer perception of value, demand, competition, and quality of service. Common methods include cost-based pricing, value-based pricing, and competitive pricing. Proper pricing helps organizations recover costs, earn profits, and satisfy customers.

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2016-Dec [7] (c)	5 Marks
Mumbai based Hero Electronics manufactures a compo-nent for RCom Mobile in batches of 2,000 each. Each component is tested before being sent to the RCom for sales. Each component can be tested at the factory at a cost of ₹ 25. If any component is found to be defective, it can be rectified by spending ₹ 200. In view of the large demand for the components and the sophisticated system of manufacture, a proposal came up that the practice of pre-testing of the components is to be dispensed with to save costs. In that event, any defective component is received back from the customer under warranty, the cost of rectification and re-dispatch will be ₹ 400 per component. State at what percentage of manufacture of components, the Hero Electronics will find it cheaper to pre-test of each component?			

Answer:

Let the defectives be D.

To set (2,000 × 25) + 200D

If defectives are rectified after return from customers the cost = 400D

At cost indifference point:

(2,000 × 25) + 200D = 400D

Or, 200D = 50,000

Or, D = 250Therefore, percentage of defective to total components = (250 ÷ 2,000) × 100 = 12.5%

Recommendation: If defectives are more than 12.5%, then pre-testing is advised Hero Electronics.

CSQ 2.2	PYQ	2017-Dec [3] (a)	10 Marks
The Stock Control Policy of Vidhata Co. is that each stock is ordered twice a year, the quantum of each order being one-half of the year's forecast demand. The Materials Manager, however, wishes to introduce a policy in which for each item of stock, Re-order Levels and EOQ are calculated. For one of the items X, the following information are available:			

Forecast Annual Demand	3,600 units
Cost per unit	₹ 100
Cost of Placing an order	₹ 40
Stockholding Cost	20% of the average stock value
Buffer Stock to cover fluctuations in demand	100 Nos.

Required:

If the new policy is adopted, calculate for stock item X,

(i) Re-order Level that would be set by the Materials Manager.

(ii) Anticipated reduction in value of the average stock investment.

(iii) Anticipated reduction in total inventory costs in the first and subsequent years.

Answer:

(i) Reorder Level = Safety Stock + Lead Time Consumption = 100 units (given) + (3,600 units ÷ 12 months) = 100 + 300 = 400 units.

(ii) Economic Order Quantity - Square Root of (2AB ÷ C) where

A = Annual Requirement of Raw Materials = 3,600 units

B = Buying or Ordering Cost per order = ₹ 40

C = Carrying or Stockholding Cost p.u. per annum= ₹ 100 × 20% = ₹ 20 On substitution, EOQ = 120 units

Average Stock Quantity under Old Policy = (1,800 units ÷ 2) = 900 units

Average Stock Quantity under EOQ = Safety Stock + (120 units ÷ 2) = 100 units + 60 units = 160 units

Reduction in the value of the Average Stock Investment = (900 – 160) × ₹ 100 = ₹ 74,000.

(iii) **Cost Comparison of Old Policy and EOQ:**

Particulars	Old Policy	EOQ
Quantity ordered every time	1,800 units	120 units
Number of orders per annum	2 orders	30 orders
Buying Cost at ₹ 40 per order	2 × ₹ 40 = ₹ 80	30 × ₹ 40 = ₹ 1,200
Average Inventory = ½ x Quantity	900 units	160 units (incl. Safety Stock)
Carrying Cost at ₹ 20 per unit	900 × ₹ 20 = ₹18,000	160 × ₹ 20 = ₹ 3,200
Total Associated Cost	**₹ 18,080**	**₹ 4,400**

Savings in Cost per annum due to EOQ Policy = ₹ 18,080 - ₹ 4,400 = ₹ 13,680

However, for the first year, the Company has to specifically purchase the safety stock also, in addition to the annual consumption requirements. This will be at a cost of ₹ 100 x 100 units = ₹ 10,000. Hence, savings in the first year will be ₹ 13,680 - ₹ 10,000 = ₹ 3,680.

CSQ 2.3	PYQ	2018-Dec [4] (a)	8 Marks

A company is organized into two divisions, namely X and Y, and produces three products A, B and C. Data per unit are:

	A	B	C
Market price (₹)	240	230	200
Variable costs (₹)	168	120	140
Direct labour (hours)	4	5	3
Maximum sales potential (units)	1,600	1,000	600

Division Y has a demand for 600 units of products B for its use. If Division X cannot supply the requirement, Division Y can buy a similar product from market at ₹ 224 per unit

Required:

What should be the transfer price of 600 units of B for Division Y, if the total direct labour- hours available in Division X are restricted to 15,000?

Answer:

		Product		
Particulars		**A**	**B**	**C**
Market price	(₹)	240	230	200
Less: Variable costs	(₹)	168	120	140
Contribution p.u.	(i)	72	110	60
Direct labour hours p.u.	(ii)	4	5	3
Contribution per D.L.H.	(i)/(ii)	18	22	20
Rank		III	I	II

Production	Max. Sales	Hrs/Unit	Production	Hours used	Balance hours
B	1,000	5	1,000	5,000	10,000

C	600	3	600	1,800	8,200
A	1,600	4	1,600	6,400	1,800

Spare hours available in Division X = 1,800 hrs
Division X can produce Product B in 1,800 spare hours
= 1,800 hrs/5 hrs. p.u. = 360 units of product B
Balance units of Products B required by Division Y = 600 units – 360 units = 240 units
Labour hours required for 240 units of Product B = 240 units x 5 hrs. per unit = 1,200 hours.
Opportunity contribution of A per hr. = ₹ 18

Calculation of Minimum Transfer Price p.u.		₹
Variable cost	(600 units × ₹ 120)	72,000
Opportunity cost of contribution lost	(1200 hrs × ₹ 18)	21,600
Amount to be recovered		93,600
Transfer price p.u. (₹)	(₹ 93,600 / 600 units)	156

CSQ 2.4	PYQ	2021-Dec [17]	1 Marks

Oasis Ltd. Wants to produce and sell a new mineral water. In order to penetrate the market, the product will have to sell at ₹ 20.00 per bottle. The company expects a profit of 20% on the selling price. Calculate the target cost per bottle.

[Sec. B - SAQ]

Answer:
₹ 16

03 Transfer Pricing

THEORY QUESTIONS

TQ 3.1	PYQ	2016-Jun [6] (a)	DESC	7 Marks

Why is Transfer Pricing (TP) necessary in the organization? Show the impact of transfer prices to the 'selling' and 'buying' profit centers.

Answer:

- **'Transfer Pricing (TP)'** is needed to monitor the flow of goods and services among the divisions of a company and to facilitate the divisional performance measurement.
- The main use of transfer pricing is to measure the notional sales of one division to another division.
- Thus the transfer prices used in the organization will have a significant effect on the performance evaluation of the various divisions.
- It becomes necessary when there is internal transfer of goods or services and it is required to appraise the separate performances of the divisions departments involved.
- If profit centers are to be used, transfer prices become necessary in order to determine the separate performances of both the 'buying' and 'selling' profit centers.
- If transfer prices are set too high, the 'selling center' will be favoured.
- On the other hand, if transfer prices are set too low, the 'buying center' will receive an unwarranted proportion of the profits.

TQ 3.2	PYQ	2017-Jun [8] (b)	SN	4 Marks

Write a short note on the following:
Transfer Pricing.

Answer:

Transfer Pricing:

A transfer price is the price of one segment sub unit, department, division etc.,) of an organization charges for a product or services supplied to another segment of the same organization. Transfer prices are used when individual entities of a larger multi- entity firm are treated and measured as separately run entities.

The benefits of Transfer Pricing Policy are as under:

(i) Divisional performance evaluation is made easier.
(ii) It will develop healthy inter-divisional competitive spirit.
(iii) Management by exception is possible.
(iv) It helps in co-ordination of divisional objectives in achieving organizational goals.

(v) It provides useful information to the top management in making policy decisions like expansion, sub-contracting, closing down of a division, make or buy decisions, etc,
(vi) Transfer Price will act as a check on supplier's prices.
(vii) It fosters economic entity and free enterprise system.
(viii) It optimizes the allocation of company's financial resources based on the relative performance of various profit centres, which in turn, are influenced by transfer pricing policies.

CASE-SCENARIO QUESTIONS

CSQ 3.1 | PYQ | 2019-Dec [4] | 2+4+3+3+4=16 Marks

XY Co. has Profit Centre Divisions X and Y, marking products X and Y respectively. Each unit of Y requires one unit of X and Y can sell a maximum of 50,000 units in the external market at a selling price of ₹150 per unit. X has the capacity to produce 1,00,000 units of X. The variable cost per unit is 12. Fixed costs are ₹7,20,000. X can sell the following quantities in the external market:

Price per unit (₹)	Demand Units
18	84,000
20	76,000
22	70,000
24	64,000
26	54,000 or less

Assume no stock build up for X or Y.
Y can purchase its requirement from the external market at ₹22 per unit, but has to incur a bulk transportation cost of ₹1,50,000 for any quantity, which will not be incurred on transfers from X.
Required:
(i) Assuming no demands from Y, what will be the best strategy for X?
(ii) What will be the minimum transfer price that X will agree to if X has to supply 50,000 units to Y? What price will Y offer as the maximum?

(iii) If Y is acceptable to partial supplies, what will be X's best strategy under no compulsion to transfer, but with the option to transfer as many units that it wants to? What will be the quantity that X will agree to transfer and the corresponding price, assuming both divisions agree to share the benefits of transfer equally?
(iv) What is the best strategy of the company? Will the company's overall strategy differ from the individual divisions' strategy? Compute the benefits/ disadvantages/ indifference between the divisional best and company best strategies.
Present relevant calculations to substantiate all your answers.

Answer:

Variable cost is constant at ₹12. Hence the value that will give the maximum contribution will be relevant.

Price per unit	Demand Units	Contbn ₹/u	Contbn Value
18	84,000	6	5,04,000
20	76,000	8	6,08,000
22	70,000	10	7,00,000
24	64,000	12	7,68,000
26	54,000	14	7,56,000

(i) The optimal strategy for X would be to manufacture 64,000 units for external demand in the absence of demand from Y.
(ii) If X has to supply 50,000 units to Y, then, it can supply only 50,000 units for external sales at ₹26. Contribution from external sales will be ₹14 × 50,000 = 7,00,000
Minimum contribution from Y will be 56,000 for 50,000 units. Hence, X will transfer at a minimum price of ₹12 + (56,000/50,000) = 13.12 or ₹13 so that it is able to maintain the contribution from its optimal strategy.
However, if X is strong enough, it can demand a price of ₹22 which Y will be paying to outside suppliers.
Y will not pay anything more than 22 + 1,50,000/50,000, i.e., 25 ₹/unit.
(iii) If X can choose, X will supply 64,000 units for external demand and supply 36,000 units to Y. Y will have to incur transport even for the 14,000 units it purchases from outside.

Hence it will not pay anything above ₹22. X will not accept anything below ₹13. Benefits to be shared equally between X and Y = 22 – 13 = 9 per unit. Hence Transfer price per unit will be ₹13 + 4.5 = ₹17.5, so that Y benefits by ₹4.5 and X also gets additional ₹4.5 contribution per unit transferred. Quantity transferred will be 36,000 units.

(iv) For the company as a whole, it is incurring a variable cost of ₹22 plus transport of ₹3 = ₹25 for every unit of Y purchased. Contribution of X as per best strategy = ₹13.

Hence, for the company, best strategy will be to transfer 50,000 units to Y and sell 50,000 units to external sales.

Contribution lost by sub optimal strategy in Div X will be 68,000 = [7,68,000 – (50,000 ×14)]

Gain by transfer

= Transport of 1,50,000 + savings in purchase cost (22 – 13) × 50,000

= ₹1,50,000 + 4,50,000 = ₹6,00,000

Net gain = – 68,000 + 6,00,000 = 5,32,000

Alternate Answer:

(i) Assuming no demand from Y, the best strategy for X

Computation of Contribution at different levels of Demand

Demand (Units)	Price (₹ per unit)	Contribution (₹ per unit)	Contribution Value (₹)
84,000	18	6	5,04,000
76,000	20	8	6,08,000
70,000	22	10	7,00,000
64,000	24	12	7,68,000
54,000	26	14	7,56,000

Advise: In the absence of demand from Y, the optimal strategy for X would be to manufacture 64,000 units for external demand whereby it can achieve the maximum contribution of ₹ 7,68,000.

Working Note: Contribution per unit has been worked out by deducting the variable cost of ₹ 12 from the respective price.

(ii) X has to supply 50,000 units to Y

If X has to supply 50,000 units to Y, then, it can supply 50,000 units for external sales at ₹ 26 per unit, the contribution being ₹ 14 per unit.

Contribution from external sales will be ₹ 14 × 50,000 = 7,00,000

Shortfall in contribution from the maximum level = 7,68,000 - 7,00,000 = 68,000

Minimum contribution from Y = 68,000 ÷ 50,000 = ₹ 1.36 per unit

Hence, the Minimum Transfer Price = VC of 12 + Contribution of 1.36 = ₹ 13.36 per unit

However, if X is strong enough, it can demand a price of ₹ 22 which Y will be paying to outside suppliers.

Y will not pay anything more than its landed of ₹ 25 per unit comprising price of ₹ 22 + transportation cost of ₹ 3 (1,50,000 ÷ 50,000 = 3).

(iii) Partial supplies to Y

If X can choose, X will supply 64,000 units for external demand and earn the maximum contribution ₹ 7,68,000. Balance of 36,000 units can be offered to Y at the variable cost of ₹ 12.

Y will have to incur bulk transportation cost of ₹ 1,50,000 even for the balance of 14,000 units it purchases from outside. Hence it will not pay anything above ₹ 22. X will not accept anything below ₹ 12.

Benefits to be shared equally between X and Y = 22 - 12 = 10 per unit.

Hence, Transfer Price per unit will be ₹ 12 + 5 = ₹ 17, so that Y benefits by ₹ 5 and X also gets additional contribution of ₹ 5 per unit transferred. Quantity transferred will be 36,000 units.

(iv) Best strategy of the company

For the company as a whole, Y is incurring a variable cost of ₹ 22 plus bulk transportation of ₹ 1,50,000.

Contribution of X as per best strategy = ₹ 7,68,000

Hence, for the company, best strategy will be to transfer 50,000 units to Y and sell 50,000 units to external sales.

Contribution lost by sub optimal strategy in Div. X = 7,68,000 - (50,000 × 14)] = ₹ 68,000

Gain for the Company = [(50,000 × 25) - (50,000 × 12)]

Answer:

(i) **Assessment of Best Strategy**

Demand (Units)	1,60,000	1,75,000	1,50,000	1,25,000	1,00,000
Particulars					
Price p.u.	25	30	35	40	45
Less: Variable Cost	15	15	15	15	15
Contribution p.u.	10	15	20	25	30
Total Contribution	16,00,000	26,25,000	30,00,000	31,25,000	30,00,000

If there is no demand from WYE, the optimal strategy for EXE would be to manufacture 1,25,000 units for external demand where it can achieve the maximum contribution of ₹ 31,25,000.

(ii) Division EXE will be able to sell only 1,00,000 units in external market if it has to supply 1,00,000 units to WYE.

Contribution from external market = 1,00,000 × 30
= ₹ 30,00,000

Profit lost due to transfer = $\frac{1,25,000}{1,00,000}$ = ₹ 1.25 p.u.

Minimum Transfer Price = 15 + 1.25 = ₹ 16.25 p.u.

If EXE is strong enough, it can demand a price of ₹ 35 which WYE will be paying to outside suppliers.

(iii) EXE can supply 1,25,000 units for external demand and earn the maximum contribution ₹ 31,25,000.

Balance 75,000 units can be offered to WYE at the variable cost of ₹ 15.

WYE will not pay anything above ₹ 35 per unit

EXE will not accept anything below ₹ 15 per unit.

Total benefit to be shared equally between X and Y = ₹ 20 per unit (35 - 15).

∴ Transfer price per unit, will be = ₹ 25 (₹ 15 + ₹ 10) so, that WYE benefits by ₹ 10 and EXE also gets additional contribution of ₹ 10 per unit transferred.

Total units to be transferred = 75,000 units.

CSQ 3.5	PYQ	2024-Dec [3] (a)	6 Marks

ROXIN Ltd., has two Divisions-M and N. Division-M manufactures product A-15 which it sells in outside market as well as to Division-N which processes it to manufacture Z-25. The manager of Division-N has expressed the opinion that transfer price is too high. The two divisional managers are about to enter into discussions to resolve the conflict and manager of Division-M is to supply him with some information prior to discussions.

Division-M has been selling 50,000 units to outsiders and 10,000 units to Division-N all at ₹ 25 per unit. It is not anticipated that these demand will change. The variable cost is ₹ 15 per unit and the fixed costs are ₹ 3,00,000. Divisional investment in assets is ₹ 12,00,000.

The manager of Division-M anticipates that Division-N will want a transfer price of ₹ 22. If he does not sell to Division-N, ₹ 40,000 of fixed costs and ₹ 2,00,000 of assets can be avoided. The manager of Division-M would have no control over the proceeds from the sale of the assets and is judged primarily on his rate of return.

Required:

(i) Analyze should the Manager of Division-M transfer its products at ₹ 22 to Division-N.

(ii) Assess the lowest price that the Division-M should accept.

Answer:

(i) Comparative Profitability Statement of Division M (figures in ₹):

Particulars	Alternative Situations		
	Sales at ₹ 25	Transfer at ₹ 22	Do not transfer
Sales Revenue:			
Market Sales	12,50,000	12,50,000	12,50,000
Transfer to Division	2,50,000	2,20,000	
Total (A)	15,00,000	14,70,000	12,50,000
Variable Cost (at ₹ 15 / unit)	9,00,000	9,00,000	7,50,000
Fixed Cost	3,00,000	3,00,000	2,60,000
Total (B) (₹)	12,00,000	12,00,000	10,10,000

Total Profit (A - B) (₹)	3,00,000	2,70,000	2,40,000
Total Assets (₹)	12,00,000	12,00,000	10,00,000
ROI (Return of Income)	25.00%	22.50%	24.00%

Judgement:

Manager of Division M should not transfer the product at ₹ 22 / unit to Division N because it is less than its selling price i.e. ₹ 25 / unit and will get low rate of return at ₹ 22/unit by 2.5% (25% - 22.50%).

(ii) Calculation of lowest transfer price:

The lowest transfer price acceptable to Division M is one, which maintains its rate of return of 24% without selling to Division N

= (Total Sales Revenue - Total Cost) / Total Assets = 0.24.

Or, [(₹ 12,50,000 + 10,000 x Transfer Price (TP)] - 12,00,000] ÷ ₹ 12,00,000 = 0.24

Or, 10,000 TP = 2,88,000 - 50,000 = 2,38,000

Or, TP = 2,38,000 ÷ 10,000 = 23.80 i.e.₹ 23.80

The lowest transfer price acceptable to Division - M is ₹ 23.80 per unit.

CSQ 3.6	PYQ	2025-Jun [3] (a)	6 Marks

REGAL Ltd., is organised into two divisions. Division X produces a component, which is used by division Y in making of a final product. The final product is sold for ₹ 540 each. Division X has capacity to produce 2,500 units and division Y can purchase the entire production. The variable cost of division X in manufacturing each component is ₹ 256.50. Division X informed that due to installation of new machines, its depreciation cost had gone up and hence wanted to increase the price of component to be supplied to division Y to ₹ 297, however division Y can buy the component from outside the market at ₹ 270 each. The variable cost of division Y in manufacturing the final product by using the component is ₹ 202.50 (excluding component cost).

Required:

Analyze and Present the statement indicating the position of each Division and the company as whole taking each of the following situations separately:

(i) If there is no alternative use for the production facilities of division X, will the company benefit, if division Y buys from outside suppliers at ₹ 270 per component?

(ii) If there is no alternative use for the production facilities of division X and the selling price for the component in the outside market drops by ₹ 20.25, should division Y purchase from outside supplier?

(iii) What transfer price would be fixed for the component in each of the above circumstances?

Answer:

(i) When Component is purchased by Division Y from outside:

	₹	₹
Division Y sales 2,500 x ₹540		13,50,000
Less: Cost of purchase 2,500 x ₹270	6,75,000	
Own Variable cost 2,500 x ₹202.50	5,06,250	11,81,250
Division Y Contribution		1,68,750
Division X Contribution		Nil
Total Contribution		1,68,750

When component is purchased from Division X:

Division X	₹	₹
Sales 2,500 x ₹297	7,42,500	
Less: Variable cost 2,500 x ₹256.50	6,41,250	
Division X Contribution (A)		1,01,250
Division Y		
Sales 2,500 x ₹540	13,50,000	
Less: Variable Cost		
Purchase Cost 2,500 x ₹297	7,42,500	
Variable Cost of division Y 2,500 x ₹202.50	5,06,250	
Division Y Contribution(B)		1,01,250
Total Contribution (A+B)		2,02,500

Decision: Thus, it will be beneficial for the company as whole to buy component from division X.

Net Selling Price after Additional Cost = 28,000

Compare the Options:

Scrapping the Inventory: 16,000

Manufacturing Further and Selling: 28,000

Conclusion:

P Ltd. should manufacture the inventory further and sell it for 40,000 because the net amount received (28,000) is higher than the scrap value (16,000).

CSQ 4.4	PYQ	2022-Dec [2] (b)	4+2=6 Marks

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

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

(i) Material B is used regularly by POBIX Ltd. and if stocks are required for this job, they would need to be replaced to meet other production demand.

(ii) Materials C and D are in stocks as the result of previous excess purchase and they have a restricted use. No other use could be found for material C but material D could be used in another job as substitute for 300 units of material E which currently cost ₹ 5 per unit (of which the company has no units in stock at the moment).

(iii) All other expenses on the contract to be specially incurred besides the relevant cost of material is ₹ 550.

Required:

What are the relevant cost of material in deciding whether or not to accept the contract?

(Show the reasons for relevancy of cost elements)

Answer:

Computation of relevant cost of the job

Particulars		Amount
A	1,000 × 6	6,000
B	1,000 × 5	5,000
C	700 × 2.5 + 300 × 4	2,950
D	300 × 5	1,500
		15,450
Add: Other expenses		550
		16,000

As the revenue from the order, which is more than the relevant cost of ₹16,000 the order should be accepted.

Reasons for Relevancy of Cost Elements:

(i) Material A is not yet owned. It would have to be purchased in full at the replacement cost of ₹ 6.00 per unit.

(ii) Material B is used by the company regularly. There is already existing a stock of 600 units. If these are used in the contract, a further 600 units would have to be purchased.
Relevant cost is therefore 1000 units at the replacement.

(iii) Material C: 1000 units of material C are, required and 700 units are already in stock. If it is used for the contract, a further 300 units will have to be purchased at a replacement cost of ₹ 4.00 each. The existing stock of 700 units will not replaced. If they are used for the contract, they cannot be used @ ₹ 2.50 each unit. The realisable value these 700 @ ₹ 2.50 per units represent an opportunity cost of sales revenue forgone.

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

CSQ 4.5	PYQ	2023-Jun [4] (a)	7 Marks

SONTECH LTD., a machine manufacturing company, had nearly completed a job relating to construction of specialized equipment when it discovered that the customer had gone into liquidation. At this stage, the position of the job was as under:

	₹
Original cost estimated	1,75,200
Costs incurred so far	1,48,500
Costs to be incurred	29,700
Progress payments received from original customer	1,00,000

After searches, a new customer for the equipment has been found. He is interested to take the equipment if certain modifications are carried out. The new customer wants the equipment in its original condition, but without its control device and with certain other modifications. The costs of these additions and modifications are estimated as under:

Direct materials at cost	₹ 1,050
Direct Wages	₹ 3,500

Variable overheads: 25% of direct wages
Delivery costs: ₹ 1,350
Fixed overheads will be absorbed at 50% of direct wages.

The following additional information is available:

(i) The direct materials required for the modification are in stock and if not used for modification of the order, they will be used in another job in place of materials that will now cost ₹ 2,250.

(ii) The Department is extremely busy. Its direct wages is ₹ 2,500 and currently yielding a contribution of ₹ 3.20 per rupee of direct wages.

(iii) Supervisory overtime payable for the modification is ₹ 1,050.

(iv) The cost of control device that the new customer does not require is ₹ 13,500. If it is taken out, it can be used in another job in place of a different mechanism. This latter mechanism has otherwise to be bought for ₹ 10,500. The dismantling and removal of the control mechanism is ₹ 120.

(v) If the conversion is not carried out, some of the materials in the original equipment can be used in another contract in place of materials that would have cost ₹ 12,000. It would have taken wages cost of ₹ 240 to make them suitable for this purpose. The remaining materials will realize ₹ 11,400 as scrap. The drawings, which are included as part of the job, can be sold for ₹1,500.

Required:

Analyse the relevant costs of equipment in deciding at what minimum price that the company can afford to quote for the new customer.

Answer:

Relevant Cost of Equipment

Particulars	₹
Cost to be incurred	29,700
Delivery cost	1,350
Place of material	2,250
D. wages (2500 + (8.2 × 250))	10,500
V. OH @ 25% of 2500	625
Supervisor overtime	1,050
Cost of control device	(10,380)
Commission	11,700
Remaining material	11,400
Scrap	1,500
F. OH (Avoidable)	1,250
Total Cost	**60,945**

CSQ 4.6	PYQ	2023-Dec [2]	14 Marks

RONTEX LTD., (Builders) has been offered a contract by Exyan Ltd. to build for it five special Guest Houses for use by top management. Each guest house will be an independent one. The contract will be for a period of one year and the offer price is ₹ 1 crore. In addition Exyan Ltd. will also provide 2 grounds of land free of cost for the purpose of construction. The Chief Accountant of Rontex Ltd. has prepared an estimate on the basis of which he has advised that the contract should not be accepted at the price offered. His estimate was as follows:-

	₹ In lakh
Land (3 Grounds at ₹ 20 lakh each)	60
Drawing and Design	7
Registration	10
Materials:	
Cement and Sand	6
Bricks and Tiles	4
Steel	10
Others (Including interior decoration)	10
Labour - Skilled	12
- Unskilled	8
Supervisor's Salary	5
Overheads General	12
Depreciation	6
Total Cost	150

The Accountant also provides the following information:

Land: The total requirement of land is 3 grounds costing ₹ 20 lacs per ground, Exyan Ltd. will provide 2 grounds free of cost.

Drawing and Design: These have already been prepared and 50% of the cost has already been incurred.

Materials:

(i) Cement and Sand are already in stock and are in regular use, if used for this contract, they have to be replaced at a cost of ₹ 8 lakh.

(ii) Bricks and Tiles represent purchases made several months before for a different contract. They could be sold readily for a net ₹ 5 lakh after meeting all further expensed.

(iii) Others: Materials worth ₹ 2 lakh relating to interior decoration are in stock for which no alternative use is expected in the near future. However, they can be sold for ₹1 lakh.

Labour:

(i) Skilled workers will be transferred to this project from another project. The project manager claimed that if the men were returned to him, he could have earned the company an additional ₹ 2 lakh in terms of profits.

(ii) The supervisor undertakes various tasks in the sites and his pay and continuity of employment will not be affected by the new contract. If the contract is taken, he will devote half of his time.

Overheads:

(i) The equipment that would be used on the contract was bought one year before for ₹ 30 lakh and is expected to last for five years. It can also be used on other contacts and the current replacement price will be ₹ 32 lakh and in a year's time it will be ₹ 25 lakh.

(ii) The general overheads includes both specific and absorbed overheads. If the contract is not undertaken, ₹ 4 lakh of the same can be avoided.

RONTEX LTD. has also on hand another project, which would not be executed if the contract from Exyan Ltd. were to be accepted. The estimated profit on that project is ₹10 lakh.

Required:

(a) Draw inference from the information given supra and identify the following.
  (i) Relevant cost if the contract is accepted
  (ii) Irrelevant cost if the contract is accepted.

(b) Indicate with reasons as a cost and management accountant of the company whether it should accept the contract from Exyan Ltd. or not.

Answer:

(a) (i) Relevant cost if the contract is accepted ₹ 93 lakh.
  (ii) Irrelevant cost if the contract is accepted ₹ 18 lakh.

(b) **Decision:**

Since the offer price of contract is ₹ 1 crore and its total relevant cost is ₹ 93 Lakh these figures clearly shows that the offer should be accepted.

Land

Total requirement: 3 grounds costing 60 lakh

Provided by Exyan Ltd.: 2 grounds (free of cost)

Cost to Rontex: 1 ground costing 20 lakh

Drawing and Design

Total cost: 7 lakh

50% already incurred: 3.5 lakh (irrelevant as it is a sunk cost)

Remaining 50%: 3.5 lakh (relevant)

Registration

Total cost: 10 lakh (relevant)

Materials

Cement and Sand

Stock replacement cost: 8 lakh (relevant)

Bricks and Tiles

Cost: 4 lakh (already bought, can be sold for 5 lakh)

Opportunity cost: 5 lakh (relevant)

Steel

Total cost: 10 lakh (relevant)

Others (including interior decoration)

Total cost: 10 lakh

Materials in stock worth 2 lakh can be sold for 1 lakh

Opportunity cost: 1 lakh (relevant)

Remaining cost: 8 lakh (relevant)

Labour

Skilled

Total cost: 12 lakh

Opportunity cost: 2 lakh (profit lost if workers are not transferred)

Total relevant cost: 14 lakh

Unskilled

Total cost: 8 lakh (relevant)

Supervisor's Salary

Total cost: 5 lakh

Already paid, and employment continuity not affected

50% time dedicated: 2.5 lakh (relevant)

Overheads

General overheads: 12 lakh

Avoidable overheads if contract not undertaken: 4 lakh (relevant)

Non-avoidable overheads: 8 lakh (irrelevant)

Depreciation

Cost: 6 lakh

Equipment replacement cost: 32 lakh (current), 25 lakh (in a year)

Depreciation is not a cash flow and irrelevant

Opportunity Cost

Profit from another project if not executed: 10 lakh (relevant)

Calculation

Relevant Costs:

Land: 20 lakh

Drawing and Design: 3.5 lakh

Registration: 10 lakh

Materials:

- Cement and Sand: 8 lakh
- Bricks and Tiles: 5 lakh
- Steel: 10 lakh
- Others: 8 lakh

Labour:

Skilled: 14 lakh

Unskilled: 8 lakh

Supervisor: 2.5 lakh

Overheads (avoidable): 4 lakh

Opportunity Cost of another project: 10 lakh

Total Relevant Costs: 93 lakh

Total Irrelevant Costs: ₹ 18 lakh

CSQ 4.7	PYQ	2023-Dec [3] (a)	7 Marks

Division A of DOXIN Ltd. has been given a budgeted target of selling 2,00,000 components TOM 22 it manufactures at a price which would fetch a return of 25% on the average assets employed by it. The following figures are relevant:

Fixed Overhead	₹ 4,00,000
Variable Cost	₹ 1 per unit
Average assets:	
Sales debtors	2,00,000
Stocks	6,00,000
Plant and other assets	4,00,000

However, the marketing department of the company finds out by a survey that the maximum number of TOM 22, the market can take, at the proposed price is only (1,40,000 units).
Fortunately, Division B, is willing to purchase the balance 60,000 units. The Manager, Division A, is willing to sell to Division B at a concessional price of ₹ 4 per unit. But the Manager, Division B, is ready to pay ₹ 2.25 only per unit, as he feels he can himself make TOM 22 in his Division at that price.
Rather than sell to Division B at ₹ 2.25, the Manager, Division A, feels he will restrict the activity of his Division to the manufacture and sale of 1,40,000 components only. By this, he could reduce ₹ 8,00,000 in stocks, ₹ 1,20,000 of plant and other assets and ₹ 40,000 in selling and administration expenses (fixed in nature).

Required:

As a cost and management accountant, you are:

(i) Asked to make comparative study of proposals of Divisional Manager and

(ii) Justify that selling 60,000 TOM 22 to Division B at ₹ 2.25 per unit would be in the interest of the organization.

Answer:

Sales price per unit		₹ 4.50
	Transfer to Division B and sale to outside parties	Sale to outside parties only
Sales (units)	2,00,000	1,40,000
	₹	₹
Sales value (1,40,000 units)	6,30,000	6,30,000
(60,000 units)	1,35,000	Nil
	7,65,000	6,30,000
Less: Variable cost	2,00,000	1,40,000
Contribution	5,65,000	4,90,000
Less: Fixed overhead	4,00,000	3,60,000
Net profit	1,65,000	1,30,000
Average assets employed	12,00,000	2,80,000
Return on investment	13.75%	46.43%

Justification: If the component is transferred to Division B as well as sold to outside parties, it is more profitable as the contribution and net profit are more than the existing proposal. Therefore selling the components to Division B at D 2.25 per unit is in the overall interest of the company is justified.

Note: There seems to be a mistake in Question and Suggested Answers. Reduction in stock should be ₹ 80,000 instead of ₹ 8,00,000 and hence Average Assets Employed should be ₹ 10,00,000 in second option with ROI of 13%.

CSQ 4.8	PYQ	2025-Dec [2]	8 Marks

BNR Ltd. has spare capacity in two of its manufacturing departments - Department 4 and Department 5. A five-day week of 40 hours is worked, but there is only enough internal work for 3 days per week so that 2 days per week (16 hours) could be available in each department. BNR Ltd. has sold this time to another manufacturer, but there is some concern about the profitability of this work.
The accountant has prepared a table given the hourly operating cost in each department. The summarized figures are as follows:

	Department 4	Department 5
	₹	₹
Power Costs	40	60
Labour Costs	40	20
Overhead Costs	40	40
	120	120

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

As a short term measure, the company has been selling processing time to another manufacturer @ ₹70 per hour in either departments. The customer is willing to continue this arrangement and to purchase any spare time available, but BNR Ltd., is considering the introduction of a new product on a minor scale to absorb the spare capacity.

Each unit of the new product would require 45 minutes in Department 4 and 20 minutes in Department 5. The variable cost of the required input material is ₹10 per unit. The market study indicated as follows:

(I) With a selling price of ₹100, the demand would be 1,500 units p.a.
(II) With a selling price of ₹110, the demand would be 1,000 units p.a.
(III) With a selling price of ₹120, the demand would be 500 units p.a.

Required:

(i) Analyze relevant cost per unit for producing the new product.
(ii) Assess the best price per unit to be charged for the new product to achieve optimum profit.
(iii) Prepare the best weekly programme for the spare time in two manufacturing departments.
(iv) Analyze and quantify the weekly gain that this programme and price should yield.

Answer:

The relevant cost of producing the new product is the variable cost plus the lost contribution from selling the processing time to another manufacturer. It is given that, the main product will absorb 3 days per week.

Calculation of Variable Overhead rates

	Dept. 4	Dept. 5
Normal Hrs. per annum (0.9 x 40 hr x 50 wks.)	1,800 hrs	1,800 hrs
Fixed O.H. rate/hr. (₹)	20 (36,000/1,800)	28 (50,400/1800)
Total O.H. rate/hr. (given) (₹)	40	40
Thus, Variable OH rate /hr. (₹)	20	12

The variable costs per hour are:

Department 4: Power Cost ₹40 + Variable Cost ₹20 = ₹60
Department 5: Power Cost ₹60 + Variable Cost ₹12 = ₹72

Note: It is given that Labour Costs are fixed

If the new product is not developed, Department 4 shall sell unused processing time at ₹70 per hour. It is not profitable for Department 5 to sell processing time at ₹70 per hour because its variable costs itself is ₹72 per hour.

Therefore, the relevant cost per processing hour is:

Department 4: ₹70 (₹60 variable cost + ₹10 lost contribution for not selling processing time)
Department 5: ₹72.

Calculation of Relevant cost for producing the new product

Direct Material (Given)	10.00
Department 4, Variable Operating Cost (0.75 hr. x ₹ 70)	52.50
Department 5, Variable Operating Cost (0.333 hr. x ₹ 72)	24.00
Relevant Cost	86.50

Alternative Presentation:

(i) The relevant cost of producing the new product is the variable cost plus the lost contribution from selling the processing time to another manufacturer. It is given that, the main product will absorb 3 days per week.

Calculation of Variable Overhead rates

	Dept. 4	Dept. 5
Normal Hrs. per annum (0.9 x 40 hr x 50 wks.)	1,800 hrs	1,800 hrs
Fixed O.H. rate/hr. (₹)	20 (36,000/1,800)	28 (50,400/1800)
Total O.H. rate/hr. (given) (₹)	40	40
Thus variable OH rate /hr. (₹)	20	12

Calculation of Relevant cost for producing the new product

Direct Material (Given)	10.00
Power Cost- Department 4 (0.75 hr. x ₹ 40)	30.00
Department 5 (0.333 hr. x ₹ 60)	20.00
Variable Overhead - Department 4 (0.75 hr. x ₹ 20)	15.00
Department 5 (0.333 hr. x ₹12)	4.00
Opportunity Costs for not selling processing time* (0.75 hr. x ₹ 10)	7.50
Relevant Cost	86.50

Note: Labour Costs are fixed (given)

* If the new product is not developed, Department 4 shall sell unused processing time at ₹70 per hour.

Therefore, opportunity costs for not selling the processing time is ₹70 - ₹60 = ₹10

It is not profitable for Department 5 to sell processing time at ₹70 per hour because its variable costs itself is ₹72 per hour.

(ii) **Additional Contribution for various selling price / demand levels**

	₹	₹	₹
Selling Price (Given)	100	110	120
Restricted Demand (Units)	1,067	1,000	500
Relevant cost (₹)	86.50	86.50	86.50
Contribution (₹)	13.50	23.50	33.50
Total Contribution (₹)	14,404.50	23,500	16,750

Decision: Hence selling 1,000 units @ ₹ 110 per unit will achieve optimum contribution

Note:

Maximum units that can be produced in Dept 4 & Dept 5 in 800 hrs are:

Department 4 (800 Hrs. / 0.75 hr.) = 1,067 units

Department 5 (800 Hrs. / 0.333 hr.) = 2,400 units

Restriction exists in Dept 4 only.

(iii) **Computation of Spare time for production of 1,000 units p.a.**

	Department 4	Department 5
Time required per unit (Hours)	$\frac{3}{4}$	$\frac{1}{3}$
Total time for producing 1,000 units (Hours)	750	334
Time available (Hours)	800	800
Spare time (Hours)	50	466
Spare time per week (Hours)	1	9.32

Conclusion:

Hence, Department 4 can sell 1 hr. per week at ₹ 70 per hour. It is not profitable to sell spare capacity of 9.32 hrs. / week at the existing rate of ₹ 70 per hour, because its relevant cost is ₹ 72 per hour.

(iv) **Weekly gain from this programme**

Selling price	₹ 110
Variable Cost	
Direct Materials	10
Department 4 variable operating cost 0.75 × 60	45
Department 5 variable operating cost 0.333 x 72	24
Total Variable Cost	79
Contribution / unit	31
Weekly sales (1,000 ÷ 50)	20 units
Additional contribution / week	₹ 620
Plus contribution of selling 1 hr. (selling price - variable cost = 70 - 60)	10
Total contribution	630
Without the new product, the weekly contribution 16 hours x ₹ 10 per hr.	160
Additional gain for introducing the new product	470

05 Target Costing

THEORY QUESTIONS

TQ 5.1	PYQ	2015-Dec [10] (a)	DESC	4 Marks

What are the criteria to be maintained by the companies which want to get maximum benefit from 'target costing'?

Answer:

The following criteria are to be maintained by the companies who want to get maximum benefit from 'target costing':

1. Assembly-oriented industries, as opposed to repetitive-process industries that produce homogeneous products.
2. Industries involved heavily with the diversification of the product lines.
3. Used technologies of factory automation, including computer-aided design, flexible manufacturing systems, office automation, computer -aided manufacturing etc.
4. Have experienced shorter product life cycles where the pay-back for factory automation typically must be achieved in short-term period (less than eight years).

5. Must develop the system for reducing costs during the planning, design and development stages of a PLC.
6. Able for implementing management methods, such as Just-in-time. Value engineering and Total Quality Control.

TQ 5.2	PYQ	2018-Jun [2] (b)	DESC	4 Marks
What is Target Cost? How would you determine it?				

Answer:

The target cost of a product is the expected selling price of the product minus the desired profit from selling it. In other words, target cost is really a measure of how low costs need to be to make a certain profit.

Target costing is an approach to determine a product's **life-cycle cost** which should be sufficient to develop specified functionality and quality, while ensuring its desired **profit**. It involves setting a target cost by subtracting a desired **profit margin** from a competitive market price. A target cost is the maximum amount of cost that can be incurred on a product, however, the firm can still earn the required profit margin from that product at a particular selling price.

How to determine target cost: The market requirement is identified regarding design, utility, need for the product. Target selling price is determined based on customer expectation and sales forecast. Target production volume is set based on price volume relationship. Target profit margin is established based on the company's long term profit objectives, projected volumes, course of action, etc.

The target cost or allowable cost is determined as the target selling price minus the target profit margin.

TQ 5.3	PYQ	2018-Dec [8] (c)	SN	4 Marks
Write short note on the following: Features of Target Costing				

Answer:

Target Costing is defined as "a structured approach in determining the cost at which a proposed product with specified functionality and quality must be produced, to generate a desired level of profitability at its anticipated selling price."

The important features or practices followed in Target Costing are:

Step 1:	Identify the market requirements as regards design, utility and need for a new product or improvements of existing product.
Step 2:	Set Target Selling Price based on customer expectations and sales forecasts.
Step 3:	Set Target Production Volumes based on relationships between price and volume.
Step 4:	Establish Target Profit Margin for each product, based on the company's long term profit objectives, projected volumes, and course of action, etc.
Step 5:	Set Target Cost (or Allowable cost) per unit, for each product. Target cost = Target selling price less Target profit margin
Step 6:	Determine Current Cost of producing the new product, based on available resources and conditions.
Step 7:	Set cost reduction Target in order to reduce the Current Cost to the Target Cost.
Step 8:	Analyze the Cost Reduction Target into various components and identify cost reduction opportunities using Value Engineering (VE) and Value Analysis (VA) and Activity Based Costing (ABC)
Step 9:	Achieve cost reduction and Target profit by Effective Implementation of Cost Reduction decisions
Step 10:	Focus on further possibilities of cost reduction i.e. Continuous Improvement program.

TQ 5.4	PYQ	2018-Dec [8] (d)	DB	4 Marks
Differences between Standard Costing and Kaizen Costing.				

Answer:

Basis of difference	Standard Costing	Kaizen Costing
1. Concepts	It is used for cost control	It is used for cost reduction.
	It is assumed that current manufacturing conditions remain unchanged.	It assumes continuous improvement.
	The cost focus is on standard costs based on static conditions	The cost focus is on actual costs assuming dynamic conditions
	The aim is to meet cost performance standards	The aim is to achieve cost reduction targets.
2. Techniques	Standards are set every six or twelve months	Cost reduction targets are set and applied monthly
	Costs are controlled using variance analysis based on standard and actual costs.	Costs are reduced by implementing continuous improvement (kaizen) to attain the target profit or to reduce the gap between target and estimated profit.
	Management should investigate and respond when standards are not met.	Management should investigate and respond when target kaizen amount are not attained.
3. Employees	They are often viewed as the cause of problems	They are viewed as the source of, and are empowered to find, the solutions.

TQ 5.5	PYQ	2019-Dec [8] (c)	SN	4 Marks
Write short notes on the following: Target costing				

Answer:

Target Costing: This technique was developed in Japan. It aims at profit planning. It is a device to continuously control costs and manage profit over a product's life cycle. It is a part of a comprehensive strategic profit management system. For a decision to enter a market prices of the competitors' products are given due consideration. Target Costing initiates cost management at the earliest stages of product development and applies it throughout the product life cycle by actively involving the entire value chain. In the product concept stage selling price and required profit are fixed after consideration of the medium term profit plans, which links the operational strategy to the long term strategic plans.

Target Cost = Planned Selling Price - Required Profit.

From this, the necessary target cost can be arrived at. Target cost, then, becomes the residual or allowable sum. If it is thought that the product cannot generate the required profit, it will not be produced as such and aspects of the product would be redesigned until the target is met. Target profit is a commitment agreed by all the people in a firm, who have any part to play in achieving it.

TQ 5.6	PYQ	2021-Dec [1]	SN	3 Marks
Write short note on advantages of Target costing *[Sec. C - Six LAQ]*				

Answer:

Advantage of Target Costing:

1. Innovation
2. Competitive advantage
3. Market driven management
4. Real cost reduction

CASE-SCENARIO QUESTIONS

CSQ 5.1	PYQ	2017-Jun [4] (b)	8 Marks

BCG Manufacturers sell their product at ₹ 1,000 per unit. Their competitors are likely to reduce the price by 15%. BCG Manufacturers want to respond aggressively by cutting price by 20% and expect that the present volume of 1,50,000 units per annum will increase to 2,00,000 units. BCGM want to earn a 10% target profit on sales. Based on a detailed value engineering, the comparative position is given below:

Particulars	Existing (₹)	Target (₹)
Direct Material Cost per unit	400	385
Direct Labour Cost per unit	55	50
Direct machinery costs per unit	70	60
Direct Manufacturing expenses per unit	525	495
Manufacturing Overheads		
No. of orders (₹ 80 per order)	22,500	21,250
Testing hours (₹ 2 per hour)	45,00,000	30,00,000
Units reworked (₹ 100 per unit)	12,000	13,000

Manufacturing overheads are allocated using relevant cost drivers. Other operating costs per unit for the expected volume are estimated as follows:

Research and Design	₹ 50
Marketing and Customer Service	₹ 130
	₹ 180

Required:

(i) Calculate target costs per unit and target costs for the proposed volume showing break up of different elements.

(ii) Prepare target product profitability statement.

Answer:

Part 1:

Target Selling Price: ₹ 1,000 less 20%	₹ 800
Less: Target Profit Margin (10% of ₹ 800)	₹ 80
Target Cost per unit	₹ 720

The breakup of the target cost per unit of ₹ 720 per unit is as follows:

Direct Materials		385
Direct Labour		50
Direct Machinery costs		60
Direct Manufacturing costs		495
Add: **Manufacturing Overheads:**		
Ordering and receiving (21,250 × ₹ 80)/2,00,000	8.50	
Testing and Inspection (30,00,000 × ₹ 2)/2,00,000	30.00	
Rework (13,000 × ₹ 100)/2,00,000	6.50	45
Other Operating Costs:		
Research and Design	50	
Marketing and Customer Service	130	180
Full Product Costs		720

Part 2:

Target Product Profitability

Particulars	Per Unit (₹)	Total for 2,00,000 units (₹)
1. Sales	800	16,00,00,000
2. **Cost of Goods Sold:**		
Direct Materials	385	7,70,00,000
Direct Labour	50	1,00,00,000
Direct Manufacturing Costs	60	1,20,00,000
	495	9,90,00,000
Manufacturing Overheads	45	90,00,000
	540	10,80,00,000
3. Gross Margin (1-2)	260	5,20,00,000
4. **Operating Costs:**		
Research and Design	50	1,00,00,000
Marketing and Customer Service	130	2,60,00,000
	180	3,60,00,000
5. Operating Profit (3 - 4)	80	1,60,00,000

CSQ 5.2	PYQ	2023-Dec [3] (b)	7 Marks

TECON LTD. (TL) a manufacturing company, sells its product at ₹ 1,200 per unit. Its competitors are likely to reduce the price by 20%. TL wants to

respond aggressively by cutting price by 25% and expects that the present volume of 1,50,000 units per annum will increase to 2,00,000 units. TL wants to earn a 15% target profit on sales. Based on a detailed value engineering, the comparative position is given below:

Particulars	Existing (₹)	Target (₹)
Direct material cost per unit	425	400
Direct Labour cost per unit	65	60
Direct machinery cost per unit	80	70
Direct manufacturing expenses per unit	550	530
Manufacturing Overheads		
No. of orders (₹ 80 per order)	23,000	22,000
Testing hours (₹ 2 per hour)	45,00,000	35,00,000
Units reworked (₹ 100 per unit)	13,000	14,400

Manufacturing overheads are allocated using relevant cost drivers. Other operating costs per unit for the expected volume are estimated as follows:

Research and Design	₹ 60
Marketing and Customer Service	₹ 124
	₹ 184

Required:

(i) Determine target costs per unit and identify target costs for the proposed volume showing breakup of different elements.

(ii) Prepare target product profitability statement.

Answer:

(i) Target Cost per unit ₹ 765

The breakup of the target cost of ₹ 765 per unit is as follows:

Particulars	Amount (₹)
Direct Materials	400
Direct Labour	60
Direct Machinery Costs	70
Direct Manufacturing Costs	530
Add: Manufacturing Overheads	51
Other Operating Costs	184
Full Product Costs	765

(ii) **Target Product Profitability**

	Particulars	Per Unit (₹)	Total for 2,00,000 Unit (₹)
1.	Sales	900	18,00,00,000
2.	Cost of Goods Sold	581	11,62,00,000
3.	Gross Margin (1 – 2)	319	6,38,00,000
4.	Operating costs	184	3,68,00,000
5.	Operating Profit (3 – 4)	135	2,70,00,000

CSQ 5.3 | PYQ | 2025-Jun [3] (b) | 7 Marks

ASLIN Company has the capacity of production of 80,000 units and presently sells 20,000 units at ₹ 100 each. Demand is sensitive to selling price and it has been observed that for every reduction of ₹ 10 in selling price, the demand is doubled.

Required:

(i) Calculate the Target Cost at full capacity, if profit margin on sale is 25%.

(ii) Assess the Cost Reduction Scheme at full capacity if at the present level 40% of the cost is variable and total fixed cost is ₹ 36 lakhs.

(iii) If Rate of Return desired is 16%, evaluate the maximum investment at full capacity.

Answer:

(i) Calculation of Target Cost at Full Capacity:

Projected Demand:

Selling Price (₹Per Unit)	Demand (Units)	Capacity Utilisation
100	20,000	25%
90	(20,000 × 2) = 40,000	50%
80	(40,000 × 2) = 80,000	100%

Selling Price at Full Capacity = ₹80.00;

Target Profit = 25% on Sales = ₹20.00

Target Cost at Full Capacity =₹(80 - 20) = ₹60.00 per unit

(ii) Cost Reduction Scheme:

(a) Computation of Variable Cost per unit at the Present Capacity of 20,000 units Selling Price = ₹100.00 per unit

Profit Margin = 25% on Sales = ₹25.00 Total Cost = (100 - 25) = ₹75.00

Variable Cost = 40% of total cost = 40% of 75 = ₹30.00

(b) Existing Projections of Total Cost at full capacity Total Variable Cost = (₹30 × 80,000) = ₹24.00 lakhs Total Fixed Cost = ₹36.00 lakhs

Total Cost = ₹(24.00 + 36.00) lakhs =₹60.00 lakhs

(c) Target Cost = (₹60 × 80,000) = ₹48.00 lakhs

(d) Cost Reduction Scheme

Cost Reduction needed = (Existing Cost - Target Cost) = (60.00 - 48.00) = ₹12.00 lakhs

(iii) Maximum Investment at full capacity:

(a) Target Profit at full Capacity:

Sales = 80.00 × 80,000 units = ₹64.00 lakhs Target Cost = ₹48.00 lakhs

Target Profit = (64.00 - 48.00) = ₹16.00 lakhs

(b) Rate of Return on Investment = 16%

(c) Maximum Investment Investment needed

= (Target Profit ÷ Target Return on Investment)

= (16.00 ÷ 16%)

= ₹100.00 lakhs

CSQ 5.4	PYQ	2026-Jun [3] (b)	7 Marks

BEE Ltd. sells its product at ₹1,000 per unit. Due to competition, its competitors are likely to reduce price by 15%. BEE wants to respond aggressively by cutting price by 20% and expects that the present volume of 1,50,000 units p.a. will increase to 2,00,000. BEE wants to earn a 10% target profit on sales. Based on a detailed value engineering the comparative position is given below:

Particulars	Existing (₹)	Target (₹)
Direct material cost per unit	400	385
Direct manufacturing labour cost per unit	55	50
Direct machinery costs per unit	70	60
Direct manufacturing costs per unit	525	495

Manufacturing overheads:		
No. of orders (₹80 per order)	22,500	21,250
Testing hours (₹2 per hour)	45,00,000	30,00,000
Units reworked (₹100 per unit)	12,000	13,000

Manufacturing overheads are allocated using relevant cost drivers. Other operating costs per unit for the expected volume are estimated as follows:

Research & Design	50
Marketing & Customer Service	130
Marketing & Customer Service	180

Required:

1. Calculate target costs per unit and target costs for the proposed volume showing break up of different elements.
2. Prepare target product profitability statement.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

06 *Product Life Cycle Costing*

THEORY QUESTIONS

TQ 6.1	PYQ	2018-Jun [8] (e)	SN	4 Marks

Life Cycle Costing

Answer:

Life cycle costing is a system that tracks and accumulates the actual costs and revenues attributable to cost object from its invention to its abandonment. Life cycle costing involves tracing cost and revenues on a

product by product base over several calendar periods. The total cost throughout its life including planning, design, acquisition and support costs and any other costs directly attributable to owning or using the asset".
Life Cycle Cost (LCC) of an item represents the total cost of its ownership, and includes all the costs that will be incurred during the life of the item to acquire it, operate it, support it and finally dispose it. Life Cycle Costing adds all the costs over their life period and enables an evaluation on a common basis for the specified period (usually discounted costs are used). This enables decisions on acquisition, maintenance, refurbishment or disposal to be made in the light of full cost implications. In essence, Life Cycle Costing is a means of estimating all the costs involved in procuring, operating, maintaining and ultimately disposing a product throughout its life.

TQ 6.2	PYQ	2019-Jun [8] (d)	SN	4 Marks
Product Life Cycle Costing				

Answer:

Product Life Cycle Costing is considered important due to the following reasons

(i) **Time based analysis:** Life cycle costing involves tracing of costs and revenues of each product over several calendar periods throughout their life cycle. Costs and revenues can analysed by time periods. The total magnitude of costs for each individual product can be reported and compared with product revenues generated in various time periods.

(ii) **Overall Cost Analysis:** Production Costs are accounted and recognized by the routine accounting system. However non-production costs like R&D; design; marketing; distribution; customer service etc. are less visible on a product by product basis. Product Life Cycle Costing focuses on recognizing both production and non-production costs.

(iii) **Pre-production costs analysis:** The development period of R&D and design is long and costly. A high percentage of total product costs may be incurred before commercial production begins. Hence;

the Company needs accurate information on such costs for deciding whether to continue with the R&D or not.

(iv) **Better Decision Making:** Based on a more accurate and realistic assessment of revenues and costs, at least within a particular life cycle stage, better decisions can be taken.

(v) **Long Run Holistic view:** Product Life Cycle Costing can promote long-term rewarding in contrast to short-term profitability rewarding. It provides an overall framework for considering total incremental costs over the entire life span of a product, which in turn facilitates analysis of parts of the whole where cost effectiveness might be improved.

(vi) **Life Cycle Budgeting:** Life Cycle Budgeting, i.e., Life Cycle Costing with Target Costing principles, facilitates scope for cost reduction at the design stage itself. Since costs are avoided before they are committed or locked in the Company is benefited.

(vii) **Review:** Life Cycle Costing provides scope for analysis of long term picture of product line profitability, feedback on the effectiveness of life cycle planning and cost data to clarify the economic impact of alternatives chosen in the design, engineering phase etc.

TQ 6.3	PYQ	2019-Dec [8] (a)	SN	4 Marks
Write short notes on the following: List down the situations where a product can be sold below the marginal cost.				

Answer:

The situations where product can be sold below the marginal cost are:

1. **When one has already produced and paid for the units and:**
   - There is no more market for the product at any price other than the one that is below the marginal cost
   - Any organization cannot keep the business open to clear the rest of the inventory because any profit you may see is not enough to cover the cost to stay open.

- As a loss leader to attract customers that can be up sold. Works only if the customer margin - sum of contribution margins from the basket of products and services customers buy is more than other available options.

2. **When one has produced each unit on demand (truly marginal):**
   - Only case is as a loss leader.
   - Any other reason not only generates a loss in the short term but also sets really bad reference price in the minds of customers. It is not going to be easy to improve prices when the seller gives it away at very low price.
   - The seller has to make sure that the cost is truly marginal cost and does not include overheads and COGS (Cost of Goods Sold) is not MC (Marginal Cost).

CASE-SCENARIO QUESTIONS

CSQ 6.1	PYQ	2017-Jun [4] (a)	8 Marks

SRM Ltd. has developed a new product 'Kent' which is about to be launched into the market and anticipates to sell 80,000 of these units at a sale price of ₹ 300 over the product's life cycle of four years. Data pertaining to product 'Kent' are as follows:

Costs of Design and Development of Moulding Dies and Other tools	₹ 10,25,000
Manufacturing costs	₹ 125 per unit
Selling costs	₹ 12,500 per year + ₹ 100 per unit
Administration costs	₹ 50,000 per year
Warranty expenses	5 replacement parts per 25 units at ₹ 10 per part, 1 visit per 500 units (cost ₹ 500 per visit)

Required:

(i) Compute the product Kent's Life Cycle Cost.

(ii) Suppose SRM Ltd. can increase sales volume by 25% through 15% decrease in selling price, should SRM Ltd. choose the lower price?

Answer:

Statement showing 'Kent's Life Cycle Cost (80,000 Units)

Particulars	Amount (₹)
Costs of Design and Development of Moulds, Dies and other tools	10,25,000
Manufacturing Costs (₹125 x 80,000 units)	1,00,00,000
Selling Costs (₹100 x 80,000 units + ₹ 12,500 x 4)	80,50,000
Administration Costs (₹ 50,000 x 4)	2,00,000
Warranty:	
(80,000 units / 25 units x 5 parts x ₹ 10)	1,60,000
(80,000 units / 500 units x 1 visit x ₹ 500)	80,000
Total cost	1,95,15,000

Statement showing 'Kent's Life Cycle Cost (1,00,000 Units)

Particulars	Amount (₹)
Costs of Design and Development of Moulds, Dies and other tools	10,25,000
Manufacturing Costs (₹125 x 1,00,000 units)	1,25,00,000
Selling Costs (₹100 x 1,00,000 units + ₹ 12,500 x 4)	1,00,50,000
Administration Costs (₹ 50,000 x 4)	2,00,000
Warranty:	
(1,00,000 units / 25 units x 5 parts x ₹10)	2,00,000
(1,00,000 units / 500 units x 1 visit x ₹ 500)	1,00,000
Total cost	2,40,75,000

Statement showing "Kent's Life Time Profit"

Particulars	Amount (₹) 80,000 units		Amount (₹) 1,00,000 units	
Sales	(80,000 x ₹ 300)	2,40,00,000	(1,00,000 x ₹ 255)	2,55,00,000
Less: Total Cost		1,95,15,000		2,40,75,000
Profit		44,85,000		14,25,000

Decision: Reducing the, price by 15% will decrease profit by ₹ 30,60,000. Therefore, SRM Ltd. should not cut the price.

CSQ 6.2	PYQ	2017-Dec [6] (a)	6+2+2=10 Marks

Wipro is examining the profitability and pricing policies of its Software Division. The Software Division develops Software Packages for Engineers. It has collected data on three of its more recent packages – (i)

ECE Package for Electronics and Communication Engineers, (ii) CE Package for Computer Engineers, and (iii) IE Package for Industrial Engineers.

Summary details on each package over their two-year cradle to grave product lives are:

Package	Selling Price	Number of units sold	
		Year 1	Year 2
ECE	₹ 250	2,000	8,000
CE	₹ 300	2,000	3,000
IE	₹ 200	5,000	3,000

Assume that no inventory remains on hand at the end of year 2. Wipro is deciding which product lines to emphasize in its software division. In the past two years, the profitability of this division has been mediocre.

Wipro is particularly concerned with the increase in R & D costs in several of its divisions. An analyst at the Software Division pointed out that for one of its most recent packages (IE), major efforts had been made to reduce R & D costs. Last week, Amit, the Software Division Manager, decides to use Life Cycle Costing in his own division. He collects the following Life Cycle Revenue and Cost information for the packages (in ₹):

Particulars	Package ECE		Package CE		Package IE	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Revenues	5,00,000	20,00,000	6,00,000	9,00,000	10,00,000	6,00,000
Costs:						
R &D	7,00,000	—	4,50,000	—	2,40,000	—
Design of Product	1,15,000	85,000	1,05,000	15,000	76,000	20,000
Manufacturing	25,000	2,75,000	1,10,000	1,00,000	1,65,000	43,000
Marketing	1,60,000	3,40,000	1,50,000	1,20,000	2,08,000	2,40,000
Distribution	15,000	60,000	24,000	36,000	60,000	36,000
Customer Service	50,000	3,25,000	45,000	1,05,000	2,20,000	3,88,000

Required:

Prepare a Product Life Cycle Income Statement for each Software Package. Which package is most profitable and which is the least profitable? How do the three packages differ in their cost structure (the percentage of total costs in each category)?

Answer:

Life Cycle Income Statement (in ₹ '000)

Particulars	Package ECE				Package CE				Package IE			
	Y1	Y2	Total	%	Y1	Y2	Total	%	Y1	Y2	Total	%
Revenues	**500**	**2,000**	**2,500**	**100%**	**600**	**900**	**1,500**	**100%**	**1,000**	**600**	**1,600**	**100%**
Costs												
R & D	700	-	700	28%	450	-	450	30%	240	-	240	15%
Design	115	85	200	8%	105	15	120	8%	76	20	96	6%
Manufacturing	25	275	300	12%	110	100	210	14%	165	43	208	13%
Marketing	160	340	500	20%	150	120	270	18%	208	240	448	28%
Distribution	15	60	75	3%	24	36	60	4%	60	36	96	6%
Cust. Service	50	325	375	15%	45	105	150	10%	220	388	608	38%
Total Costs	1,065	1,085	2,150	86%	884	376	1,260	84%	969	727	1,696	106%
Profit			350	14%			240	16%			(96)	-6%

Observation: Package ECE is most profitable, while package IE is least profitable.

CSQ 6.3	PYQ	2019-Dec [3] (a)	12 Marks

Zenith Ltd. manufactures tablet batteries. The company is preparing a product life cycle budget for a new type of battery. Development on the new battery is to start shortly. Estimates for the new battery are as follows:

Life cycle units manufactured and sold	2,00,000
Selling price per battery	₹55
Life cycle costs:	
R&D and design cost	₹8,00,000
Manufacturing:	
Variable cost per battery	₹25
Variable cost per batch	₹300
Battery per batch	250
Fixed costs	₹12,00,000
Marketing:	
Variable cost per battery	₹3.50
Fixed costs	₹8,00,000
Distribution:	

Variable cost per batch	₹140
Battery per batch	100
Fixed costs	₹4,60,000
Customer service cost per battery (Variable)	₹1.70

Ignore the time value of money.

Required:

(i) Calculate the budgeted life cycle operating income for the new battery.

(ii) What percentage of the budget total product life cycle costs will be incurred by the end of the R&D and design stages?

(iii) Company's market research department estimates that reducing price by ₹2.50 will increase life cycle unit sales by 8%. If unit sale increases by 8%, the company plans to increase manufacturing and distribution batch sizes by 8% as well. Assume that all variable costs per battery, per batch and fixed costs will remain the same. Should the company reduce battery price by ₹2.50? Show your calculations.

Answer:

(i) Statement of Budgeted Life Cycle revenue and cost

Revenue (2,00,000 × 55) = 1,10,00,000

Costs:

Pre-manufacturing cost	₹
Research and design	8,00,000
Manufacturing Costs:	
Variable Cost (25 × 2,00,000)	50,00,000
Batch (300 × 2,00,000/250)	2,40,000
Fixed cost	12,00,000
Marketing Costs:	
Variable Costs (3.5 × 2,00,000)	7,00,000
Fixed cost	8,00,000
Distribution costs	
Batch (140 × 2,00,000/100)	2,80,000
Fixed Cost	4,60,000
Customer Service (Variable) 1.7 × 2,00,000	3,40,000
Total cost	98,20,000
Operating Income	11,80,000

(ii)

Budgeted product life cycle costs for R&D and design	₹8,00,000
Total budgeted life cycle product costs	₹98,20,000
Percentage of budgeted product life cycle cost incurred	
Till the R&D and design	₹8,00,000/ 98,20,000 = 8.14%

(iii) Statement of Revised Budgeted Life Cycle revenue and cost

Revenue (2,16,000 × 52.50) = 1,13,40,000

Costs:

Pre-manufacturing cost	₹
Research and design	8,00,000
Manufacturing Costs:	
Variable Cost (25 × 2,16,000)	54,00,000
Batch (300 × 800)	2,40,000
Fixed cost	12,00,000
Marketing Costs:	
Variable Costs (3.5 × 2,16,000)	7,56,000
Fixed cost	8,00,000
Distribution costs	
Batch (140 × 2,000)	2,80,000
Fixed Cost	4,60,000
Customer Service (Variable) 1.7 × 2,16,000	3,67,200
Total cost	1,03,03,200
Operating Income	10,36,800

Since profit is lower, price should not be reduced.

CSQ 6.4	PYQ	2021-Dec [16]	1 Marks

Hefty Company produces A and B with contribution margins per unit of ₹ 40 and ₹ 30, respectively. Only 500 labor hours and 300 machine hours are available for production.

Time requirements to produce two unit of A and three units of B are as follows:

	A	B
Labour hours	5	2
Machine hours.	1	4

Write the constraint on labour in a linear programming model considering x units of A and y units of B before simplifying the coefficients.

[Sec. B - SAQ]

Answer:

$5/2\ x + 2/3y \leq 500$

CSQ 6.5	PYQ	2025-Dec [3] (b)	7 Marks

RRS International Ltd. has developed a new product 'Meu' which is to be launched soon. The company anticipates to sell 1,25,000 of these units at a sale price of ₹400 per unit over the product life cycle of three years. The other data pertaining to the product 'Meu' are as under:

Research & Development cost	₹32,50,000
Manufacturing cost per unit	₹175
Fixed Manufacturing cost per year	₹12,75,000
Marketing cost per unit (including 4% commission on sales)	₹90
Fixed Marketing cost per year	₹6,72,000
Administration cost per year	₹6,60,000
Warranty expenses	4 replacements parts per 50 units @ ₹30 per part

Required:

(i) Analyze and assess the life cycle cost of the product 'Meu'.

(ii) Evaluate the revised life cycle cost if the company increases sales by 12% through 5% reduction in sales price along with increase in fixed manufacturing cost by ₹1,20,000 per year.

(iii) Advise whether the company should go for reduction in sale price.

Answer:

(i) **Statement showing Meu's Life Cycle Cost (1,25,000 units):**

Particulars	Amount (₹)
Research & Development Cost	32,50,000
Manufacturing Costs (₹ 175 × 1,25,000 + ₹ 12,75,000 × 3)	2,57,00,000
Marketing Costs [(₹ 74 + ₹ 16) × 1,25,000 + ₹ 6,72,000 × 3]	1,32,66,000
Administration Cost (₹ 6,60,000 × 3)	19,80,000
Warranty (1,25,000 units/ 50units × 4 parts × ₹ 30)	3,00,000
Total Cost	4,44,96,000

Commission on sales = 4% of ₹400 = ₹16;

Marketing cost excluding commission = ₹ 90 - ₹ 16 = ₹ 74

(ii) **Statement showing Meu's Revised Life Cycle Cost (1,40,000 units):**

Revised Sales units = 1,25,000 × 1.12 = 1,40,000

Revised Selling Price per unit = ₹400 × 95% = ₹380

Fixed Manufacturing cost = ₹ 12,75,000 + ₹ 1,20,000 = ₹13,95,000

Particulars	Amount (₹)
Research & Development Cost	32,50,000
Manufacturing Costs (₹ 175 × 1,40,000 + ₹ 13,95,000 × 3)	2,86,85,000
Marketing Costs [(₹ 74 + ₹ 380 × 4%) × 1,40,000 + ₹ 6,72,000 × 3]	1,45,04,000
Administration Cost (₹ 6,60,000 × 3)	19,80,000
Warranty (1,40,000 units/ 50units × 4 parts × ₹ 30)	3,36,000
Total Cost	4,87,55,000

(iii) **Decision:**

Statement Showing Meu's Life Time Profit:

Particulars	Amount (₹) 1,25,000 units	Amount (₹) 1,40,000 units
Sales	5,00,00,000 (1,25,000 × ₹ 400)	5,32,00,000 (1,40,000 × ₹ 380)
Less: Total Cost	4,44,96,000	4,87,55,000
Profit	55,04,000	44,45,000

Reducing the price by 5% will decrease profit by ₹ 10,59,000 (i.e. 19.24%). Therefore, the company should not go for price reduction.

07 Asset Life Cycle Costing

CASE-SCENARIO QUESTIONS

CSQ 7.1 | PYQ | 2017-Jun [3] (b) | 8 Marks

A2Z p.l.c. supports the concept of tero technology or life cycle costing for new investment decisions covering its engineering activities. The financial side of this philosophy is now well established and its principles extended to all other areas of decision making. The company is to replace a number of its machines and the Production Manager is torn between the Exe Machine, a more expensive machine with a life of 12 years, and the Wye machine with an estimated life of 6 years. If the Wye machine is chosen, it is likely that it would be replaced at the end of 6 years by another Wye machine. The pattern of maintenance and running costs differs between the two types of machine and relevant data are shown below:

	Exe	Wye
Purchase price	₹ 19,000	₹ 13,000
Trade-in value/breakup/scrap	₹ 3,000	₹ 3,000
Annual repair costs	₹ 2,000	₹ 2,600
Overhaul costs	(at year 8) ₹ 4,000	(at year 4) ₹ 2,000
Estimated financing costs averaged over machine life	10% p.a.	10% p.a.

Required: Recommend with supporting figures, which machine to purchase, stating any assumptions made?

Answer:

Profitability of Alternate Machines

		Exe Machine		WYE Machine
Initial cost (₹)		19,000		13,000.00
Less: Scrap at the end of the life (₹)	(3,000x0.32)	960.00	(3,000x0.56)	1,680.00
		18,040.00		11,320.00
Present value of total annual cost (₹)	(2,000x6.81)	13,620.00	(2,600x4.36)	11,336.00
Overhaul Cost	(4,000x0.47)	1,880.00	(2,000x0.68)	1,360.00
		33,540.00		24,016
Capital recovery factor	(1/6.81)	0.15	(1/4.36)	0.23
Equivalent annual cost (₹)		5,031.00		5,523.68

Conclusion:

As the equivalent annual cost is less for Exe Machine, it is better to purchase the same.

CSQ 7.2 | PYQ | 2018-Dec [5] (b) | 6 Marks

For a machine the financial data are given below:

Time (Year)	0	1	2	3	4
Outlay (₹)	5,000				
Operating Costs (₹)		1,400	1,500	1,600	1,700
Maintenance (₹)			300	400	500
Value if Scrapped (₹)		3,400	2,000	800	600

The appropriate interest rate is 12% p.a. and the discount factor is as follows:

Year	0	1	2	3	4
12% Disc. Factor	1	0.893	0.797	0.712	0.636

Required:

Determine the optimal length of replacement cycle.

Answer:

Year	0	1	2	3	4	Present Value	Annuity Factor	Average PV
12% Disc. Factor	1	0.893	0.797	0.712	0.636			
1	-5,000	2,000				3,214	0.893	3,599
2	-5,000	-1,400	200			6,091	1.69	3,604
3	-5,000	-1,400	-1,800	-1,200		8,539	2.402	3,555
4	-5,000	-1,400	-1,800	-2,000	-1,600	10,126	3.038	3,333

Decision: Better to replace at the end of year 4 as the average present value is the lowest.

CSQ 7.3	PYQ	2024-Jun [3] (b)	7 Marks

POSIN Limited supports the concept of the life cycle costing for new investment decisions covering its engineering activities.
The Company is to replace a number of its machines and the Production Manager is to decide between the 'BX' machine, a more expensive machine with a life of 12 years, and the 'SW' machine with an estimated life of 6 years. If the 'SW' machine is chosen it is likely that it would be replaced at the end of 6 years by another 'SW' machine. The pattern of maintenance and running cost differs between two types of machine and relevant data are shown below:

Machine	BX (₹)	SW (₹)
Purchase Price	38,00,000	26,00,000
Trade-in-value	6,00,000	6,00,000
Annual Repair Cost	4,00,000	5,20,000
Overhaul Cost (p.a.)	8,00,000 (at year 8)	4,00,000 (at year 4)
Estimated financing costs averaged over machine life (p.a.)	10%	10%

Given:

Years	3	4	5	6	7	8	10	12
PVIF (10%)	0.75	0.68	0.62	0.56	0.51	0.47	0.38	0.32

PVIF (10%, 6) = 4.36, PVIFA (10%, 12) = 6.81
Required:
Analyze and Recommend which machine should be purchased.

Answer:

Statement for Calculation of Equivalent Annualized Cost (EAC)

(in ₹)

S. No.	Particulars	Machine BX	Machine SW
1.	Life	12 years	6 years
2.	Purchase Price	38,00,000	26,00,000
3.	Annual Repair Cost	4,00,000	5,20,000
4.	P.V. of Annual Repair Cost	4,00,000 × 6.81 = 27,24,000	5,20,000 × 4.36 = 22,67,200
5.	Overhaul Cost (p.a.)	8,00,000 (at year 8)	4,00,000 (at year 4)
6.	P.V. of Overhaul Cost	8,00,000 × 0.47 = 3,76,000	4,00,000 × 0.68 = 2,72,000
7.	P.V. of Trade-in Value	₹ 6,00,000 × 0.32 = 1,92,000	6,00,000 × 0.56 = 3,36,000
8.	Total P.V. of Cost (2) + (4) + (6) - (7)	67,08,000	48,03,200
9.	Equivalent Annualized Cost	67,08,000 / 6.81 = ₹ 9,85,022	48,03,200 / 4.36 = ₹ 11,01,651

Equivalent Annualized Cost (EAC) = ₹ 9,85,022 (Machine BX-life 12 year)
Equivalent Annualized Cost (EAC) = ₹ 11,01,651 (Machine SW-life 6 year)

Recommendation:

Since the annualized equivalent Cost of Machine BX (₹ 9,85,022) is lower than that of Machine SW
(₹ 11,01,651), the Machine BX should be purchased

08 Decision Making Using Probability

CASE-SCENARIO QUESTIONS

CSQ 8.1	PYQ	2019-Jun [4] (a)	8 Marks

A company produces three products A, B and C, from a joint process. Costs and other details are given below:

	Joint Costs (₹)	Post-separation Costs		
Costs:		A (₹)	B (₹)	C (₹)
Materials	20,000	1,500	3,500	2,000
Labour	8,000	1,000	1,000	1,500
Overhead	4,000	500	1,000	500
	32,000	3,000	5,500	4,000

Others:			
Sales value (₹)	10,000	25,000	15,000
S & D Exp. (as % of sales)	20%	20%	20%
Estimated Net Profit (as % of sales)	20%	10%	20%

Required:

Prepare a statement showing the apportionment of joint costs over three products using Net Value Method.

Answer:

Statement of Allocation of Joint Costs

	A	B	C	Total
Sales (₹)	10,000	25,000	15,000	50,000
Less:				
Estimated NP	2,000	2,500	3,000	7,500
S & D Cost (20%) ₹	2,000	5,000	3,000	10,000
Post-separation cost (₹)	3,000	5,500	4,000	12,500
Total	7,000	13,000	10,000	30,000
Net Value (i.e. basis of allocation)	3,000	12,000	5,000	20,000
Share of joint costs (₹)	4,800	19,200	8,000	32,000
	$\left(\frac{3}{20}\times 32,000\right)$	$\left(\frac{12}{20}\times 32,000\right)$	$\left(\frac{5}{20}\times 32,000\right)$	

CSQ 8.2 | PYQ | 2017-Jun [6] (b) | 8 Marks

You are given the following estimates for next year's budgeted sales and costs of single product produced by Bee Ltd.:

Selling Price		₹ 12
Sales demand:	Units	Probability
	3,200	0.50
	4,000	0.30
	5,000	0.20
	₹	Probability
Variable cost per unit	5.00	0.3
	6.00	0.5
	7.00	0.2

Fixed cost for the period: ₹ 20,000

Required:

(i) Expected value of sales for the period.
(ii) Expected variable cost and contribution for the period.
(iii) Expected profit or loss for the budget period.

Answer:

(1)	**Expected Value of Sales:**		
	Expected Sales × Profitability		
	3,200 × 0.5 = 1,600		
	4,000 × 0.3 = 1,200		
	5,000 × 0.2 = 1,000	3,800 @ ₹ 12	45,600
(2)	**Expected Variable Cost:**		
	Unit Variable costs × Profitability		
	₹ 5 × 0.3 = 1.5		
	₹ 6 × 0.5 = 3.0		
	₹ 7 × 0.2 = 1.4	5.9 × 3,800	22,420
	Expected Contribution		23,180
(3)	**Expected Profit:**		
	Expected Contribution		23,180
	(-) Fixed Cost		20,000
	Expected Profit	₹	3,180

CSQ 8.3 | PYQ | 2024-Dec [3] (b) | 7 Marks

SOVAN Ltd., a manufacturing company is preparing budget for 2025. The parameters relating to sales, price and cost are as follows:

Sales Price	₹ 200 per unit
Variable Cost	₹ 120 per unit
Fixed Costs	₹ 20,00,000 per year

Sales forecast have been prepared which disclose the following:

Quantity	Probability	Quantity	Probability
15,000	0.10	35,000	0.30
20,000	0.10	40,000	0.10
25,000	0.10	45,000	0.10
30,000	0.20	-	-

Required:
(i) Analyze the break-even quantity.
(ii) Analyze how many units must be sold to (a) earn a profit of ₹6,00,000 (b) incur a loss of ₹ 5,00,000.
(iii) Based on the sales forecast, identify the probability that the company can break-even.
(iv) Analyze the probability of achieving sales volumes involved in part (ii).

Answer:

(i) Calculation of Break-Even Quantity:

Particulars	Amount (₹)
Selling Price per unit	200
Variable Cost per unit	120
Contribution per unit	80
Total Fixed Costs	20,00,000
Break Even Quantity	25,000

(ii)

(a) Calculation of No. of units to earn a profit of ₹ 6,00,000:

Particulars	Amount (₹)
Total Fixed Costs	20,00,000
Required Profit	6,00,000
Total contribution required	26,00,000
Contribution per unit	80
Units to be sold to earn a profit of ₹ 6,00,000	32,500

(b) Calculation of No. of units to incur a loss of ₹ 5,00,000:

Particulars	Amount (₹)
Total Fixed Costs	20,00,000
Required Loss	5,00,000
Total contribution required	15,00,000
Contribution per unit	80
Units to be sold to incur loss of ₹ 5,00,000	18,750

(iii) Calculation of probability that the company will Break-Even:

To calculate the probability that the company will break even, we have to calculate the cumulative probability of Sales Volume equal to or higher than the 25,000 units i.e. the break-even volume.

Note: Hence, the required probability is 10 % + 20 % + 30 % + 10 % + 10 % i.e. 80%.

(iv) Calculation of probability of sales volume mentioned at (ii) above:

(a) Required Sales volume = 32,500 units
Cumulative probability of sales volume being greater than 32,500 units is 30 % + 10 % + 10 % i.e. 50%

(b) Required Sales volume = 18,750 units
Cumulative probability of sales volume being less than 18,750 units is 10 %. Further, chances of incurring loss are cumulative probability of sales volume being less than 25,000 units is 10 % + 10 % i.e. 20%.

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 4	Activity Based Management and Just in Time (JIT)

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1	Activity Based Cost Management	16	-
2	(JIT)	4	-
3	Throughput Accounting	4	-
4	Back flush Accounting	3	-
5	Bench marking	-	-

SECTION-A

PYQ 2012-Dec [1] (b) (iv) {C} State whether the following statements, based on the quoted terms, are 'TRUE' or 'FALSE' with justifications for your answer. If any statement is false, you are required to give the correct terms, duly quoted. No credit will be given for any answer without justification:
ABC costing is the process of identifying and learning from the best practices anywhere in the world. **(1 Mark)**
Answer: False. Benchmarking is the process of identifying and learning from the best practices anywhere in the world.

PYQ 2016-Dec [1] (d) (iv) {C} In each of the case/statement given below, one of four alternatives is correct. Indicate the correct answer:
The operation of Activity Based Cost Management system involves the use of the following terms, except
(a) Blanket overhead recovery
(b) Resources

(c) Cost pools
(d) Cost drivers **(1 Mark)**

Answer: (a) Blanket overhead recovery

PYQ 2017-Jun [1] {C} Choose the most appropriate answer to the following questions giving justification.

(viii) Back flush costing is most likely to be used when:
(a) Management desires sequential tracking of costs
(b) A Just-in-Time inventory philosophy has been adopted
(c) The company carries significant amount of inventory
(d) Actual production costs are debited to work-in-progress **(2 Marks)**

Answer: (b) Explanation: A Just-in-Time inventory philosophy has been adopted. The reason for this is that JIT assumes zero inventory for raw materials, work-in-progress and finished goods and the system of back flush accounting records the transaction only at the termination of the production and sales cycle.

(v) The following tasks are associated with ABC system:
I. Allocation of costs to products
II. Identification of cost pools
III. Identification of cost drivers
IV. Calculation of pool rates
The proper order of the preceding tasks is:
(a) III, II, IV, I (b) I, II, III, IV
(c) III, IV, II, I (d) IV, III, II, I **(2 Marks)**

Answer: (a) Explanation: Because cost is allocated based on the cost pool rates. So, whole process starts with identification of cost drivers followed by identification of cost pools, determination of rates and then allocation.

PYQ 2017-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification.

(ii) A company uses traditional standard costing system. The inspection and set-up costs are actually ₹ 1,760 against a budget of ₹ 2,000. ABC system is being implemented and accordingly the number of batches is identified as the cost driver for inspection and set up. The budgeted production is 10,000 units in batches of 1,000 units whereas actually 9,000 units were produced in 11 batches. The cost per batch under ABC system will be
(a) ₹ 160 (b) ₹ 200
(c) ₹ 180 (d) ₹ 220 **(2 Marks)**

Answer: (b) Number of batches under ABC = 9,000 ÷ 1,000 = 9
Std. Cost under ABC = Budg Cost / Batch × ABC number of batches = ₹ 200 × 9 = ₹ 1,800

Production	9,000 Units
Number of batches	9
Cost /Batch	₹ 200

(vii) When you wait until the manufacture of a product has been completed and then record all of the related issuances of inventory from stock that were required to create the product, it is called
(a) Forensic Accounting (b) Back -flush Accounting
(c) Tax Accounting (d) Lean Accounting **(2 Marks)**

Answer: (b) Back-flush Accounting

PYQ 2018-Jun [1] (i) Choose the most appropriate answer to the following questions giving justification:
A company operates an activity based costing (ABC) system to attribute its overhead costs to cost objects. In its budget for the year-ending 31st August, 2018. The company expected to place a total of 2,000 purchase orders at a total cost of ₹ 1,00,000. This activity and its related costs were budgeted to occur at a constant rate throughout the budget year which is divided into 13 four week periods.

During the four week period ended 30th June 2017, a total of 200 purchase orders were placed at a cost of ₹ 9,000. The over recovery of these costs for the four week period was placed at a cost of ₹ 9,000. The over recovery of these costs for the four week period was

(a) ₹ 2,000 (b) ₹ 3,000
(c) ₹ 1,500 (d) ₹ 1,000 **(2 Marks)**

Answer: (d) Explanation:

For 2,000 purchase orders, cost budgeted is 1 lac. For 200, corresponding amount would be 10,000. But actual = 9,000. Hence over recovered is 10,000 – 9,000 = 1,000.

Or

Cost driver rate for order = 1,00,000 / 2,000 = 50 per order.
Cost recovered = 50 × 200 = 10,000.
Actual = 9,000
Over recovery = 1,000

PYQ 2018-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification:

(ii) Twin Ltd. uses JIT and back flush accounting. It does not use a raw material stock control account. During September 2018, 10,000 units were produced and sold. The standard cost per unit is ₹ 150 which includes materials of ₹ 60. During September 2018, ₹ 9,90,000 of conversion costs were incurred. The debit balance in cost of goods sold account for September 2018 was

(a) ₹ 14,00,000 (b) ₹ 14,80,000
(c) ₹ 15,90,000 (d) ₹ 16,20,000 **(2 Marks)**

Answer: (c)

	₹
Standard cost of goods sold (10,000 units @ ₹ 150)	15,00,000
Less: Std. material cost (10,000 @ ₹ 60)	6,00,000
	9,00,000
Standard conversion cost	
Conversion cost incurred	9,90,000

Excess charged to cost of goods sold a/c. (debit)	90,000

∴ Total debit balance of cost of goods sold Account = ₹ 15,00,000 + 90,000 = ₹ 15,90,000

(vi) AB company is a supermarket group that incurs the following costs:

(a) The bought- in price of the goods
(b) Inventory finance costs
(c) Self refilling costs
(d) Costs of repacking or 'pack out' prior to storage before sale

AB company's calculation of direct product profit (DPP) would include

(a) Cost (a) and (c) only
(b) All of the above costs except (b)
(c) All of the above costs except (d)
(d) All of the above costs **(2 Marks)**

Answer: (d) Because all of the costs mentioned can be identified with specific goods/product and would be deducted from the selling price to determine the direct product profit.

PYQ 2019-Jun [1] (v) Choose the most appropriate answer the to following questions giving justification:

A company manufactures and sells packaging machines. It recently introduced activity-based costing to refine its existing system. Each packaging machine requires direct materials costs of ₹ 50,000; 50 equipment parts; 12 machine hours; 15 assembly line hours and 4 inspection hours. The details about the cost pools, allocation bases and allocation rates are given below:

Indirect cost pool	*Cost allocation base*	*Budgeted allocation rate*
Material handling	No. of component parts	₹ 8 per part
Machining	Machine hours	₹ 68 per machine hour
Assembly	Assembly line hours	₹ 75 per assembly hour
Inspection	Inspection hours	₹ 104 per inspection hour

The company has received an order for 40 can-packaging machines from a customer. Using activity-based costing, indirect costs allocated to the order of the customer would be:

(a) ₹ 1,30,850 (b) ₹ 1,25,280
(c) ₹ 1,15,050 (d) ₹ 1,10,280 **(2 Marks)**

Answer: (d) Indirect costs per machine:

		₹
Material handling	₹ 8 × 50 =	400
Machining	₹ 68 × 12 =	816
Assembly	₹ 75 × 15 =	1,125
Inspection	₹ 104 × 4 =	416
		₹ 2,757

For the order: ₹ 2,757 × 40 = ₹ 1,10,280

PYQ 2019-Dec [1] (ix) Choose the most appropriate answer to the following questions giving justification/reasonable workings:
Which of the following is not a correct match?

	Activity	Cost Drivers
(a)	Production scheduling	Number of production runs
(b)	Despatching	No. of Despatch orders
(c)	Goods receiving	Goods received order
(d)	Inspection	Machine hours

(2 Marks)

Answer: (d) Inspection hours, and not machine hours, drive the cost of inspection.

PYQ 2021-Dec [4] Companies that would benefit from back-flush costing include companies
(1) None of these.
(2) whose inventories vary from period to period.
(3) which have fast manufacturing lead times.
(4) companies that require audit trails. **(1 Mark) [Sec. A - MCQ]**

Answer:
(3) which have fast manufacturing lead times.

PYQ 2021-Dec [6] Which of the following is TRUE about the theory of constraints?
(1) TOC recognizes that lower inventories means slower response to customers.
(2) TOC recognizes that lowering inventory decreases carrying costs and thus decreases operating expenses and improves net income.
(3) TOC recognizes that lower inventories means more defects.
(4) TOC recognizes that EOQ is important. **(1 Mark) [Sec. A - MCQ]**

Answer:
(2) TOC recognizes that lowering inventory decreases carrying costs and thus decreases operating expenses and improves net income.

PYQ 2021-Dec [20] The operational activity of setting up equipment is classified as a
(1) unit level activity.
(2) facility level activity.
(3) batch level activity.
(4) product level activity. **(1 Mark) [Sec. A - MCQ]**

Answer:
(3) batch level activity.

PYQ 2022-Dec [1] (v) {C} Choose the most appropriate answer to the following questions giving justification/reasonable workings:
AMRIT Ltd., a manufacturer of doors using a Throughput costing system, is experiencing a bottleneck in its plant. Set up time at one of its work stations has been identified as the offender. The Manager (Finance) has proposed a plan to reduce the set up time at a cost of ₹ 5,24,000. The change will result in 500 additional doors. The selling price per door is ₹ 19,300, Direct Labour costs are ₹ 2,400 per door and the cost of Direct Materials is ₹ 8,000 per door. All units produced can be sold. The change will result in an increase in the Throughput Contribution of _____.
(a) ₹ 60,20,000 (b) ₹ 56,50,000
(c) ₹ 44,50,000 (d) None of the above **(2 marks)**

Answer: (b) ₹ 56,50,000

PYQ 2023-Jun [1] {C} Choose the most appropriate answer to the following questions with justification.

(iv) Producing more non-bottleneck output:
(a) creates more inventory and increases throughput contribution.
(b) creates more inventory but does not increase throughput contribution.
(c) creates less pressure for the bottleneck workstations.
(d) allows for the maximisation of overall contribution. **(2 Marks)**
Answer: (b) creates more inventory but does not increase throughput contribution.

(vii) At ROXIN LTD., cost of personnel department has always been charged to production department based upon number of employees. Recently opinion gathered from the department managers indicate that number of new hires might be better predictor of personnel cost. Total personnel department costs are ₹ 3,00,000.

Department	C	D	F
Number of Employees	40	300	160
Number of new Hires	10	32	8

If the number of new hire is considered the cost driver, what amount of cost will be allocated to Department D?
(a) ₹ 2,00,000 (b) ₹ 1,92,000.
(c) ₹ 1,50,000 (d) ₹1,30,000 **(2 Marks)**
Answer: (b) ₹ 1,92,000.

PYQ 2023-Dec [1] (vii) {C} Choose the correct option.
RRS, a manufacturer of large windows, is experiencing a bottleneck in its plant. Setup time at one of its workstations has been identified as the culprit. A manager has proposed a plan to reduce setup time at a cost of ₹ 7,20,000. The change will result in 800 additional windows. The selling price per window is ₹ 18,000, direct labour costs are ₹ 3,000 per window, and the cost of direct materials is ₹ 7,000 per window. Assume all units produced can be sold. The change will result in an increase in the throughput contribution of _____.

(a) ₹ 64,00,000 (b) ₹ 88,00,000
(c) ₹ 56,80,000 (d) ₹ 1,44,00,000 **(2 Marks)**
Answer: (b) ₹ 88,00,000

PYQ 2024-Jun [1] (viii) {C} Choose the correct option from the four alternatives given:
Production overheads of XYZ Ltd. for 500 units of product X are:
Machine oriented activity cost: ₹ 1,35,400
Material ordering overheads: ₹ 69,570
Machine hours are 1:50 hours per unit and No. of material orders are 6 per unit.
What is the Machine Oriented Cost per unit and Material Ordering Cost per unit respectively?
(a) ₹ 270.80 & ₹ 139.14
(b) ₹ 180.53 & ₹ 23.19
(c) ₹ 23.19 & ₹ 180.53
(d) ₹ 139.14 & ₹ 270.80 **(2 Marks)**
Answer: (a) ₹ 270.80 & ₹139.14

PYQ 2024-Dec [1] (viii) {C} Choose the correct option from the four alternatives given:
At KL Company, cost of personnel department has always been charged to production department based upon number of employees. Recently, opinion gathered from the department managers indicate that number of new hires might be better predictor of personnel cost. Total personnel department cost are ₹ 2,00,000.

Department	A	B	C
Number of employees	30	270	100
Number of new hires	8	12	5

If number of new hires is considered the cost driver, what amount of cost will be allocated to Department A?
(a) ₹ 15,000 (b) ₹ 64,000
(c) ₹ 72,000 (d) ₹ 40,000 **(2 Marks)**
Answer: (b) ₹ 64,000

PYQ 2025-Jun [1] (iii) {C} Choose the correct option from the given alternatives:

The companies that would benefit from backflush costing include companies

(a) which have fast manufacturing lead time.
(b) whose inventory vary from period to period.
(c) Company requires that audit trails.
(d) None of the above **(2 Marks)**

Answer: (a) which have fast manufacturing lead time.

2025-Dec [1] {C} Choose the correct option from the given alternatives:

(iv) TONZ Ltd. manufactures two products BX and BZ using common material handling facility. The total budgeted material handling cost is ₹80,000. The other details are:

	Product BX	Product BZ
Number of units produced	20	40
Material moves per product line	15	5
Direct Labour hour per unit	100	100

Under Activity Based Costing System the material handling cost to be allocated to product BZ (per unit) would be

(a) ₹400
(b) ₹500
(c) ₹1,500
(d) ₹None of the above **(2 Marks)**

Answer: (b) ₹500

(xii) Kanban Japanese System under JIT Approach ensures

(a) continuous supply of inventory or product.
(b) minimum and maximum level of stock to be maintained.
(c) inventory valuation.
(d) All of the above **(2 Marks)**

Answer: (a) continuous supply of inventory or product.

PYQ 2026-Jun [1] {C} Choose the correct option from the four alternatives given:

(iv) AON Ltd. following Activity Based Costing expected to place a total of 2,895 purchase orders at a total cost of ₹1,10,010. These costs are expected to occur at a constant rate throughout the budget year, which is divided into 13 four-week periods. During the four-week period ended on 30th September,2025, a total of 210 purchase orders were placed at a cost of ₹7,650. The over-recovery of these costs for the four-week period was

(a) ₹330
(b) ₹350
(c) ₹370
(d) ₹390 **(2 Marks)**

(xii) A Kanban is a visual signal that indicates that it is time to replenish stock and possibly reorder. In which of the following this is referred to?

(a) JIT Systems
(b) JIT Strategy
(c) Both (a) and (b)
(d) None of the above **(2 Marks)**

SECTION-B

01 Activity Based Cost Management

THEORY QUESTIONS

TQ 1.1	PYQ	2015-Dec [7] (a) {C}	DESC	5 Marks
What is meant by the term Activity Based-Cost Management (ABM)?				

Answer:

Activity Based Management (ABM): is a discipline that focuses on the management of activities as a way to improve customer value and profit. ABM includes cost driver analysis, activity analysis, and performance measurement.

- Increasing competition, both globally and locally, make it clear that businesses know accurately and understand the source of process, product and service costs within their organization.
- Activity Based Costing (ABC), with its focus on deconstructing overhead pools and assigning costs to products and services in a more meaningful manner, has been a giant leap forward from traditional costing models where a high percentage of cost is arbitrarily allocated to products.
- However, ABC Models often look at cost from a financial point of view, making sure only that all costs are assigned to some product accounting "box" without a thorough understanding of the business process that underlines and defines the resource utilization that creates the cost.
- The methodology that combines business process analysis with ABC to create a tool that translates Activity Based Costing into Activity Based Management (ABM).

TQ 1.2	PYQ	2015-Dec [7] (b) {C}	DESC	3 Marks
How the ABC information in business strategic decision is used in ABM system?				

Answer:

ABM utilizes cost information gathered through ABC. Through various different types of analysis, ABM manages activities rather than resources. It determines what drives the activities of the organization and how these activities can be improved to increase the profitability.

ABC information can be used in an ABM system to assist in business strategic decision. Such as:

(i) Whether to continue with a particular activity?
(ii) The effect on cost structure of a change in strategy, (e.g. from mass production to smaller lot).
(iii) How changes in activities and components affect the suppliers and the value chain?

TQ 1.3	PYQ	2015-Dec [7] (c) {C}	DESC	2 Marks
Mention four applications of ABM in business.				

Answer:

The customers require: Lower costs, Higher quality, Faster response time, and Greater innovation and development of products or services. The customers perceived these needs and all of which must be satisfied simultaneously. To satisfy these needs ABM currently being used for a variety of business applications. Such as:

(i) Cost reduction or elimination of entire activity, specially there is no value added item/activity.
(ii) Activity based budgeting or cost-effective budgeting.
(iii) Business Process Re-engineering (BPR).
(iv) Bench-marking.
(v) Activity performance measurement.

TQ 1.4	PYQ	2017-Jun [2] (b) (ii)	DESC	3 Marks
How can Activity - Based Costing help refining such costing system?				

Answer:

The Activity-Based Costing (ABC) is a system that focuses on activities as the fundamental cost objects and uses the cost of these activities for

computing the costs of products. The Activity-Based Costing refines the problems of Traditional Costing System by the following means:

1. In the traditional system, cost analysis is done by product. In ABC, the managers focus attention on activities rather than products because activities in various departments may be combined and costs of similar activities ascertained, e.g., quality control, handling of materials, repairs to machines etc., if detailed costs are kept by activities, the total company costs for each activity can be obtained, analysed, planned and controlled.
2. Unlike the Traditional Costing Systems, managers under ABC, manage activities and not products. Changes in activities lead to changes in costs. Therefore, if the activities are managed well, costs will fall and the resulting products will be more competitive.
3. Allocating Overhead Cost to production based on a single cost driver (allocation base, such as unit basis, percentage of material, percentage of prime cost, labour hour rate, machine hour rate etc.) can result in an unrealistic product cost because the traditional system fails to capture cause-and-effect relationships. To manage activities better and to make wiser economic decisions, managers need to identify the relationships of causes (activities) and effects (costs) in a more detailed and accurate manner.
4. ABC highlights problem areas that deserve management's attention and more detailed analysis. Many actions are possible, on pricing, on process technology, on product design, on operational movements and on product mix. Traditional Costing can lead to under costing or over costing of products or services. Over or Under Costing of products distorts cost information. A poor quality of cost information causes management to make poor decisions for pricing, product emphasis, make or buy etc.

ABC differs from the traditional system only in respect of allocations of overheads or indirect costs. Direct Costs are identified with, or assigned to, the cost object, in the same manner as is done in case of traditional costing system. Overhead costs are linked to the cost objects based on activities.

CASE-SCENARIO QUESTIONS

CSQ 1.1 | **PYQ** | **2018-Jun [2] (a)** | **12 Marks**

Relevant data relating to Trident Industries Limited are:

	Products			
	P	Q	R	Total
Production and Sales (Units)	60,000	40,000	16,000	
Raw Material Usage (in Units)	10	10	22	
Raw Material Costs (₹)	50	40	22	49,52,000
Direct Labour Hours	2.5	4	2	3,42,000
Machine Hours	2.5	2	4	2,94,000
Direct Labour Costs (₹)	16	24	12	
No. of Production Runs	6	14	40	60
No. of Deliveries	18	6	40	64
No. of Receipts	60	140	880	1,080
No. of Production Orders	30	20	50	100

Overheads:	₹
Set-up	60,000
Machines	15,20,000
Receiving	8,70,000
Packing	5,00,000
Engineering	7,46,000

The Company operates a JIT inventory policy and receives each component once per production run.

Required:

(a) (i) Compute the product cost based on direct labour hour recovery rate of overheads.

(ii) Compute the product cost using Activity Based Costing

Answer:

(i) Computation of Overhead rate based on direct labour hours:

P	60,000	2.5	1,50,000
Q	40,000	4	1,60,000

R	16,000	2	32,000
Total			3,42,000

Total Overheads = 60,000 + 15,20,000 + 8,70,000 + 5,00,000 + 7,46,000 = 36,96,000

Overhead rate per direct labour hour = 36,96,000/3,42,000 = 10.807 = 10.81

Product Cost based on direct labour recovery rate:

	P	Q	R
Raw Material	50	40	22
Direct Labour	16	24	12
Overheads @ ₹ 10.81 per hour 2.5 x 10.81	27.03		
4 x 10.81		43.24	
2 x 10.81			21.62
Total Cost	93.03	107.24	55.62

(ii) Cost Driver Rates:

Nature of Overhead	Overhead Cost (₹)	Total Quantity of Activity Driver	Activity Driver	Cost Driver Rate ₹/ Unit of Cost Driver
Set-up	60,000	60	Production Runs	1,000
Machines	15,20,000	2,94,000	Machine Hours	5.17
Receiving	8,70,000	1,080	No. of Receipts	805.56
Packing	5,00,000	64	No. of Deliveries	7,812.5
Engineering	7,46,000	100	No. of Production Orders	7,460
Total				

Overhead allocation to products based on Activity Based Costing: (Total Value for Production Units Basis)

Based on the whole production figures,

	P	Q	R
Production Units	60,000	40,000	16,000
Raw Material	30,00,000	16,00,000	3,52,000
Direct Labour	9,60,000	9,60,000	1,92,000

Overheads Set-up @ ₹ 1,000 per hour production run 1,000 x 6 1,000 x 14 1,000 x 40	6,000	14,000	40,000
Machines @ ₹ 5.17 per machine hour 2.5 x 60,000 x 5.17 2 x 40,000 x 5.17 4 x 16,000 x 5.17	7,75,500	4,13,600	3,30,880
Receiving @ 805.56 per receipt 60 x 805.56 140 x 805.56 880 x 805.56	48,333.60	1,12,778.40	7,08,892.80
Packing @ 7,812.5 per delivery 18 x 7,812.5 6 x 7,812.5 40 x 7,812.5	1,40,625	46,875	3,12,500
Engineering @ 7460 per production order 30 x 7,460 20 x 7,460 50 x 7,460	2,23,800	1,49,200	3,73,000
Total Overhead Cost	11,94,258.60	7,36,453.40	17,65,272.80
Total Cost	51,54,258.60	32,96,453.40	23,09,272.80

CSQ 1.2	PYQ	2018-Dec [2] (a)	1+3+4=8 Marks

You are given the following data for a period in respect of two products, X and Y, which consume support services in different proportions:

	Product X	Product Y
Units produced	40	40
Material moves per product unit	12	28
Direct labour hrs. per unit	1,740	1,740

Budgeted material handling costs: ₹ 3,48,000

Required:

(i) Determine cost per unit of X and Y using the volume - based allocation method (direct labour hrs.).

(ii) Compute cost per unit of X and Y using ABC.
(iii) How would you explain the results?

Answer:

(i) Direct labour hour rate = $\frac{\text{Budgeted overheads}}{\text{Budgeted direct labour hours}}$

$= \frac{₹3,48,000}{(40 \times 1,740 + 40 \times 1,740)} = \frac{₹3,48,000}{1,39,200} = ₹ 2.5$

	Product X	Product Y
Total direct labour hours taken	69,600	69,600
Labour rate	₹ 2.5	₹ 2.5
Material handling cost absorbed (hrs. x Rate)	1,74,000	1,74,000
Units produced	40	40
Material handling cost per unit	4,350	4,350

(ii) Since number of material moves causes material handling costs, use of this cost driven gives a better result:

Rate per material move = $\frac{₹3,48,000}{12 + 28} = ₹ 8,700$

	Product X	Product Y
Total Material moves	12	28
Material handling costs applied @ ₹ 8,700/-	₹ 1,04,400	2,43,600
units produced	40	40
Material handling cost per unit	₹ 2,610	6,090

(iii) Product Y requires more material moves and hence shares nationally more material handling costs under (ii) above. In other words, the complexity or diversity of Product Y is taken care of when overhead costs are allocated to this product using appropriate cost driven under ABC.

CSQ 1.3 | PYQ | 2019-Jun [3] (a) | 8 Marks

Vikas Associates a firm of Chartered Accountants offers three different types of services, namely, accounting and auditing, taxation and management consultancy. Each service is charged on the basis of number of billable hours. The average charge per billable hours is ₹ 500. For the year ending 31.03.2019 the firm projects the following estimate of direct and indirect costs:

			₹ (Lakhs)
Direct Costs:	Accounting and Auditing	100.00	
	Taxation	100.00	
	Management consultancy	50.00	250.00
Indirect Costs:	Planning and review	7.50	
	Computer processing	7.20	
	Professional salaries	5.60	
	Books, Seminars, periodicals	1.80	
	Programming costs	8.00	
	Building costs	4.90	
	General administration costs	15.00	50.00
	TOTAL		300.00

Until 31.03.2018 the firm has been allocating the indirect costs on the basis of billable hours. For the year ending 31.03.2019 it was decided to introduce a system of activity based costing to capture the indirect cost more accurately. The following data were gathered accordingly:

Particulars	Accounting and Auditing	Taxation	Management Consultancy
Billable hours	55,000	35,000	10,000
EDP hours	5,000	2,500	500
Professionals (No)	30	16	10
Books, Seminars and periodicals (₹)	57,500	62,500	60,000
Programming hours	1,250	500	2,250
Building (Sq) ft) space occupied	8,000	4,000	2,000
Administration (No. of clients)	150	250	100

Required:

(i) Prepare a comparative profitability statement on the basis of (A) conventional costing and (B) activity-based costing (ABC)

(ii) Any suggestion for improving the billable charge on the basis of ABC?

Answer:

Schedule of Allocation of Indirect Cost by ABC

₹ In lakhs

	Cost Driver		Accounting &		Management consulting
Overhead	**Ratio**	**Total**	**Auditing**	**Taxation**	
		₹	₹	₹	₹
Planning and Review	Billable Hrs	7.500	4.125	2.625	0.750
Computer Processing	EDP Hour	7.200	4.500	2.250	0.450
Professional Salaries	30:16:10	5.600	3.000	1.600	1.000
Books, Seminar, Periodicals	Actual	1.800	0.575	0.625	0.600
Programmed Costs	5:2:9	8.000	2.500	1.000	4.500
Building Costs	Sq Ft	4.900	2.800	1.400	0.700
Administration Cost	3:5:2	15.000	4.500	7.500	3.000
Total		50	22	17	11

Comparative Profitability Statement (₹ in Lakhs)

	Conventional		ABC			
	A&A	**Tax**	**MGMT**	**A&A**	**Tax**	**MGMT**
Revenue	275.00	175.00	50.00	275.00	175.00	50.00
Direct Costs	100.00	100.00	50.00	100.00	100.00	50.00
Overhead Cost	27.50	17.50	5.00	22.00	17.00	11.00
Profit	147.50	57.50	-5.00	153.00	58.00	-11.00

Suggestions:

On the basis of the ABC system the total cost of each division/service is ₹ 122 Lakhs, ₹ 117 Lakhs and ₹ 61 Lakhs respectively. Hence the billable charge should be revised accordingly. Assuming the same margin i.e. 40% of revenue overall or 66⅔% on cost the revenue works out to

	A&A	**Tax**	**Mgmt**
Cost	122.00	117.00	61.00
Margin	81.33	78.00	40.67
	203.33	195.00	101.67
Billable Hours	55,000	35,000	10,000
Charge per Hour	370	560	1,017

The analysis clearly reveals that Management Accountancy services are under charged.

CSQ 1.4	**PYQ**	**2019-Dec [2] (a)**	**6 Marks**

State with brief reason whether you would recommend an Activity Based Costing system in each of the following independent situations:

(i) A consultancy firm consisting of Lawyers, Accountants and Computer Engineers provides management consultancy services to clients.

(ii) Company X produces one product. The overhead costs mainly consist of Depreciation.

(iii) Company Z produces two different labour intensive products. The contribution per unit in both products is very high. The BEP is very low. All the work is carried on efficiently to meet target costs.

(iv) Company Y produces 4 different products using different production facilities.

Answer:

(i) ABC system uses the cost of activities as the basis for assigning cost of services to jobs which provides more accurate cost information for services. Therefore, ABC can be used for the consultancy firm.

(ii) ABC is required by organizations for product costing where there is a great diversity in product range. Since company X produces only one product, ABC is not necessary. Also, overhead consists of mainly depreciation, hence, ABC is not required.

(iii) Company Z is highly labour intensive and does not have a great diversity of products. All work is carried out efficiently, therefore ABC is not required. Moreover Target costs are achieved, NVA activities have already been identified and eliminated.

(iv) There is diversity in product range which use different amounts of overhead resources as different production facilities are involved. ABC improves product costing by avoiding over or under costing of products. ABC system is recommended.

CSQ 1.5	PYQ	2021-Dec [2]	1 Mark

At KL Company, the cost of the personnel department has always been charged to production departments based upon number of employees. Recently, opinions gathered from the department managers indicate that the number of new hires might be a better predictor of personnel costs. Total personnel department costs are ₹ 200,000.

Department	A	B	C
Number of employees	30	270	100
The number of new hires	8	12	5

If number of new hires is considered the cost driver, what amount of personnel costs will be allocated to Department A?

[Sec. B - SAQ]

Answer:

Total personnel department costs: 2,00,000

Number of New Hires:

- Department A: 8 new hires
- Department B: 12 new hires
- Department C: 5 new hires
- Total new hires: 8 + 12 + 5 = 25
- Allocation rate per new hire = Total personnel department costs / Total number of new hires
- Allocation rate per new hire = 2,00,000 / 25
- Allocation rate per new hire = 8,000
- Number of new hires in Department A: 8
- Personnel costs allocated to Department A = Number of new hires in Department A × Allocation rate per new hire
- Personnel costs allocated to Department A = 8 × 8,000
- Personnel costs allocated to Department A = 64,000

Conclusion:

The amount of personnel costs that will be allocated to Department A is 64,000.

CSQ 1.6	PYQ	2021-Dec [9]	1 Mark

Activities	Total Costs ₹	Activity – cost drivers
Account inquiry hours	4,00,000	10,000 hours
Account billing lines	2,80,000	40,00,000 lines
Account verification accounts	1,50,000	40,000 accounts
Correspondence letters	50,000	4,000 letters
Total cost	8,80,000	

M provides the above ABC information. The above activities are used by Departments A and B as follows:

	Dept A	Dept B
Account inquiry hours	2,000	4,000
Account billing lines	4,00,000	2,00,000

How much of the account inquiry cost will be assigned to Department A?

[Sec. B - SAQ]

Answer:

Total account inquiry costs: 4,00,000

- Total account inquiry hours: 10,000
- Allocation rate per account inquiry hour = Total account inquiry costs / Total account inquiry hours
- Allocation rate per account inquiry hour = 4,00,000 / 10,000
- Allocation rate per account inquiry hour = 40
- Account inquiry hours for Department A: 2,000
- Account inquiry cost allocated to Department A = Account inquiry hours for Department A × Allocation rate per account inquiry hour
- Account inquiry cost allocated to Department A = 2,000 × 40
- Account inquiry cost allocated to Department A = 80,000

Conclusion:

The amount of account inquiry cost that will be assigned to Department A is 80,000.

CSQ 1.7	PYQ	2021-Dec [14]	1 Mark

How many separate cost pools should be formed given the following information:

Cost	Cost driver
Postage costs	No. of brochures mailed
Printing and paper costs	No. of brochures mailed
Quality control costs	No. of inspections
Customer service costs	No. of customers served

[Sec. B - SAQ]

Answer:

Cost and Cost Driver Analysis:

1. **Postage Costs:**
   - Cost driver: Number of brochures mailed
2. **Printing and Paper Costs:**
   - Cost driver: Number of brochures mailed
3. **Quality Control Costs:**
   - Cost driver: Number of inspections
4. **Customer Service Costs:**
   - Cost driver: Number of customers served

Conclusion:

- Postage costs and printing and paper costs both have the same cost driver: number of brochures mailed. These can be combined into one cost pool.
- Quality control costs have a unique cost driver: number of inspections. This forms a separate cost pool.
- Customer service costs have a unique cost driver: number of customers served. This forms another separate cost pool.

Therefore, the number of separate cost pools that should be formed is 3.

CSQ 1.8	PYQ	2022-Dec [5] (a)	10 Marks

BON Ltd. manufactures 3 types of biscuits F,G and H in a fully mechanized factory. The company has been following conventional method of costing and wishes to shift to Activity Based Costing (ABC) System and therefore wishes to have the following data presented under both the system for the month.

	₹
Inspection Cost	73,000
Machine-Repairs & Maintenance	1,42,000
Dye Cost	10,250
Selling Overheads	1,62,000

	Products		
	F	G	H
Prime Cost (₹ Per unit)	12	9	8
Selling Price (₹ Per unit)	18	14	12
Gross Production (units/production run)	2,520	2,810	3,010
No. of defective (units/production run)	20	10	10
Inspection:			
No. of hours/Production run	3	4	4
Dye Cost/Production run (₹)	200	300	250
No. of Machine hours/Production run	20	12	30
Sales— No. of Units/Month	25,000	56,000	27,000

The following additional information is given:

(i) No accumulation of inventory is considered. All goods units produced are sold.

(ii) All manufacturing and selling overheads are conventionally allocated on the basis of units sold.

(iii) Product F needs no advertisement. Due to its nutritive value, it is readily consumed by diabetic patients of a Hospital. Advertisement costs included in the total selling overhead is ₹ 83,000.

(iv) Product G needs to be specially packed before being sold, so that it meets competition. ₹54,000 was the amount spent for the month in specially packing G, and this has been included in the total selling overhead cost given.

Required:

(i) Present product-wise profitability of statement under the conventional system and

(ii) Present product-wise profitability of statement under the Activity Based Costing (ABC) system and accordingly rank the products.

Answer:

(i) Profitability Under Conventional Accounting System.

	Products			
	Total	F	G	H
Sales – Units / Production (Goods Units)	1,08,000	25,000	56,000	27,000
Gross Margin (₹)	5,33,080	1,47,600	2,78,200	1,07,280
Production Overheads (₹)	2,25,250	52,141	1,16,796	56,313
Selling Overheads (₹)	1,62,000	37,500	84,000	40,500
Sub-Total Overhead (₹)	3,87,250	89,641	2,00,796	96,813
Net Profit (₹)	1,45,830	57,959	77,404	10,467
Ranking		II	I	III

(ii) Profitability Under Activity Based Costing (ABC)

	Products		
	F	G	H
Sales–Units/Production (Goods Units)	25,000	56,000	27,000
Gross Margin (₹)	1,47,600	2,78,200	1,07,280
Production Overhead (₹)	57,000	94,000	74,250
Selling Overheads	5,787	1,22,963	33,250
Sub-Total Overheads	62,787	2,16,963	1,07,500
Net Profit	84,813	61,237	(220)
Ranking	I	II	III

CSQ 1.9	PYQ	2023-Dec [4] (a)	7 Marks

ADF Bank operated for years under the assumption that profitability can be increased by increasing Rupee volumes. But that has not been the case. Cost analysis has revealed the following:-

Activity	Activity Cost (₹)	Activity Driver	Activity Capacity
Providing ATM Service	1,00,000	No. of transactions	2,00,000
Computer processing	10,00,000	No. of transactions	25,00,000
Issuing Statements	8,00,000	No. of statements	5,00,000
Customer inquiries	3,60,000	Telephone minutes	6,00,000

The following annual information on three products was also made available:

	Checking Accounts	Personal Loans	Gold Visa
Units of Product	30,000	5,000	10,000
ATM Transactions	1,80,000	0,000	20,000
Computer transactions	20,00,000	2,00,000	3,00,000
Number of statements	3,00,000	50,000	1,50,000
Telephone minutes	3,50,000	90,000	1,60,000

Required:

(i) Calculate rates for each activity.

(ii) Using the rates computed in requirement (i), assess the cost of each product.

Answer:

Rates for Each Activity

Providing ATM Service

Total Cost: ₹ 1,00,000

Activity Capacity: 2,00,000 transactions

Activity Rate: 0.50 per transaction

Computer Processing

Total Cost: ₹ 10,00,000

Activity Capacity: 25,00,000 transactions

Activity Rate: 0.40 per transaction

Issuing Statements

Total Cost: ₹ 8,00,000

Activity Capacity: 5,00,000 statements

Activity Rate: 1.60 per statement

Customer Inquiries

Total Cost: ₹ 3,60,000

Activity Capacity: 6,00,000 telephone minutes

Activity Rate: 0.60 per minute

Cost of Each Product

Checking Accounts

ATM Transactions: 1,80,000 transactions × 0.50 = 90,000

Computer Transactions: 20,00,000 transactions × 0.40 = 8,00,000

Number of Statements: 3,00,000 statements × 1.60 = 4,80,000
Telephone Minutes: 3,50,000 minutes × 0.60 = 2,10,000
Total Cost: 90,000 + 8,00,000 + 4,80,000 + 2,10,000 = 15,80,000
Cost per Unit: 15,80,000 / 30,000 = 52.67 per unit

Personal Loans

ATM Transactions: 0 transactions × 0.50 = 0
Computer Transactions: 2,00,000 transactions × 0.40 = 80,000
Number of Statements: 50,000 statements × 1.60 = 80,000
Telephone Minutes: 90,000 minutes × 0.60 = 54,000
Total Cost: 0 + 80,000 + 80,000 + 54,000 = 2,14,000
Cost per Unit: 2,14,000 / 5,000 = 42.80 per unit

Gold Visa

ATM Transactions: 20,000 transactions × 0.50 = 10,000
Computer Transactions: 3,00,000 transactions × 0.40 = 1,20,000
Number of Statements: 1,50,000 statements × 1.60 = 2,40,000
Telephone Minutes: 1,60,000 minutes × 0.60 = 96,000
Total Cost: 10,000 + 1,20,000 + 2,40,000 + 96,000 = 4,66,000
Cost per Unit: 4,66,000 / 10,000 = 46.60 per unit

CSQ 1.10	PYQ	2024-Dec [4] (a)	7 Marks

ANTOX Ltd., is producing a product in 10 batches each of 15,000 units in a year and incurring the following overheads thereon:

	Amount (₹)
Material procurement	22,50,000
Maintenance	17,30,000
Set up	6,84,500
Quality control	5,14,800

The prime costs for the year amounted to ₹ 3,01,39,000.
The company is using currently the method of absorbing overheads on the basis of prime cost. Now it wants to shift to activity based costing. Information relevant to activity drivers for the year are as under:

Activity Driver	Activity Volume
No. of purchase orders	1,500
Maintenance hours	9,080

No. of set-ups	2,250
No. of inspections	2,710

The company has produced a batch of 15,000 units and has incurred ₹ 26,38,700 and ₹ 3,75,200 on materials and wages respectively.
The usage of activities of the said batch are as follows:

Material orders	48 orders
Maintenance hours	810 hours
No. of set-ups	40
No. of inspections	25

Required:
(i) Evaluate cost of product per unit on absorption costing basis for the said batch.
(ii) Assess the cost driver rate.
(iii) Analyze the total cost per unit of output of the said batch on the basis of activity based costing.

Answer:

Absorption of overhead on the basis of Prime Cost

Calculation of Absorption of overhead cost rate

$$\frac{22,50,000 + 17,30,000 + 6,84,500 + 5,14,800}{3,01,39,000}$$

Absorption of Overhead Rate = 17.18 %
(For a batch of 15,000 units)

(i) Calculation of Cost of Product per unit on the basis of absorption costing method.

Particulars	Amount (₹)
Materials	26,38,700.00
Wages	3,75,200.00
Prime Cost	30,13,900.00
Overhead Cost (17.18% of Prime Cost)	5,17,788.02
Cost of Product	35,31,688.02
No. of unit in a batch	15,000 units
Cost of Product Per unit	235.45

(ii) Statement Showing Cost Driver Rate

Overhead	Cost (₹)	Cost Driver	Cost Driver Rate (₹)
Material Procurement	22,50,000	No. of Purchase Orders = 1,500 Order	1,500 per order
Maintenance	17,30,000	Maintenance Hours = 9,080 hours	190.53 per hour
Set up	6,84,500	No. of Setup = 2,250 Setup	304.22 per setup
Quality Control	5,14,800	No. of inspections = 2,710 insp.	189.96 per inspection

(iii) Statement Showing Total Cost and Per unit Cost based on Activity Based Costing:

Particulars	Total Cost (₹)	Per Unit Cost (₹)
Materials	26,38,700.00	175.91
Wages	3,75,200.00	25.01
Prime Cost	30,13,900.00	200.92
Overhead Activity Cost:		
Material Order Cost	72,000.00	4.80
Maintenance Cost	1,54,329.30	10.29
Setup Cost	12,168.80	0.81
Quality control Cost	4,749.00	0.32
Total Cost	32,57,147.10	217.14

CSQ 1.11	PYQ	2025-Jun [4] (a)	7 Marks

PASN Ltd., manufactures four products, namely A, B, C and D using the same plant and process. The following information relates to a production period:

Product	A	B	C	D
Output in Units	720	600	480	504

The four products are similar and are usually produced in production runs of 24 units and sold in batches of 12 units. The total overheads incurred by the company for the period are as follows:

	₹
Machine operation and maintenance cost	63,000
Setup costs	20,000

Store receiving	15,000
Inspection	10,000
Material handling and dispatch	2,592

During the period the following cost drivers are to be used for the overhead cost:

Cost	Cost Driver
Setup cost	No. of production runs
Store receiving	Requisitions raised
Inspection	No. of production runs
Material handling and dispatch	Orders executed

It is also determined that:

- Machine operation and maintenance cost should be apportioned between setup cost, store receiving and inspection activity in the ratio 4 : 3 : 2.
- Number of requisition raised on store is 50 for each product and the number of orders executed is 192, each order being for a batch of 12 units of a product.

Required:

(i) Analyse the Activity Based Costing Recovery Rate.

(ii) Integrate the total overhead cost per unit of each Product using Activity Based Costing.

Answer:

Calculation of Activity Based Costing Recovery Rate:

Activity	Activity Cost Pool	Cost Driver	Quantity	ABC RATE
Set Up	20,000 + 28,000 = ₹48,000	No. of Production Runs	96	₹500 per Run
Stores Receiving	15,000 + 21,000 = ₹36,000	Requisitions raised	50 x 4 = 200	₹180 per Reqn.
Inspection	10,000 +14,000 = ₹24,000	No. of Production Runs	96	₹250 per Run
Material Handling	Given = ₹2,592	Orders executed	192	₹13.5 per Batch

Note:

1. Machine Operation and Maintenance Cost of ₹63,000 is apportioned to the first three activities in the ratio 4:3:2, i.e. ₹28,000, ₹21,000 and ₹14,000.
2. Number of Production Runs and Number of Batches are computed as under:

Product	A	B	C	D	Total
(a) Output Quantity	720 units	600 units	480 units	504 units	
(b) Quantity per Production Run	24 units	24 units	24 units	24 units	
(c) Number of Production Runs (a ÷b)	30 runs	25 runs	20 runs	21 runs	96 runs
(d) Quantity per Batch Order	12 units	12 units	12 units	12 units	
(e) Number of Batches (a ÷ d)	60 batches	50 batches	40 batches	42 batches	192 batches

(ii) Computation of OH Costs using Activity Based Costing System

Product	A	B	C	D	Total
Setup	500 x 30 = ₹15,000	500 x 25 = ₹12,500	500 x 20 = ₹10,000	500 x 21 = ₹10,500	₹48,000
Stores Receiving	₹9,000	₹9,000	₹9,000	₹9,000	₹36,000
Inspection	250 x 30 = ₹7,500	250 x 25 = ₹6,250	250 x 20 = ₹5,000	250 x 21 = ₹5,250	₹24,000
Material Handling	13.50 x 60 = ₹810	13.50 x 50 = ₹675	13.50 x 40 = ₹540	13.50 x 42 = ₹567	₹2,592
Total OH Cost	₹32,310	₹28,425	₹24,540	₹25,317	₹1,10,592
Output	720 units	600 units	480 units	504 units	
OH Cost per unit	₹44.875	₹47.375	₹51.125	₹50.232	

CSQ 1.12	PYQ	2026-Jun [4] (a)	7 Marks

MOKN Ltd., manufactures four products, namely A, B, C and D using the same plant and process. The following information relates to a production period.

Product	A	B	C	D
Output in Units	720	600	480	504

The four products are similar and are usually produced in production runs of 24 units and sold in batches of 12 units. The total overheads incurred by the company for the period are as follows :

	₹
Machine operation and maintenance cost	63,000
Setup costs	20,000
Store receiving	15,000
Inspection	10,000
Material handling and dispatch	2,592

During the period the following cost drivers are to be used for the overhead cost:

Cost	Cost Driver
Setup cost	No. of production runs
Store receiving	Requisitions raised
Inspection	No. of production runs
Material handing and dispatch	Orders executed

It is also determined that :

- Machine operation and maintenance cost should be apportioned between setup cost, store receiving and inspection activity in the ratio 4 : 3 : 2.
- Number of requisition raised on store is 50 for each product and the no. of orders executed is 192, each order being for a batch of 12 units of a product.

Required :

(1) Analyze the Activity Based Costing Recovery Rate.
(2) Assess the total overhead costs per unit of each product using Activity Based Costing.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

02 (JIT)

THEORY QUESTIONS

TQ 2.1	PYQ	2021-Dec [2]	DESC	4 Marks

What is the impact of Just-in-time on Product Prices?

[Sec. C - Four LAQ]

Answer:

Impact of Just-in-time on Product Prices:

- When a company achieves a higher level of product quality, along with ability to deliver products on the dates required, customers may be willing to pay a premium.
- This is particularly true in industries where quality or delivery reliability is low. If customers are highly sensitive to these two factors, it may be possible to increase the price substantially.
- Alternatively, if these factors are not of great importance, if customers place a higher degree of importance on other factors, then there will be no opportunity for a price increase.
- In industries where many companies are adopting JIT systems at the same time or have already installed them, an improvement in product quality and delivery times does not differentiate a company from its peers.
- Instead, since everybody else is offering the same level of quality and service it just keeps a company from losing sales to its competitors.
- In such a situation it is more likely that all companies remaining in the industry will use their new-found lower costs to initiate a price war that will result in a drop in prices.

- Consequently, the impact of a JIT system on product pricing is primarily driven by customers' perceived need for higher product quality and reliable delivery times, as well as the presence of competitors with JIT system, the same installation, and operational base.

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2015-Jun [4] (b) (i)	8 Marks

Maruti India Ltd., offers a range of cars from economy, Sedans, SUVs and used cars have decided to adopt JIT policy, in making of the New Alto Car materials.

The following effects of JIT policy are identified:

1. To implement JIT, the company has to modify its production and material receipt facilities at a capital cost of ₹ 10,00,000. The new machine will require a cash operating cost of ₹ 1,08,000 per annum. The capital cost will be depreciated over 5 years.
2. The Raw Material Stockholding will be reduced from ₹ 40,00,000 to ₹ 10,00,000.
3. The company can earn 15% on its long-term investments.
4. The company can avoid rental expenditure on storage facilities amounting to ₹ 33,000 per annum. Property taxes and insurance amounting to ₹ 22,000 will be saved due to JIT programme.
5. Presently there are 7 workers in the store department at a salary of ₹ 5,000 each per month. After implementing JIT scheme, only 5 workers will be required in this department. Balance 2 workers' employment will be terminated.
6. Due to receipt of smaller lots of Raw Materials, there will be some disruption of production. The costs of Stock-outs are estimated at ₹ 77,000 per annum.

Determine the financial impact of the JIT policy; is it advisable for the Maruti company to implement JIT for New Alto production system?

Answer:

The cost- benefit analysis of JIT policy at Maruti India Ltd.

Costs	₹	Benefits	₹
Interest on capital for Modifying production Facilities (₹10,00,000 × 15%)	1,50,000	Interest on investment on released funds (₹40,00,000 - ₹ 10,00,000) × 15%	4,50,000
Operation Costs of new production facilities	1,08,000	Saving in salary of 2 workers terminated (₹5,000 × 12 × 2)	1,20,000
Depreciation of new production facilities	Nil	Saving in rental expenditure	33,000
Stock-outs Cost (given)	77,000	Saving in property tax Insurance	22,000
Net Benefit due to JIT policy	2,90,000		
Total	6,25,000	Total	6,25,000

Conclusion: The JIT policy for New Alto may be implemented, as there is a net benefit of ₹ 2,90,000 per annum.

Note: Depreciation, being apportionment of capital cost, has been ignored in decision-making. Further the tax saving on Depreciation has not been considered in the above analysis.

CSQ 2.2	PYQ	2018-Dec [4] (b)	8 Marks

Prism Ltd. has decided to adopt JIT policy for materials. The following effects of JIT policy are identified:

(i) To implement JIT, the company has to modify its production and material receipt facilities at a capital cost of ₹ 2,00,000. The new machine will require a cash operating cost ₹ 2,16,000 p.a. The capital cost will be depreciated over 10 years.

(ii) Raw material stockholding will be reduced from ₹ 40,00,000 to ₹ 15,00,000.

(iii) The company can earn 12% on its long-term investments.

(iv) The company can avoid rental expenditure on storage facilities amounting to ₹ 66,000 per annum. Property Taxes and Insurance amounting to ₹ 44,000 will be saved due to JIT programme.

(v) Presently there are 7 workers in the Store department at a salary of ₹ 10,000 each per month. After implementing JIT scheme, only 4 workers will be required in this department. Balance 3 worker's employment will be terminated.

(vi) Due to receipt of smaller losts of Raw Materials, there will be some disruption of production. The costs of stockouts are estimated at ₹ 1,54,000 per annum.

(vii) Since the supplier is new having no reputation as yet in the market, an additional inspection cost of ₹ 12,000 p.a. has to be incurred.

Required:

Determine the financial impact to the JIT policy. Is it advisable for the company to implement JIT system?

Answer:

Cost-Benefit Analysis of JIT policy.

Costs	₹	Benefits	₹
Interest on capital for modifying production facilities (₹ 2,00,000 x 12%)	24,000	Interest on investment on released funds (₹ 40,00,000–₹ 15,00,000) x 12%	3,00,000
Operating Costs of new production facilities	2,16,000	Saving in salary of 3 workers terminated	
Depreciation of new production facilities	Nil	(₹ 10,000 x 12 months x 3)	3,60,000
		Saving in rental Expenditure	66,000
Stock-Outs costs (given)	1,54,000	Saving in Property Tax & Insurance	44,000
Inspection cost	12,000		
Net benefit due to JIT policy	3,64,000		
Total	7,70,000	Total	7,70,000

Conclusion: The JIT policy may be implemented, as there is a Net Benefit of ₹ 3,64,000 per annum.

Note: Depreciation, being apportionment of non-cash capital cost, is ignored in decision-making. Tax saving on Depreciation is not considered in the above analysis.

CSQ 2.3	PYQ	2023-Jun [4] (b)	5 Marks

PANIT LTD., a video company sells package of blank video tapes to its customers. It purchases video tapes from VISAN (1) Company @ ₹ 140 a packet. VISAN (I) Company pays all freight to PANIT LTD. No incoming inspection is necessary because VISAN (1) Company has a superb

reputation for delivery of quality merchandise. Annual demand of PANIT LTD. is 13,000 packages. PANIT LTD. requires 15% annual return on investment. The purchase order lead time is two weeks. The purchase order is passed through internet and it costs ₹ 3 per order. The relevant insurance, material handling etc. ₹ 5.10 per package per year. PANIT LTD, has to decide whether or not to shift to JIT purchasing. VISAN (1) company agrees to deliver 100 packages of video tapes 130 times per year (5 times every two weeks) instead of existing delivery system of 1,000 packages 13 times a year, with additional amount of ₹ 0.50 per package. PANIT LTD. incurs no stock out under its current purchasing policy. It is estimated, PANIT LTD. incurs stock out cost on 50 video tape packages under a JIT purchasing policy. In the event of a stock out, PANIT LTD. has to rush order tape packages which costs ₹ 4 per package.

Required:

Assess the information as stated supra and advise PANIT LTD. as to whether it should implement JIT Purchasing system?

Answer:

Comparative statement of cost for purchasing from VISAN (I) Company under current policy & JIT.

Particulars	Current purchasing Policy	JIT Purchasing Policy
Total Relevant Cost	₹ 18,33,089	₹ 18,28,398.75

Advice: As may be seen from above, the relevant cost under the JIT purchasing policy is lower than the cost incurred under the existing system. Hence, PANIT Ltd. is advised to implement the JIT Purchasing System.

03 *Throughput Accounting*

THEORY QUESTIONS

TQ 3.1	PYQ	2021-Dec [5]	SN	3 Marks

Write short note on concept and aim of Theory of Constraints

[Sec. C - Six LAQ]

Answer:

Concept and aim of theory of Constraints:

TOC analyses the Bottlenecks and constraints within the firm that restrict output and hinder speedy production.

Throughput is related directly to the ability to cope with the constraint and to manage the bottle neck.

This focus on throughput enables management to examine both constraints and bottlenecks in order to increase Throughput contribution.

CASE-SCENARIO QUESTIONS

CSQ 3.1	PYQ	2017-Dec [5] (a)	3+3=6 Marks

Zip Ltd. manufactures three products. The material cost, selling price and bottleneck resource details per unit are as follows:

Particulars	Product T	Product C	Product S
Selling Price (₹)	66	75	90
Material and other variable cost (₹)	24	30	40
Bottleneck resource time (minutes)	15	15	20

Budgeted factory costs for the period are ₹ 4,43,200. The bottleneck resource time available is 1,50,240 minutes per period.

Required:

(i) Company adopted throughput accounting and products are ranked according to 'product return per minute'.
Select the highest rank product.

(ii) Calculate throughput accounting ratio and comment on it.

Answer:

(i) Calculation of Rank according to product return per minute:

(₹)

Particulars	T	C	S
Selling price	66	75	90
Less: Variable Cost	24	30	40
Throughput contribution (a)	42	45	50

Minutes per unit (b)	15	15	20
Contribution per minute (a) ÷ (b)	2.8	3	2.5
Ranking	II	I	III

(ii) Calculation of Throughput Accounting ratio:

Particulars	T	C	S
Factory cost per minute (₹ 2,21,600/75,120 minutes) (₹)	2.95	2.95	2.95
TA Ratio (Contribution per minute/Cost per minute)	0.95	1.02	0.85
Ranking based on TA ratio	II	I	III

Analysis: Product C yields more contribution compared to average factory contribution per minute, whereas T and S yield less.

CSQ 3.2 | PYQ | 2024-Jun [4] (a) | 7 Marks

BIVON Ltd., a manufacturing company, manufactures 3 products VN, DN and XN. Due to scarcity of machine hours, management of BIVON Ltd., is planning to adopt Throughput Accounting in the company. The informations pertaining to the three products are as follows:

	VN	DN	XN
Selling price per unit	₹ 5,000	₹ 4,000	₹ 3,500
Material Cost per unit	₹ 2,500	₹ 2,500	₹ 2,000
Machine Hours required	5	6	4
Maximum annual demand	3,000 units	4,000 units	2,000 units

Total factory cost is ₹ 1,05,00,000 and available machine hours are 35,000 hours.

BIVON Ltd. has to supply 2,500 units of product DN to Beta Ltd. as per a court judgement which cannot be denied.

Required:

(i) Rank the products using Throughput Accounting and prepare a statement showing Optimal Mix for maximization of profit.

(ii) Whether court Judgement has affected the Optimum Plan of profit of the company, if yes, by which amount?

Answer:

(I) **Statement of Ranking**

Particulars	VN	DN	XN
Selling price per unit	₹ 5,000	₹ 4,000	₹ 3,500
Less: Material cost per unit	₹ 2,500	₹ 2,500	₹ 2,000
Throughput per unit	₹ 2,500	₹ 1,500	₹ 1,500
Throughput Return per hour	₹ 500	₹ 250	₹ 375
Throughput Accounting Ratio	1.67	0.83	1.25
Ranking	I	III	II

Statement showing optimal mix for maximization of profit

Product	No. of units	Total Machine hours	T/P per hr. (₹)	Total T/P (₹)
DN to Beta Ltd.	2,500	15,000	250	37,50,000
VN	3,000	15,000	500	75,00,000
XN	1,250	5,000	375	18,75,000
Total				1,31,25,000
Less: Total Factory cost				1,05,00,000
Profit				26,25,000

(ii) **Statement showing optimal plan of profit if there is no such court's judgement:**

Product	No. of units	Total Machine hours	T/P per hr. (₹)	Total T/P (₹)
VN	3,000	15,000	500	75,00,000
XN	2,000	8,000	375	30,00,000
DN	2,000	12,000	250	30,00,000
Total				1,35,00,000
Less: Total Factory Cost				1,05,00,000
Profit				30,00,000

From the above Calculations, we can conclude that court's judgement has affected the optimal plan of profit. Due to court's judgement profit of the company has declined by ₹ 3,75,000.

CSQ 3.3	PYQ	2025-Dec [4] (a)	7 Marks

A factory of MOBN Ltd. a manufacturing company using Throughput Accounting System produces products S and T for a month in 2025 details of which are presented below:

Particulars	Product S	Product T
Selling price per unit(₹)	110	120
Direct Material cost per unit (₹)	50	76
Direct Labour cost p.u. (₹)	12	10
Variable Overheads p.u. (₹)	20	15
Production (units)	20,000	30,000
Time required on the bottleneck resources (Hrs. p.u.)	5	4

Total fixed overhead is ₹4,50,000 each month. There are 2,30,000 bottle-neck hours available each month.

Required:

Calculate the following:

(i) Total Factory Cost (TFC)
(ii) Cost per factory hour
(iii) Return per bottleneck hour for both Product S and Product T
(iv) Throughput Accounting (TA) ratios for both Product S and Product T
(v) Throughput cost per month
(vi) Efficiency Ratio

Answer:

(i) **Total Factory Cost (TFC)**

[20,000 × (12 + 20) + 30,000 x (10 + 15) + 4,50,000]
= 13,90,000 + 4,50,000 = ₹18,40,000

(ii) **Cost per factory hour:**

18,40,000 ÷ 2,30,000 = ₹ 8

(iii) **Return per bottleneck hour for both products:**

Product S:

$\frac{110 - 50}{5} = \frac{60}{5} = ₹ 12$

Product T:

$\frac{120 - 76}{4} = \frac{44}{4} = ₹ 11$

(iv) **Throughput Accounting (TA) Ratio for both Products:** $\frac{\text{Return per hr.}}{\text{Cost per hr.}}$

Product S:

$\frac{₹12}{₹8} = 1.5$

Product T:

$\frac{11}{8} = 1.375$

(v) **Throughput cost per month:**

(20,000 × 5 + 30,000 × 4) = 2,20,000 hours
2,20,000 × ₹ 8 = ₹ 17,60,000

(vi) **Efficiency Ratio:**

(Throughput Cost ÷ Actual TFC) × 100
= (₹ 17,60,000 ÷ ₹ 18,40,000) × 100
= 0.9565 i.e. 95.65 %

04 Back flush Accounting

THEORY QUESTIONS

TQ 4.1	PYQ	2017-Jun [8] (a)	SN	3 Marks

Write a short note on the following:
Variants of Back flush Accounting.

Answer:

There are a number of variants of the Back flush system, each differing as to the 'trigger points' at which costs are recognized within the cost accounts and thus, associated with products.

Variant-1: This has two trigger points (TP): TP 1 - purchase of raw materials/components. A 'raw and in process (RIP)' account will be debited

with the actual cost of materials purchased, and creditors credited. TP 2 - completion of good units. The finished goods (FG) account will be debited with the standard cost of unit produced and the RIP and CC account will be credited with the standard cost.

Variant-2: This has only one trigger points - the completion of good units. The FG account is debited with the standard cost of units produced, with corresponding credits to the CC account and the creditors account.

TQ 4.2	PYQ	2018-Jun [8] (a)	SN	4 Marks
Write a short note on the following: Back flush Accounting				

Answer:

Back flush accounting is when you wait until the manufacture of a product has been completed, and then record all of the related issuances of **inventory** from stock that were required to create the product. This approach has the advantage of avoiding all manual assignments of **costs** to products during the various production stages, thereby eliminating a large number of transactions and the associated clerical labour.

Back flush accounting is entirely automated, with a computer handling all transactions. The back flushing formula is:

Number of units produced × unit count listed in the **bill of materials** for each component = Number of **raw material** units removed from stock

Back flushing is not suitable for long production processes, since it takes too long for the inventory records to be reduced after the eventual completion of products. It is also not suitable for the production of customized products, since this would require the creation of a unique bill of materials for each item produced.

TQ 4.3	PYQ	2022-Dec [8] (c)	SN	4 Marks
Write a short note on the following: Areas where Back flush costing is useful				

Answer:

Areas where back flush Accounting is useful:

Back flush costing is generally used by companies that keep low levels of inventory and experience high turnover in inventory.

It is because costs are still recorded relatively close to the day they are incurred. Companies with slow inventory turnover tend to record costs as they are incurred, as the product may remain unsold for a longer duration of time.

The back flush costing method works particularly well, where many different costs go into the production of a good. In such an instance.

It can simplify the accounting process significantly. As a result, many manufacturing companies with complex production processes use back flush costing.

However, companies that sell more customized products are less suited to a back flush costing method, as the unit cost will vary.

For Notes

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 5 Evaluating Performance

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1	Variance Analyses	24	-
2	Uniform Costing and Inter-firm Comparison	1	-

SECTION-A

PYQ 2016-Dec [1] (b) {C} Match the statement under Column I with the appropriate statement under Column II:

Column I	Column II
(A) Maturity stage of PLC	(i) Provides accurate, timely and understandable information that can be used by managers, sales personnel, operational leaders and others.
(B) Lean Accounting	(ii) Based on the assumption that all other variables remain constant.
(C) Kaizen Costing	(iii) Clarity of objectives.
(D) Cost-Volume-Profit Analysis	(iv) Improvements in manufacturing processes.

(E) Successful Benchmarking requires		(v) Focuses on the production process and cost reductions are derived primarily through the efficiency of the production process.

(1 × 5 = 5 Marks)

Answer:
(A) (iv)
(B) (i)
(C) (v)
(D) (ii)
(E) (iii)

PYQ 2016-Dec [1] (i) (c) {C} Define the following terms in just one or two sentence(s):
Responsibility Accounting **(1 Mark)**

Answer: Responsibility Accounting- Responsibility Accounting is the collection, summarization and reporting of financial information about various decision centres throughout an organization.

PYQ 2017-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification.

(iv) ABC Limited has current PBIT of ₹ 19.20 lakhs on total assets of ₹ 96 lakhs. The company has decided to increase assets by ₹ 24 lakhs, which is expected to increase the operating profit before depreciation by ₹ 8.40 lakhs. There will be a net increase in depreciation by ₹ 4.80 lakhs. This will result in ROI

(a) to increase by 1% (b) to decrease by 1%
(c) to decrease by 1.5% (d) to remain the same

(2 Marks)

Answer: (b)

	Before installin new assets	**After installing new assets**
PBIT	₹ 19.20 lakhs	= ₹ 19.20 lakhs + ₹ 8.40 lakhs − ₹ 4.80 lakhs = ₹ 22.80 lakhs

Value of Assets	₹ 96.00 lakhs	₹ 96.00 lakhs + ₹ 24.00 lakhs = ₹ 120.00 lakhs
ROT	= 20%	= 19%

Conclusion: There will be a decrease of 1% in ROI under the proposed dispensation.

(ix) Sab Ltd. fixes the inter-divisional transfer prices for its products on the basis of cost plus a return on investment in the division. The budget for division X for 2016-17 appears as under:

	₹
Fixed Assets	5,00,000
Current Assets	3,00,000
Debtors	2,00,000
Annual Fixed cost of the Division	8,00,000
Variable cost per unit of product	10
Budgeted Volume	4,00,000 units per year
Desired R.O.I	28%

Transfer price for division X is
(a) ₹ 12.70 (b) ₹ 10.70
(c) ₹ 8.70 (d) ₹ 14.70 **(2 Marks)**

Answer: (a) VC ₹ 10; FC per unit = ₹ 8,00,000 ÷ 4,00,000 = ₹ 2
Total Cost = 10 + 2 = ₹ 12

$$\text{Required Return} = \frac{₹10,00,000 \times 28\%}{4,00,000} = 0.70$$

∴ T.P. ₹ 12 + 0.70 = ₹ 12.70

PYQ 2018-Dec [1] (viii) {C} Choose the most appropriate answer to the following questions giving justification:
H Group has two divisions, Division P and Division Q. Division P manufactures an item that is transferred to Division Q. The item has no external market and 6000 units produced are transferred internally each year. The costs of each division are as follows:

	Division P	Division Q
Variable cost	₹ 100 per unit	₹ 120 per unit
Fixed cost each year	₹ 1,20,000	₹ 90,000

Head Office management decides that a transfer price should be set that provides a profit of ₹ 30,000 to Division P. What should be the transfer price per unit?

(a) ₹ 145 (b) ₹ 125
(c) ₹ 120 (d) ₹ 135 **(2 Marks)**

Answer: (b) Variable cost + (Fixed cost + Profit Desired) ÷ Volume = ₹ 100 + (1,20,000 + 30,000) ÷ 6,000 = ₹ 125/-

PYQ 2019-Dec [1] Choose the most appropriate answer to the following questions giving justification/reasonable workings:

(viii) Max Ltd. fixes the inter divisional transfer prices for its products on the basis of cost plus a return on investment in the division. The budget for division X for 2019-20 appears as under-

	₹
Fixed assets	5,00,000
Current assets	3,00,000
Debtors	2,00,000
Annual fixed cost of the division	8,00,000
Variable cost per unit of the product	10
Budgeted volume	4,00,000 units per year
Desired ROI	28%

Transfer price for division X is

(a) 12.70 (b) 10.70
(c) 8.70 (d) 14.70 **(2 Marks)**

Answer: (a)

	Per unit (₹)
VC	10.00
FC (₹8,00,000 ÷ 4,00,000)	2.00
Investment: (FA + CA + Debtors) = ₹10,00,000	
Return = $\frac{₹10,00,000 \times 0.28}{4,00,000}$	0.70
TP for Div. X	**12.70**

(x) A manufacturing company uses two types of materials, X and Y, for manufacture of a standard product. The following information is given:

	Standard mix			Actual mix		
Materials	X	120 Kg. @ ₹ 5	= ₹ 600	112 Kg. @ ₹ 5	= ₹	560
	Y	80 Kg. @ ₹ 10	= ₹ 800	88 Kg. @ ₹ 10	= ₹	880
		200	₹ 1,400	200	₹	1,440
30% loss		60		25% loss 50		
		140	₹ 1,400	150	₹	1,440

Direct Materials Mix Variance is:

(a) ₹ 40 (fav.)
(b) ₹ 40 (unfav.)
(c) ₹ 80 (fav.)
(d) ₹ 80 (unfav.) **(2 Marks)**

Answer: (b) A manufacturing company uses two types of Materials, X and Y, for manufactures of a standard product:

	Standard Mix		Actual mix	
Materials X	120 kg. @ ₹5 =	₹600	112 Kg.@₹5 =	₹560
Y	80 kg.@ ₹10 =	₹800	88 Kg. @₹10=	₹880
	200	₹1,400	200	₹1,440
30% loss	60		25% loss 50	
	140	₹1,440	150	₹1,440

Direct Materials Mix Variance is: ₹40 (unfav.)

		SP (SQ – AQ)
X	₹5 (120 – 112) =	₹40 (fav.)
Y	₹10 (80 – 88) =	₹80 (unfav.)
		₹40 (unfav.)

PYQ 2021-Dec [2] A manufacturing company has the following information pertaining to a normal monthly production of 10,000 units of a product. Standard factory overhead rates are based on a normal monthly volume of one standard direct hour per unit.

Standard factory overhead rates per direct labor hour are:

Fixed	₹ 6.00
Variable	₹ 10.00
	₹ 16.00

Units actually produced in current month	9,000 units
Actual factory overhead costs incurred (Includes ₹ 70,000 fixed)	₹ 156,000
Actual direct labor hours	9,000 hours

The variable overhead spending variance is

(1) ₹ 0
(2) ₹ 10,000 (F)
(3) ₹ 4,000 (F)
(4) ₹ 86,000 (A) **(1 Mark) [Sec. A - MCQ]**

Answer: (3) ₹ 4,000 (F)

PYQ 2022-Dec [1] (vi) {C} Choose the most appropriate answer to the following questions giving justification/reasonable workings:

RON Ltd., a manufacturer of product CEMO using a standard costing system provides the following information pertaining to the Direct Materials for the month of November, 2022:

1 tonne of material input yields standard output of (units)	1,00,000
Standard price of material per kg. (₹)	20
The Actual quantity of material used (Tonnes)	10
Actual price of material per kg. (₹)	21
Actual output obtained for the month (units)	9,00,000

Material cost variance will be—

(a) ₹ 40,000 (Adv) (b) ₹ 40,000 (Fav)
(c) ₹ 30,000 (Adv) (d) ₹ 25,000 (Adv) **(2 Marks)**

Answer: (c) Standard Material required per unit of output = 1 ton/1,00,000 = 1 × 1,000 kg/

1,00,000 = 1/100 kg.

For 9,00,000 units required = 9,00,000 × 1/100 kg = 9,000 kg.

Actual Quantity of Material used = 10 tons = 10,000 kg.

Material Cost Variance = (Standard Quantity for Actual Output × Standard Price) - (Actual Quantity × Actual Price)

= (9,000 × ₹ 20) - (10,000kg × ₹ 21)
= ₹ 1,80,000 - ₹ 2,10,000
= ₹ 30,000(A)

PYQ 2023-Jun [1] (viii) {C} Choose the most appropriate answer to the following questions with justification.

BOSAN LTD. using standard costing system provides the following information pertaining to Direct Labour for its product JUM for the month of May, 2023:

Standard Direct Labour Rate per hour:	₹ 16
Actual Direct Labour Rate per hour	₹ 14.50
Labour Rate variance	₹ 15,000 (Fav)
Standard hours allowed for Actual production	8,000 hours

Actual output is 800 units,

How many Direct Labour hours were worked during the month of May, 2023?

(a) 12,000 hours (b) 11,000 hours
(c) 10,000 hours (d) None of the above **(2 Marks)**

Answer: (c) 10,000 hours

PYQ 2023-Dec [1] (x) {C} Choose the correct option.

A Co. producing output X and Y uses standard costing. The standard overhead contents of each product is:

X: ₹ 3 per unit and Y: ₹ 2.25 per unit.

The budgeted overhead is ₹ 860 and budgeted time is 3,440 hours.

Actual Output:

X 200 units and Y 100 units.

Actual time: 3,200 hours

Actual overhead: ₹ 875. Compute Overhead Volume variance.

(a) ₹ 35 (A) (b) ₹ 35 (F)
(c) ₹ 25 (F) (d) ₹ 15 (A) **(2 Marks)**

Answer: (a) ₹ 35 (A)

PYQ 2024-Jun [1] (iii) {C} Choose the correct option from the four alternatives given:

BONAS Ltd. adopting a Standard Costing System provides the following information pertaining to Direct Materials for the month of April, 2024:

Standard price per unit	₹ 7.20
Actual quantity purchased in units	3,200

Standard quantity allowed for actual production in units	2,900
Material Price Variance on purchase (FAV)	₹ 960

What will be the actual purchase price per unit?

(a) ₹ 8.50 (b) ₹ 7.80
(c) ₹ 6.90 (d) ₹ 6.50 **(2 Marks)**

Answer: (c) ₹ 6.90

PYQ 2024-Dec [1] (v) {C} Choose the correct option from the four alternatives given:

In a factory where standard costing system is followed the production department consumed 1100 kgs of a material @ ₹ 8 per kg for product X resulting in material price variance of ₹ 2,200 (Fav) and material usage variance of ₹ 1,000 (Adv). What is the standard material cost of actual production of product X?

(a) ₹ 11,000 (b) ₹ 20,000
(c) ₹ 14,000 (d) ₹ 10,000 **(2 Marks)**

Answer: (d) 10,000

PYQ 2025-Jun [1] (xi) {C} Choose the correct option from the given alternatives:

In a factory where standard costing system is followed, the production department consumed 1,100 kgs. of material @ ₹ 8 per kg. for product X resulting in material price variance of ₹ 2,200 (Fav) and material usage variance of ₹ 1,000 (Adv). What is the standard material cost of actual production of product X?

(a) ₹ 11,000 (b) ₹ 20,000
(c) ₹ 14,000 (d) ₹ 10,000 **(2 Marks)**

Answer: (d) ₹10,000

2025-Dec [1] {C} Choose the correct option from the given alternatives:

(v) YEN Ltd., adopting Standard Costing System in its factory, budgets for fixed overhead of ₹50,000 and production of 10,000 units for a month of year 2025. Actual production is 9,500 units. If the fixed overhead cost is increased to ₹52,000, the fixed overhead volume variance will be

(a) ₹1,000 (Adv.) (b) ₹2,000 (Fav.)
(c) ₹2,500 (Fav.) (d) ₹2,500 (Adv.) **(2 Marks)**

Answer: (d) ₹2,500 (Adv.)

(xiii) Standard Cost and Budgeted Cost are
(a) interrelated but not interdependent.
(b) interdependent but not interrelated.
(c) interrelated and interdependent.
(d) None of the above **(2 Marks)**

Answer: (a) interrelated but not interdependent.

PYQ 2026-Jun [1] {C} Choose the correct option from the four alternatives given:

(v) AB Ltd.uses standard cost system. The following information pertains to direct labour for Product X for the month of March,2026:

Standard rate per hour	= ₹8
Actual rate per hour	= ₹8.40
Standard hours allowed for acual production	= 2,000 hours
Labour Efficiency variance	= ₹1,600 (Adverse)

What were the actual hours worked?

(a) 1,800 (b) 1,810
(c) 2,200 (d) 2,190 **(2 Marks)**

(xiii) Uniform Costing may not be successfully applied in the following case:
(a) In a single enterprise having a number of branches, each of which manufactures the same set of products with the same facilities
(b) In a number of entities in the same industry bound by a trade association
(c) In a number of units across different geographical locations manufacturing one or more of a given set of products
(d) In different branches of the same company, each branch making a different product using a unique process **(2 Marks)**

SECTION-B

01 *Variance Analyses*

THEORY QUESTIONS

TQ 1.1	PYQ	2018-Jun [4] (b)	DESC	4 Marks
What are the advantages of Inter-firm comparison?				

Answer:

Advantages of Inter-Firm Comparison:

Proper Inter-firm Comparison presents the following notable advantages:

1. There is no uncertainty in it as it is taken from a successful firm and as such, it helps the management to take corrective measures for its improvement in efficiency in near future.
2. Inter-firm comparison locates or points out the snags and weakness of the firm and thus assist the management to take all possible steps in order to improve the productivity of all factors which are directly connected.
3. It also helps the business world to run in the correct way.
4. This Comparison helps the Government to regulate the prices of the commodity in the country.
5. Since the data are collected and presented by the central agency/body, bias is absent.
6. Inter-firm Comparison develops the cost consciousness amongst its members since various ratios are known.
7. Inter-firm Comparison presents not only the difference between the two firms, it also explains the reasons for such difference and suggest the possible remedies for its improvement both for liquidity and profitability aspect of the firms.

TQ 1.2	PYQ	2018-Jun [8] (c)	SN	4 Marks
Write a short note on the following: Treatment of Variances in cost accounts				

Answer:

When the actual cost differs from the standard cost, it is called variance. If the actual cost is less than the standard cost or the actual profit is higher than the standard profit, it is called **favorable variance.** On the contrary, if the actual cost is higher than the standard cost or profit is low, then it is called **adverse variance.**

Each element of cost and sales requires variance analysis. Variance is classified as follows:

- Direct Material Variance
- Direct Labor Variance
- Overhead Variance
- Sales Variance

TQ 1.3	PYQ	2019-Jun [8] (a)	SN	4 Marks
Write short notes of the following: Principal Budget Factor				

Answer:

Principal Budget Factor:

The principal budget factor is the factor that limits the activities of functional budgets of the organisation.

The early identification of this factor is important in the budgetary planning process because it indicates which budget should be prepared first. In general sales volume is the principal budget factor. So, sales budget must be prepared first, based on the available sales forecasts. All other budgets should then be linked to this.

Failure to identify the principal budget factor at an early stage could lead to delays later on when managers realize that the targets they have been working with are not feasible.

In case of one limiting factor, we shall need to apply the concept of Marginal costing. In this we initially allot the limiting resource on the basis of highest contribution per limiting factor.

Principa Budget Factor is important concept in the process of budgetary control. This is the factor the extent of whose influence must first assessed in order to ensure that the functional budgets are reasonably capable of fulfillment. A budget key factor or principal budget factor is described as - The factor which at a particular time or over a period which limit the activities of an undertaking.

The limiting factor is usually the level of demand for the products or services of the undertaking but it could be a shortage of one of the productive resources, e.g., skilled labour, raw material or machine capacity. In order to ensure that the functional budgets are reasonably capable of fulfillment the extent of the influence of this factor must first be assessed.

TQ 1.4	PYQ	2019-Jun [8] (e)	SN	4 Marks
Write a short note on the following: Activity Ratio				

Answer:

Activity Ratio:

It is the number of standard hours equivalent to the work produced, expressed as a percentage of the budgeted standard hours.

$$\text{Activity Ratio} = \frac{\text{Standard Hours for Actual Work}}{\text{Budgeted Standard hours}} \times 100$$

Activity ratios gauge an organization's operational efficiency and profitability. These ratios are most useful when compared to a competitor or industry to establish whether an entity's processes are favourable or unfavourable. Activity ratios can form a basis of comparison across multiple reporting periods to determine changes over time.

CASE-SCENARIO QUESTIONS

CSQ 1.1	PYQ	2015-Dec [9] (c)	2 Marks
The budgeted fixed overhead for the year 2015 amounted to ₹ 14,400. It is anticipated that 288 days would be worked during the year. During the month of February, 2015 only 20 days were worked. Find out Calendar Variance.			

Answer:

Standard working days per month = 288 ÷ 12 = 24 days

Calendar variance = (Std. No. of working days – Actual no. of working days) × (Total fixed OH in the budgeted period ÷ Std. No. of days in the budgeted period)

= (24 – 20) × ₹ 14,400/288

= ₹ 200 (A)

CSQ 1.2	PYQ	2015-Dec [9] (d)	6 Marks
From the following data you are required to compute: (i) Labour Rate Variance; (ii) Efficiency Variance; (iii) Idle Time Variance; and (iv) Total Variance.			

Standard time per unit	2.5 hours
Actual hours worked	2,000 hours
Standard rate of pay	₹ 2 per hour
25% of the actual hours have been lost as idle time	
Actual output	1,000 units
Actual wages	₹ 4,500

Answer:

Std. Labour cost charged to production = 1,000 units × 2.5 hours × ₹ 2
= ₹ 5,000

Actual wages rate per hour = ₹ 4,500 ÷ 2,000 hours
= ₹ 2.25

Abnormal idle time = 25% of 2,000 hours
= **500 hours**

Computation of Variances:

(i) Rate Variance = Actual time × (Std. Rate – Actual Rate)
= 2,000 hours × ₹ (2 – 2.25)
= ₹ 500 (A)

(ii) Efficiency Variance = Std. Rate × (Std. Time for actual output – Actual time less idle time)
= ₹ 2 × hrs. (2,500 – 1,500)
= ₹ 2,000 (F)

(iii) Idle Time Variance = Idle time × Std. rate
= 500 hrs. × ₹ 2 = ₹ 1,000 (A)

(iv) Total Variance = Std. Labour Cost – Actual Labour Cost
= ₹ (5,000 – 4,500)
= ₹ 500 (F)

CSQ 1.3	PYQ	2016-Jun [8] (a)	3 Marks

1 ton of material input yields standard output of 1,00,000 units. The standard price of material is ₹ 20 per kg. The actual quantity of material used is 10 tons and the actual price paid is ₹ 21 per kg. Actual output obtained is 9,00,000 units.
Compute Material Cost Variance.

Answer:

Standard Material required per unit of output = 1 ton/1,00,000 = 1×1,000 kg/ 1,00,000 = 1/100 kg.
For 9,00,000 units required = 9,00,000 × 1/100 kg = 9,000 kg.
Actual Quantity of Material used = 10 tons = 10,000 kg.
Material Cost Variance =
(Standard Quantity for Actual Output × Standard Price) - (Actual Quantity × Actual Price)
= (9,000 × ₹ 20) - (10,000kg × ₹ 21)
= ₹ 1,80,000 - ₹ 2,10,000
= ₹ 30,000 (A)

CSQ 1.4	PYQ	2018-Jun [3]	13 Marks

An Engineering Co. manufactures a single product whose standard cost structure is as follows:

	₹
Direct materials: 2.4kg at ₹ 30 per kg	72.00
Direct Labour: 6 hours at ₹ 4 per hour	24.00
Factory Overheads: 6 hours at 0.75 per hour	4.50
Total	100.50

The factory overheads are based on the following flexible budget:

Capacity	80%	90%	100%	100%
Production (units)	6,000	6,750	7,500	8,250
Overheads (₹)	29,250	3,150	33,750	36,000

Actual data for the month of January, 2018:

Budgeted production	7,500 units
Materials used	19,240 kg at ₹ 31 per kg
Direct labour	46,830 hours at ₹ 4.20 per hour
Actual factory overheads	₹ 36,340
Production completed	7,620 units

Details of Work-in Progress:

Opening:	120 units, materials fully supplied, 50% converted.
Closing:	100 units, materials fully supplied, 50% converted.

Required:

(i) Effective or Equivalent Production for each element of cost.
(ii) Calculate:
(a) Material variances (cost, price and usage)
(b) Labour variances (cost, rate of pay and efficiency)
(c) Overhead variances (expenditure and volume variance, efficiency and capacity variance)

Answer:

(i) **Statement of Equivalent Production**

	Units	Material		Labour and Overheads	
		%	Units	%	Units
Opening Work-in-Progress	120	---	---	50	60

Completely Processes during the month	7,500	100	7,500	100	7,500
Closing Work-in-Progress	100	100	100	50	50
	7,720		7,600		7,610

Some required data (computed)

Material:

Standard Quantity: 7,600 @ 2.40 kg = 18,240 kg

Standard Value: 18,240 kg @ ₹ 30 = ₹ 5,47,200

Labour:

Standard Hours: 7,610 @ 6 hours = 45,660 hours

Standard Wages: 45,660 @ ₹ 4 per hour = ₹ 1,82,640

Standard Production = $\frac{\text{Actual Hours}}{\text{Standard Hours Per Unit}} = \frac{46,830}{6}$ = 7,805 Unit

Budgeted Production = 7,500 Units

Standard Rate Per Unit = $\frac{\text{Budgeted Overheads}}{\text{Budgeted Production}} = \frac{₹33,750}{7,500}$ = ₹ 4.5

Standard Overheads (or overheads recovered) = 7,610 @ ₹ 4.50 = ₹ 34,245

Actual Cost of Materials: 19,240 kg @ ₹ 31 = ₹ 5,96,440

Actual Wages: 46,830 hr @ ₹ 4.20 = ₹ 1,96,686

(ii) **Statement of Variances**

(a) Material Cost Variance: (SC - AC) = (₹ 5,47,200 - 5,96,440) = ₹ 49,240(A)

Which can be analyzed into:

(a) Material Price Variance: (SP - AP) AQ = (30 - 31) x 19,240 = ₹ 19,240 (A)

(b) Material usage Variance: (SQ - AQ) SP = (18,240 - 19,240) x ₹30 = ₹30,000 (A)

(b) Labour Cost Variance: (SC - AC) = (₹ 1,82,640 - 1,96,686) = ₹ 14,046 (A)

which can be further analyzed as follows:

(a) Rate variance: (SR - AR) AT = (4.00 - 4.20) x 46,830 = ₹ 9,366 (A)

(b) Efficiency Variance: (AP - SP) SR = (7,610 - 7,805) x ₹ 24 = ₹ 4,680 (A)

(c) Factory O.H. Cost Variance: Std. O.H. - Actual O.H. = ₹34,245 - 36,340 = ₹2,095 (A)

which can be analyzed as follows:

(a) Expenditure or Budgeted Variance: Budgeted O.H. - Actual O.H. ₹ 33,750 - 36,340 = ₹ 2,590 (A)

(b) Volume Variance: SR (AP - BP) = ₹ 4.5 (7,610 - 7,500) = ₹ 495 (F)

Volume Variance can be further divided as follows:

1. Efficiency Variance: SR (AP - SP) = ₹ 4.50 (7,610 - 7,805) = ₹ 877.50 (A)
2. Capacity Variance: SR (SP - BP) = ₹ 4.50 (7,805 - 7,500) = ₹ 1372.50 (F)

CSQ 1.5	PYQ	2018-Dec [5] (a)	10 Marks

One kilogram of product 'K' requires two chemicals A and B. The following were the details of product 'K' for the month of June 2018:

(i) Standard mix ratio is 1: 1

(ii) Standard price per kilogram of chemical 'A' ₹ 12 and chemical 'B' ₹15

(iii) Actual input of chemical 'B' 70 kilograms

(iv) Actual price per kilogram of Chemical 'A' ₹ 15

(v) Standard normal loss 10% of total input

(vi) Materials cost variance total ₹ 650 adverse and the same was fully attributable to Chemical 'B'

(vii) Materials yield variance total ₹ 135 adverse*Required:*

Compute all missing variances and complete the Variance Report

Answer:

	SPSQ	SPRSQ	SPAQ	AQAP
A	12*?	12*?	12*?	?*15
B	15*?	15*?	15*70	70*?

1. Let the total actual input be X kgs. Therefore applying the Standard Mix Ratio, the Revised Standard Quantity of Chemicals A and B each would be 0.5 kgs.

2. Total YIELD VARIANCE of 135 adverse can be split according to the ratio of SPSQ. Since inputs are equal the ratio will be that of price i.e. 4:5. Hence YIELD VARIANCE of A is 60 Adverse and B is ₹ 75 Adverse. Substituting yield variance we get SQ of A & B each as 50 kgs.
   A = 12*(SQ – 0.5X) = -60 SQ-0.5X = .5 SQ = 0.5X-5
   Similarly for B SQ = 0.5X-5
3. Total actual input = X kgs.: Actual input of A = (X-70)
4. Material Cost Variance of A = Nil (i.e. SPSQ - AQAP) = 0
   i.e., 12*(05.X-5) – 15*(X-70)
   Solving this X = 110

Therefore, Revised Standard Quantity of A and B each is 55 kg and Standard Quantity of A and B each is 50 Kgs.
Material Cost Variance of B = ₹ 650 Adverse
i.e. (15*50) – 70*AP = -650
∴ 750 – 70AP = -650, 70AP = 1,400, AP = 20

The final variance report is as follows:

	SPSQ	SPRSQ	SPAQ	AQAP
A	600	660	480	600
B	750	825	1,050	1,400
Total	1,350	1,485	1,530	2,000

	Yield	Mix Variance	Usage Variance	Price Variance	Cost Variance
A	60A	180F	120F	120A	0
B	75A	225A	300A	350A	650A
Total	135A	45A	180A	470A	650A

CSQ 1.6	PYQ	2019-Jun [4] (b)	8 Marks

Fifteen workers (10 Type I workers and 5 Type II Workers) work in a production process during a month of 25 working days. Each Type I worker is expected to produce 8 units per day and Type II worker is expected to produce 12 units per day. They work on the regular shift from 9:00 a.m. to 5 p.m. and have a tea break between 10:30 to 10:45 a.m. and 3:00 to 3:15 p.m. and also have a lunch break from 1:00 to 1.30 p.m. The actual production was 1,800 units by Type I workers and 1,200 units by Type II workers. The standard wage rate per hour were ₹ 50 and ₹ 60 for Type I and Type II workers, respectively and corresponding actuals were 60 and 70, respectively. During the month, 16 hours were lost actually for both types of workers, which is also as per expectation for waiting for materials and inspection.

Required:

Calculate the following:

(i) Standard labour cost for the month
(ii) Labour cost variance
(iii) Labour efficiency variance
(iv) Idle time variance

Indicate (A) or (F) to denote whether the variances are adverse or favourable.

Answer:

	Type I	Type II	Total
Available/m (hrs)	10 workers x 25 days/m x 8 hrs/day (bet 9 to 5) = 2,000hrs	5 workers x 25 days/m x 8hrs/day = 1,000hrs	
Units per day per worker	8	12	
Hours/unit	8/8 = 1 hr/u	8 hrs/12 units = 2/3 = 0.67 hrs/unit	
Actual production (u)	1,800	1,200	
Std hrs for actual production	1,800 x 1 = 1,800	1,200x2/3 = 800	
Standard rate/hr	50	60	
Std cost of production	1,800x50 = 90,000	800 x 60 = 48,000	1,38,000
Actual hours paid	2,000 hours	1,000 hrs	
Actual rate	60	70	
Actual cost	1,20,000	70,000	1,90,000
Labour cost variance			52,000(A)
Efficiency variance	(1,800-2,000)x50 = 10,000(A)	(800-1,000)x60 = 12,000(A)	22,000(A)

Idle time variance (Since normal waiting and break are included in standard labour hours)	Nil	Nil	

(Standard production hours per day = 8 (normal breaks and waiting time have to be include in the standard)
No. of days per month = 25.
Standard hours per month = 25 x 8 = 200 hours per worker x 10 workers = 2,000 hours.)

CSQ 1.7	PYQ	2021-Dec [7]	1 Mark

A factory is trying to establish standard time for a certain job. Workers arrive at 8:00 am, during the day take tea and lunch breaks for 1 ½ hours, machines need set up for ½ an hour and workers leave by 4 p.m A worker can ideally produce a unit of output if he is at his job for two hours. How much is the standard labour hour per unit?

[Sec. B - SAQ]

Answer:

Workers arrive at 8:00 a.m. and leave at 4:00 p.m.

- Total time at the job: 4:00 p.m. - 8:00 a.m. = 8 hours
- Tea and lunch breaks: 1.5 hours
- Machine setup time: 0.5 hours
- Total non-productive time: 1.5 hours + 0.5 hours = 2 hours
- Productive time in a day = Total working hours - Total non-productive time
- Productive time in a day = 8 hours - 2 hours
- Productive time in a day = 6 hours
- A worker can ideally produce a unit of output if he is at his job for 2 hours.
- Standard labour hour per unit = Productive time in a day / Number of units produced in a day
- Number of units produced in a day = Productive time in a day / Time to produce one unit
- Number of units produced in a day = 6 hours / 2 hours per unit

- Number of units produced in a day = 3 units
- Standard labour hour per unit = Total working hours / Number of units produced in a day
- Standard labour hour per unit = 8 hours / 3 units
- Standard labour hour per unit ≈2.67 hours

Conclusion:

The standard labour hour per unit for the factory job is approximately 2.67 hours.

CSQ 1.8	PYQ	2021-Dec [1]	8 Marks

ST Ltd. uses a standard costing system. The following data relating to a single product for the month of September has been furnished to you. The Standard cost per unit was:
Direct Material: Standard Price ₹ 10 per kg, Standard quantity 20 kgs per unit
Direct Labour: Standard Rate of pay ₹ 5.50 per hour, Standard Time 12 hours per unit
Production OH Costs, all classified as fixed, were budgeted at ₹ 9,00,000 p.a. The standard time for producing one unit is 12 machine hours and normal capacity is 60,000 machine hours p.a. Production OH is absorbed on
machine hours. The costs incurred and other relevant information for the month is given below:
Direct Material used-1,00,000 kgs at a cost of ₹ 10,50,000
Direct Wages paid- ₹ 3,10,000 for 62,000 hours
Production Overhead- ₹ 9,26,000
Machine capacity used-60,000 hours
Actual output-4,800 units. Assume no stocks of WIP or Finished Goods at the year end.

(i) The standard product cost for one unit is
(ii) Variance for Material (Usage and Price) are
(iii) Variance for Labour (Rate and Efficiency) are:
(iv) Variance for Fixed OH (Volume and Expenditure) are

[Sec. C - Four LAQ]

Answer:

1. **Direct Material Cost:**
   - Standard Price 10 per kg.
   - Standard Quantity 20 kgs per unit
   - Standard Direct Material Cost = Standard Price x Standard Quantity
   - Standard Direct Material Cost = 10 x 20 = 200
2. **Direct Labour Cost:**
   - Standard Rate of Pay: 5.50 per hour
   - Standard Time: 12 hours per unit
   - Standard Direct Labour Cost = Standard Rate of Pay x Standard Time
   - Standard Direct Labour Cost = 5.50 x 12 = 66
3. **Production Overhead Cost:**
   - Budgeted Production Overhead Costs: 9,00,000 per annum
   - Normal Capacity: 60,000 machine hours per annum
   - Standard Time for Producing One Unit: 12 machine hours
   - Overhead Absorption Rate = Budgeted Production Overhead Costs / Normal Capacity
   - Overhead Absorption Rate = 9,00,000 / 60,000 = 15 per machine hour
   - Standard Production Overhead Cost = Overhead Absorption Rate x Standard Time for Producing One Unit
   - Standard Production Overhead Cost = 15 x 12 = 180
4. **Standard Product Cost:**
   - Standard Product Cost per Unit = Standard Direct Material Cost + Standard Direct Labour Cost + Standard Production Overhead Cost
   - Standard Product Cost per Unit = 200 + 66 + 180 = 446

Material Variances

1. **Material Usage Variance:**
   - Standard Quantity for Actual Output = Standard Quantity x Actual Output
   - Standard Quantity for Actual Output = 20 kgs x 4,800 units = 96,000kgs
   - Actual Quantity Used: 1,00,000 kgs

   - Material Usage Variance = (Actual Quantity Used - Standard Quantity for Actual Output)x Standard Price
   - Material Usage Variance = (1,00,000 - 96,000) x 10 = 4,000 x 10 = 40,000 (Adverse)
2. **Material Price Variance:**
   - Actual Quantity Used: 1,00,000 kgs
   - Standard Price: 10 per kg.
   - Actual Cost Incurred: 10,50,000
   - Material Price Variance = (Actual Cost Incurred - (Actual Quantity Used x Standard Price))
   - Material Price Variance = 10,50,000 - (1,00,000 x 10) = 10,50,000 - 10,00,000 = 50,000 (Adverse)

Labour Variances

1. **Labour Efficiency Variance:**
   - Standard Hours for Actual Output = Standard Time x Actual Output
   - Standard Hours for Actual Output = 12 hours x 4,800 units = 57,600 hours
   - Actual Hours Worked: 62,000 hours
   - Standard Rate of Pay: 5.50 per hour
   - Labour Efficiency Variance = (Actual Hours Worked - Standard Hours for Actual Output) x Standard Rate of Pay
   - Labour Efficiency Variance = (62,000 - 57,600) x 5.50 = 4,400 x 5.50 = 24,200 (Adverse)
2. **Labour Rate Variance:**
   - Actual Hours Worked: 62,000 hours
   - Standard Rate of Pay: 5.50 per hour
   - Actual Labour Cost Incurred: 3,10,000
   - Labour Rate Variance = Actual Labour Cost Incurred - (Actual Hours Worked x Standard Rate of Pay)
   - Labour Rate Variance = 3,10,000 - (62,000 x 5.50) = 3,10,000 - 3,41,000 = 31,000 (Favorable)

Fixed Overhead Variances

1. **Fixed Overhead Volume Variance:**
   - Standard Hours for Actual Output = 57,600 hours

- Budgetec Hours: 60,000 hours
- Overhead Absorption Rate: 15 per machine hour
- Fixed Overhead Volume Variance = (Standard Hours for Actual Output - Budgeted Hours) × Overhead Absorption Rate
- Fixed Overhead Volume Variance = (57,600 - 60,000) × 15 = (2,400) × 15 = 36,000 (Adverse)

2. **Fixed Overhead Expenditure Variance:**
   - Budgeted Fixed Overhead Cost: 9,00,000 per annum
   - Actual Fixed Overhead Cost: 9,26,000
   - Fixed Overhead Expenditure Variance = Budgeted Fixed Overhead Cost - Actual Fixed Overhead Cost
   - Fixed Overhead Expenditure Variance = 9,00,000 - 9,26,000 = 26,000 (Adverse)

CSQ 1.9	PYQ	2022-Dec [4] (a)	5+4+3=12 Marks

The budgeted output of SAB Ltd., a single product manufacturing company for the year ending 31st March was 5,000 units. The financial results in respect of the actual output of 4,800 units achieved during the year were as under:

	₹
Direct Material	29,000
Direct Wages	45,000
Variable Overheads	72,500
Fixed Overheads	40,000
Profit	37,000
Sales	2,23,500

The standard wage rate is ₹4.50 per hour and the standard variable overhead rate is ₹7.50 per hour.

The cost accounts recorded the following variances for the year:

Variances	Favourable (₹)	Adverse (₹)
Material price		70
Material usage		130
Wage rate	450	
Labour efficiency		2,250
Variable overheads expenses	3,000	
Variable overhead efficiency		3,500
Fixed overhead expenses		2,500
Selling price	7,500	

Required:

(i) Prepare the standard product cost sheet per unit.

(ii) Compute the Fixed Overhead volume variance, Sales volume variance, Sales price variance and Standard profit for the year.

(iii) Prepare a statement showing the reconciliation of Standard profit and the Actual profit.

Answer:

(i) Standard Material Cost per Unit: = ₹ 6
Standard Wage rate per Unit: = ₹ 9
Standard Variable overhead per unit: = ₹ 15
Standard Fixed overhead rate per Unit: = ₹ 7.50

(ii) Fixed overhead Volume Variance: ₹ 1,500 (Adv.)
Sales Volume Variance: = ₹ 9,000 (Adv.)
Sales Price Variance: = ₹ 7,500 (Fav)
Standard Profit: = ₹ 36,000

(iii) Statement Showing Reconciliation of the Standard Profit and the Actual Profit:

		₹
Standard Profit		36,000
Add: Sales Price Variance (Favourable)		7,500
		43,500
Add: Favourable Cost Variances:		
Wages Rate Variance	450	
Variable overhead expenses	3,000	3,450
Less: Adverse Cost Variances		46,950
Material price	70	
Material usage	130	
Labour efficiency	2,250	
Variable overhead efficiency	3,500	

Fixed overhead Expense	2,500	8,450
		38,500
Less: Fixed overhead volume variance (Adverse)		1,500
Actual Profit		37,000

CSQ 1.10	PYQ	2023-Jun [5] (a)	8 Marks

Director-Operations of ABC Ltd.(ABCL) is of the view that Standard Costing has little to offer in the reporting of material variances due to frequently change in price of materials.

ABCL can utilize one of two equally suitable raw materials and always plan to utilize the raw material which will lead to cheapest total production costs. However ABCL is frequently trapped by price changes and the material actually used often provides, after the event, to have been more expensive than the alternative which was originally rejected.

During last accounting period, to produce a unit of 'Gama', ABCL could use either 5 kg. of 'Exe' or 5 kg. of 'Wye'. ABCL planned to use 'Exe' as it appeared it would be cheaper of the two and plans were based on a cost of 'Exe' of ₹ 3 per kg. Due to market movements the actual price changed and if ABCL had purchased efficiently the cost would have been:

'Exe' ₹ 4.50 per kg.

'Wye' ₹ 4 per kg.

Production of 'Gama' was 1,000 units and usage of 'Exe' amounted to 5,400 kg at a total cost of ₹ 25,920.

Calculate the material variance for 'Gama' by:

(i) Traditional Variance analysis and

(ii) An approach which distinguishes between Planning and Operational Variances.

Answer:

Traditional Variance:

Total Cost variance = ₹ 10,920 (A)

Operational Variance:

Total Cost variance = ₹ 3,420 (A)

Planning Variance:

Total variance = ₹ 7,500 (A)

Traditional Variance

Operational variance + Planning variance

₹ 3,420(A) + ₹ 7,500(A)

= ₹ 10,920 (A)

CSQ 1.11	PYQ	2023-Jun [5] (b)	4 Marks

SUZIN LTD. using a detailed system of standard costing finds that the cost of investigation of variances is ₹ 20,000. If after investigation an out of control situation is discovered, the cost of correction is ₹ 30,000. If no investigation is made, the present value of extra cost involved is ₹ 1,50,000. The probability of the process being in control is 0.82 and the probability of the process being out of control is 0.18.

You are required to advise:

(I) Whether investigation of the variances should be undertaken or not

(II) the probability at which it is desirable to institute investigation into variance.

Answer:

(i) Total Cost of investigate = ₹ 25,400

Cost of not to investigate = ₹ 27,000

Since cost when investigation is undertaken is less than the cost of no Investigation it should be done.

(ii) Probability at which Investigation into Variance should be instituted

Finding out the probability at which both costs are equal.

Let x be the probability of process being in control.

∴ 1 – x is probability of process being out of control

Equating two costs:

50,000 – 30,000 x = 1,50,000 — 1,50,000 x

1,20,000 x = 1,00,000 or x = 0.833

At the probability level of 0.83 (Process-in-Control), both costs are equal. As this probability level declines, the cost of not investigating will be greater than cost of Investigating. If probability level is anywhere below 0.83, investigation should be instituted.

CSQ 1.12	PYQ	2023-Dec [5]	14 Marks

DOTSON Ltd. has a manufacturing division which makes a product to which the following details relate:

	Per unit (₹)
Direct Material: 5 kg at ₹ 20	100
Direct labour: 12 hours at ₹ 20	240
Variable overheads: 12 hours at ₹ 10	120

Relevant fixed overheads are based at ₹ 1,00,000 per month and planned output is 2,000 units per month. The selling price is ₹ 550 per unit. During a recent month, when output was 1,800 units, the following actual cost were incurred.

	₹
Direct materials (8,500 kg)	1,72,000
Direct labour (20,000 hours)	4,20,000
Variable overhead	2,20,000
Fixed overhead	98,000
	9,10,000
Profit	40,000
Sales Value	9,50,000

Required:

(a) Analyse the variances which occurred during the month.

(b) Reconcile the actual profit with standard profit, showing the causes of differences.

Answer:

(a) **Computation of Variance**

(i)	Material Price Variance =	2,000 (Adv)
(ii)	Material Usage Variance =	10,000 (FAV)
(iii)	Wage Usage Variance =	20,000 (Adv)
(iv)	Wage Efficiency Variance =	32,000 (Fav)
(v)	Variable Overhead expenditure Variance =	20,000 (Adv)
(vi)	Variable overhead efficiency Variance =	16,000 (Fav)
(vii)	Fixed overhead expenditure Variance =	2,000 (Fav)
(viii)	Fixed overhead Capacity Variance =	16,667 (Adv)

(ix)	Fixed overhead efficiency Variance =	6,667 (Fav)
(x)	Sales Margin price Variance =	40,000 (Adv)
(xi)	Sales Margin Volume variance =	8,000 (Adv)

(b) **Reconciliation of Profit.**

	₹
Budgeted Profit	80,000
Add: Favorable Variances:	66,667
Less: Adverse variances:	(1,06,667)
Actual Profit (for the period):	40,000

Variance Analysis and Profit Reconciliation for DOTSON Ltd.

Step 1: Calculate Variances

Material Price Variance

Actual Cost of Materials: ₹ 1,72,000

Standard Cost of Materials: 8,500 kg * ₹ 20 = ₹ 1,70,000

Variance: ₹ 1,72,000 - ₹ 1,70,000 = ₹ 2,000 (Adverse)

Material Usage Variance

Actual Usage: 8,500 kg

Standard Usage: 1,800 units * 5 kg = 9,000 kg

Variance: (9,000 kg - 8,500 kg) * ₹ 20 = ₹ 10,000 (Favorable)

Wage Usage Variance

Actual Labor Cost: ₹ 4,20,000

Standard Labor Cost: 20,000 hours * ₹ 20 = ₹ 4,00,000

Variance: ₹ 4,20,000 - ₹ 4,00,000 = ₹ 20,000 (Adverse)

Wage Efficiency Variance

Actual Hours: 20,000 hours

Standard Hours: 1,800 units * 12 hours = 21,600 hours

Variance: (21,600 hours - 20,000 hours) * ₹ 20 = ₹ 32,000 (Favorable)

Variable Overhead Expenditure Variance

Actual Variable Overhead: ₹ 2,20,000

Standard Variable Overhead: 20,000 hours * ₹ 10 = ₹ 2,00,000

Variance: ₹ 2,20,000 - ₹ 2,00,000 = ₹ 20,000 (Adverse)

Variable Overhead Efficiency Variance

Actual Hours: 20,000 hours

Standard Hours: 21,600 hours

Variance: (21,600 hours - 20,000 hours) * ₹ 10 = ₹ 16,000 (Favorable)
Fixed Overhead Expenditure Variance
Actual Fixed Overhead: ₹ 98,000
Budgeted Fixed Overhead: ₹ 1,00,000
Variance: ₹ 1,00,000 - ₹ 98,000 = ₹ 2,000 (Favorable)

Fixed Overhead Efficiency Variance

Standard Hours: 21,600 hours
Actual Hours: 20,000 hours
Variance: (21,600 hours - 20,000 hours) * (1,00,000 / 24,000) = ₹ 6,667 (Favorable)

Sales Margin Price Variance

Actual Sales: 1,800 units * ₹ 550 = ₹ 9,90,000
Standard Sales: 1,800 units * ₹ 550 = ₹ 9,90,000
Variance: (Sales Price - Standard Price) * Actual Units Sold = ₹ 9,50,000 - ₹ 9,90,000 = ₹ 40,000 (Adverse)

Sales Margin Volume Variance

Actual Units Sold: 1,800
Budgeted Units: 2,000
Variance: (2,000 - 1,800) * (₹ 550 - Total Cost per Unit) = ₹ 8,000 (Adverse)

CSQ 1.13	PYQ	2024-Jun [5] (a)	7 Marks

Eighteen workers (12 Type I workers and 6 Type II workers) work in a production process of RONT Ltd. during a month of 25 working days. Each Type I worker is expected to produce 8 units per day and Type II worker is expected to produce 10 units per day. They work on the regular shift from 9:00 a.m. to 5:00 p.m. and have a tea break between 10:30 to 10:45 a.m. and 3:00 to 3:15 p.m. and also have a lunch break from 1:00 to 1:30 p.m. The actual production was 2,000 units by Type I workers and 1,200 units by Type II workers. The standard wage rate per hour were ₹ 80 and ₹ 90 for Type I and Type II workers respectively and corresponding actuals were ₹ 90 and ₹ 100 respectively. During the month, 16 hours were lost actually for both types of workers, which is also as per expectation for waiting for materials and inspection.

Note: Normal waiting and breaks time are included in standard hours for production.
Required:
Analyze and calculate the following:
(i) Standard Labour Cost for the month
(ii) Labour Cost Variance
(iii) Labour Efficiency Variance
(iv) Idle Time Variance

Answer:

Statement for Calculation of Labour Variances

Type	Standard for Standard Output		Standard for Actual Output		Actual for Actual Output				
	I = 2,400 units, II = 1,500 units		I = 2,000 units, II = 1,200 units		I = 2,000 units, II = 1,200 units				
	Hours	Rate	Amount	Hours	Rate	Amount	Hours	Rate	Amount
I	12×8×25= 2,400	80	1,92,000	2,000	80	1,60,000	2,400	90	2,16,000
II	6×8×25 = 1,200	90	1,08,000	960	90	86,400	1,200	100	1,20,000
Total	3,600		3,00,000	2,960		2,46,400	3,600		3,36,000

1. Standard Labour Cost for Type I = ₹ 1,60,000 and
   Type II = ₹ 86,400.
   Total = ₹ 2,46,400
2. Labour Cost Variance
   Type I = ₹ 1,60,000 – ₹ 2,16,000 = ₹ 56,000 (A)
   Type II = ₹ 86,400 – ₹ 1,20,000 = ₹ 33,600 (A)
   Total = ₹ 89,600 (A)
3. Efficiency Variance
   Type I = (2,000 – 2,400) × 80 = ₹ 32,000 (A)
   Type II = (960 – 1,200) × 90 = ₹ 21,600 (A)
   Total = ₹ 53,600 (A)

	Type I	Type II	Total (₹)
Std. Labour Cost (₹)	1,60,000	86,400	2,46,400
Labour Cost Variance (₹)	56,000 (A)	33,600 (A)	89,600(A)
Efficiency Variance (₹)	32,000 (A)	21,600 (A)	53,600 (A)
Idle Time Variance ** (₹)	Nil	Nil	0

** Since normal waiting and break are included in standard hours of production

CSQ 1.14	PYQ	2024-Jun [5] (b)	7 Marks

ZOSIN Ltd., a manufacturing company using the budgetary control and standard costing system, has furnished the following information:

Standard overhead absorption rate per unit	₹ 20
Standard rate per hour	₹ 4
Budgetec production	12,000 units
Actual production	15,560 units
Actual working hours	74,000

Actual overheads amounted to ₹ 2,95,000 out of which ₹ 62,500 are fixed.
Overheads are based on the following flexible budget:

Production (units)	Total overheads (₹)
8,000	1,80,000
10,000	2,10,000
14,000	2,70,000

Required:
Analyze and calculate the following overheads variances on the basis of hours:
(i) Variable Overhead Efficiency variance
(ii) Variable Overhead Expenditure variance
(iii) Fixed Overhead Efficiency variance
(iv) Fixed Overhead Capacity variance

Answer:

Standard Rate per hour = ₹ 4
Standard Overhead (OH) Rate per Unit = ₹ 20
Standard Hours per Unit = $\frac{20}{4}$ = 5 hours/unit
Budgeted Production = 12,000 units
Budgeted Hours = 12,000 × 5 = 60,000 hours
Actual Production = 15,560 units
Standard Hours = 15,560 × 5 = 77,800 hours

Actual Fixed OH = ₹ 62,500
Actual Variable OH = ₹ 2,95,000 - ₹ 62,500 = ₹ 2,32,500
Actual Variable OH Rate per hour = 2,32,500/74,000 = ₹ 3.1418918
Standard Variable Rate per unit = $\frac{2,70,000 - 1,80,000}{14,000 - 8,000}$

$= \frac{90,000}{6,000}$ = ₹ 15 per unit

Budgeted Fixed OH = ₹ 1,80,000 - (8,000×15) = ₹ 60,000
Standard Fixed OH Rate per hour = $\frac{₹60,000}{60,000}$ = ₹ 1per hour
Standard Variable OH Rate per hour = $\frac{₹15}{5}$ = ₹ 3 per hour

1. Variable OH Efficiency Variance = (77,800 - 74,000) × 3
   = ₹ 11,400 (F)
2. Variable OH Expenditure Variance = (3 - 3.1418918) × 74,000
   = ₹ 10,500 (A)
3. Fixed OH Efficiency Variance = (77,800 - 74,000) × 1
   = ₹ 3,800 (F)
4. Fixed OH Capacity Variance = (74,000 - 60,000) × 1
   = ₹ 14,000 (F)

(i) Variable Overhead Efficiency Variance = ₹ 11,400 (F)
(ii) Variable Overhead Expenditure Variance = ₹ 10,500 (A) or ₹ 10,501 (A)
(iii) Fixed Overhead Efficiency Variance = ₹ 3,800 (F)
(iv) Fixed Overhead Capacity Variance = ₹ 14,000 (F)

CSQ 1.15	PYQ	2024-Dec [5]	14 Marks

GINTECH Ltd., a manufacturing company using the budgetary control and standard costing system, manufactures a product for which the standard selling price has been ascertained as follows:

	₹ per unit
Material = 2 units at ₹ 20	40
Labour = 20 hours @ ₹ 2	40
Variable overhead	8

Fixed overhead	20
Total Cost	108
Profit	32
Selling Price	140

During the budget period the company could produce and sell only 8,000 units as against, a budget of 10,000 units.
The company's Profit and Loss Account is presented below:

	₹		₹
To Material (16,500 units)	3,96,000	By Sales (8,000 units)	11,20,000
Wages (1,70,000 hrs.)	3,46,800		
Variable overhead	60,000		
Fixed overhead	1,84,000		
Net Profit	1,33,200		
	11,20,000		11,20,000

4,000 hours were lost due to power failure. There were no opening or closing work in progress.
Required:
(i) Analyze the relevant variances (Material, Wages, Variable overhead, Fixed overhead and Sale etc.)
(ii) Prepare a statement reconciling Actual Profit with Standard Profit in terms of the variances.

Answer:

(i) Analysis of Variances:

1. Direct Material Cost Variances:

Direct Material Price Variance = 16,500 (₹ 20 - ₹ $\frac{3,96,000}{16,500}$)
= ₹ 3,30,000 - ₹ 3,96,000
= ₹ 66,000 (A)

Direct Material Usage Variance = ₹ 20 (8,000 X 2 - 16,500)
= ₹ 10,000 (A)

2. Direct Wages Variances:

Wages Rate Variance = (₹ 2 - ₹ $\frac{3,46,800}{1,70,000}$) 1,70,000
= ₹ 3,40,000 - ₹ 3,46,800 = ₹ 6,800 (A)

Wages Efficiency Variance = ₹ 2 (8,000 X 20 - 1,66,000)
= ₹ 2 (1,60,000 - 1,66,000) = ₹ 12,000 (A)
Idle time Variance = 4,000 × ₹ 2 = ₹ 8,000 (A)

3. Variable Overhead Cost Variance

Variable Overhead Cost Variance = ₹ 8 × 8,000 - ₹ 60,000
= ₹ 4,000 (F)

4. Fixed Overhead Cost Variance

FO Expenditure Variance = ₹ 2,00,000 - ₹ 1,84,000 = ₹ 16,000 (F)
FO Volume Variance = ₹ 20 × 8,000 - ₹ 2,00,000 = ₹ 40,000 (A)

5. Sales Margin Variances

Now, actual sales margin per unit and standard sales margin per unit remains same i.e. actual price - standard cost = ₹ 140 - ₹ 108 = ₹ 3
Sales Margin Price Variance = (₹ 32 - ₹ 32) × 8,000 = NIL
Sales Margin Volume Variance = (8,000-10,000) × ₹ 32
= ₹ 64,000 (A)

(ii) Calculation of Standard Profit

Particulars	Per Unit (₹)
Selling Price	140
Less: Variable Cost	88
Contribution	52
Standard Sales Quantity	8,000
Total Contribution	4,16,000
Less: Standard Fixed Overhead @ ₹20 per unit	1,60,000
Standard Profit	2,56,000

Reconciliation between Standard Profit and Actual Profit

Standard Profit			₹ 2,56,000
Cost Variances	Adverse (₹)	Favourable (₹)	
Direct Material			
Price Variance	66,000		
Usage Variance	10,000		
Wages			
Rate Variance	6,800		
Idle Time Variance	8,000		

Efficiency Variance	12,000		
Variable Overhead			
Cost Variance		4,000	
Fixed Overhead			
Expenditure Variance		16,000	
Volume Variance	40,000		
	1,42,800	20,000	1,22,800 (A)
Actual Profit			1,33,200

Alternate Answer:

(i) Analysis of Variances:

		Amount (₹)
A.	**For Material Cost Variances:**	
	M1 - Actual Cost of Material used	3,96,000
	M2 - Standard Cost of Material used	3,30,000
	M3 - No mix variance	Nil
	M4 - Standard material cost Output	3,20,000
	Material Price Variance. (M1 - M2)	66,000 (A)
	Material Usage Variance. (M2 - M4)	10,000 (A)
B.	**For Direct Wages Variances:**	
	L1- Actual payment made to workers for actual hours worked	3,46,800
	L2- Payment involved, if workers had been paid at standard rate	3,40,000
	L3- No gang variance	
	L4- Standard labour cost of labour hours utilised. (This step will have value when there is a difference between hours available and hours utilised.)	3,32,000
	L5- Standard labour cost of output achieved	3,20,000
	Wage Rate Variance (L1 - L2)	6,800 (A)
	Wage idle Time Variance (L2 - L4)	8,000 (A)
	Wage Yield Variance (L4 - L5)	12,000 (A)
C.	**For Variable Overhead Variances:**	
	VO1 - Actual variable overhead (given)	60,000
	VO2 - No expenditure variance	Nil
	VO3 - Standard variable overhead for production	64,000
	Variable Overhead Variance (VO1 - VO3)	4,000 (F)
D.	**For Fixed Overhead Variances:**	
	FO1 - Actual fixed overhead incurred (given)	1,84,000

	FO2 - Budgeted fixed overhead for the period	2,00,000
	FO3 -There is no calendar or idle time variance	
	FO4 - Fixed overhead for actual hours worked at standard rate	1,66,000
	FO5 - Standard fixed overhead for production	1,60,000
	Fixed overhead expenditure variance (FO1 - FO2)	16,000 (F)
	Fixed overhead idle time variance (FO2 - FO4)	34.000 (A)
	Fixed overhead efficiency variance (FO4 - FO5)	6,000 (A)
E.	**For Sales Margin Variances:**	
	Standard sales margin = ₹ 32 (given). Actual sales margin also remains the same i.e., actual price - standard cost.	
	SM1- Actual sales margin on actual sales.	2,56,000
	SM2- Standard sales margin on actual sales	2,56,000
	SM3- No Mix Variances	Nil
	SM4- Standard sales margin on standard sales mix or budgeted sales margin as per budget or standard.	3,20,000
	Sales Margin Price Variance (SM1 - SM2)	Nil
	Sales Margin Volume Variance (SM2 - SM4)	64,000 (A)

(ii) Calculation of Standard Profit

Particulars	Amount (₹)
Budgeted Profit	3,20,000
Less: Sales Margin Volume Variance (Adverse)	64,000
Standard Profit	2,56,000

Reconciliation between Standard Profit& Actual Profit

Particulars			Amount (₹)
Standard Profit			2,56,000
Cost Variances	Adverse (₹)	Favourable (₹)	
Direct Material			
Price Variance	66,000		
Usage Variance	10,000		
Wages			
Rate Variance	6,800		
Idle Time Variance	8,000		
Yield Variance	12,000		
Variable Overhead			

Cost Variance		4,000	
Fixed Overhead			
Expenditure Variance		16,000	
Idle Time Variance	34,000		
Efficiency Variance	6,000		
	1,42,800	20,000	1,22,800 (A)
Actual Profit			1,33,200

CSQ 1.16 | PYQ | 2025-Jun [5] | 14 Marks

ZINTECH Ltd., operating a system of Standard Costing, makes and sells a single product "JULAM" for which the standard cost is as follows:

		₹ per unit
Direct materials	4 kilograms at ₹ 12.00 per kg	48.00
Direct labour	5 hours at ₹ 7.00 per hour	35.00
Variable production overhead	5 hours at ₹ 2.00 per hour	10.00
Fixed production overhead	5 hours at ₹ 10.00 per hour	50.00
		143.00

The variable production overhead is deemed to vary with the hours worked.

Overhead is absorbed into production on the basis of standard hours of production and the normal volume of production for the period just ended was 20,000 units (1,00,000 standard hours of production).

For the period under consideration, the actual results were:

Production of "JULAM"	₹ 18,000 units
Direct material used :- 76,000 kgs. at a cost of	₹ 8,36,000
Direct labour cost incurred :- for 84,000 hours worked	₹ 6,04,800
Variable production overhead incurred	₹ 1,72,000
Fixed production overhead incurred	₹ 10,30,000

Required:

(i) Assess and show, by element of cost, the standard cost of the output for the period.

(ii) Analyze the relevant variances of all costs (Material, Wages, Overheads).

(iii) Prepare a statement showing the reconciliation of standard cost with the actual cost.

Note: Fixed production overhead sub-variance of capacity and volume efficiency (productivity) are not required.

Answer:

(i) Statement showing Standard Cost of output produced:

Element of Cost	Calculation	Amount (₹)
Direct Material	18,000 x ₹48	8,64,000
Direct Labour	18,000 x ₹35	6,30,000
Variable Production Overhead	18,000 x ₹10	1,80,000
Fixed Production Overhead	18,000 x ₹50	9,00,000
Total		25,74,000

(ii) Analysis of Variances:

1. Direct Material Cost variance:

Direct Material Price Variance

= (Standard price/Kg. - Actual Price/Kg.) x Actual Quantity

= (₹12 - ₹11) x 76,000 = ₹76,000 (F)

Direct Material Usage Variance

= Standard Price (Standard Quantity for actual production - Actual Quantity)

= ₹12 (4 x 18,000 - 76,000) = ₹48,000 (A)

2. Direct Labour Cost Variance:

Direct Labour Rate Variance

= (Standard rate per hour - Actual rate per hour) x Actual hour

= (₹7 - ₹7.2) x 84,000 = ₹16,800 (A)

Direct Labour Efficiency Variance

= SR / hour (Std. Hours for actual production - Actual Hours)

= ₹7 (5 hours x 18,000 - 84,000) = ₹42,000 (F)

3. Variable Overhead Cost Variance:

Variable Overhead Expenditure Variance

= (Standard rate / hour - Actual rate / hour) x Actual hours

= (₹2 - ₹1,72,000/84,000) x 84,000 = ₹4,000 (A)

Variable Overhead Efficiency variance

= Standard rate / hour (Std hours for Actual Output - Actual Hours)
= ₹2 (5 x 18,000 - 84,000) = ₹12,000 (F)

4. Fixed Overhead Cost Variance:

Fixed Overhead Expenditure variance
= Budgeted Fixed overhead - Actual Fixed Overhead
= 20,000 x ₹50 - ₹10,30,000 = ₹30,000 (A)
Fixed Overhead Volume variance
= Recovered Fixed overhead - Budgeted Fixed overhead
= ₹50 x 18,000 - ₹10,00,000 = ₹1,00,000 (A)

(iii) Statement showing reconciliation of Standard Cost with Actual Cost:

Standard Cost of Actual Output			₹25,74,000
Adjustment for Variances	Favourable	Adverse	
Direct Material Price Variance	76,000		
Direct Material Usage Variance		48,000	
Direct Labour Rate Variance		16,800	
Direct Labour Efficiency Variance	42,000		
Variable Overhead Expenditure Variance		4,000	
Variable Overhead Efficiency Variance	12,000		
Fixed Overhead Expenditure variance		30,000	
Fixed Overhead Efficiency variance		1,00,000	
	1,30,000	1,98,800	68,800 (A)
Actual Cost			₹26,42,800

Alternative Solution

(i) Statement showing Standard Cost of output produced:

Element of Cost	Calculation	Amount (₹)
Direct Material	18,000 x ₹48	8,64,000
Direct Labour	18,000 x ₹35	6,30,000
Variable Production Overhead	18,000 x ₹10	1,80,000
Fixed Production Overhead	18,000 x ₹50	9,00,000
Tota		25,74,000

(ii) Analysis of Variances:

1.	For Direct Material Cost Variances	**Amount (₹)**
	M1 - Actual cost of material used	8,36,000
	M2 - Standard cost of actual material (76,000 kgs. x ₹12)	9,12,000
	M4 - Standard material cost of output (18,000 x ₹ 48)	8,64,000
	Material price variance = (M1 - M2) = ₹8,36,000 -₹9,12,000	76,000 (F)
	Material usage variance = (M2 - M4) = ₹9,12,000 - ₹8,64,000	48,000 (A)
2.	For Direct Labour Cost Variances	
	L1 - Actual payment made to workers for actual hours worked	6,04,800
	L2 - Payment involved, if the workers had been paid at standard rate (84,000 hours x ₹7)	5,88,000
	L5 - Standard labour cost of output achieved (18,000 units x ₹35)	6,30,000
	Labour Rate Variance = L1 - L2 = ₹6,04,800 -₹5,88,000	16,800 (A)
	Labour efficiency variance = L2 - L5 = ₹5,88,000 - ₹6,30,000	42,000 (F)
3.	For Variable Overhead Cost Variances	
	VO1 - Actual Variable Overhead	1,72,000
	VO2 - Actual hours worked at standard variable overhead rate (84,000 hrs. x ₹2)	1,68,000
	VO3 - Standard variable overhead for the production (18,000 units x ₹10)	1,80,000
	V.O. Expenditure Variance = VO1 - VO2 = 1,72,000 - 1,68,000	4,000 (A)
	V.O Efficiency Variance V2 - V3 1,68,000 - 1,80,000	12,000 (F)
4.	For Fixed Overhead Cost Variance	
	FO1 - Actual Fixed Overhead incurred	10,30,000
	FO2 - Budgeted Fixed Overhead for the period 1,00,000 x ₹10	10,00,000
	FO3- Standard Fixed Overhead for production 18,000 units x ₹50	9,00,000
	F.O. Expenditure variance = FO1 - FO2 = 10,30,000 - 10,00,000	30,000 (A)
	F.O. Volume variance = FO2 - FO3 = 10,00,000 - 9,00,000	1,00,000 (A)

(iii) Statement showing relevant variances and reconciliation of standard cost with actual cost:

	Ref No.	Standard cost of output (₹)	Variances	Actual Cost (₹)
Direct Materials		8,64,000		
Price variance	(1)		76,000 (F)	
Usage variance	(1)		48,000 (A)	
Actual Direct Material cost				8,36,000
Direct labour		6,30,000		
Rate variance	(2)		16,800 (A)	
Efficiency variance	(2)		42,000 (F)	

Actual Direct Labour cost				6,04,800
Variable Production Overhead		1,80,000		
Expenditure variance	(3)		4,000 (A)	
Efficiency variance	(3)		12,000 (F)	
Actual Variable Prodn. OH				1,72,000
Fixed production overhead		9,00,000		
Expenditure variance	(4)		30,000 (A)	
Volume variance	(4)		100,000 (A)	
Actual Fixed Overhead				10,30,000
TOTAL		25,74,000	68,800 (A)	26,42,800

CSQ 1.17 | PYQ | 2025-Dec [5] (a) | 7 Marks

DOXIN Ltd., a manufacturing company operating the Budgetary Control and Standard Costing System, has furnished the following information:

Particulars	Product P	Product R
Standard price per unit (₹)	24	30
Actual price per unit (₹)	30	40
Standard input (kg.)	50	?
Actual input (kg.)	40	70
Material Price Variance (₹)	?	?
Material Usages Variance (₹)	?	600(Adv.)
Material Cost Variance (₹)	?	?

Material Mix Variance for both products together was ₹90 (Adv.).

Required:

Assess the following which includes missing variances as indicated by Question Marks in the above table:

(i) Material Mix Variance (Product P and R)
(ii) Material Usage Variance (Product P)
(iii) Material Price Variance (Product P and R)
(iv) Material Cost Variance (Product P and R)

Answer:

(i) **Material Mix Variance = Standard Price per unit × (Revised Standard Quantity-Actual Quantity)**

Material	Calculation	Variance (₹)
P	24 × (55* - 40)	360 (F)
R	30 × (55 *- 70)	450 (A)
Total		**90 (A)**

*RSQ has been calculated by the following formula: Total Actual Quantity/ Total Standard Quantity × Individual Standard Quantity.

Material P: (50/100 × 110) = 55

Material R: (50/100 × 110) = 55

(ii) **Material Usage Variance = Standard Price per unit X (Standard Quantity - Actual Quantity)**

Material	Calculation	Variance (₹)
P	24 (50 - 40)	240 (F)

Calculation of Standard Input of Material R:

Material Usage Variance = Standard Price per unit × (Standard Quantity - Actual Quantity)

We have, 30 (a - 70) = 600 (A), where a is the Standard Input of Material R.

30a = 2,100 - 600 = 1,500

Or, a = 1,500 / 30 = 50

(iii) **Material Price Variance = Actual Quantity X (Standard Price per unit - Actual Price per unit)**

Material	Calculation	Variance (₹)
P	40 (24 - 30)	240 (A)
R	70 (30 - 40)	700 (A)
Total		940 (A)

(iv) **Material Cost Variance = Standard Price per unit X Standard Quantity - Actual Price per unit × Actual Quantity**

Material	Calculation	Variance (?)
P	24 × 50 - 30 × 40	NIL
R	30 × 50 - 40 × 70	1,300 (A)
Total		**1,300 (A)**

Alternate Solution:

Let SQ for Material R = Q units

Material Usage Variance for R:

= (SQ x SP) - (AQ x SP)

600 (A) = (SQ x 30) - (70 x 30)

600 (A) = 30 SQ - 2,100

30 SQ = 2,100 - 600

$SQ = \frac{1,500}{30} = 50$ units

Variance Computation Chart

Materials	(1) SQ x SP	(2) RSQ x SP	(3) AQ x SP	(4) AQ x AP
P	50 ×24 = 1,200	55 x 24 = 1,320	40 x 24 = 960	40 ×30 = 1,200
R	50 x 30 = 1,500	55 x 30 = 1,650	70 x 30 = 2,100	70 x 40 = 2,800
	2,700	**2,970**	**3,060**	**4,000**

Material wise Break-up of Variances

	Particulars	Product P	Product R	Total
I.	Mix Variance [(2) - (3)]	360 (Fav.)	450 (Adv.)	90 (Adv.)
II.	Usage Variance [(1) - (3)]	240 (Fav.)	600 (Adv.)	360 (Adv.)
III.	Price Variance [(3) - (4)]	240 (Adv.)	700 (Adv.)	940 (Adv.)
IV.	Total Material Cost Variance [(1) - (4)]	0	1300 (Adv.)	1300 (Adv.)

CSQ 1 18	PYQ	2025-Dec [5] (b)	7 Marks

The following are the information regarding overheads of a company:

Overhead Cost Variance	=	₹2,800 (A)
Overhead Volume Variance	=	₹2,000 (A)
Budgeted overheads	=	₹12,000
Actual overhead recovery rate	=	₹8 per hour
Budgeted hours for the period	=	2,400 hours

Required:

Assess the following:

(i) Overhead Expenditure Variance
(ii) Actual incurred overheads
(iii) Actual hours for actual production
(iv) Overhead Capacity Variance
(v) Overhead Efficiency Variance
(vi) Standard hours for actual production
(vii) Standard Rate per hour

Answer:

(i) Overheads Expenditure Variance
= Overheads Cost Variance (-) Overheads Volume Variance
= ₹ 2,800(A)- ₹ 2,000(A)
= ₹ 800(A)

(ii) **Actual incurred overheads**
Overheads Expenditure Variance = Budgeted Overheads (-) Actual Overheads
₹ 800(A) = ₹12,000 (-) Actual Overheads
Therefore, Actual Overheads = ₹ 12,800

(iii) **Actual hours for actual production**
= Actual Overhead/ Actual Overhead Recovery Rate
= ₹12,800/8 = 1,600 Hrs.

(iv) **Overheads Capacity Variance**
Budgeted Overheads for Actual Hours (-) Budgeted Overheads
= ₹ 5 x 1,600 hrs. - ₹ 12,000
= ₹ 8,000 - ₹ 12,000
= ₹ 4,000 (A)

(v) **Overheads efficiency variance**
= Absorbed Overheads (-) Budgeted Overheads for Actual Hours
= ₹ 10,000 - ₹ 5 x 1,600 hours
= ₹ 2,000 (F)

(vi) **Standard hours for actual production**
= Absorbed Overhead/ Standard rate per hour
= ₹ 10,000/₹ 5
= 2,000 hrs

(vii) **Calculation of Standard Rate/Hour**
Overhead Cost Variance = Absorbed Overheads (-) Actual Overheads
₹ 2,800 (A)= Absorbed Overheads (-) ₹ 12,800

Absorbed Overheads = ₹ 10,000
Standard Rate per Hour = Budgeted Overhead/Budgeted Hours
= ₹ 12,000/2,400 hrs
= ₹ 5 /hr

CSQ 1.19	PYQ	2026-Jun [5] (a)	7 Marks

Zenith Manufacturing Ltd. produces a finished product using two grades of raw materials: Grade A (premium) and Grade B (standard). The company has been experiencing quality issues and cost overruns in their latest product line.

Standard specifications of finished product:

- Grade A material: 60 kg at ₹150 per kg
- Grade B material: 40 kg at ₹100 per kg
- Standard loss in process: 5% of total input
- Standard output from 100 kg input: 95 kg of finished product

Actual Results for March 2026:

- Finished output: 9,500 kg
- Grade A used: 6,200 kg at ₹160 per kg
- Grade B used: 4,500 kg at ₹90 per kg
- Total actual cost: ₹13,97,000

Required:

Assess comprehensive material variances: Cost, Price, Usage, Mix, and Yield Variances.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

CSQ 1.20	PYQ	2026-Jun [5] (b)	7 Marks

The standard cost data of three products X, Y and Z manufactured by Preet India Ltd. (PIL) are given below together with the budgeted sales and unit selling prices for 2025-26:

	X	Y	Z
Budgeted sales (units)	25,000	20,000	15,000
Selling price per unit (₹)	40	60	80
Cost per unit (₹)	28	48	64

In April 2026, the cost department of PIL gathered the following details for 2025-26:

	X	Y	Z
Actual sales (units)	20,000	22,000	16,000
Average Selling price per unit (₹)	42	56	81
Actual Cost per unit (₹)	30	50	63

Required:

1. Calculate Budgeted profit and Actual profit for 2025-26
2. Assess the variance in profit analyzed into:
   (a) Cost Variance
   (b) Sales Price Variance
   (c) Sales Volume Variance

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

02 Uniform Costing and Inter-firm Comparison

THEORY QUESTIONS

TQ 2.1	PYQ	2022-Dec [4] (b)	DESC	4 Marks
Enumerate the requisites for installation of an Uniform Costing in an organization.				

Answer:

The organisational set up for implementing the principles and methods of Uniform Costing may take different forms. It may range from a small association of a number of concerns who agree to have uniform information regarding a few specific cost accounting respects, to be a large organisation which has a fully developed scheme covering all the aspects of costing. The success of a uniform costing system will depend upon the following:

(a) There should be a spirit of mutual trust, co-operation and a policy of give and take amongst the participating members.
(b) There should be a free exchange of ideas and methods.
(c) The bigger units should be prepared to share with the smaller ones, improvements, achievements of efficiency, benefits of research and know-how.
(d) There should not be any hiding or withholding of information.
(e) There should be no rivalry or sense of jealousy amongst the members.

For Notes

For Notes

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 6

Linear Programming

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	1	-
2.	Requirements of Linear Programming	-	-
3.	Advantages of Linear Programming	-	-
4.	Limitations of Linear Programming	-	-
5.	Formulation of Linear Programming Problem	9	-
6.	Methods of Solving Linear Programming Problems	4	-

SECTION-A

PYQ 2012-Dec [1] (a) (iv) {C} In each of the cases/statements given below, one of four alternatives is correct. Indicate the correct answer:
Which model among the following is not example of mathematical programming models (optimization models)?
(a) Linear programming model
(b) EOQ model
(c) CPA or PERT model
(d) Game theory model **(1 Mark)**
Answer: (d) Game theory model

PYQ 2019-Jun [1] Choose the most appropriate answer the to following questions giving justification:
(ix) Which of the following is a valid constraint for a linear programming problem?

(a) $3x^2 + 4x + 1 = 0$ (b) $5x_1 + 2x_2 \leq 10$
(c) $4x_1 + 3x_2 > 7$ (d) $(12x_1 + 4x_2)/3x_2 \leq 8x_1$ **(2 Marks)**

Answer: (b) Other options do not conform to linearity or fundamental of constraints.

(X) The shadow price of skilled labour for SD Ltd. is currently ₹ 10 per hour. What does this mean?
(a) The cost of obtaining additional skilled labour is ₹ 10 per hour.
(b) There is a hidden cost of ₹ 10 for each hour of skilled labour actively worked.
(c) Contribution will be increased by ₹ 10 per hour for each extra hour of skilled labour that can be obtained.
(d) The total costs will be reduced by ₹ 10 for each additional hour of skilled labour that can be obtained. **(2 Marks)**

Answer: (c) A shadow price for a scarce resource is its opportunity cost. It is the amount of contribution that would be lost if one unit less of that resource were available. It is similarly the amount of additional contribution that would be earned if one unit more of that resource were available.(This is on the assumption that the scarce resource is available at its normal variable cost).

PYQ 2022-Dec [1] (viii) {C} Choose the most appropriate answer to the following questions:
The constraints in a linear programming Model are—
(a) Included in the Objective function
(b) Costs
(c) Scarce Resources
(d) Dependent Variables **(2 Marks)**

Answer: (c) Scarce Resources

2025-Dec [1] (vi) {C} Choose the correct option from the given alternatives:
If (50, 0), (50, 14), (25, 50) and (13, 50) are the Corner Points of the feasible region of the Linear Programming problem, Maximize $Z = 2x_1 + 3x_2$, then maximum value of the objective function will be

(a) ₹200
(b) ₹270
(c) ₹240
(d) ₹120 **(2 Marks)**

Answer: (a) ₹200

SECTION-B

01 Introduction

THEORY QUESTIONS

TQ 1.1	PYQ	2016-Jun [8] (b)	DESC	3 Marks
Write the practical uses (three in each case) of Linear Programming in industrial and administrative applications.				

Answer:

The following are the industrial application areas of Linear Programming:
Product-mix problems (production planning),
Blending problems (various compositions and prices of raw materials), Diet problems, Trim problems (paper industry),
Advertising-mix problems.
The following are the administrative application areas of Linear Programm ng: Operational scheduling problems in aircraft,
The investment portfolio selection problems (financial applications),
Several military problems (scheduling military tanker fleet, minimizing the number of carriers to meet a fixed schedule, etc.),
Cost cutting in business,
Agriculture applications (i.e., to maximize the return from the allocation activity or to minimize some defined cost).

05 Formulation of Linear Programming Problem

CASE-SCENARIO QUESTIONS

CSQ 5.1	PYQ	2017-Jun [7] (b)	8 Marks
In a processing industry two products A and B are made involving two operations. The production of B also results in a by-product C. The product A can be sold at a profit of ₹ 3 per unit and B at a profit of ₹ 8 per unit. The by-product C has a profit of ₹ 2 per unit. Forecast shows that upto 5 units of C can be sold. The company gets 3 units of C for each unit of B produced. The manufacturing times are 3 hours per unit for A on each of the operation one and two and 4 hours and 5 hours per unit for B on operation one and two, respectively. Because the product C results from producing B, no time is used in producing C. The available times are 18 hours and 21 hours of operation one and two respectively. The company desires to know how much of A and B should be produced keeping C in mind to make the highest profit. **Required:** Formulate LP model for this problem.			

Answer:

Let X_1, X_2, X_3 be the number of units produced of products A, B and C respectively.

Objective function:

Then the profit gained by the industry is given by $Z = 3x_1 + 8x_2 + 2x_3$

Here, it is assumed that all the units of products A and B are sold.

Condition-1:

In first operation, A takes 3 hrs of manufacturer's time and B takes 4 hrs of manufacturer's time. Therefore, total number of hours required in first operation becomes - $3x_1 + 4x_2$

In second operation, per unit of A takes 3 hrs of manufacturer's time and per unit B takes 5 hrs of manufacturer's time. Therefore, the total number of hours used in second operation becomes - $3x_1 + 5x_2$

Since there are 18 hours available in first operation and 21 hours in second operation, the restrictions become

$3x_1 + 4x_2 \leq 18$

$3x_1 + 5x_2 \leq 21$

Condition-2:

Since the maximum number of units of C that can be sold is 5, therefore,

$X_3 \leq 5$

Condition-3:
Further, the company gets three units of by product C for every unit of product B produced, therefore,

$X_2 = 3X_3$

Now, the allocation problem of the industry can be finally put in the following linear programming problem:

Maximise

$z = 3x_1 + 8x_2 + 2x_3$

Subject to the Constraints

$3x_1 + 4x_2 \leq 18$

$3x_1 + 5x_2 \leq 21$

$x_3 \leq 5$

$x_2 = 3x_3$

$x_1, x_2, x_3 \geq 0$

CSQ 5.2	PYQ	2017-Dec [7] (b)	4+4=8 Marks

A company produces products P, Q and R from three raw materials A, B and C. One unit of product P requires 2 units of A and 3 units of B. One unit of product Q requires 2 units of B and 5 units of C and one unit of product R requires 3 units of A, 2 units of B and 4 units of C. The company has 8 units of material A, 10 units of B and 15 units of C available to it. Profits per unit of product P, Q and R are ₹ 3, ₹ 5 and ₹ 4 respectively.

(i) Formulate the problem mathematically.
(ii) Write the Dual problem.

Answer:

Raw Materials	P	Q	R	Available Units
A	2	-	3	8
B	3	2	2	10
C	-	5	4	15

Profits 3/- , 5/-, 4/-

Let x_1 be the number of units of P

Let x_2 be the number of units of Q

Let x_3 be the number of units of R

(i) Formulation of the problem

Objective function:

Max $Z = 3x_1 + 5x_2 + 4x_3$

Subject to constraints:

$2x_1 + 3x_3 \leq 8$

$3x_1 + 2x_2 + 2x_3 \leq 10$

$5x_2 + 4x_3 \leq 15$

$X_1, X_2, X_3 \geq 0.$

(ii) Dual of the problem

Min $C = 8y_1 + 10y_2 + 15y_3$

Subject to constraints:

$2y_1 + 3y_2 \geq 3$

$2y_2 + 5y_3 \geq 5$

$3y_1 + 2y_2 + 4y_3 \geq 4$

$y_1, y_2, y_3 \geq 0.$

CSQ 5.3	PYQ	2018-Jun [7] (b)	6 Marks

The management of SAB Ltd. has suggested that a linear programming model might be used for selecting the best mix of five possible products — A, B, C, D and E. The following information are available.

Per Unit of Product

	A	B	C	D	E
Selling price (₹):	96	84	76	62	54
Costs (₹):					
Material	30	28	32	30	32
Direct Labour	36	32	12	8	8
Fixed Overhead	18	16	6	4	4
Total Costs	84	76	50	42	44

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

A	B	C	D	E
3,000	2,400	1,800	1,200	1,200

Cost of material includes a special component which is in short supply. It costs ₹ 6 per unit. Only 11,600 units are available to the company during the

week. The number of units of the special component needed for a unit of each product is:

A	B	C	D	E
2	1	4	3	6

The management of SAB Ltd. has ruled that expenditure on materials must not exceed a sum of ₹ 60,000.
All other resources are freely available in sufficient quantities for planned need.
Formulate a linear programming model stating clearly the criterion you use.

Answer:

	A	B	C	D	E
Selling Price	96	84	76	62	54
Variable Cost	66	60	44	38	40
Contribution	30	24	32	24	14

Let a, b, c, d, e be the number of units respectively of A, B, C, D and E to be produced.
Objective function: Maximise contribution: $Z = 30a + 24b + 32c + 24d + 14e$
Subject to: Demand Constraint

a	≤	3,000
b	≤	2,400
c	≤	1,800
d	≤	1,200
e	≤	1,200

Special Raw Material availability constraint
$2a + b + 4c + 3d + 6e \leq 11600$
Special raw material cost constraint
$12a + 6b + 24c + 18d + 36e \leq 60,000$
Non negativity constraint: $a, b, c, d, e \geq 0$

CSQ 5.4	PYQ	2018-Dec [7] (b)	8 Marks

Coffee powder is made by a shop by blending different flavours of coffee seeds. 520 gms. of Plantation A seeds and 510 gms. of Plantation B seeds are ground to yield 1,000 gms. of Special Blend powder. 520 gms. of Peaberry seeds and 560 gms. of Plantation A seeds are ground to yield

1,050 gms. of Special Peaberry powder. 500 gms. of Plantation B seeds and 510 gms. of Robusta seeds are ground to get 980 gms. of Normal Blend powder. The contribution per kg. of Special Blend, Special Peaberry and Normal Blend are ₹ 100,120 and 140 respectively. The following stocks are available for the production period:
Plantation A: 200 kgs; Plantation B: 300 kgs; Peaberry: 250 kgs; Robusta: 51kgs.
Grinding capacity on a total is limited to 500 kgs. of output in a production period.
Required:
Formulate the above as a linear programme with the objective to maximise contribution. Identify the variables and give the constraints.
(Consider 1,000 gms. = 1 kg).

Answer:

Let X, Y and Z be the no. of kgs. of Special Blend, Special Peaberry and Normal Blend respectively to be produced in the production period.
Then, Objective fn: Max $Z = 100X + 120Y + 140Z$

The following are resources per kg of output:

	X	Y	Z	Availability
Plantation A	520 / 1,000	560/1,050		200
Plantation B	510 / 1,000		500/980	300
Peaberry		520/1,050		250
Robusta			510/980	51

Resource constraint:

$\frac{520}{1,000} X + \frac{560}{1,050} Y \leq 200$

$\frac{510}{1,000} X + \frac{500}{980} Z \leq 300$

$\frac{520}{1,050} Y \leq 250$

$\frac{510}{980} Z \leq 51$

Production Capacity: $X + Y + Z \leq 500$
$X, Y, Z \geq 0$

CSQ 5.5	PYQ	2019-Dec [6] (b)	8 Marks

Nava Bharat Industries Ltd. manufactures four products (1,2,3,4) on two machines (X and Y). The time (in minutes) to process one unit of each product on each machine is shown below:

		Machine	
		X	Y
Product	1	12	26
	2	15	19
	3	18	30
	4	10	25

The profit per unit for each product (1, 2, 3, 4) is ₹ 120, ₹ 150, ₹ 190 and ₹ 100 respectively. Product 1 must be produced on *both* machines X and Y but products 2, 3 and 4 can be produced on either machine.

Due to acute space constraints in the company's works, only one week's production is stored in 4,000 square feet of floor space where the floor space taken up by each product is 1.0, 1.5, 5.0 and 0.50 (square ft.) for products 1,2,3 and 4 respectively.

As per customer requirements the output of Product 2 is related with that of Product 3 and over a week approximately twice as many units of product 2 should be produced as product 3.

Machine X is out of action (for maintenance/because of breakdown) 8% of the time and machine Y 10% of the time.

Required:

Assuming a working week 42 hours, formulate the problem of how to manufacture these products as a linear programme.

Answer:

Variables:

Essentially the company is interested in the amount produced on each machine.

Hence let:

x_i = amount of product i (i = 2,3,4) produced on machine X per week

y_i = amount of product i (i = 2,3,4) produced on machine Y per week

where $x_i >= 0$ i = 1,2,3,4 and $y_i >= 0$ i = 2,3,4

It may be stated here that as product 1 must be processed on both machines X and Y, y_i has not been defined here.

Then objective function will be

Maximize $120x_1 + 150(x_2 + y_2) + 190(x_3 + y_3) + 100(x_4 + y_4)$ subject to constraints

- Floor space
  $1x_1 + 1.5(x_2 + y_2) + 5(x_3 + y_3) + 0.5(x_4 + y_4) <= 4,000$
- Customer requirements
  $x_2 + y_2 = 2(x_3 + y_3)$
- Available time
  $12x_1 + 15x_2 + 18x_3 + 10x_4 <= 0.92(42)(60)$ (machine X)
  $26y_1 + 19y_2 + 30y_3 + 25y_4 <= 0.90(42)(60)$ (machine Y)
  With non negative constraints to be inserted: X1, X2, X3, X4 and Y1, Y2, Y3, Y4 >_ 0.

CSQ 5.6	PYQ	2022-Dec [7] (b)	6 Marks

A manufacturer of medicine is proposed to prepare a production plan for medicines A and B. There are sufficient ingredients available to make 20,000 bottles of medicine A and 40,000 bottles of medicine B. But there are 45,000 bottles into which either of the medicine can be filled. Further it takes 3 hours to prepare enough material to fill 1,000 bottles of medicine A and 1 hour to prepare enough material to fill 1,000 bottles of medicine B and there are 66 hours available for this operation. The profit is ₹ 8 per bottle of medicine A and is ₹ 7 per bottle of medicine B.

Formulate the above as a Linear Programming Problem. (Do not solve)

Answer:

Let x_1 and x_2 be the no. of bottles of medicine A and B to be manufactured.

(i) Objective function is Maximize $Z = 8x_1 + 7x_2$

S.T constraints:

Bottle capacity constraint = $x_1 + x_2 \leq 45,000$

Hour constraint = $(3x_1/1,000) + (x_2/1,000) \leq 66$

Or $3x_1 + x_2 \leq 66,000$

Ingredient constraint for Medicine A = $x_1 \leq 20,000$
Ingredient constraint for Medicine B = $x_2 \leq 40,000$
$x_1, x_2 \geq 0$

CSQ 5.7	PYQ	2023-Jun [8] (a)	6 Marks

UTKARSH Bank is in the process of formulating its loan policy involving a maximum of ₹ 600 million. Table below gives the relevant types of loans. Bad debts are not recoverable and produce no interest revenue. To meet competition from other banks, the following policy guidelines have been set. At least 40% of the funds must be allocated to the Agricultural and Commercial loans. Funds allocated to Housing must be at least 50% of all loans given to personal, car, housing. The overall bad debts on all loans may not exceed 0.06.

Type of Loan	Interest Rate (%)	Bad Debt (Probability)
Personal	17	0.10
Car	14	0.07
Housing	11	0.05
Agricultural	10	0.08
Commercial	13	0.06

Required:
Develop and formulate a linear programming model to determine optimal loan allocation.

Answer:
Let X_1, X_2, X_3, X_4 and X_5 be loan to the 5 sectors In ₹ million
The objective function will be:
Maximize, $Z = 0.17 X_1 + 0.14 X_2 + 0.11 X_3 + 0.10 X_4 + 0.13 X_5$
Subject to the Constraints:
$X_1 + X_2 + X_3 + X_4 + X_5 \leq 600$ (Fund limit)
$X_4 + X_5 \geq 240$ (Ag + com loan at least 40%) $(.40 \times 600) = 240$
$X_3 \geq 0.50 (X_1 + X_2, + X_3)$ i.e. $0.5X_3 - 0.5X_1 - 0.5X_2 \geq 0$ (Housing Loan)
Bad Debt – Limit = $0.06 \times 600 =$ ₹ 36 million
$0.10 X_1 - 0.07 X_2 + 0.05 X_3 + 0.08 X_4 + 0.06 X_5 \leq 36$
With non-negative constraints
$X_1, X_2, X_3, X_4, X_5 \geq 0$

CSQ 5.8	PYQ	2024-Jun [6] (a)	7 Marks

FAMC Ltd., a manufacturing company produces three products A, B and C. It uses two types of raw materials I and II of which 5,000 and 7,500 units respectively are available. The raw material requirements per unit of the products are given below:

Raw Material	Requirement per unit of Product		
	A	B	C
I	3	4	5
II	5	3	5

The labour time for each unit of product A is twice that of product B and three times that of product C. The entire labour force of the firm can produce the equivalent of 3,000 units. The minimum demand of the three products is 600, 650 and 500 units respectively. Also the ratios of the number of units produced must be equal to 2 : 3 : 4. The profits per unit of A, B and C are ₹ 50, ₹ 50 and ₹ 80 respectively.
Required:
Analyze and Formulate the problem as a linear programming model in order to determine the number of units of each product which will maximize the profit.

Answer:
Let the firm produce X_1 units of product A, X_2 units of product B and X_3 units of product C. The profit per unit of products A, B and C is ₹ 50, ₹ 50 and ₹ 80 respectively.
The objective function is : Maximise $Z = 50X_1 + 50X_2 + 80X_3$
Raw material constraints are : $3X_1 + 4X_2 + 5X_3 \leq 5,000$ & $5X_1 + 3X_2 + 5X_3 \leq 7,500$
The labour time for each unit of product A is twice that of product B and three times that of product C. Also, the entire labour force can produce the equivalent of 3,000 units.

$$X_1 + \frac{X_2}{2} + \frac{X_3}{3} \leq 3,000$$

$6X_1 + 3X_2 + 2X_3 \leq 18,000$
Demand constraints are: $X_1 \geq 600$, $X_2 \geq 650$ and $X_3 \geq 500$

Since the ratios of the number of units produced must be equal to 2 : 3 : 4, therefore,

$\frac{1}{2}X_1 = \frac{1}{3}X_2$ and $\frac{1}{3}X_2 = \frac{1}{4}X_3$

Or, $3X_1 = 2X_2$ and $4X_2 = 3X_3$

The linear programming model can be formulated as follows:

Maximise $Z = 50\ X_1 + 50\ X_2 + 80\ X_3$

Subject to the Constraints

$3X_1 + 4X_2 + 5X_3 \leq 5,000$

$5X_1 + 3X_2 + 5X_3 \leq 7,500$

$6X_1 + 3X_2 + 2X_3 \leq 18,000$

$3X_1 = 2X_2$ and $4X_2 = 3X_3$

$X_1 \geq 600$, $X_2 \geq 650$ and $X_3 \geq 500$

CSQ 5.9	PYQ	2025-Dec [6] (a)	7 Marks

LM Company has the option of producing two products in its plant. The costs and selling prices per unit of two products are detailed below:

Product	Alfa (₹)	Beta (₹)
Selling Price	1,000	900
Direct Materials @ ₹50 per kg	200	200
Direct Labour @ ₹40 per hour	160	80
Painting @ ₹60 per hour	60	120
Variable Overheads	380	350
Fixed costs @ ₹35/D.L. hour	140	70
Total costs	940	820
Profit	60	80

In any month the maximum availability of inputs is limited to the following:

Direct Materials : 960 kgs

Direct Labour hours : 800 hours

Painting hours : 400 hours

Required:

(i) Formulate a Linear Programming Problem to determine the production plan which maximizes the contributions. (You are not required to solve the LPP)

(ii) Prepare the DUAL to the problem formulated in (i).

Answer:

(i) Contribution made by product Alfa = 1,000 - [200 + 160 + 60 + 380]
= ₹ 200

Contribution made by product Beta = 900 - [200 + 80 +120 + 350]
= ₹ 150

Direct Material per unit of product Alfa = 200/50 = 4 kgs	Direct Material per unit of product Beta = 200/50 = 4 kgs
Direct Labour hour per unit of product Alfa = 160/40 = hrs	Direct Labour hour per unit of product Beta = 80/40 = 2 hrs
Painting hour per unit of product Alfa = 60/60 =1 hr	Painting hour per unit of product Beta = 120/60 = 2 hrs

Let the decision variables x1 and x2 denote the number of units of product Alfa and product Beta to be produced respectively.

The appropriate mathematical formulation of the given problem as LP model is:

Maximize (contribution) Z = 200 x1 + 150 x2

Subject to the constraints

4x1 + 4 x 2 ≤ 960 (Raw material constraint)

4x1 + 2 x 2 ≤ 800 (Direct Labour hour constraint)

x1+ 2 x 2 ≤ 400 (Painting hour constraint)

x1 ≥ 0, x 2 ≥ 0 (Non negativity constraint)

(ii) **DUAL problem is expressed as follows:**

Minimize Zy = 960 y1 + 800 y2+ 400 y3

Subject to the constraints

4y1 + 4y2 + y3 ≥200

4y1 + 2y2 + 2y3 ≥150

y1, y2, y3 ≥0

CSQ 5.10	PYQ	2026-Jun [6] (a)	7 Marks

A firm produces three products A, B and C. It uses two types of raw materials I and II of which 5,000 and 7,500 units respectively are available. The raw material requirements per unit of the products are given below:

Raw Material	Requirement per unit of Product		
	A	B	C
1	3	4	5
2	5	3	5

The labour time for each unit of product A is twice that of product B and three times that of product C. The entire labour force of the firm can produce equivalent of 3,000 units. The minimum demand of the three products is 600, 650 and 500 units respectively. Also, the ratios of the number of units produced must be equal to 2:3:4. Assume the profits per unit of A,B and C as ₹50, ₹50 and ₹80 respectively.
Develop a Linear Programming Model for this problem.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

06 *Methods of Solving Linear Programming Problems*

THEORY QUESTIONS

TQ 6.1	PYQ	2015-Jun [3] (i) {C}	DESC	1+4 = 5 Marks

What is the "Simplex Method"? State its advantage over the Graphical Method.

Answer:

The Simplex Method is a computational procedure-an algorithm-for solving Linear Programming Problems. It is an iterative optimizing technique. In the Simplex process, we must first find an initial basic solution (extreme point).

We then proceed to an adjacent extreme point. We continue moving from point to point until we reach an optimal solution.

Advantage of Simplex Method over the Graphical Solution:

Algebraic Method and Graphical Method can only be used when there are only less than 2 variables in an LPP. Further Algebra will fail, if there are inequalities. In case the no. of variables exceeds 2, it will not be possible to solve the problem by Algebra/Graphically. In that case, we have to resort to the Simplex method only.

Simplex Method is highly efficient and versatile as also amenable to further mathematical treatment and offers interesting economic interpretations. Thus it is possible to solve conveniently linear programming problem graphically, as long as the number of variables is not more than two. Further, the Simplex method is popular, due to its ability to easily program the algorithm on a computer.

Simplex Methods use the concept of slack variables and two theorems-The Extreme Point Theorem and the Basis Theorem. In Simplex, we move from the initial basic solution to a better solution and proceed for a further better solution and so on, till we reach the optimum solution. As the Simplex Method is quite tedious and highly computational, one has to keep his head cool while solving a LPP by Simplex Method.

CASE-SCENARIO QUESTIONS

CSQ 6.1	PYQ	2015-Jun [3] (ii) {C}	4 Marks

Solve the following LPP by using Simplex Method. (Please note that no credit shall be given, if solved by any other method).

Maximize

$Z = 2x_1 + 5x_2$

Subject to $x_1 + 4x_2 \leq 24$

$3x_1 + x_2 \leq 21$

$x_1 + x_2 \leq 9$

$x_1, x_2 \geq 0$

Answer:

By introducing slack variables S_1, S_2 and S_3, the problem becomes:

Maximize $Z = 2x_1 + 5x_2 + 0S_1 + 0S_2 + 0S_3$

Subject to

$x_1 + 4x_2 + S_1 + 0S_2 + 0S_3 = 24$

$3x_1 + x_2 + 0S_1 + S_2 + 0S_3 = 21$

$x_1 + x_2 + 0S_1 + 0S_2 + S_3 = 9$

$x_1, x_2, S_1, S_2, S_3 \geq 0$

The simplex tables in this case are:

FR (Fixed ratio Program)		Profit Unit	Quantity	2 x_1	5 x_2	0 S_1	0 S_2	0 S_3	RR
	S_1	0	24	1	4	1	0	0	6
1/4	S_2	0	21	3	1	0	1	0	21
1/4	S_3	0	9	1	1	0	0	1	9
			NER (Net Evaluation Row)	2	5	0	0	0	

1/3	x_2	5	6	1/4	1	1/4	0	0	24
11/3	S_2	0	15	11/4	0	-1/4	1	0	60/11
	S_3	0	3	3/4	0	-1/4	0	1	4
			NER	3/4	0	-5/4	0	0	

x_2	5	5	0	1	1/3	0	-1/3	NER elements are all non-positive
S_2	0	4	0	0	2/3	1	-11/3	
x_1	2	4	1	0	-1/3	0	4/3	
		NER	0	0	-1	0	0	

Hence $x_1 = 4$, $x_2 = 5$ and Z max $= 2 \times 4 + 5 \times 5 = 8 + 25 = 33$.

Alternate Answer:

Maximize $Z = 2X_1 + 5X_2 + 0.X_3 + 0.X_4 + 0.X_5$

Subject to constraints

$X_1 + 4X_2 + X_3 + 0.X_4 + 0.X_5 = 24$

$3X_1 + X_2 + 0.X_3 + X_4 + 0.X_5 = 21$

$X_1 + X_2 + 0.X_3 + 0.X_4 + X_5 = 9$

$X_1, X_2, X_3, X_4, X_5 \geq 0$

		b	2 x_1	5 x_2	0 x_3	0 x_4	0 x_5	MR
x_3	0	24	1	4	1	0	0	6
x_4	0	21	3	1	0	1	0	21
x_5	0	9	1	1	0	0	1	9
$Z_j - C_j$		0	-2	-5	0	0	0	

x_3 = Departing Vector

x_2 = Entering Vector

		b	2 x_1	5 x_2	0 x_3	0 x_4	0 x_5	MR
x_2	5	6	1/4	1	1/4	0	0	24
x_1	0	15	11/4	0	-1/4	1	0	60/11
x_5	0	3	3/4	0	-1/4	0	0	4
$Z_j - C_j$		30	-3/4	0	5/4	0	0	

x_5 = Departing Vector

x_1 = Entering Vector

		b	2 x_1	5 x_2	0 x_3	0 x_4	0 x_5	Since all the elements of $Z_j - C_j$ are non-negative, optimal solution is obtained as $x_2 = 5$, $x_1 = 4$ Max $Z = 33$
x_2	5	5	0	1	1/3	0	-1/3	
x_4	0	4	0	-11/4	2/3	1	-11/3	
x_1	2	4	1	0	-1/3	0	4/3	
$Z_j - C_j$		33	0	0	1	0	1	

CSQ 6.2	PYQ	2016-Dec [5] (b)	8 Marks

An electronic firm is undecided as to the most profitable mix for its products. The products which are manufactured now are Transistors, Resistors and Carbon Tubes with a profit (per 100 units) of ₹ 10, ₹ 6 and ₹ 4 respectively. To produce a shipment of Transistors (containing 100 units) requires 1 hour of engineering, 10 hours of direct labours and 2 hours of administration services. To produce a shipment of Resistors (containing 100 units) requires 1 hour, 4 hours and 2 hours of engineering, direct labour and administration services respectively. To produce a shipment of Carbon Tubes (containing 100 units) requires 1 hour engineering, 5 hours of direct labour and 6 hours of administration

services. There are 100 hours of engineering services, 600 hours of direct labour and 300 hours of administration services available.
Formulate the LPP model.
Find out the product mix to maximize profit.

Answer:

Let us tabulate data in a convenient manner:

	Products (Units)			Availability (Hrs.)
	Transistors	Resistors	Carbon Tubes	
Engineering	1	1	1	100
Labour	10	4	5	600
Administration	2	2	6	300
Profit (per 100 units)	₹ 10	₹ 6	₹ 4	

Symbolically, the LPP would be as: $Z_{max} = 10x + 6y + 4z$

Here, x, y and z represents units of Transistors, Resistors and Carbon Tubes (in 100 units).

Subject to $x + y + z \leq 100$

$10x + 4y + 5z \leq 600$

$2x + 2y + 6z \leq 300$

$x \geq 0, y \geq 0$, and $z \geq 0$

Introducing stock variables, S_1, S_2 and S_3

Maximize, $Z = 10x + 6y + 4z + 0S_1 + 0S_2 + 0S_3$

Subject to, $x + y + z + S_1 = 100$

$10x + 4y + 5z + S_2 = 600$

$2x + 2y + 6z + S_3 = 300$

$x \geq 0, y \geq 0, z \geq 0, S_1 \geq 0, S_2 \geq 0$ and $S_3 \geq 0$

Simplex tableau 1

Cj				10	6	4	0	0	0	Replacement Ratio
Fixed Ratio	Basic Variables	C_B	Value of basic variables $b = (X_B)$	x	y	z	S_1	S_2	S_3	
1/10	S_1	0	100	1	1	1	1	0	0	100
	S_2	0	600	**10**	4	5	0	1	0	← 60
1/5	S_3	0	300	2	2	6	0	0	1	150
$Z_J = \Sigma C_{BI} X_J$				0	0	0	0	0	0	
$C_J - Z_J$				10↑	6	4	0	0	0	

Simplex tableau 2

Cj				10	6	4	0	0	0	Replacement Ratio
Fixed Ratio	Basic Variables	C_B	Value of basic variables $b = (X_B)$	x	y	z	S_1	S_2	S_3	
	S_1	0	40	0	**6/10**	5/10	1	-1/10	0	←400/6 = 67
2/3	x	10	60	1	4/10	5/10	0	1/10	0	600/4 = 150
2	S_3	0	180	0	12/10	5	0	-2/10	1	150
$Z_J = \Sigma C_{BI} X_J$				10	4	5	0	1	0	
$C_J - Z_J$				0	2↑	-1	0	-1	0	

Simplex tableau 3

Cj				10	6	4	0	0	0	Replacement Ratio
Fixed Ratio	Basic Variables	C_B	Value of basic variables $b = (X_B)$	x	y	z	S_1	S_2	S_3	
	y	6	400/6	0	1	5/6	10/6	-1/6	0	
	x	10	100/3	1	0	1/6	-2/3	0	0	
	S3	0	100	0	0	4	-2	0	-1	
$Z_J = \Sigma C_{BI} X_J$				10	6	20/3	10/3	+2/3	0	
$C_J - Z_J$				0	0	-8/3	-10/3	-2/3	0	

$C_J - Z_J$ since all entries in index row $(C_J - Z_J)$ are - ve or zero. Current solution is optimum.

Hence, the most profitable mix is y = 400/6 Resistors, x = 100/3 Transistors and z = 0 Carbon tube.

The Maximum Profit is $6 \times 400/6 + 10 \times 100/3 =$ ₹ 733.33

For Notes

For Notes

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 7	Transportation

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	-	-
2.	Procedure of solution of Transportation Problems	4	-

SECTION-A

PYQ 2021-Dec [7] Activities required to design, develop, produce, market, distribute, and service a product are known as
(1) target activities.
(2) value-chain activities.
(3) whole life activities.
(4) overhead. **(1 Mark) [Sec. A - MCQ]**

Answer:
(2) value-chain activities.

PYQ 2021-Dec [14] In a transportation matrix (where Ri are rows and Cj are columns), the second allocation under the North West Corner Rule can be
(1) R1C2 (2) None of these
(3) R2C3 (4) R1C3
(1 Mark) [Sec. A - MCQ]

Answer:
(1) R1C2

PYQ 2023-Jun [7] (i) {C} Choose the most appropriate answer to the following questions giving justification.
Assignment Problem can be considered as a particular case of
(a) Transportation problem
(b) Sequencing problem
(c) Queuing problem
(d) All of the above **(2 Marks)**
Answer: (a) Transportation problem

PYQ 2023-Dec [1] (vi) {C} Choose the correct option.
The highest negative opportunity cost value in an unused cell of a Transportation Matrix is chosen to improve the current solution because–
(a) It represents maximum possible cost reduction per unit.
(b) It ensures no violation of Rim Condition.
(c) It represents per unit cost improvement.
(d) Either one of the above **(2 Marks)**
Answer: (a) It represents maximum possible cost reduction per unit.

PYQ 2024-Jun [1] (xiii) {C} Choose the correct option from the four alternatives given:
When a maximisation assignment problem is converted to minimisation problem, the resultant matrix is called:
(a) Profit Matrix (b) Regret Matrix
(c) Cost Matrix (d) Dummy Matrix **(2 Marks)**
Answer: (b) Regret Matrix

PYQ 2025-Jun [1] (vii) {C} Choose the correct option from the given alternatives:
In marking assignments which of the following should be preferred?
(a) Only row having single zero
(b) Only column having single zero
(c) Column having more than one zero
(d) Only row/column having single zero **(2 Marks)**
Answer: (d) Only row/column having single zero

SECTION-B

02 *Procedure of solution of Transportation Problems*

THEORY QUESTIONS

TQ 2.1	PYQ	2016-Jun [8] (d)	DESC	4 Marks
Write two conditions which are to be fulfilled for application of 'Optimality Test' in case of transportation problem.				

Answer:
Once an initial solution is obtained, the next step is to check its optimality. The 'optimality test' can be applied if it satisfies the following two conditions:
1. It contains exactly m + n - 1 allocation where m and n represent the number of rows and column of the table respectively.
2. These allocations are independent i.e. a loop cannot be performed by them.

TQ 2.2	PYQ	2018-Dec [8] (e)	SN	4 Marks
Write short notes on the following: Methods of Solving Transportation Problem				

Answer:
The following are the methods of solving transportation problem:
1. The North-West corner rule
2. Least Cost Method
3. Vogel's Approximation Method

1. North West Corner Method (NWCM):
The simplest of the procedures used to generate an initial feasible solution is NWCM.

It is so called because we begin with the north west or upper left corner cell of our transportation table.

Different steps of this method are given below:

Step 1:	Select the north west (upper left-hand) corner cell of the transportation table and allocate as many units as possible equal to the minimum between available supply and demand requirement, i.e., min
Step 2:	Adjust the supply and demand numbers in the respective rows and columns allocation.
Step 3:	(a) If the supply for the first row is exhausted, then move down to the first cell in the second row and first column and go to step 2. (b) If the demand for the first column is satisfied, then move horizontally to the next cell in the second column and first row and go to step 2.
Step 4:	If for any cell, supply equals demand, then the next allocation can be made in cell either in the next row or column.
Step 5:	Continue the procedure until the total available quantity is fully allocated to the cells required.

2. Least Cost Method:

The allocation according to this method is very useful as it takes into consideration the lowest cost and hence, reduces the computation as well as the amount of time necessary to arrive at the optimum Solution.

Different steps of this method are given below:

Step 1:	(a) Select the cell with the lowest transportation cost among all the rows or columns of the transportation table. (b) If the minimum cost is not unique, then select arbitrarily any cell with this minimum cost.

Step 2:	Allocate as many units as possible to the cell determined in step 1 and remove that row (column) in which either supply is exhausted or demand is satisfied.
Step 3:	Repeat steps 1 and 2 for the reduced table until the entire supply at different factories is exhausted to satisfy the demand at different warehouses

3. Vogel's Approximation Method

This method is preferred over the other two methods because the initial basic feasible solution obtained is either optimum or very close to the optimum solution.

Hence, the amount of time required to arrive at the optimum solution is greatly reduced. Different steps of this method are given below:

Step 1:	Compute a penalty for each row and column in the transportation table. The penalty for a given row and column is merely the difference between the smallest element and the next smallest element in that particular row or column.
Step 2:	Identify the row or column with the largest penalty. In this identified row or column, choose the cell which has the smallest cost and allocate the maximum possible quantity to the lowest cost cell in that row or column so as to exhaust either the supply at a particular source or satisfy demand at a warehouse.
Step 3:	Reduce the row supply or the column demand by the amount assigned to the cell.
Step 4:	If the row supply is now zero, eliminate the row, if the column demand is now zero, eliminate the column, if both the row supply and the column demand are zero, eliminate both the row and column.
Step 5:	Re-compute the row and column difference for the reduced transportation table, omitting rows or columns crossed out in the preceding step.

Step 6:	Repeat the above procedure until the entire supply at factories is exhausted to satisfy demand at various warehouses.

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2025-Jun [6] (a)	7 Marks

CNG Ltd., (CNGL), a compressed natural gas (CNG) company, has three plants producing gas and four outlets. The cost of transporting gas from different production plants to the outlets, production capacity of each plant and requirement at different outlets is shown in the following cost-matrix table:

Plants	Outlets				Capacity of Production (Units)
	A	B	C	D	
X	4	6	8	6	700
Y	3	5	2	5	400
Z	3	9	6	5	600
Requirement (Units)	400	450	350	500	1,700

(The cost in the cost-matrix is given in thousand of rupees.)

Required:

(i) Analyze and show the production and distribution schedule in a way which minimizes the transportation costs of the company using Vogel's Approximation Method (VAM).

(ii) Assess the total costs of transporting gas of the company.

Answer:

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

	OUTLETS					
PLANTS	A	B	C	D	CAPACITY	DIFF.
X	4	[400] 6	8	[300] 6	700/300/0	2,200
Y	3	[50] 5	[350] 2	5	400/50/0	1,200
Z	[400] 3	9	6	[200] 5	600/200/0	224-
Requirement	400/0	450/400/0	350/0	500/300/0		

Diff.	0	1	4	0
	0	1	-	0
	-	1	-	0
	-	1	-	1

The initial feasible solution obtained by VAM is given below:

	OUTLETS				
PLANTS	A	B	C	D	CAPACITY
X	4	[400] 6	8	[300] 6	700
Y	3	[50] 5	[350] 2	5	400
Z	[400] 3	9	6	[200] 5	600
Requirement	400	450	350	500	

As the number of allocations = 6 = (m + n - 1), the above initial basic feasible solution is non-degenerate and hence an optimum solution can be obtained.

Test of Optimality:

Let us introduce U_i (i = 1, 2, 3) and V_j (J = 1, 2, 3, 4) . We assume $U_1 = 0$ and other Ui and Vj can be calculated by using the relation $C_{ij} = U_i + V_j$ for allocated cells.

The opportunity costs for the unallocated cells can be calculated using the relation $\Delta_{ij} = C_{ij} - (U_i + V_j)$. The calculations of U_i'S, V_j'S and Δ_{ij}'S are given below:

	OUTLETS				
Plants	**A**	**B**	**C**	**D**	**Ui**
X	0 4	[400] 6	5 8	[300] 6	0
Y	0 3	[50] 5	[350] 2	0 5	-1
Z	[400] 3	4 9	4 6	[200] 5	-1
Vj	4	6	3	6	

On Calculating Δ_{ij}'S for non-allocated cells, we found that all the Δ_{ij} 0, hence the initial solution obtained above is optimal.

(ii) Calculations of the total costs:

Plants	Outlet	Units		Cost		Total Cost
X	→B	400	X	6	=	2,400
X	→D	300	X	6	=	1,800
Y	→B	50	X	5	=	250
Y	→C	350	X	2	=	700
Z	→A	400	X	3	=	1,200
Z	→D	200	X	5	=	1,000
						7,350

The minimum cost = 7,350 thousand rupees.

CSQ 2.2	PYQ	2026-Jun [6] (b)	7 Marks

Singh Transporters has trucks available at four different sites in the following numbers:
Site A - 5 trucks
Site B - 10 trucks
Site C - 7 trucks
Site D - 3 trucks

Customers - W, X and Y require trucks as shown below:
Customer W - 5 trucks
Customer X - 8 trucks
Customer Y - 10 trucks
Variable costs of getting trucks to the customers are given below:
From A to W = ₹7, to X = ₹3,to Y = ₹6
From B to W = ₹4 ,to X = ₹6, to Y = ₹8
From C to W = ₹5, to X = ₹8, to Y = ₹4
From D to W = ₹8, to X = ₹4, to Y = ₹3
Develop the above as a transportation problem and apply Vogel's Approximation Method to find the initial solution.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

For Notes

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THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 8	Assignment

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	2	-
2.	Mathematical statement of the problems	8	-

SECTION-A

PYQ 2023-Dec [1] (xi) {C} Choose the correct option.
The value of the game of

Player A		Player B	
		B_1	B_2
	A1	4	6
	A2	-10	10

is _____. Fill in the above.
(a) 4 (b) 6
(c) 8 (d) None of the above **(2 Marks)**
Answer: (a) 4

PYQ 2024-Jun [1] (v) {C} Choose the correct option from the four alternatives given:
The Pay-off Matrix of a game is given below:

$$\begin{matrix} & \text{Player B} \\ \text{Player A} & \begin{pmatrix} 3 & -1 & 4 \\ -1 & 8 & 2 \\ 16 & 8 & 6 \end{pmatrix} \end{matrix}$$

What is the value of Game to Player A (using Maximin-Minimax Principle)?

(a) 6
(b) 8
(c) 16
(d) None of the above **(2 Marks)**

Answer: (a) 6

PYQ 2025-Jun [1] (x) {C} Choose the correct option from the given alternatives:
The pay-off matrix of game for Firm A and Firm B is given below:

	FIRM B			
FIRM A	30	15	12	35
	20	13	8	10
	40	4	11	6

What is the value of game (using Maximin – Minimax Principle)?
(a) 6
(b) 10
(c) 12
(d) None of the above **(2 Marks)**

Answer: (c) 12

PYQ 2026-Jun [1] (vi) {C} Choose the correct option from the four alternatives given:
A firm is required to procure three items I, II & III from three vendors V_1, V_2 & V_3 respectively. The quoted prices in Rupees are given in the table below. The management policy clearly states that each item should be procured from only one vendor and each vendor should supply only one item. The minimum total cost of procurement following the principle of Assignment is

	VENDORS		
ITEMS	V_1	V_2	V_3
I	220	240	260
II	230	280	280
III	250	290	330

(a) ₹750
(b) ₹770
(c) ₹780
(d) ₹790 **(2 Marks)**

SECTION-B

01 Introduction

THEORY QUESTIONS

TQ 1.1	PYQ	2018-Dec [8] (b)	SN	4 Marks
Write short notes on the following: Assignment				

Answer:
Assignment is a special linear programming problem.
There are many situations where the assignment of people or machines etc. may be called for.
Assignment of workers to machines, clerks to various check-out counters, salesmen to different sales areas are typical examples of these.
The Assignment is a problem because people possess varying abilities for performing different jobs and therefore the costs of performing jobs by different people are different.
Hence, in an assignment problem, the question is how the assignments should be made in order that the total cost involved is minimized.
The following are the methods of solving an assignment problem. They are:
1. Complete Enumeration Method
2. Simplex Method
3. Transportation Method and
4. Hungarian Method

TQ 1.2	PYQ	2019-Dec [8] (e)	SN	4 Marks
Write short notes on the following: Assignment.				

Answer:
Please refer 2018-Dec [8] (b)

02 Mathematical statement of the problems

CASE-SCENARIO QUESTIONS

CSQ 2.1 | PYQ | 2019-Jun [7] (a) | 8 Marks

In the manufacturing plant of Delite Industries Ltd., four jobs can be processed on four different machines, one job on one machine. Resulting profits vary with assignments. They are given below:

		Machines			
Jobs	I	42	35	28	21
	II	30	25	20	15
	III	30	25	20	15
	IV	24	20	16	12

Required:
Find the optimum assignment of jobs to machines and the corresponding profit.

Answer:

Profit Matrix:

0	7	14	21
12	17	22	27
12	17	22	27
18	22	26	30

Row Operation:

0	7	14	21
0	5	10	15
0	5	10	15
0	4	8	12

Column Operation:

0	3	6	9
0	1	2	3
0	1	2	3
0	0	0	0

Improved Matrix:

0	2	5	8
0	0	1	2
0	0	1	2
1	0	0	0

Further Improvement:

0	2	4	7
0	0	0	1
0	0	0	1
2	1	0	0

I	-	1	-	42
II	-	2	-	25
III	-	3	-	20
IV	-	4	-	12
				99

Maximum Profit = ₹ 99

CSQ 2.2 | PYQ | 2021-Dec [20] | 1 Mark

In a 4 x 4 assignment algorithm carried out by a student, the number of lines used to cover the zeroes was 4, though he could have covered them in three lines. What will he face in the next step?

[Sec. B - SAQ]

Answer:

3 allotments and zeros will be exhausted

CSQ 2.3 | PYQ | 2021-Dec [1] | 8 Marks

A company has four territories open, and four salesmen available for assignment. The territories are not equally rich in their sales potential; it is estimated that typical salesman operating in each territory would bring in the following annual sales.

Territory	1	2	3	4
Annual Sales (₹ In 000's)	60	50	40	30

The four salesmen are also considered to differ in their ability; it is estimated that, working under the same conditions, their yearly sales would be proportionately as follows:

Salesman	A	B	C	D
Proportion	6	4	3	8

(i) If the criterion is maximum expected sales, the cost minimization matrix is
(ii) Matrix for Column minimum operation is
(iii) If the criterion is maximum expected sales, final assignment of salesman to the territories that result in optimum expected sales is

[Sec. C - Three LAQ]

Answer:

Maximisation matrix

T/S	6	5	4	3
6	36	30	24	18
4	24	20	16	12
3	18	15	12	9
8	48	40	32	24

(i) Cost Minimisation matrix

12	18	24	30
24	28	32	36
30	33	36	39
0	8	16	24

Row Minimum operation

0	6	12	18
0	4	8	12
0	3	6	9
0	8	16	24

(ii) Columum Minimum operation

0	3	6	9
0	1	2	3
0	0	0	0
0	5	10	15

Minimum uncovered element operation

0	2	5	8
0	0	1	2
-	0	0	0
0	4	9	14

Minimum uncovered element operation

0	2	4	7
0	0	0	1
2	1	0	0
0	4	8	13

Minimum uncovered element operation

0	0	2	5
2	0	0	1
4	4	0	0
0	2	6	11

S \ T	1	2	3	4
A		[0]		
B			[0]	
C				[0]
D	[0]			

(iii) Optimal assignment. Optimum Sales Value is as follows:

Sales Man	Territory	Sales (₹ 000)
A	2	30
B	3	16
C	4	9
D	1	48
	Total	**103**

CSQ 2.4 | **PYQ** | **2022-Dec [6] (a)** | **8 Marks**

In a textile sales emporium of SONTEX Ltd. four salesmen A,B,C and D are available to four counters W, X, Y and Z. Each salesman can handle any counter. Their services (in hour) of each counter, when manned by each salesman is given below:

Counter	Salesman			
	A	B	C	D
W	41	72	39	52
X	22	29	49	65
Y	27	39	60	51
Z	45	50	48	52

Required:
How should the salesmen be allocated appropriate counters so as to minimize the service time? Each salesman must handle only one counter.

Answer:

Step: 1 Row subtraction

Counter \ Sales Man	A	B	C	D
W	2	33	0	13
X	0	7	27	43
Y	0	12	33	24
Z	0	5	3	7

Column subtraction

Counter \ Sales Man	A	B	C	D
W	2	28	0	6
X	0	2	27	36
Y	0	7	33	17
Z	0	0	3	0

Step 2: Minimum straight lines to cover zeros.

Counter \ Sales Man	A	B	C	D
W	~~2~~	~~28~~	~~0~~	~~6~~
X	0	2	27	36
Y	0	7	33	17
Z	~~0~~	~~0~~	~~3~~	~~0~~

Step 3: Smallest uncovered number subtracted from uncover numbers, added to number at intersection of two lines.

Counter \ Sales Man	A	B	C	D
W	~~1~~	~~28~~	~~0~~	~~0~~
X	0	0	25	34
Y	0	5	31	15
Z	~~1~~	~~0~~	~~9~~	~~0~~

In row Z, column 3, should be 3 instead of 9.

Step 4: Return to Step 2. Cover all Zeros. since the number of lines is 4, the optimality criteria is satisfied.

Counter \ Sales Man	A	B	C	D
W	4	28	[0]	6
X	~~0~~	[0]	25	34
Y	[0]	5	31	15
Z	2	~~0~~	3	[0]

It should be step 3 instead of 2.

Allocation of Sales men and Total Times

Counter	Salesmen	Times (Hours)
W	C	39
X	B	29
Y	A	27
Z	D	52
Total		**147**

CSQ 2.5	PYQ	2023-Jun [8] (b)	8 Marks

A travelling salesman has to visit five cities. S,T, X,Y and Z. The inter city distances are tabulated below. Note the distance between two cities need not be same both ways.

From/To	S	T	X	Y	Z
S	-	14	26	27	17
T	8	-	18	20	9
X	12	13	-	20	14
Y	16	19	24	-	18
Z	14	15	25	27	-

The distance are in km.

Required:

If the travelling salesman starts from City S and has to come back to city S, by applying the principle of quantitative technique, which route would you advise him to take so that total distance travelled by him is minimized?

Answer:

	Profit matrix				
	S	T	X	Y	Z
S	-	14	26	27	17
T	8	-	18	20	9
X	12	13	-	20	14
Y	16	19	24	-	18
Z	14	15	25	27	-

Step 1: Row operation					
	S	T	X	Y	Z
S	-	0	12	13	3
T	0	-	10	12	1
X	0	1	-	8	2
Y	0	3	8	-	2
Z	0	1	11	13	-

Step 2: Column operation					
	S	T	X	Y	Z
S	-	0	4	5	2
T	0	-	2	4	0
X	0	1	-	0	1
Y	0	3	0	-	1
Z	0	1	3	5	-

Assignment Allocation					
	S	T	X	Y	Z
S	-	[0]	4	5	2
T	0	-	2	4	[0]
X	0	1	-	[0]	1
Y	0	3	[0]	-	1
Z	[0]	1	3	5	-

S – T – Z – Y – X – S

14 + 9 + 20 + 24 + 14

= 81 KMs.

The Optimum Distance is 81 KMs.

CSQ 2.6	PYQ	2023-Dec [6] (a)	7 Marks

MR TUSHAR, production supervisor is considering how he should assign five jobs that are to be performed, to the mechanists working under him. He wants to assign the jobs to the mechanists in such a manner that the aggregate cost to perform the jobs is the least. He has following information about the wages paid to the mechanists for performing these jobs.

	Jobs				
Mechanist	**1**	**2**	**3**	**4**	**5**
A	10	3	3	2	8
B	9	7	8	2	7
C	7	5	6	2	4
D	3	5	8	2	4
E	9	10	9	6	10

Required:

Analyse and assign the jobs to the mechanists so that the aggregate cost is the least.

Answer:

The given problem is a standard minimization problem.

Subtracting minimum element of each row from all the elements of that row, the given problem reduces to

	JOBS				
Mechanist	1	2	3	4	5
A	8	1	1	0	6
B	7	5	6	0	5
C	5	3	4	0	2
D	1	3	6	0	2
E	3	4	3	0	4

Subtract the minimum element of each column from all the elements of that column. Draw the minimum number of lines horizontal or vertical so as to cover all zeros.

JOBS

Mechanist	1	2	3	4	5
A	~~7~~	~~0~~	~~0~~	~~0~~	~~4~~
B	6	4	5	0	3
C	4	2	3	0	0
D	~~0~~	~~2~~	~~5~~	~~0~~	~~0~~
E	2	3	2	0	2

Since the minimum number of lines covering all zeros is equal to 4 which is less than number of columns/row (= 5), the above table will not provide optimal solution. Subtract the minimum uncovered element (= 2) from all uncovered elements and add to the elements lying on the intersection of two lines, we get the following matrix.

Mechanist	JOBS 1	2	3	4	5
A	7	0	0	2	6
B	4	2	3	0	3
C	2	0	1	0	0
D	0	2	5	2	2
E	0	1	0	0	2

Since the minimum number of horizontal and vertical lines to cover all zeros is equal to five which is equal to the order of the matrix, the above table will give the optimal solution. The optimal assignment is made below.

Mechanist	JOBS 1	2	3	4	5
A	7	[0]	~~0~~	2	6
B	4	2	3	[0]	3
C	2	~~0~~	1	~~0~~	[0]
D	[0]	2	5	2	2
E	~~0~~	1	[0]	~~0~~	2

The optimal assignment is given below:

Mechanist	Job	Wages (₹)
A	2	3
B	4	2
C	5	4
D	1	3
E	3	9
		21

The total least cost associated with the optimal mechanist-job assignment = 21

CSQ 2.7	PYQ	2024-Dec [6] (a)	7 Marks

A salesman has to visit five cities A, B, C, D and E. The inter-city distances in kilometre are tabulated below. Note the distance between two cities need not be same both ways.

From / To	A	B	C	D	E
A	-	12	24	25	15
B	6	-	16	18	7
C	10	11	-	18	12
D	14	17	22	-	16
E	12	13	23	25	-

If the salesman starts from city A and has to come back to city A, by applying the principles of Assignment which route would you advise him to take so that total distance travelled by him is minimised?

Answer:

Reduced matrix after Row subtraction operation:

Table-1

From / To	A	B	C	D	E
A	-	0	12	13	3
B	0	-	10	12	1
C	0	1	-	8	2
D	0	3	8	-	2
E	0	1	11	13	-

Reduced matrix after Column subtraction operation:

Table-2

From / To	A	B	C	D	E
A	-	0	4	5	2
B	0	-	2	4	0
C	0	1	-	0	1
D	0	3	0	-	1
E	0	1	3	5	-

Now, minimum number of straight lines to cover all the zeroes = 5 = order of the matrix. Thus, the solution is optimal. Here, assignments done by following standard rules of Hungarian method is as follows:

From / To	A	B	C	D	E
A	-	[0]	4	5	2
B	0	-	2	4	[0]
C	0	1	-	[0]	1
D	0	3	[0]	-	1
E	[0]	1	3	5	-

In the above solution, the salesman will travel from A to B, B to E, then E to A. This is not meeting the requirement of travelling through all the cities and finally returning to the starting point. Therefor, the solution is unacceptable. Under this situation, it is decided to try for the assignment at the cells which are having next higher entry after zero. The next minimum non-zero element in the matrix is 1and 2.Thus, an assignment is made at cell (5,4) instead of zero assignment at cell (4,3) and at cell (2,3) instead of cell (2,5).

The resulting solution will be:

From / To	A	B	C	D	E
A	-	[0]	4	5	2
B	0	-	[2]	4	0
C	0	1	-	[0]	1
D	0	3	0	-	[1]
E	[0]	1	3	5	-

The solution is A →B →C →D →E → A.

The distance travelled will be = 12+16+18+16+12 = 74 km.

There can be another schedule also: A →B →E →C →D →A.

Based on this, distance will be = 12 + 7 + 23 + 18 + 14 = 74 km.

CSQ 2.8	PYQ	2025-Dec [6] (b)	7 Marks

A State Municipal Corporation has decided to carry out road repairs on four main roads in the city and you have been asked to advise them the least cost allocation.

It is learnt that the State Government has agreed to make a special grant of ₹114 lakhs towards the cost with the condition that the repairs should be carried at the lowest cost. Five contractors have sent their bids. Only one road will be awarded to one contractor. The bids are given below:

		Cost of Repairs (₹ in Lakhs)			
Contractors	Road	R1	R2	R3	R4
	C1	18	28	38	30
	C2	14	34	40	39
	C3	18	36	42	38
	C4	20	24	36	36
	C5	20	30	42	32

You are also informed that contractor C1 should get R1 and C5 should get R2 to minimise costs.

(i) By applying the principles of Assignment, assess the minimum cost of allocation.

(ii) Calculate the minimum discount that the eliminated contractor should offer for meriting a contract.

Answer:

(i) There are 5 rows and 4 columns, hence a dummy column is to be inserted. Further, assigning C1 → R1 and C5 → R2, we have the cost table:

Contracto	Cost of Repairs (₹in Lakhs)		
Road	R3	R4	Dummy
C2	40	39	0
C3	42	38	0
C4	36	36	0

As there is ZERO in each row, we go straight to the column reduction:

Contracto	Cost of Repairs (₹in Lakhs)		
Road	R3	R4	Dummy
C2	4	3	0
C3	6	2	0
C4	0	0	0

The minimum number of lines to cover all zeroes is 2, which is less than 3, the order of the matrix. Hence, optimum solution has not been reached and the solution needs to be improved.

To improve the solution, the minimum uncovered element (i.e. 2) is deducted from all the uncovered elements and added with the covered elements at the junction. The new matrix will be as under:

Contracto	Cost of Repairs (₹in Lakhs)		
Road	R3	R4	Dummy
C2	2	1	0
C3	4	0	0
C4	0	0	2

The minimum number of lines to cover all zeroes is 3, which is equal to the order of the matrix, hence optimum solution has been reached. The assignment is made below:

Contracto	Cost of Repairs (₹ in Lakhs)		
Road	R3	R4	Dummy
C2	2	1	[0]
C3	4	[0]	0
C4	[0]	0	2

The optimal assignment is:

Contractor	Road	Cost (₹ in lakhs)
C1	R1	18

C2	No assignment	X
C3	R4	38
C4	R3	36
C5	R2	30
Total		122

Hence, total minimum cost of the repair project is ₹ 122 lakhs.

(ii) **Minimum Discount for eliminated contractor is calculated below:**

The eliminated contractor is C2, as they were not assigned any road in the optimal plan.

To "merit a contract" C2 must offer a price lower than the current winning bids for the roads they are most competitive in (R3 or R4)

Current cost for R4: 38 lakhs (assigned to C3)

C2 's current bid for R4: ₹ 39 lakhs.

Required discount: C2 must at least match the current assignment: ₹ (39 - 38) = ₹ 1 lakh. C2 must offer a minimum Discount of ₹ 1 lakh to equal C3 from R4.

OR: The minimum discount of ₹ 4 lakhs (40- 36) must offer by C2 to get/ equal C4 from R3

For Notes

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 9 Game Theory

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	1	-
2.	Solution of Pure Strategy Games with saddle Point	-	-
3.	Principle of Dominance	1	-
4.	Solution of mixed Strategy Games	1	-
5.	Limitation of Game Theory	-	-

SECTION-A

PYQ 2023-Dec [1] (ix) {C} Choose the correct option.
The drive-up window of a fast-food operation was being studied using simulation for a variety of operating characteristics. As part of the study, data was collected on Order Processing Time as given in the following table. Using the first two digits of the Random Numbers, determine the processing time that would be used to simulate the fifth sample.

Processing time (Minutes)	1	2	3	4
Probability	0.30	0.45	0.20	0.05

Customer	1	2	3	4	5	6	7	8	9
Random No.	1048	2236	2413	4216	3757	1501	4657	4836	9309

(a) 2 minutes (b) 4 minutes
(c) 1 minute (d) 3 minutes **(2 Marks)**
Answer: (a) 2 minutes

PYQ 2024-Jun [1] (xiv) {C} Choose the correct option from the four alternatives given:
The important step(s) required for simulation approach in solving a problem is/are:
(a) Test and validate the Model
(b) Design the experiment
(c) Conduct the experiment
(d) All of the above **(2 Marks)**
Answer: (d) All of the above

PYQ 2024-Dec [1] (xv) {C} Choose the correct option from the four alternatives given:
Children's Park in a city with various signals and crossing is the simulated model of city traffic. This is a type of
(a) Analogue Simulation
(b) Computer Simulation
(c) Monte Carlo Simulation
(d) Both (A) and (C) of the above **(2 Marks)**
Answer: (a) Analogue Simulation

2025-Dec [1] (vii) {C} Choose the correct option from the given alternatives:
The pay-off matrix of a game for the Company S and Company T is given below:

	Company T			
Company S	25	12	10	30
	15	13	6	8
	30	5	8	6

Using Maximin-Minimax principle what will be the value of the game?
(a) 15
(b) 12
(c) 10
(d) None of the above **(2 Marks)**
Answer: (c) 10

SECTION-B

01 Introduction

CASE-SCENARIO QUESTIONS

CSQ 1.0	PYQ	2026-Jun [7] (a)	7 Marks

The two breakfast food manufacturing firms A and B are competing for an increased market share. To improve its market share, both the firms decide to launch the following strategies:
A1, B1 = Give coupons
A2, B2 = Decrease price
A3, B3 = Maintain present strategy
A4, B4 = Increase advertising
The pay- off matrix, shown in the following table, describes the increase in market share for firm A and decrease in market share for firm B:

		FIRM B			
		B1	B2	B3	B4
FIRM A	A1	35	35	25	5
	A2	30	20	15	0
	A3	40	50	0	10
	A4	55	60	10	15

Suggest the optimal strategy for Firm A and assess the value of the game.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.
Access the LMS using the secret code printed on the first coloured page of this book.
For Your Reflections & Learning Notes:

03 Principle of Dominance

CASE-SCENARIO QUESTIONS

CSQ 3.1	PYQ	2023-Jun [9] (a)	8 Marks

A and B play game in which each has three coins, a 5R, 10R and 20R. Each selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, A wins B's coin, if the sum is even B wins A's coin.
Required:
(i) Prepare the pay-off matrix for two players (A and B).
(ii) Find the best strategy for each player and
(iii) Calculate the value of Game using Dominance Principle.

Answer:
(i) The pay – off matrix for two players is given by

$$\begin{array}{cc} & \begin{matrix} B_1 & B_2 & B_3 \end{matrix} \\ \text{Player A} \begin{matrix} A_1 \\ A_2 \\ A_3 \end{matrix} & \begin{bmatrix} -5 & 10 & 20 \\ 5 & -10 & -10 \\ 5 & -20 & -20 \end{bmatrix} \end{array}$$

(ii) As all elements of 2nd Row of the above matrix are either greater than or equal to the corresponding elements of the 3rd Row, the 2nd row can be considered to dominate the 3rd Row. So 3rd Row is ignored and new matrix is shown below:

$$\begin{array}{cc} & \begin{matrix} B_1 & B_2 & B_3 \end{matrix} \\ \text{Player A} \begin{matrix} A_1 \\ A_2 \end{matrix} & \begin{bmatrix} -5 & 10 & 20 \\ 5 & -10 & -10 \end{bmatrix} \end{array}$$

Again all the elements of 3rd Column are greater than or equal than the all elements of 2nd column, the 2nd column is dominated by 3rd Column. Hence 3rd column is ignored and the new matrix is shown below:

	Player B B_1	Player B B_2
Player A A_1	-5	10
Player A A_2	5	-10

The game, clearly, has no saddle point and using the principle of dominance, the reduced 2 x 2 pay – off matrix will be:

	Player B B_1	Player B B_2
Player A A_1	-5	10
Player A A_2	5	-10

The optimum mixed strategy for player A:

$P_1 = \frac{1}{2}$ and $P_2 = \frac{1}{2}$

And for the player B:

$q_1 = \frac{2}{3}$ and $q_2 = \frac{1}{3}$

(iii) The expected value of the game: v = 0

04 Solution of mixed Strategy Games

CASE-SCENARIO QUESTIONS

CSQ 4.1 | PYQ | 2024-Dec [8] (a) | 7 Marks

Two Firms P and Q are competing for business under the conditions so that one firm's gain is another firm's loss. Firm P's pay-off matrix is given below:

		Firm Q		
		No Advertising	Medium Advertising	Heavy Advertising
Firm P	No Advertising	10	5	-2
	Medium Advertising	13	12	15
	Heavy Advertising	16	14	10

Required:

(i) Suggest optimal strategies for the two firms.

(ii) Assess the value of Game.

Answer:

Clearly, the first column is dominated by the second column as all the elements of the first column are greater than elements of second column. Thus eliminating first column, we get

		FIRM Q: Medium Advertising	FIRM Q: Heavy Advertising
FIRM P	No. Advertising	5	-2
	Medium Advertising	12	15
	Heavy Advertising	14	10

Again, first row is dominated by second and third row as all the elements of first row are less than the respective elements of second and third row. Therefore eliminating first row, we obtain the following 2 x 2 pay-off matrix.

		FIRM Q: Medium Advertising	FIRM Q: Heavy Advertising
FIRM P	Medium Advertising	12	15
	Heavy Advertising	14	10

Since the pay-off matrix does not possess any saddle point, the firms will use mixed strategies. The optimum mixed strategy for firm P is determined by:

$p_i = \frac{10-14}{12+10-(14+15)} = \frac{4}{7}$ and $p_2 = 1-p_i = \frac{3}{7}$

and for the firm Q is given by:

$q_i = \frac{10-15}{12+10-(14+15)} = \frac{5}{7}$ and $q_2 = 1-q_i = \frac{2}{7}$

Therefore, the optimum strategies for the two firms are:

	No Advertising	Medium Advertising	Heavy Advertising
S_A =	0	4/7	3/7

For Notes

$$S_B = \begin{matrix} \text{No Advertising} & \text{Medium Advertising} & \text{Heavy Advertising} \end{matrix} \\ \begin{bmatrix} 0 & 5/7 & 2/7 \end{bmatrix}$$

The Value of the game (corresponding to the above strategies) is given by:

$$v = \frac{12\times10 - 14\times15}{12+10-(14+15)} = \frac{90}{7}$$

Hence, the Value of the game is v = 90 / 7

For Notes

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER	
10	**Simulation**

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	1	-
2.	Advantages of Simulation	-	-
3.	Limitations of Simulation	2	-
4.	Steps involved in constructing and using a Simulation Model	-	-
5.	Monte Carlo Simulation	9	-

SECTION-A

PYQ 2016-Dec [1] (c) (iv) {C} Define the following terms in just one or two sentence(s):

PERT **(1 Mark)**

Answer: Programme, Evaluation and Review Technique (PERT)- Programme, Evaluation and Review Technique (PERT) is a technique for planning, scheduling and controlling of projects whose activities are subject to uncertainty in the performance. PERT and CPM are the two techniques of network analysis. PERT is known as a probabilistic model.

PYQ 2018-Jun [1] (x) Choose the most appropriate answer to the following questions giving justification:

Which of the following is correct in the context of network analysis?

(a) There can be one or more activities without a predecessor in a network

(b) Where two activities have the same start and end events, the end event of one activity is numbered differently and then connected by a dummy to the original start event.

(c) When crashing is carried out, the non-critical paths have to remain non critical.

(d) If the critical path is longer than the other paths, the project may be completed by using a path having a shorter duration. **(2 Marks)**

Answer: (a) Explanation: More than 1 activity can begin at the first node, say 1 – 2, 1 – 3, 1 – 4, etc. Each of these will have no predecessor.

PYQ 2018-Dec [1] {C} Choose the most appropriate answer to the following questions giving justification:

(ix) In the context of Critical Path Analysis, the portion of the float of an activity which cannot be consumed without affecting adversely the float of the subsequent activities is called

(a) Free float (b) Interfering float
(c) Independent float (d) Total float **(2 Marks)**

Answer: (b) Interfering float is that part of the total float which causes a reduction in the float of the successor activities. It is the difference between the latest finish time of the activity in question and the earliest starting time of the following activity or zero, whichever is larger.

(x) In CPA (Critical Path Analysis) which of the following is not a correct step in sequence?

(a) Understanding the logic of the system under consideration
(b) Constructing the net work
(c) Providing estimates for activity duration
(d) Implementing and controlling the net work **(2 Marks)**

Answer: (d) Because step no. 4 i.e. (d) should be satisfying the objectives. Implementing and controlling the network would be the final step.

PYQ 2019-Dec [1] (iii) Choose the most appropriate answer to the following questions giving justification/reasonable workings:
In a PERT network, the optimistic time for a particular activity is 9 weeks and the pessimistic time is 21 weeks. Which one of the following is the best estimate of the standard deviation for the activity?

(a) 12 (b) 9
(c) 6 (d) 2 **(2 Marks)**

Answer: (d) Standard Deviation equals (pessimistic time minus optimistic Time)/6 that is 21– 9/6 = 2

PYQ 2021-Dec [12] The following will be the appropriate action to finish a project early

(1) Crash activities on the non critical path so that they become critical
(2) Crash activities on the non critical paths so that they remain non critical
(3) Crash activities on the critical path so that they become non critical
(4) Crash activities on the critical paths such that the critical paths remain critical **(1 Mark) [Sec. A - MCQ]**

Answer:

(4) Crash activities on the critical paths such that the critical paths remain critical

PYQ 2022-Dec [1] (viii) {C} Choose the most appropriate answer to the following questions:
A PERT network has only two activities on its critical Path. The Standard Deviation of these activities are 6 and 8 respectively. What is the Standard Deviation of the Project completion time?

(a) 7 (b) 10
(c) 14 (d) 100 **(2 marks)**

Answer: (b) 10

PYQ 2023-Jun [7] (ii) {C} Choose the most appropriate answer to the following questions:
In PERT CHART, the Activity time distribution is

(a) Normal (b) Binomial
(c) Beta (d) Poisson **(2 Marks)**

Answer: (c) Beta

PYQ 2023-Dec [1] (xii) {C} Choose the correct option.
The slack time of tail event of activity Z of a project is 2 days. If the Total Float and Free float of the activity Z are 10 days and 7.days respectively, the Independent float of activity Z will be:
(a) 5 days (b) 6 days
(c) 7 days (d) 2 days **(2 Marks)**
Answer: (a) 5 days

PYQ 2024-Jun [1] (xv) {C} Choose the correct option from the four alternatives given:
The expected time for an activity of Project LM is 20 days. If the most likely and pessimistic time are 19 days and 28 days, what will be the variance of the activity?
(a) 1.36 (b) 1.78
(c) 4 (d) 0 **(2 Marks)**
Answer: (c) 4

PYQ 2024-Dec [1] (ix) {C} Choose the correct option from the four alternatives given:
Optimistic and pessimistic time of an activity respectively are 4 days and 16 days. Variance of the duration of the activity will be:—
(a) 4 days (b) 2 days
(c) 3 days (d) None of the above **(2 Marks)**
Answer: (a) 4 days

(ii) The normal duration and normal cost of an activity of project BOZ are 12 days and ₹ 400 respectively. The cost slope is ₹ 80 per day, if the crash cost of the activity is ₹ 560, what will be the crash duration of the activity?
(a) 12 Days (b) 10 Days
(c) 8 Days (d) 6 Days **(2 Marks)**
Answer: (b) 10 Days

PYQ 2025-Jun [1] (xiv) {C} Choose the correct option from the given alternatives:
A PERT Network has four activities on its Critical Path. The Standard Deviation of each activity on the Critical path is 4 days. What will be the standard deviation of the CRITICAL PATH?
(a) 8 days (b) 4 days
(c) 2 days (d) None of the above **(2 Marks)**
Answer: (a) 8 days

PYQ 2026-Jun [1] (vii) {C} Choose the correct option from the four alternatives given:
The daily demand for a product follows the distribution below:

Demand(units)	0	1	2	3	4
Probability	0.10	0.20	0.30	0.20	0.20

Random number intervals are assigned as below:

00-09	10-29	30-59	60-79	80-99
0	1	2	3	4

A simulation is run for 4 days using the random numbers:
14,67,85,33
What is the average simulated demand over these 4 days?
(a) 2 units (b) 2.25 units
(c) 2.50 units (d) None of the above
(2 Marks)

SECTION-B

01 Introduction

THEORY QUESTIONS

TQ 1.1	PYQ	2017-Jun [8] (e)	SN	4 Marks

Write a short note on the following:
Simulation Technique.

Answer:

Simulation:

Simulation is a modelling and analysis tool that is widely used for the purpose of designing, planning and control of manufacturing systems. Simulation in general is to pretend that one deals with a real thing while really working with an imitation. In Operations Research, the imitation is a computer model of the simulated reality. The task of executing simulations provides insight and a deep understanding of physical processes that are being modelled.

Simulation is generally referred to as computer simulation, which simulates the operation of a manufacturing system. A computer simulation or a computer model is a computer program, which attempts to simulate an abstract model of a particular system.

A simple example of a simulation involves the tossing of a ball into the air. The ball can be said to "simulate" a missile, for instance. That is, by experimenting with throwing balls starting at different initial heights and initial velocity vectors, it can be said that we are simulating the trajectory of a missile.

Monte Carlo method of simulation is the most popular method of simulation. In Linear Programming, Simulation is called the 'technique of last resort'. It means, when all other methods fails, we resort to Simulation as the last resort.

03 Limitations of Simulation

THEORY QUESTIONS

TQ 3.1	PYQ	2021-Dec [2]	DESC	2.5+2.5 = 5 Marks

(i) State the major reasons for using Simulation technique to solve management problem.
(ii) Outline the limitations of Simulation.

[Sec. C - Five LAQ]

Answer:

(i)
- A simulation model is easier to explain to management.
- Model experimentation. Experimenting with the actual system itself would be too costly.
- Suitable in cases of large complex problems.
- Cost savings.

(ii) Limitation of Simulation:
- Simulation is not precise.
- Only situations involving uncertainty can be measured.
- Simulation generates only a way to evaluate solutions but does not generate the solution techniques.
- Choice of random numbers is subjective.

CASE-SCENARIO QUESTIONS

CSQ 3.1	PYQ	2021-Dec [8]	1 Marks

The average demand per day of cars from a travel company by past weeks observation is 4, whereas, by a simulation for 7 days using random numbers, the average demand is 7 per day. Should you advise the company to go by the simulation result?

[Sec. B - SAQ]

Answer:

No. Simulation is required for a large no. of days in order to arrive at a reasonable conclusion for taking action.

04 *Steps involved in constructing and using a Simulation Model*

CASE-SCENARIO QUESTIONS

CSQ 4.1	PYQ	2025-Dec [7] (a)	7 Marks

A computer service centre services laptops. It is proposed to study the arrival and servicing pattern of the service centre. The following information was collected over 100 days.

No. of laptops	Frequency of arrival	Frequency of service
8	10	15
9	25	20
10	20	25
11	15	16
12	18	14
13	12	10

Simulate the arrival and servicing pattern for 7 days and analyze and assess the average number of laptops held for more than one day for service. Assume FIFO method is followed for service and there is one laptop held from previous day for service at the beginning of the first day. Use the following series of random numbers:

Arrivals	69	45	46	10	82	16	35
Service	52	36	62	49	68	77	55

Answer:

Random No. coding for Arrival

No. of laptops	Probability	Cumulative Probability	Random Number
8	0.10	0.10	00 - 09
9	0.25	0.35	10 - 34
10	0.20	0.55	35 -54
11	0.15	0.70	55 - 69
12	0.18	0.88	70 - 87
13	0.12	1.00	88 - 99

Random No. coding for Service

No. of laptops	Probability	Cumulative Probability	Random Number
8	0.15	0.15	00 - 14
9	0.20	0.35	15 - 34
10	0.25	0.60	35 -59
11	0.16	0.76	60 - 75
12	0.14	0.90	76 - 89
13	0.10	1.00	90 - 99

Simulation Sheet:

Let us simulate the arrival and service of laptops for the next seven days using the given random numbers:

Day	R No. of Arrival	No. of laptops arrived	Opening Job	R No. of Service	No. of Laptops serviced*	Closing Job
1	69	11	1	52	10	2
2	45	10	2	36	10	2
3	46	10	2	62	11	1
4	10	9	1	49	10	0
5	82	12	0	68	11	1
6	16	9	1	77	12	0
7	35	10	0	55	10	0

* This represents the service capacity of service centre.

Average No. of laptops held for more than one day = Total Closing Jobs/ No. of days = 6 laptops / 7 days = 0.86 laptops per day.

05 Monte Carlo Simulation

CASE-SCENARIO QUESTIONS

CSQ 5.1 | PYQ | 2016-Jun [7] (c) | 11 Marks

The output of a production line is checked by an inspector for one or more of three different types of defects, called defects Major, Minor and Medium. If defect Major occurs, the item is scrapped. If defect Minor or Medium occurs, the items must be reworked. The time required for reworking for a Minor defect and a Medium defect is 15 minutes and 30 minutes respectively.

The probabilities of Major, Minor and Medium defects are 0.15, 0.20 and 0.10 respectively. You are required to present data table with random number assigned and the existence of defect in Major, Minor and Medium type separately.

For 10 items coming off the assembly line, determine the number of items without any defects and with defects, the number of item scrapped and the total minutes of reworked time.

Use the following Random Numbers (RN) of three defects:

RN for Defect Major	48	55	91	40	93	01	83	63	47	52
RN for Defect Minor	47	36	57	04	79	55	10	13	57	09
RN for Defect Medium	82	95	18	96	20	84	56	11	52	03

Answer:

The probabilities of occurrence of Major, Minor and Medium defects are 0.15, 0.20 and 0.10 respectively. So, the numbers 00 - 99 are allocated in proportion to the probabilities associated with each of the three defects.

Defect Major		Defect Minor		Defect Medium	
Exists	RN Assigned	Exists ?	RN Assigned	Exists ?	RN Assigned
Yes	00 -14	Yes	00 - 19	Yes	00 - 09
No	15 - 99	No	20 - 99	No	10 - 99

Simulation of output of the assembly line for 10 items:

Item No.	RN: Defect Major	RN: Defect Minor	RN: Defect Medium	Defect Exist or Not	Rework time (in min.)	Scrap
1.	48	47	82	None	Nil	–
2.	55	36	95	None	Nil	–
3.	91	57	18	None	Nil	–
4.	40	04	96	Minor	15	–
5.	93	79	20	None	Nil	–
6.	01	55	84	Major	Nil	Scrap
7.	83	10	56	Minor	15	–
8.	63	13	11	Minor	15	–
9.	47	57	52	None	Nil	–
10.	52	09	03	Minor & Medium	15+30=45	–

(i) During the simulated period, 5 items had defect and other 5 items had no defect.

(ii) One item was scrapped.

(iii) Total reworked time is required for four items = 15+15+15+45 = 90 minutes.

CSQ 5.2 | PYQ | 2018-Dec [6] (b) | 5+3=8 Marks

The following was the pattern for demand of cars rented out by a tourist operator observed for 100 days:

No. of cars	5	7	10	15
No. of days	20	30	40	10

The random numbers are 88, 76, 10, 05, 23.

Required:

(i) Simulate the demand for cars over five days.

(ii) How many cars should the operator have in order to have at least 75% probability of fulfilling the demand based on your simulated results?

Answer:

No. of Cars	No. of Days	Probability	Cumulative Prob	Random No. Interval	Day	Random No.	Demand
5.	20	0.2	0.2	00-19	1	88	10
7.	30	0.3	0.5	20-49	2	76	10
10.	40	0.4	0.9	50-89	3	10	5
15.	10	0.1	1	90-99	4	5	5
					5	23	7
		-1		-1		-1	(a)

(i) For 75% or more probability, we need more than 3 days when demand is fulfilled i.e. 3/5 = 60%. Therefore at least 4 days' demand is fulfilled.

(ii) In this case, 10 cars when there is a 100% chance of all demand being fulfilled based on simulated results.

CSQ 5.3 | PYQ | 2019-Jun [7] (b) | 8 Marks

The following information are given:

Arrival of patients		Services	
Inter-arrival time (minutes)	Probability	Inter-Service time (minutes)	Probability
2	0.2	4	0.25
4	0.24	6	0.34
6	0.28	8	0.26
8	0.18	10	Balance
10	Balance		

The following random number are to be used for the simulation of arrival and service patterns:

Arrival	740	225	906	48	421
Service	402	183	706	923	638

Required:

(i) Find out the average time spent by the patient in the queue by simulation. Assume that the time starts at 6:00 a.m. and that there is only one counter and there is no time gap between finishing with one patient and starting the next patient if the next patient is already in the queue.

(ii) A second counter is to be set up if the probability of waiting beyond 3 minutes exceeds 40% or if the average waiting time of a patient exceeds 5 minutes if there is a wait. Should the second counter be set up? Substantiate based on the simulation results.

Answer:

Arrivals				Service			
Minutes	Probability	Cumulative Probability	Random No. Interval	Minutes	Probability	Cumulative Probability	Random No. Interval
2	0.2	0.2	000-199	4	0.25	0.25	000-249
4	0.24	0.44	200-439	6	0.34	0.59	250-589
6	0.28	0.72	440-719	8	0.26	0.85	590-849
8	0.18	0.9	720-899	10	0.15	1	850-999
10	0.1	1	900-999				

Sl. No	Random No. Arrival	Time	Entry time In queue	Service Start time	Random No For Service	Service Time	Service End Time	Waiting Time of Patient	Idle Time of Centre
1.	740	8	6:08	6:08	402	6	6:14	-	08
2.	225	4	6:12	6:14	183	4	6:18	2	-
3.	906	10	6:22	6:22	706	8	6:30	-	4
4.	048	2	6:24	6:30	923	10	6:40	06	-
5.	421	4	6:28	6:40	638	8	6:48	12	

Probability of waiting time being more than 3 minutes = 2/5 = 40%
Hence is not exceeding 40%.

Average waiting time of a patient = Total of waiting time column/3 instances of waiting = 20/3
= 6.67

Hence, the second counter should be set up based on simulated results.

Note: Ideally, for best results and interpretation, simulation should be carried out a large number of times. The decision based on small numbers, tend to be unrealistic and erroneous.

CSQ 5.4 | PYQ | 2022-Dec [6] (b) | 6+2=8 Marks

The output of a production line of SONPIM Ltd. is checked by an inspector for one or more of three different types of defects, called defects Major,

Minor and Medium. If defect Major occurs, the item is scrapped. If defect Minor or Medium occurs, the items must be reworked. The time required for reworking for a Minor defect and a Medium defect is 15 minutes and 30 minutes respectively.

The probabilities of Major, Minor and Medium defects are 0.15, 0.20 and 0.10 respectively.

Use the following Random Numbers (RN) of three defects:

RN for Defect Major	48	55	91	40	93	01	83	63	47	52
RN for Defect Minor	47	36	57	04	79	55	10	13	57	09
RN for Defect Medium	82	95	18	96	20	84	56	11	52	03

(i) For 10 items coming off the assembly line, you are required to present data table with Random Number assigned and the existence of defect in Major, Minor and Medium type separately.

(ii) Determine the number of items without any defects and with defects, the number of item scrapped and the total minutes of reworked time.

Answer:

The probabilities of occurrence of Major, Minor and Medium defects are 0.15, 0.20 and 0.10 respectively. So, tile numbers 00-99 are allocated in proportion to the probabilities associated with each of the three defects.

Defect Major Defect Minor Defect Medium

Defect Major		Defect Minor		Defect Medium	
Exists	RN Assigned	Exists ?	RN Assigned	Exists ?	RN Assigned
Yes	00 -14	Yes	00 – 19	Yes	00 - 09
No	15 – 99	No	20 - 99	No	10 – 99

Simulation of output of the assembly line for 10 items:

Item No.	RN: Defect Major	RN: Defect Minor	RN: Defect Medium	Defect Exist or Not	Rework time (in min.)	Scrap
1.	48	47	82	None	Nil	-
2.	55	36	95	None	Nil	-
3.	91	57	18	None	Nil	-
4.	40	04	96	Minor	15	-

5.	93	79	20	None	Nil	-
6.	01	55	84	Major	Nil	Scrap
7.	83	10	56	Minor	15	-
8.	63	13	11	Minor	15	-
9.	47	57	52	None	Nil	-
10.	52	09	03	Minor & Medium	15 + 30 = 45	-

(i) During the simulated period, 5 items had defect and other 5 items had no defect.

(ii) One item was scrapped.

(iii) Total reworked time is required for four items = 15+15+15+45 = 90 minutes.

CSQ 5.5	PYQ	2023-Dec [6] (b)	7 Marks

Sugam Travelling Agency has to deal with a number of clients. The time taken by the officer of the agency to deal with clients and the arrival pattern of clients follow the distribution given below:

Time to deal with the clients:

Minutes	Probability
2	0.05
4	0.10
6	0.15
10	0.30
14	0.25
20	0.10
30	0.05

Time elapsing between arrivals of clients:

Minutes	Probability
1	0.20
8	0.40
15	0.30
25	0.10

Required:

(i) Simulate the arrival and serving of 10 clients by taking the following Random numbers.

	Random Numbers for:									
Arrival pattern	02	48	43	75	89	36	96	47	36	61
Serving pattern	60	73	61	35	28	16	80	46	60	11

(ii) Indicate which of the clients will wait for how many minutes.

(iii) Assess probability of time office being idle, taking the starting time as 10 a.m.

Answer:

Simulation Worksheet: (Starting Time at 10 A.M.)

Client No.	Random Nos. for arrival	Time between arrivals	Arrival time at (hours)	Service beginning (hours)	Random Nos. for services (minutes)	Service time (minutes)	Service end (hours)	Time client waiting (minutes)	Time Office idle (minutes)
1.	2	1	10.01	10.01	60	14	10.15	--	1
2.	48	8	10.09	10.15	73	14	10.29	6	—
3.	43	8	10.17	10.29	61	14	10.43	12	—
4.	75	15	10.32	10.43	35	10	10.53	11	—
5.	89	15	10.47	10.53	28	6	10.59	6	—
6.	36	8	10.55	10.59	16	6	11.05	4	—
7.	96	25	11.20	11.20	80	14	11.34	—	15
8.	47	8	11.28	11.34	46	10	11.44	6	—
9.	36	8	11.36	11.44	60	14	11.58	8	—
10.	61	15	11.51	11.58	11	4	12.02	7	—
								60	**16**

From the table above, it may be seen that the simulation study has been carried out on the queue system for duration of 122 minutes (10 AM to 12.02 PM). During this time, TIME OFFICE of the agency was idle for a total for 16 minutes.

Probability of the time office being idle 13.11%

CSQ 5.6	PYQ	2024-Jun [6] (b)	7 Marks

MOSAN Ltd., an International tourist company deals with numerous personal callers each day and prides itself on its level of service. The time to deal with each caller depends on the client's requirements which range from, say a request for a brochure to booking a round - the - world - cruise. If a client has to wait for more than 10 minutes for attention, it is company's policy for the manager to see him personally and to give him a holiday voucher worth ₹ 15.

The company's observations have shown that the time taken to deal with clients and the arrival pattern of their calls follow the following distribution pattern:

Time to deal with clients	Minutes	2	4	6	10	14	20	30
	Probability	0.05	0.10	0.15	0.30	0.25	0.10	0.05
Time between call arrivals	Minutes	1	8	15	25			
	Probability	0.2	0.4	0.3	0.1			

Required:

(i) Demonstrate how you would simulate the operation of the travel agency based on the use of random number tables.

(ii) Simulate the arrival and serving of 12 clients and show the number of clients who receive a voucher (use Line 1 of the random numbers below to derive the arrival pattern and Line 2 for serving times).

Note: for using Random Number.

Line 1	3	47	43	73	86	36	96	47	36	61	46	98
Line 2	63	71	62	33	26	16	80	45	60	11	14	10

Answer:

(i) & (ii) Time to deal with Clients:

Time (Minutes)	Probability	Cumulative Probability	Assigned Random Number
2	0.05	0.05	00 – 04
4	0.10	0.15	05 – 14
6	0.15	0.30	15 – 29
10	0.30	0.60	30 – 59
14	0.25	0.85	60 – 84
20	0.10	0.95	85 – 94
30	0.05	1.00	95 – 99

Time between arrivals

Time (Minutes)	Probability	Cumulative Probability	Assigned Random Number
1	0.2	0.2	00 – 19
8	0.4	0.6	20 – 59
15	0.3	0.9	60 – 89
25	0.1	1.0	90 – 99

Simulation table for time between arrivals and service time:

Client	RN for arrival	Time Between Arrival	Arrival Time	Time in	RN for Service	Serving Time	Time out	Waiting Time
1	3	1	1	1	63	14	15	–
2	47	8	9	15	71	14	29	6
3	43	8	17	29	62	14	43	12
4	73	15	32	43	33	10	53	11
5	86	15	47	53	26	6	59	6
6	36	8	55	59	16	6	65	4
7	96	25	80	80	80	14	94	–
8	47	8	88	94	45	10	104	6
9	36	8	96	104	60	14	118	8
10	61	15	111	118	11	4	122	7
11	46	8	119	122	14	4	126	3
12	98	25	144	144	10	4	148	–

If a client has to wait for more than 10 minutes, he is entitled for a holiday voucher worth ₹ 15. It is obvious from the above table that Clients 3 & 4 wait for more than 10 minutes. Hence, number of clients who receive a holiday voucher is 2.

CSQ 5.7	PYQ	2024-Dec [6] (b)	7 Marks

A bakery bakes 100 cakes per day. The sale of cakes depends upon demand which has the following distribution:

Sale of cakes (Nos.)	Probability
97	0.10
98	0.15
99	0.20
100	0.35
102	0.15
103	0.05

There is no carry-over of inventory. The following details are given:

Variable production cost per cake	₹ 14
Selling price per cake	₹ 18
Penalty attracted per unsold cake	₹ 3
Penalty attracted per unit of demand not met	₹ 1

Random numbers to be used: 09, 98, 64, 98, 94, 01, 78, 10, 15, 19
Simulate and assess the profit/loss for the next ten days using the above random numbers.

Answer:

Allocation of Random No.

Demand	Probability	Cumulative probability	Random number interval
97	0.10	0.10	00-09
98	0.15	0.25	10-24
99	0.20	0.45	25-44
100	0.35	0.80	45-79
102	0.15	0.95	80-94
103	0.05	1.00	95-99

Simulation table for simulated demand, unsatisfied demand and unsold cakes:

TABLE: SIMULATION WORKSHEET						
Day	Random No	Demand	No. of cakes produced	No. of cakes sold	Unsatisfied demand	No. of cakes unsold
1	9	97	100	97	0	3
2	98	103	100	100	3	0
3	64	100	100	100	0	0
4	98	103	100	100	3	0
5	94	102	100	100	2	0
6	1	97	100	97	0	3
7	78	100	100	100	0	0

8	10	98	100	98	0	2
9	15	98	100	98	0	2
10	19	98	100	98	0	2
	Total	996	1,000	988	8	12

Calculation of Bakery's Profit/Loss

Particulars	Number	Unit rate (₹)	Amount (₹)
Sale of cakes	988	18	17,784
Less: Variable production cost	1,000	14	14,000
Less: Penalty on unsatisfied demand	8	01	8
Less: Penalty on unsold cakes	12	03	36
Profit/Loss			3,740

So, the simulated profit for 10 days' operation is ₹ 3,740.

CSQ 5.8	PYQ	2025-Jun [6] (b)	7 Marks

The management of PIKON LTD. is considering the proposal of marketing a new product. The fixed cost required in the project is ₹ 4,000. Three factors are uncertain viz. the selling price, variable cost and the annual sales volume. The product has a life of only one year. The management has the data on these three factors as under:

Selling Price (₹)	Probability	Variable cost (₹)	Probability	Sale Units	Probability
3	0.20	1	0.30	2,000	0.30
4	0.50	2	0.60	3,000	0.30
5	0.30	3	0.10	5,000	0.40

Consider the following sequence of fifteen random numbers:

81, 32, 60	04, 46, 31	67, 25, 24	10, 40, 02	39, 68, 08

Required:

Using the sequence (first 3 random numbers for the first trial, etc), simulate the average profit for the above project on the basis of 5 trials.

Answer:

Allocation of Random No- Selling Price:

Selling Price (₹)	Probability	Cumulative Probability	Allocation of RN
3	0.20	0.20	00-19
4	0.50	0.70	20-69
5	0.30	1.00	70-99

Allocation of Random No- Variable Cost:

Variable Cost (₹)	Probability	Cumulative Probability	Allocation of RN
1	0.30	0.30	00-29
2	0.60	0.90	30-89
3	0.10	1.00	90-99

Allocation of Random No- Sales Units:

Sales (Units)	Probability	Cumulative Probability	Allocation of RN
2,000	0.30	0.30	00-29
3,000	0.30	0.60	30-59
5,000	0.40	1.00	60-99

Calculation of Simulated Profit:

Trial	RN	SP	RN	VC	RN	Sales Units	Profit (₹)
1	81	5	32	2	60	5,000	(5-2)5,000-4,000 = 11,000
2	4	3	46	2	31	3,000	(3-2)3,000-4,000 = -1,000
3	67	4	25	1	24	2,000	(4-1)2,000-4,000 = 2,000
4	10	3	40	2	2	2,000	(3-2)2,000-4,000 = -2,000
5	39	4	68	2	8	2,000	(4-2)2,000-4,000 = 0
							Total = 10,000

Average Annual Profit = ₹10,000/5 = ₹2,000

Alternative Solution

Probability Distribution (Selling Price):

SP	Probability	Cum. Prob.	Probability range	Probability range for simulation
3	0.20	0.20	0 - 0.20	0 - 0.19
4	0.50	0.70	0.20 - 0.70	0.20 - 0.69
5	0.30	1.00	0.70 - 1.00	0.70 - 0.99

Probability Distribution (Variable Cost):

VC	Probability	Cum. Prob.	Probability range	Probability range for simulation
1	0.30	0.30	0 - 0.30	0 - 0.29
2	0.60	0.90	0.30 - 0.90	0.30 - 0.89
3	0.10	1.00	0.90 - 1.00	0.90 - 0.99

Probability Distribution (Sales Units):

Sale units	Probability	Cum. Prob.	Probability range	Probability range for simulation
2,000	0.30	0.30	0 - 0.30	0 - 0.29
3,000	0.30	0.60	0.30 - 0.60	0.30 - 0.59
5,000	0.40	1.00	0.60 - 1.00	0.60 - 0.99

Simulated Profit:

Trial	RN	Profit (₹)
1	81, 32, 60	(5 - 2) (5,000) - 4,000 = 11,000
2	04, 46, 31	(3 - 2) (3,000) - 4,000 = -1,000
3	67, 25, 24	(4 - 1) (2,000) - 4,000 = 2,000
4	10, 40, 02	(3 - 2) (2,000) - 4,000 = -2,000
5	39, 68, 08	(4 - 2) (2,000) - 4,000 = 0
		Total = ₹10,000

Average Annual Profit = ₹10,000/5 = ₹2,000

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 11	Network Analysis - PERT, CPM

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	-	-
2.	Difference between PERT and CPM	-	-
3.	Procedure of drawing a Network Diagram	2	-
4.	Time Estimates and Critical Path in Network Analysis	4	-
5.	Three Time Estimates of PERT	8	-
6.	Procedure of Crashing a Project Network	6	-

SECTION-A

PYQ 2017-Dec [1] (v) {C} Choose the most appropriate answer to the following questions giving justification.

For a Learning Curve percentage of 72%, the time to be taken to complete the 4th unit of a 12-unit job involved in the assembly line, if the initial unit requires 80 hours, will be

(a) 43.50 hrs (b) 41.47 hrs

(c) 46.71 hrs (d) 40.95 hrs **(2 Marks)**

Answer: (b) At 72% Learning Curve,

T-4 - Time taken by the 4th Unit = 80 (.72)(.72) = 41.47 hrs.

Note: In the arithmetic method followed above, every time the number the number of repetitions doubles, the time to perform the activity is reduced by the Learning Curve Coefficient.

PYQ 2018-Jun [1] (vi) Choose the most appropriate answer to the following questions giving justification:
An operation has a 90% learning curve and the first unit produced took 28 minutes. The labour cost is ₹ 20 per hour. How much should the second unit cost?
(a) ₹ 9.80 (b) ₹ 7.60
(c) ₹ 8.40 (d) ₹ 6.60 **(2 Marks)**
Answer: (b) Explanation:
1st unit = 28 min.
Average time pu for 2 units = 0.9 × 28 = 25.2
Total time for 2 units = 25.2 × 2 = 50.4
Time for second unit = 50.4 – 28 = 22.4 minutes
Cost for second unit = 22.4 × 20 ₹ /hr./60 minutes = 7.47
Since, (b) is close to 7.47, b is acceptable. Otherwise, none of the given data.

PYQ 2018-Dec [1] (vii) {C} Choose the most appropriate answer to the following questions giving justification:
S Ltd. manufactures a product whose time for the first unit is 1,000 hours. It experiences a learning curve of 80%. What will be the total time taken in hours for units 5 to 8?
(a) 4,096 hours (b) 3,200 hours
(c) 1,536 hours (d) 2,000 hours **(2 Marks)**
Answer: (c) Variable cost + (Fixed cost + Profit Desired) ÷ Volume = ₹ 100 + (1,20,000 + 30,000) ÷ 6,000 = ₹ 125/-

PYQ 2019-Jun [1] (iv) Choose the most appropriate answer the to following questions giving justification:
S Ltd. recently sold an order of 50 units having the following costs:

	₹
Direct materials	1,500
Direct labour (1,000 hours @ ₹ 8.50)	8,500
Variable overhead (1,000 hours @ ₹ 4.00)[1]	4,000
Fixed overhead[2]	1,400
	15,400

[1]Allocated on the basis of direct labour-hours.
[2]Allocated at the rate of 10% of variable cost.
The company has now been requested to prepare a bid for 150 units of the same product.
If an 80% learning curve is applicable, Stone Isle's tota cost on this order would be
(a) ₹ 38,500 (b) ₹ 37,950
(c) ₹ 26,400 (d) ₹ 31,790 **(2 Marks)**
Answer: (c) Cumulative hours 200 × (20 × 0.8 × 0.8) = 2,560
Less: 50 × 20 = 1,000
Net hours for 150 units = 1,560
Cost: Direct Materials 150 × 30 = 4,500
Direct Labour 1,560 × 8.50 = 13,260
Variable Overhead 1,560 × 4 = 6,240
Total Variable Cost = 24,000
Allocated Fixed OH = 10% = 2,400
Estimated Cost of the Order = 26,400

PYQ 2019-Dec [1] (v) Choose the most appropriate answer to the following questions giving justification/reasonable workings:
X is a factory making a certain product where learning curve ratic of 80% and 90% apply respectively for two equally paid workers, A and B.
(a) The labour cost of manufacturing the 4th product will be more for A.
(b) The labour cost of manufacturing the 4th product will be more for B.
(c) The labour cost is the same for the fourth product.
(d) Nothing can be said about the specific product since learning applies ratio to the average quantity of the product. **(2 Marks)**
Answer: (b) The labour cost of manufacturing the 4th product will be more for B since B will take more time per unit of product.

PYQ 2021-Dec [5] A learning curve is a function
(1) where unit costs increase as productivity increases.

(2) that increases at a greater rate as workers become more familiar with their tasks.
(3) that is linear.
(4) that measures the decline in labor-hours per unit due to workers becoming better at a job. **(1 Mark) [Sec. A - MCQ]**

Answer:
(4) that measures the decline in labor-hours per unit due to workers becoming better at a job.

PYQ 2021-Dec [11] To complete the first setup on a new machine took an employee 200 minutes. Using an 80% incremental unit-time learning model indicates that the second setup on the new machine is expected to take
(1) 120 minutes. (2) 160 minutes.
(3) 60 minutes (4) 80 minutes.
(1 Mark) [Sec. A - MCQ]

Answer:
(1) 120 minutes.

PYQ 2022-Dec [1] (iii) {C} Choose the most appropriate answer to the following questions:
SIXT Ltd. has developed a new product and just completed the manufacture of the first four units of the product. The first unit took 3 hours to manufacture and the first four units together took 8.3667 hours to produce. The learning curve rate is
(a) 83.50% (b) 75.00%
(c) 60.65% (d) 58.50% **(2 marks)**

Answer: (a) Justification:
Let the learning rate be X
Since the first unit took 3 hrs, average time for first two units is 3X
The average time for the first four units = $3X \times X = 3X^2$
Therefore $3X^2 = 8.3667/4$
Or $X = \sqrt{0.697}$
$= 0.835$ or 83.50%

PYQ 2023-Dec [1] (viii) {C} Choose the correct option.
An employee of ROB Ltd. took 200 minutes to complete the first set up on a new machine. Using a 90% incremental unit time learning model indicates that the second set up on the new machine is expected to take-
(a) 160 minutes (b) 120 minutes
(c) 100 minutes (d) 80 minutes **(2 Marks)**
Answer: (a) 160 minutes

PYQ 2024-Jun [1] (viii) {C} Choose the correct option from the four alternatives given:
DOXT Ltd., a manufacturing company, is preparing a quotation for a new product-D. The time taken for the first unit is 30 hours. The company expects 85% learning curve (Index is = -0.2345). The company desires that the quotation should be based on the time taken for the final output within the Learning period which is expected to end after the company has produced 200 units. What will be the time per unit of product to be used for the quotation?
(Given: $199^{-0.2345} = 0.28901$, $200^{-0.2345} = 0.28867$ and $201^{-0.2345} = 0.28834$)
(a) 6:63 hours (b) 10:34 hours
(c) 11:50 hours (d) None of the above **(2 Marks)**
Answer: (a) 6:63 hours

PYQ 2024-Dec [1] (xiii) {C} Choose the correct option from the four alternatives given:
LONAX Ltd., a manufacturing company has developed a new product and just completed the manufacture of first 16 units of the product. If the first unit took 6 hours to manufacture and the first 16 units together took 62.9856 hours to produce, the Learning Curve (LC) rate would be
(a) 80 % (b) 85 %
(c) 90 % (d) 95 % **(2 Marks)**
Answer: (c) 90 %

PYQ 2025-Jun [1] (xiii) {C} Choose the correct option from the given alternatives:
When 24 hours is required to produce a condenser of a particular type then the time required to produce the 16th unit with 85% Learning Curve is
(a) between 9 and 10 hours.
(b) between 12 and 14 hours.
(c) between 15 and 17 hours.
(d) between 18 and 20 hours. **(2 Marks)**

Answer: (b) between 12 and 14 hours.

SECTION-B

03 *Procedure of drawing a Network Diagram*

CASE-SCENARIO QUESTIONS

CSQ 3.1	PYQ	2017-Jun [7] (a)	8 Marks

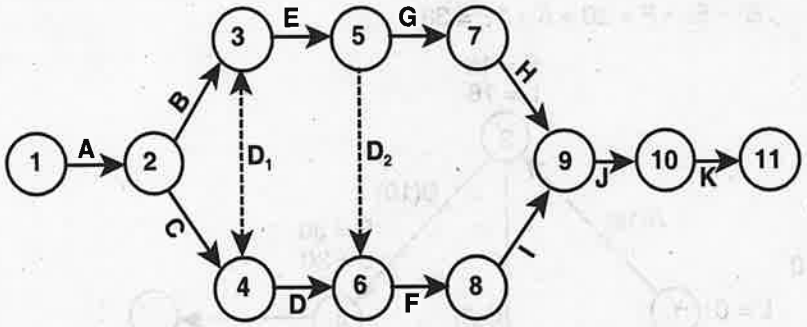
XYZ Auto-manufacturing company has to prepare a design of its latest model of motorcycle. The various activities to be performed to prepare a design are as follows:

Activity	Description of activity	Preceding activity
A	Prepare drawing	-
B	Carry out cost analysis	A
C	Carry out financial analysis	A
D	Manufacture tools	C
E	Prepare bill of material	B, C
F	Receive material	D, E
G	Order sub-accessories	E
H	Receive sub-accessories	G
I	Manufacture components	F
J	Final assembly	I, H
K	Testing and shipment	J

Prepare an appropriate network diagram.

Answer:

The network diagram will be as follows:



CSQ 3.2	PYQ	2021-Dec [11]	1 Marks
In a network, can you have nodes 1 and 2 to be starting nodes, so that the activities 1-3 and 2-3 have no predecessors? *[Sec. B - SAQ]*			

Answer:

Yes, 1-2 is a dummy

04 *Time Estimates and Critical Path in Network Analysis*

THEORY QUESTIONS

TQ 4.1	PYQ	2016-Dec [8] (a) (i)	DESC	3 Marks
How Critical Path Analysis (CPA) helps an organization?				

Answer:

- Critical Path Analysis and PERT are powerful project management tools that help the organization to schedule and manage the complex projects.

- They were developed in the 1950s to control large defense projects and have been used routinely since then.
- As with Gantt Charts, CPA helps the organization to plan all tasks that must be completed as part of a project.
- They act as the basis both for preparation of a schedule and of resource planning. During management of project, they allow to monitor achievement of project goals.
- They help the organization to identify where remedial actions are to be taken to get a project back on course.
- A further benefit of CPA is that it helps the organization to identify the minimum length of time needed for completing the project.

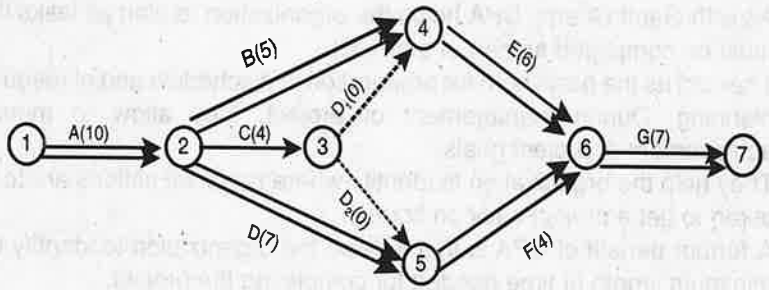
CASE-SCENARIO QUESTIONS

CSQ 4.1	PYQ	2017-Dec [7] (a)	8 Marks
Draw a network from the following activities. Find the critical path and total duration of the project.			

Activity	Immediate predecessor activity	Duration (days)
A	—	10
B	A	5
C	A	4
D	A	7
E	B,C	6
F	C,D	4
G	E,F	7

Answer:

The network is drawn as follows:



Network Diagram

Various paths Duration of paths (days)

(i)	1-2-4-6-7	10 + 5 + 6 + 7	= 28
(ii)	1-2-3-4-6-7	10 + 4 + 0 + 6 + 7	= 27
(iii)	1-2-3-5-6-7	10 + 4 + 0 + 4 + 7	= 25
(iv)	1-2-5-6-7	10 + 7 + 4 + 7	= 28

Critical paths are 1-2-4-6-7 and 1-2-5-6-7 with duration of 28 days and are marked with double lines.

CSQ 4.2	PYQ	2018-Dec [7] (a)	2+2+4=8 Marks

Given the following information regarding a project and the time duration of each activity:

Activity	Preceding activity	Normal Time (days)
A	–	16
B	–	20
C	A	8
D	A	10
E	B, C	6
F	D, E	12

Required:

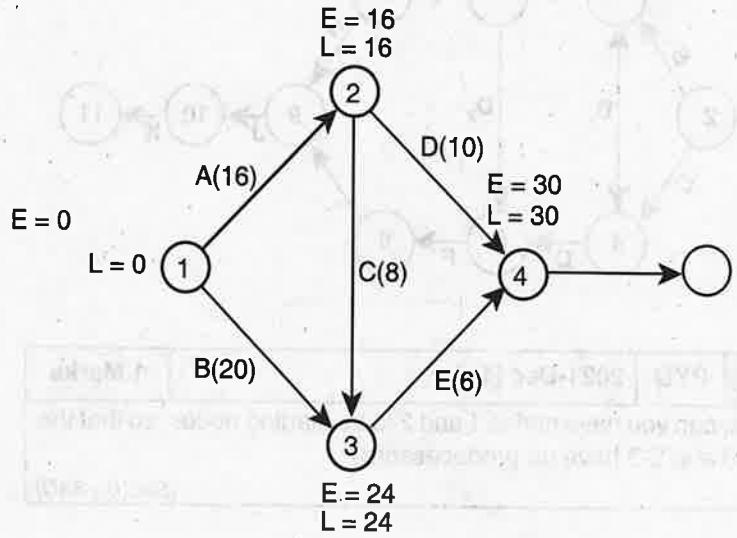
(i) Draw the activity network of the project.
(ii) Find critical path and duration of the project.
(iii) Find the total float and free-float for each activity.

Answer:

(i) The network for the given problem

A → D → F = 16 +10 + 12 = 38

B → E → F = 20 + 6 + 12 = 38



(ii) A – C – E – F = 16 + 8 + 6 + 12 = 42 days (Critical path)

(iii) Total float and free float for each activity.

Activity	Normal time (Days)	EST	EFT	LST	LFT	Total Float	Free Float
A	16	0	16	0	16	0	0
B	20	0	20	4	24	4	4
C	8	16	24	16	24	0	0
D	10	16	26	20	30	4	4
E	6	24	30	24	30	0	0
F	12	30	42	30	42	0	0

CSQ 4.3	PYQ	2021-Dec [13]	1 Mark

Activity 1-2 lies on the critical path which has three other activities, each of the same duration of 1 week. If the project can be completed in 4 weeks, what is the earliest finish time of 1-2?

[Sec. B - SAQ]

Answer:

1 week

05 *Three Time Estimates of PERT*

CASE-SCENARIO QUESTIONS

CSQ 5.1	PYQ	2015-Dec [10] (b)	11 Marks

The activities involved in a PERT project are detailed in the following table:

Job (I - j)	DURATION TIME (DAYS)		
	most optimistic time	most likely time	most pessimistic time
1-2	3	6	15
2-3	6	12	30
3-5	5	11	17
7-8	4	19	28
5-8	1	4	7
6-7	3	9	27
4-5	3	6	15
1-6	2	5	14
2-4	2	5	8

(i) Draw a network diagram.

(ii) Find the critical path, expected time for completion of the project and project variance after estimating the earliest and latest event times for all nodes.

(iii) Find the probability of completing the project before 31 days.

(iv) What is the chance of project duration exceeding to 46 days?

(v) What will be the effect on the current critical path if the most likely time of activity 3 - 5 gets revised to 14 instead of 11 days (given in the table)?

[Given that the probability of standard normal curve between]:

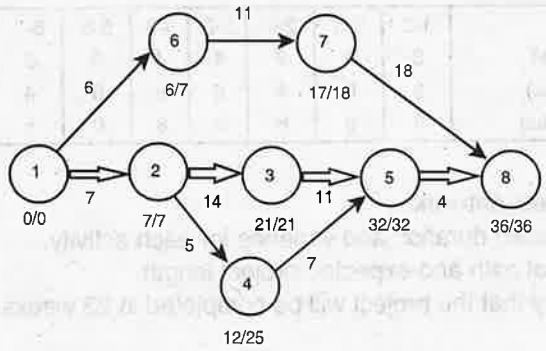
(a) Z = 0 and Z = 2 is 0.4772, and

(b) Z = 0 and Z = -0.1 is 0.3413

Answer:

Job	Duration Time (Days)			Expected Time	Variance
	Optimistic (t_o)	Most Likely (t_m)	Pessimistic (t_p)	$t_e = \frac{t_o + 4t_m + t_p}{6}$	$S_t^2 = \left(\frac{t_p - t_o}{6}\right)^2$
1-2	3	6	15	7	4
2-3	6	12	30	14	16
3-5	5	11	17	11	4
7-8	4	19	28	18	16
5-8	1	4	7	4	1
6-7	3	9	27	11	16
4-5	3	6	15	7	4
1-6	2	5	14	6	4
2-4	2	5	8	5	1

(i)



(ii) The Critical Path is 1 -----2-----3----5----8

Expected time E(T) for completion of the project is 7 + 14 + 11 + 4 = 36 days.

Project Variance is obtained by summing variances of all the critical activities, i.e. $\delta_t^2 = 4 + 16 + 4 + 1 = 25$

Therefore, $\delta_t = \sqrt{25} = 5$

(iii) Probability of completing the project before 31 days is given by:
$P(T \leq 31) = P[Z \leq (31 - 36)/5] = P(Z \leq -1) = 0.5 - P(-1 < Z \leq 0)$
$= 0.5 - 0.3413 = 0.1587$
(where $Z = [T - E(T)] / \delta_t$]

(iv) Probability of project duration exceeding 46 days is given by:
$P(T > 46) = P(Z > 2) = 1 - P(Z \leq 2) = 1 [P(-\infty < Z \leq 0) + P(0 \leq Z \leq 2)]$
$= 1 - (0.5 + 0.4772) = 1 - 0.9772 = 0.0228$

(v) The weighted average time for activity (3 - 5) will become (5 + 56 + 17)/6 = 13.
Since this is on critical path, the project will get delayed by (13 -11) = 2 days

CSQ 5.2	PYQ	2018-Jun [7] (a)	10 Marks

A small project is composed of 8 activities whose estimated time are listed below:

Activity	1-2	2-3	2-4	3-5	4-6	5-6	5-7	6-7
Optimistic time (in weeks)	3	3	2	4	4	0	3	2
Most likely time (in weeks)	3	6	4	6	6	0	4	5
Pessimistic time (in weeks)	3	9	6	8	8	0	5	8

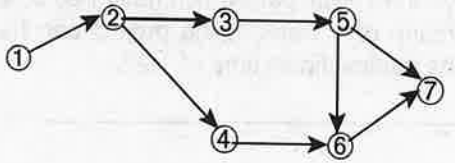
Required:
(i) Draw the project network.
(ii) Find the expected duration and variance for each activity.
(iii) Find the critical path and expected project length.
(iv) The probability that the project will be completed in 23 weeks.

Given that:

Z Value:	1.00	1.91	1.92	1.93	1.94
Probability:	0.9713	0.9719	0.9726	0.9732	0.9738

Answer:

(i) The network diagram for the given data is shown below:



Network Diagram

(ii) The earliest and latest expected time for each event is calculated by considering the expected time of each activity as shown in the following table:

Table: Calculation of Expected Times and Variances

Activity	t_o	t_m	T_p	$t_e = \frac{1}{6}[t_o + 4t_m + t_p]$	$\sigma^e = [\frac{1}{5}(t_p - t_o)]^2$
1 – 2	3	3	3	3	0
2 – 3	3	6	9	6	1
2 – 4	2	4	6	4	4/9
3 – 5	4	6	8	6	4/9
4 – 6	4	6	8	6	4/9
5 – 6	0	0	0	0	0
5 – 7	3	4	5	4	1/9
6 – 7	2	5	8	5	1

The expected duration and variance for each activity is shown in the above table.

(iii) Critical path is: 1 — 2 — 3 — 5 — 6 — 7.
Expected project length. $T_e = 3+6+6+0+5 = 20$ weeks

(iv) Probability that the project will be completed in 23 weeks is given by:
$P(0 \leq X \leq 23) = P(0 \leq Z \leq \frac{23-20}{\sqrt{2.444}})$
$= P(0 \leq Z \leq 1.920) = 0.9726$ or 97.26%.

CSQ 5.3	PYQ	2021-Dec [1]	7 Marks

A project consists of 7 activities and the time estimates of the activities are furnished as under:

Activity	Optimistic days	Most likely days	Pessimistic days
1-2	4	10	16
1-3	3	6	9
1-4	4	7	16
2-5	5	5	5
3-5	8	11	32
4-6	3	6	9
5-6	2	5	8

(i) Possible paths of the project are
(ii) Identify the critical path and its duration
(iii) Variance of the critical path is:[1]
(iv) What project duration will provide 95% confidence level of completion ($Z_{0.95} = 1.65$)?

[Sec. C - Five LAQ]

Answer:

(i) te = (t0 + 4tm + tp)/6
Possible paths are = 1 – 3 – 5 – 6 = 6 + 14 + 5 = 25 days
1 – 2 – 5 – 6 = 10 + 5 + 5 = 20 days
1 – 4 – 6 = 8 + 6 = 14 days

(ii) Critical path is 1 – 3 – 5 – 6 = 6 + 14 + 5 = 25 days

(iii) Variance of Critical path is:$[(t_p-t_0)/6]^2$ = 1+ 16 + 1 = 18 days

(iv) Given that Z = 1.65 for probability of 95%
So [Tr – Tcp]/SD = [Tr– 25]/4.24 = 1.65
Hence Tr = 25 + 6.996 = 32 days

CSQ 5.4	PYQ	2023-Jun [11] {C}	8 Marks

DHAMIN & CO., an Audit firm having numerous clients with identical financial years, is faced with a problem of framing the audit programme in such a way that reports of all its clients do not get delayed. Manpower and time are its chief constraints. Mr. Panth, partner of the firm, an auditor, is a Manager in the same that he has to plan his audit programme, organize the firm's articles and it's clerks, direct them to achieve their pre-determined objectives, control quality of work, time and cost, and lastly

report his observations to the firm's clients. Thus, the knowledge of sophisticated techniques PERT/CPM helps him as an auditor to plan his audit programme logically and control avoidable and unnecessary delays and costs. In order to simplify the analysis, the following assumptions are made:

(i) The audit is a medium sized limited company.
(ii) A final or complete audit is undertaken.
(iii) The size of the audit team is one senior and three juniors.
(iv) No significant fraud or irregularities are observed to hamper the audit time schedule.
(v) All queries are clarified during the process of audit itself.
(vi) Expected time (duration) is based on past experience.

Activity and identification		Activity description	Preceded by	Expected Time (Days)		
				Optimistic	Most likely	Pessimistic
A	1-2	Pursue the memorandum and Article of Association, prospectus etc. of the company	–	1	1	7
B	1-3	Scrutinize the Board Minutes and Important resolutions which have a bearing on accounts	–	1	4	7
C	1-4	Vouch and post cash book involving receipts and payments etc.	–	2	2	8
D	2-5	Test the efficiency of internal control in operation	A	1	1	1
E	3-5	Vouch and post purchases and sales ledger and check purchases and sales ledger balances	B	2	5	14

F	4-6	Examine journal entries and check their posting and examine and check trial balance	C	2	5	8
G	5-6	Verify and value various assets and liabilities of the company and check all the schedules forming part of P&L A/c and Balance Sheet	D & E	3	6	15
H	6-7	Ensure the truth and fairness of P&L A/c and Balance Sheet and finalise report keeping in mind the requirements of Sec. 143 of the Companies Act and forward it for approval and signature	F&G	1	2	3

Required:

(I) Design the PERT network.

(II) Identify the critical path and assess the expected project (Audit) completion time.

(III) Evaluate what duration will have 95% confidence for project (Audit) completion.

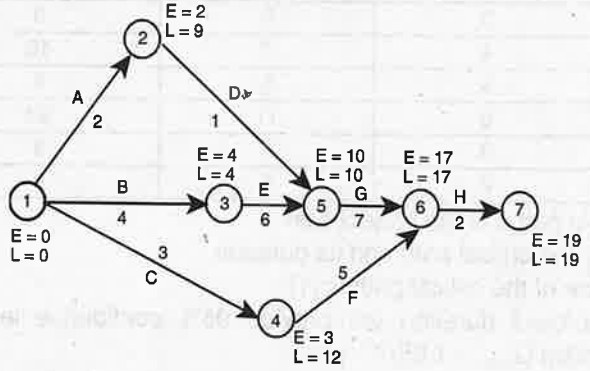
(IV) If the average duration for Activity F increases to 14 days (assume its variance = 1), assess what will be its effect on the expected project (Audit) completion time which will have 95% confidence.

Given:

Z Value	1.00	1.50	1.645	2.00
Probability	0.8413	0.9332	0.950	0.9772

Answer:

(i) The required network is designed below:



(ii) The critical path is 1 – 3 – 5 – 6 – 7 or B – E – G – H and the expected project (Audit) completion time is 19 days.

(iii) 24 days of project (Audit) completion time will have 95% probability of its completion.

(iv) The project (Audit) duration of 24.48 days will have 95% confidence of completion.

CSQ 5.5	PYQ	2023-Dec [7] (a)	7 Marks

An engineering firm is tendering for a contract to supply a steel fabrication with target duration of 46 days. The tasks have been analysed as follows:

Activity	Duration (Days)
1-2	10
1-3	12
1-4	10
2-4	9
2-5	13
3-6	17
4-6	12
5-6	14

The firm is awarded the contract and starts work with all activities on their earliest start times but after work on the 15th day there is a fire which

destroys all the work -in-progress on task 2-4, 2-5 and 3-6. Fortunately, no other completed tasks are affected but it is estimated that task 5-6 will now need 20 days. The project manager feels that due to fire there will be variability in the task times and has made some uncertainty estimates which are shown as task standard deviation in days:

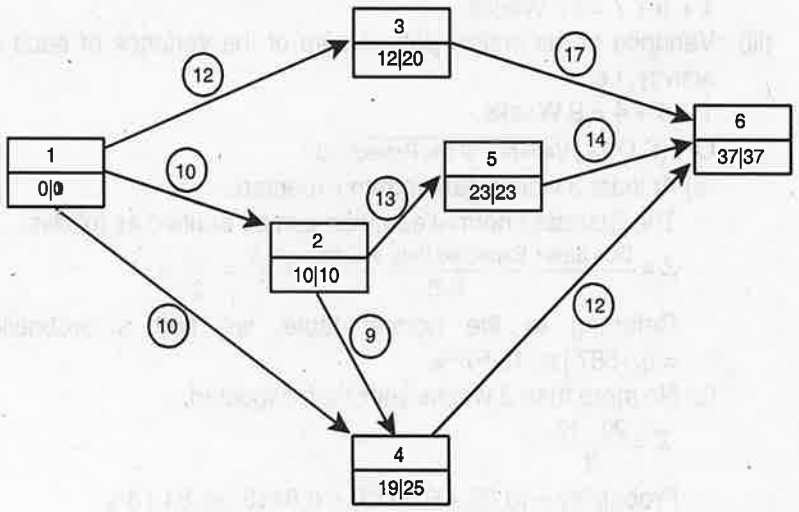
Activity	Standard Deviation (Days)
2-4	0.82
2-5	1.33
5-6	0.47
4-6	2.17
3-6	1.33

(i) Prepare a PERT network as originally envisaged.
(ii) Assess the new expected project duration and identify the critical path through the remaining activities after the fire.
(iii) Evaluate the probability of the project being completed on time after the fire.

[Given area between Z = 0 and Z = -1.42 is 0.4222]

Answer:

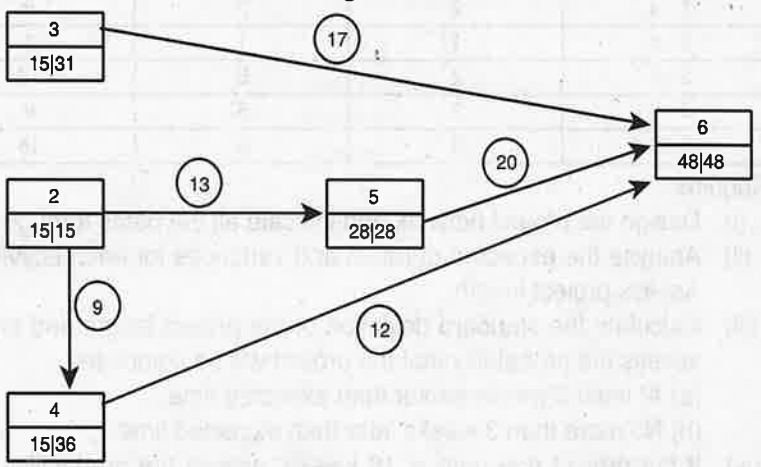
(i) **Network Diagram before Fire**



Activities 1-2, 1-3 and 1-4 had already been completed before the fire. After fire, 15 days are over and 31 days (46 days-15 days) remain with the following outstanding activities:

Activity	Duration (Days)
2-4	9
2-5	13
3-6	17
4-6	12
5-6	20

Network Diagram after Fire



(ii) New Expected Project Duration is 48 days and Revised Critical Path after fire is 2-5-6.

(iii) Standard Deviation of the Project = 1.41
Using Z value, we have Z = -1.42
Using area under standard normal curve, the probability of achieving 46 days is = 8%.

CSQ 5.6	PYQ	2024-Jun [7]	14 Marks

JOBSON Ltd., a manufacturer of plant and machinery is in the process of quoting a tender called by ZOYB Ltd. Delivery date once promised is crucial and penalty clause is applicable. The Project Manager of JOBSON Ltd. has listed down the activities of the project as under:

ACTIVITY (i - j)	Estimated Duration (in Weeks)		
	Optimistic (a)	Most likely (m)	Pessimistic (b)
1 - 2	1	1	7
1 - 3	1	4	7
1 - 4	2	2	8
2 - 5	1	1	1
3 - 5	2	5	14
4 - 6	2	5	8
5 - 6	3	6	15

Required:

(i) Design the project network and indicate all the paths through it.

(ii) Analyse the expected duration and variances for each activity and Assess project length.

(iii) Calculate the standard deviation of the project length and critically assess the probability that the project will be completed:
(a) At least 3 weeks earlier than expected time.
(b) No more than 3 weeks later than expected time.

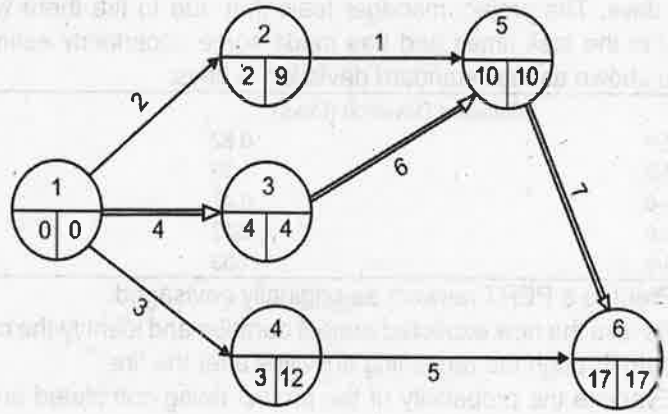
(iv) If the project due date is 18 weeks, assess the probability of not meeting the due date.

Given: Table for areas under normal curve for O to Z.

Z = O to Z	0.10	0.33	0.67	1.00	1.33	2.00
Table Value	0.0398	0.1293	0.2486	0.3413	0.4082	0.4772

Answer:

(i) The network as below:



(ii) Critical path is 1 – 3 – 5 – 6

The total project duration is sum of the duration of each critical activity, i.e.

4 + 6 + 7 = 17 Weeks.

(iii) Variance of the critical path is sum of the variance of each critical activity, i.e.

1 + 4 + 4 = 9 Weeks.

OR,(S.D.) = $\sqrt{\text{Variance of the Project}}$ = 3

(a) At least 3 weeks earlier than expected:

The Standard normal equation can be applied as follows:

$$Z = \frac{\text{Due date - Expected date of Completion}}{\text{S.D.}} = \frac{-3}{3} = -1$$

Referring to the normal table, we find a prcbability of = 0.1587 i.e. 15.87 %

(b) No more than 3 weeks later than expected:

$$Z = \frac{20 - 17}{3} = 1$$

Probability = (0.50 + 0.3413) = 0.8413 i.e. 84.13%

(iv) $Z = \frac{18 - 17}{3} = 0.33$

Therefore, Probability of meeting the due date = 0.50 + 0.1293 = 0.6293 i.e. 62.93%

Probability of not meeting the due date = (1 – 0.6293) = 0.3707 = 0.3707 i.e. 37.07%

CSQ 5.7	PYQ	2025-Jun [7]	14 Marks

SIMCON, a construction company has an opportunity to submit a bid for the construction of Administrative Building of LNP Ltd. From the specifications provided, project manager has estimated most likely, optimistic and pessimistic completion time (in days) for each activity of the project as under:

		Time (days)		
Activity	Immediate Predecessor	Most likely	Optimistic	Pessimistic
A	—	5	4	6
B	—	12	8	16
C	—	5	4	12
D	A, B	3	1	5
E	B	2	2	2
F	C	5	4	6
G	B, C	14	10	18
H	D, E, G	20	18	34

Required:

(i) Assess the expected duration for each activity.

(ii) Design the PERT Network and indicate all paths through it.

(iii) Identify the Critical path and assess the expected completion time (in days) and its standard deviation.

(iv) Assess the probability that the project will be completed in 54 days.

(v) There is evidence that managers are poor in estimating extreme values. It is suspected that in this project the times for tasks A, B, C and F underestimate the pessimistic times by 1 day and overestimate the optimistic time by 1 day. In the case of tasks G & H, the under/over estimation is put at 2 days.

In consideration of above aspects, assess the new probability of completing the project in 54 days.

Given: Table for areas under Normal Curve from 0 to Z

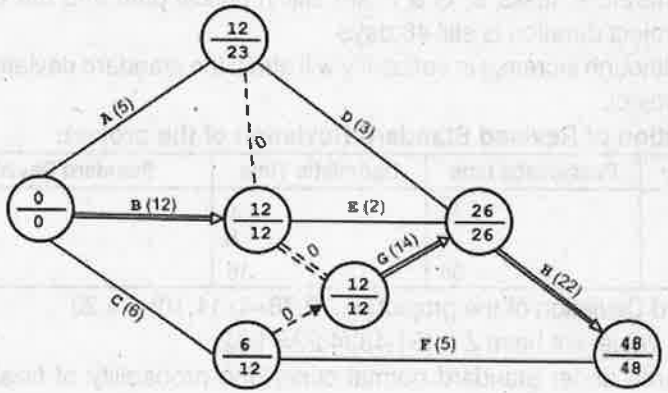
Z = 0 to Z	0.50	1	1.3	1.42	1.84	2.00
Table Value	0.0915	0.3413	0.4032	0.4222	0.4667	0.4772

Answer:

(i) Calculation of Expected Project Duration:

Activity	Most Likely (M)	Optimistic (O)	Pessimistic (P)	Expected Duration (O+4M+P)/6 (Days)
A	5	4	6	5
B	12	8	16	12
C	5	4	12	6
D	3	1	5	3
E	2	2	2	2
F	5	4	6	5
G	14	10	18	14
H	20	18	34	22

(ii) Project Network Diagram



Critical Path Diagram

(iii) Critical Path, Expected project duration & Std. Deviation:
From the EST and LST calculated above, it is clear that, tasks B, G and H are in critical path. The overall project duration is 48 days.

Calculation of Standard Deviation of the activities in Critical Path:

Activity	Pessimistic time	Optimistic Time	Standard Deviation
B	16	8	1.33
G	18	10	1.33
H	34	18	2.67

Standard Deviation of the Project = $\sqrt{(1.33^2 + 1.33^2 + 2.67^2)} = 3.27$

(iv) Calculation of probability that the project will be completed in 54 days:

Using Z value, we have Z = (54-48)/3.27= 1.84

Using area under standard normal curve, the probability of finishing the project in 54 days is 0.5-
+0.4667=0.9667= 96.67%

(v) Calculation of new probability:

The revised estimates do not affect the average task times as the reduction in optimistic time equals the increase in pessimistic times. Therefore, tasks B, G & H are still in critical path and the expected project duration is still 48 days.

Although increase in variability will affect the standard deviation of the project.

Calculation of Revised Standard Deviation of the project:

Activity	Pessimistic time	Optimistic Time	Standard Deviation
B	17	7	2.78
G	20	8	4.00
H	36	16	11.10

Standard Deviation of the project = $\sqrt{(2.78+4+11.10)} = 4.23$

Using Z value, we have Z = (54-48)/4.23= 1.42

Using area under standard normal curve, the probability of finishing the project in 54 days is 0.5-
+0.4222=0.9222= 92.22%.

CSQ 5.8	PYQ	2026-Jun [7] (b)	7 Marks

A project consists of the following activities whose time estimates are given against each as under:

Activity	Estimated Duration (weeks)		
	Optimistic	Most Likely	Pessimistic
1-2	3	6	15
1-3	2	5	14
1-4	6	12	30
2-5	2	5	8
2-6	5	11	17
2-6	3	6	15
2-7	3	9	27
2-7	1	4	7
2-7	4	19	28

Required:

(1) Develop the project network clearly showing EST and LST for each activity.
(2) Analyze the critical path and assess the expected project duration.
(3) Assess the probability that the project will be completed in 38 weeks.
(4) Assess what project duration will have 95% chance of completion ($Z_{0.95}$ = 1.65)

Z	0.21	0.41	0.82
ϕ	0.0832	0.1591	0.2939

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

06 Procedure of Crashing a Project Network

THEORY QUESTIONS

TQ 6.1	PYQ	2016-Dec [8] (a) (ii)	DESC	5 Marks

If a project is delayed to any of the activities on the critical path, what steps are to be taken by an organization?

Answer:

- If there is any delay in any of the activities on the critical path the whole project will be delayed unless the firm makes other changes to bring the project back on track.
- In this type of project delayed situation the company can follow the following steps:
  - (i) If there is float elsewhere, it might be possible to switch over the staff from one activity to another activity to help catch up the delayed activity.
  - (ii) Most projects can be brought back on track by using extra labour - either by hiring additional people or arranging overtime to the existing labour. There will be using an extra cost.
  - (iii) Nodes are numbered to identify each one and show the Earliest Start Time (EST) of the activities that immediately followed the node, and the Latest Finish Time (LFT) of the immediately preceding activities.
  - (iv) The CPA must begin and end in one node.
  - (v) There must be no crossing activities in the CPA.

TQ 6.2	PYQ	2021-Dec [4]	SN	3 Marks

Write short note on Project crashing

[Sec. C - Six LAQ]

Answer:

Project Crashing:

- Project crashing is a network technique with a focus on reducing the project duration to the optimum level. Reduction in project duration may involve extra costs.
- Therefore, project crashing seeks to determine the optimum duration of the project, i.e. time that corresponds to the minimum costs.
- The activity cost slope indicates the additional cost incurred per unit of time saved in reducing the duration of an activity.

CASE-SCENARIO QUESTIONS

CSQ 6.1	PYQ	2016-Dec [8] (b)	8 Marks

ABC Machinery Company has been offered a contract to build and deliver nine extruding presses to PQR Boating Company. The contract price negotiated is contingent upon meeting a specified delivery time, with a bonus offered for every delivery. The marketing department has established the following cost and time information:

Activity	Normal time (weeks)			Normal cost (₹)	Crash time (weeks)	Crash Cost (₹)
	t_o	t_p	t_m			
1-2	1	5	3	5,000	1	9,000
2-3	1	7	4	8,000	3	14,000
2-4	1	5	3	4,000	2	6,000
2-5	5	11	8	5,000	7	6,000
3-6	2	6	4	3,000	2	5,000
4-6	5	7	6	2,000	4	3,600
5-7	4	6	5	10,000	4	14,000
6-7	1	5	3	7,000	1	10,600

Normal delivery time is 16 weeks for a contract price of ₹ 62,000.
On the basis of the calculated profitability for each delivery time specified in the following table, what delivery schedule do you recommend that the company may implement?

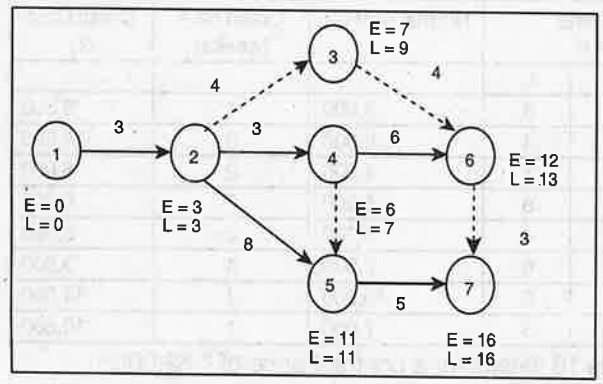
Contract Delivery Time (weeks)	Contract Amount (₹)
15	62,500
14	65,000
13	70,000
12	72,500

(Here, t_o = Optimistic time, t_p = Pessimistic time, t_m = Most likely time)

Answer:

Activity	Normal Time (Weeks)			Expected Duration (Weeks)	Normal Cost (₹)	Crash Time (Weeks)	Crash Cost (₹)	Cost Slope (₹)
	t_o	t_p	t_m					
1-2	1	5	3	3	5,000	1	9,000	2,000
2-3	1	7	4	4	8,000	3	14,000	6,000
2-4	1	5	3	3	4,000	2	6,000	2,000
2-5	5	11	8	8	5,000	7	6,000	1,000
3-6	2	6	4	4	3,000	2	5,000	1,000
4-6	5	7	6	6	2,000	4	3,600	800
5-7	4	6	5	5	10,000	4	14,000	4,000
6-7	1	5	3	3	7,000	1	10,600	1,800
Total					44,000			

The Network for the given problem is below:



The Critical Path is 1 - 2 - 5 - 7.
Total Duration is 16 Weeks.
Cost of all activities is ₹ 44,000.
Contract Price is ₹ 62,000 for normal delivery time of 16 weeks.
Hence, the Profit is ₹ 18,000.

Step 1: The critical activity 2-5 has the least cost Slope ₹ 1,000, so we crash this activity by 1 week.
Crashing cost is ₹ 1,000. The contract for delivery time of 15 weeks is ₹ 62,500.
Then, profit = ₹ 62,500 - (44,000 + 1,000) = ₹ 17,500.

Step 2: Now there are two Critical Path viz. **1 - 2 - 4 - 6 - 7** and **1 - 2 - 5 - 7** with duration of 15 weeks. So we crash activity 1 - 2 by one week at crash cost of ₹ 2,000. Project duration is 14 weeks.
Then, profit = ₹ 65,000 - (45,000 + 2,000) = ₹ 18,000

Step 3: We again crash activity 1 — 2 by 1 week. So the project duration is 13 weeks.
Then, profit is ₹ 70,000 - (47,000 + 2,000) = ₹ 21,000.

Step 4: Now crash activity of 4 - 6 for path 1 - 2 - 4 - 6 - 7 at crash cost of ₹ 800 and activity 5-7 for path 1-2-5-7 at crash cost of ₹ 4,000. The project duration is now 12 weeks.
Then, profit is ₹ 72,500 - (49,000 + 4,000 + 800) = ₹ 18,700.
No further crashing is possible.
From step 3 it can be seen the profit is maximum when the project duration is 13 weeks.
Hence, the company should implement the delivery schedule of 13 weeks at a contract amount of ₹ 70,000 to gain maximum profit of **₹ 21,000.**

CSQ 6.2	PYQ	2019-Dec [7]	4+2+10=16 Marks

The following table gives data on normal time & cost and crash time & cost for a project.

Activity	Normal		Crash	
	Time (days)	Cost (₹)	Time (days)	Cost (₹)
1-2	6	600	4	1,000

1-3	4	600	2	2,000
2-4	5	500	3	1,500
2-5	3	450	1	650
3-4	6	900	4	2,000
4-6	8	800	4	3,000
5-6	4	400	2	1,000
6-7	3	450	2	800

The indirect cost per day is ₹ 100.

Required:

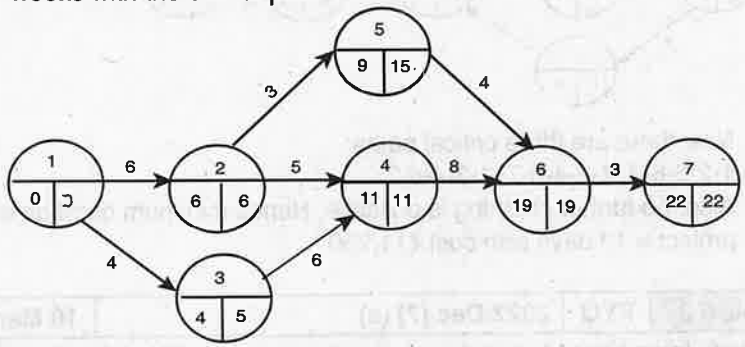
(i) Draw the network and identify the critical path.

(ii) What are the normal project duration and associated cost?

(iii) Crash the relevant activities systematically and determine the optimum project completion time and cost.

Answer:

(i) The network for normal activity times indicates a project time of 22 weeks with the critical path 1-2-4-6-7.



(ii) Normal project duration is 22 weeks and the associated cost is as follows: Total cost = Direct normal cost + indirect cost for 22 weeks.
= 4,700 + 100 × 22 = ₹6,900.

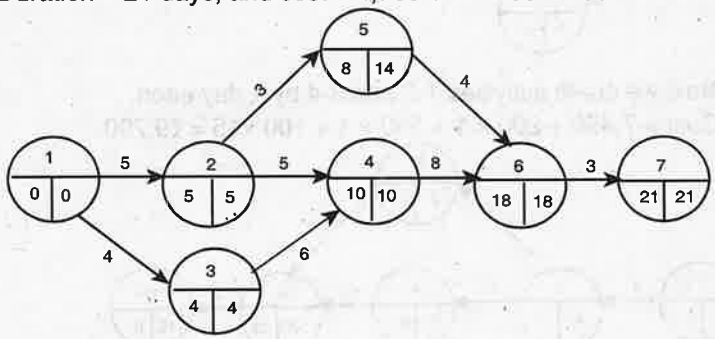
(iii) For critical activities, crash cost – slope is given below:

Critical activity	Crash cost-slop
1-2	$\frac{1,000 - 600}{6 - 4} = 200$
2-4	$\frac{1,500 - 500}{5 - 3} = 500$
4-6	$\frac{3,000 - 800}{8 - 4} = 550$
6-7	$\frac{800 - 450}{3 - 2} = 350$

Of the activities lying on the critical path, activity 1-2 has lowest cost slope.

Therefore, we shall first crash this activity by just one day.

Duration = 21 days, and cost = 4,700 + 1 × 200 + 100 × 21 = ₹7,000.



Other activities too have become critical. Now we have 2 critical paths: 1→2→4→6→7 and 1→3→4→6→7.

To reduce duration of the activity further, we shall have to reduce duration of both the paths. We have following alternatives:

Crash activity 6 - 7 by 1 day at a cost of ₹350.

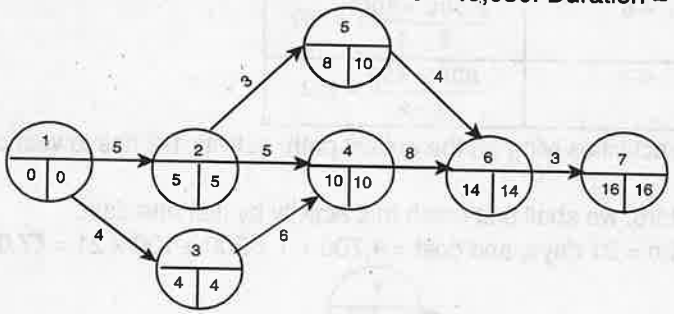
Crash activity 4 – 6 by 4 days at the cost of ₹550 per day.

Crash activities 1-2 and 1-3 by 1 day each at a cost of ₹(200 + 700) = ₹900.

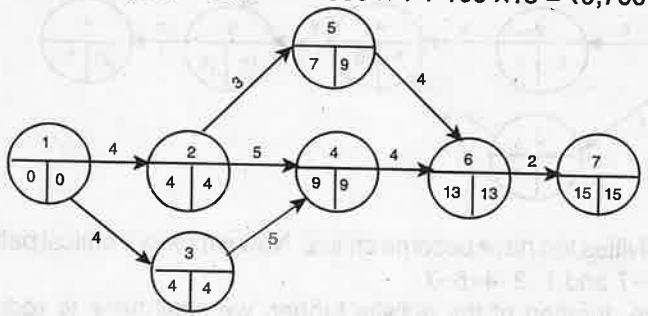
Crash activities 2-4 and 3-4 by 2 day each at a cost of ₹(500 + 550) = ₹1,050/day.

Thus, we shall first crash activities 6-7 by 1 day and then activity 4-6 by 4 days.

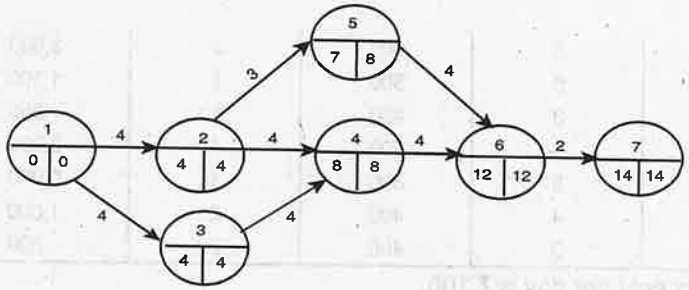
On crashing activity 6-7 by 1 day, cost = 4,900 + 350 × 1 + 100 × 20 = ₹7,250, and duration = 20 days. Next we crash 4-6 by 4 days. Cost = 5,250 + 550 × 4 + 100 × 16 = ₹9,050. Duration = 16 days.



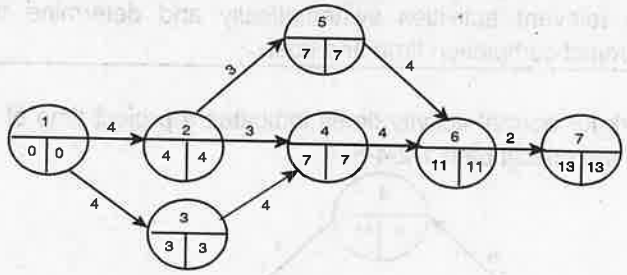
Next we crash activities 1-2 and 3-4 by 1 day each,
Cost = 7,450 + 200 × 1 + 550 × 1 + 100 ×15 = ₹9,700.



Next we crash activities 2→4 and 3→4 by 1 day each.
Cost = 8,200 + 500 × 1 + 550 × 1 + 100 × 14 = ₹10,650. Duration = 14 days.



We crash activities 1-3 and 2-4 by 1 day each.
Cost = 9,250 + 700 × 1 + 500 × 1 + 100 × 13 = ₹11,750. Duration = 13 days.



Now there are three critical paths:
1-2-5-6-7, 1-2-4-6-7, 1-3-4-6-7
Also, no further crashing is possible. Hence minimum duration of the project = 13 days with cost ₹11,750.

CSQ 6.3	PYQ	2022-Dec [7] (a)	10 Marks

Projects India Limited undertakes special contracts. The following table gives estimates of time and cost for activities involved in completing one contract which has just been offered to them:

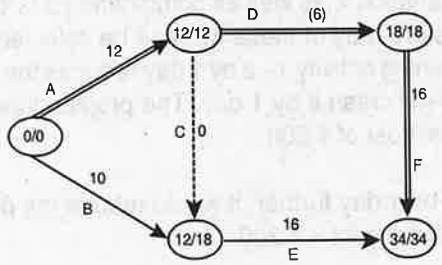
Activity	Previous activities	Normal time (Days)	Normal cost (₹)	Minimum time	Cost of minimum time (₹)
A	—	12	10,000	8	14,000
B	—	10	5,000	10	5,000

C	A	0	0	0	0
D	A	6	4,000	4	5,000
E	B, C	16	9,000	14	12,000
F	D	16	3,200	8	8,000

(i) Draw a network diagram and identify the critical path for normal procedures.

(ii) Recommend the least number of days required to be crashed to achieve the minimum time and calculate the total cost.

Answer:



Critical Path with duration = A -> D -> F, 34 days

Activity	Normal time	Crash Time	Crash Cost	Normal cost	Cost Slope
	Days	Days	₹	₹	₹
A	12	8	14,000	10,000	1,000
B	10	10	5,000	5,000	–
C	–	–	–	–	–
D	6	4	5,000	4,000	500
E	16	14	12,000	9,000	1,500
F	16	8	8,000	3,200	600

Step	Critical Path	No. of Days	Activity reduced	No. of days	Cost slope	Crash cost	Cumulative Crash cost
1	A D F	34	D	2	500	1,000	1,000
2	A D F	32	F	4	600	2,400	3,400
3	A D F / A C E	28	A	2	1,000	2,000	5,400
4	All Paths	26	F,E	2	2,100	4,200	9,600

Revised time 24 days; Total Cost ₹ 40,800.

CSQ 6.4 | **PYQ** | **2024-Dec [7]** | **14 Marks**

RONTECH (I) Ltd., an engineering firm won a contract to install an instrument landing device at the local airport. The complete installation can be broken down into seven separate activities. Each activity (Labelled A through G), its predecessor activities, normal time (days) and cost and crash time (days) and cost are given below (in table):

Activity and Identification	Predecessor Activity	Normal duration (Days)	Crash duration (Days)	Normal Cost (₹)	Crash Cost (₹)
A (1–2)	—	7	5	500	900
B (2–4)	A	4	5	400	600
C (2–3)	A	5	5	500	500
D (2–5)	A	6	4	800	1,000
E (4–6)	B, C	7	4	700	1,000
F (5–6)	C, D	5	2	800	1,400
G (6–7)	E, F	6	4	800	1,600

Required:

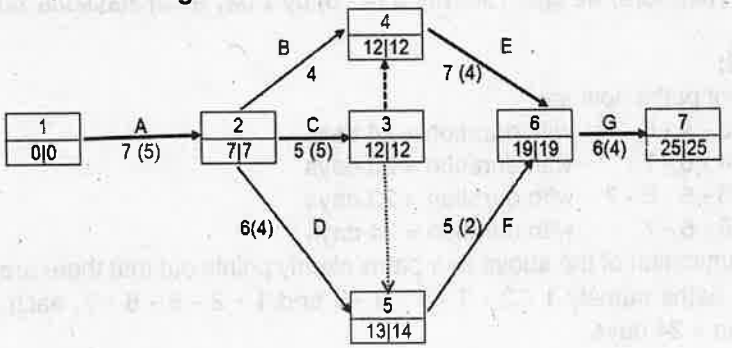
(i) Design the project network and indicate all paths through it.

(ii) Assess the critical path and the normal duration.

(iii) Evaluate the percentage increase in cost to complete the project in 21 days.

Answer:

(i) Network Diagram:



Various paths of the network are given below:

1 - 2 - 3 - 4 - 6 - 7 with duration = 25 days
1 - 2 - 4 - 6 - 7 with duration = 24 days
1 - 2 - 3 - 5 - 6 - 7 with duration = 23 days
1 - 2 - 5 - 6 - 7 with duration = 24 days

(ii) The critical path of the project is A → C → E → G or 1 - 2 - 3 - 4 - 6 - 7 with normal duration of 25 days.

(iii) Calculation of Cost Slope for various activities:

Activity	Normal duration	Crash duration	Normal Cost (₹)	Crash Cost (₹)	Cost Slope (₹)
A (1 - 2)	7	5	500	900	200
B (2 - 4)	4	5	400	600	-200
C (2 – 3)	5	5	500	500	N.A.
D (2 - 5)	6	4	800	1,000	100
E (4 - 6)	7	4	700	1,000	100
F (5 - 6)	5	2	800	1,400	200
G (6 - 7)	6	4	800	1,600	400
		Total	4,500		

Step-1:

In order to decide the cost of completing the project in 21 days, let us crash that activity on the critical path which has minimum cost slope.

It can be seen that the minimum cost slope of ₹100 corresponds to activity E (4 - 6) and it lies on the critical path.

Note: Therefore, we crash activity E (4 - 6) by 1 day at an additional cost of ₹ 100.

Step-2:

Different paths now are

1 - 2 - 3 - 4 - 6 - 7 with duration = 24 days
1 - 2 - 4 - 6 - 7 with duration = 23 days
1 - 2 - 3 - 5 - 6 - 7 with duration = 23 days
1 - 2 - 5 - 6 - 7 with duration = 24 days

An examination of the above four paths clearly points out that there are two critical paths namely 1 - 2 - 3 - 4 - 6 - 7 and 1 - 2 - 5 - 6 - 7, each with duration = 24 days.

To reduce the project duration by three days more, there are following possible combination of activities:

1. Crash activities 4 - 6 on the path 1 - 2 - 3 - 4 - 6 - 7 and 5 - 6 on the path 1 - 2 - 5 - 6 - 7 by one day each at an additional cost of ₹ 100 + ₹ 200 = ₹ 300.
2. Crash activities 4 - 6 on path1 - 2 - 3 - 4 - 6 - 7 and 2 - 5 on path 1 - 2 - 5 - 6 - 7 by one day each at an additional cost of ₹ 100 + ₹ 100 = ₹ 200.
3. Crash activity 1 - 2 by one day at an additional cost of ₹ 200.

It can be observed that the additional cost of reducing the project duration by one day in combination 2 as well as combination 3 is ₹ 200.

Conclusion: Therefore, any of these two can be selected for crashing. Although, since crashing activity 1 - 2 by 1 day reduces the duration of all the paths by 1 day, we will crash it by 1 day. The project duration becomes 23 days at an additional cost of ₹ 200.

Step-3:

Crash activity 1 - 2 by 1 day further, it would reduce the project duration to 22 days at an additional cost = ₹ 200.

Step-4:

Activity 1 - 2 cannot be crashed further. So, we now select the combination 2 stated above for crashing. Crash activities 4 - 6 and 2 - 5 by one day each at an additional cost of ₹ 100 + ₹ 100 = ₹ 200.

The project duration now becomes equal to 21 days.

Therefore, in order to complete the project in 21 days, an additional cost of ₹ 100 + ₹ 200 + ₹ 200 + ₹ 200 = ₹ 700 will be incurred.

The normal cost of completing the project in 25 days = ₹ 4,500.

Conclusion: Therefore, the percentage increase in cost to complete the project in 21 days = $\frac{₹700}{₹4,500} \times 100 = 15.55\%$

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER	
12	**Learning Curve**

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Concept of Learning Curve	2	-
2.	Learning Curve Ratio	2	-
3.	Graphical presentation of Learning Curve	-	-
4.	Pros and cons of the Learning Curve Theory	2	-
5.	Factors affecting Learning Curve	-	-
6.	The Experience Curve	2	-

SECTION-A

PYQ 2024-Jun [1] (xii) {C} Choose the correct option from the four alternatives given:

Total Revenue of ZOM Ltd., from the Sales of the quantity (units) is given by the equation $R = \frac{1}{3} x3 - x2 + 10x + 5$. If the Marginal revenue is 25, what will be number of quantity (in units)?

(a) 6 (b) 4
(c) 5 (d) None of the above **(2 Marks)**

Answer: (c) 5

PYQ 2024-Dec [1] (vii) {C} Choose the correct option from the four alternatives given:

The average cost function for a product is given by $AC = \frac{1}{3}x^2 + x + 8$, in terms of output x.

If the marginal cost is ₹ 23, what will be the number of units (Output)?
(a) 3 (b) 4
(c) 5 (d) 0 **(2 Marks)**
Answer: (a) 3

PYQ 2025-Jun [1] (viii) {C} Choose the correct option from the given alternatives:
The Cost function of TNZ PIC is given by $C = X^3 - 4X^2 + 7X$ in terms of Output X. Assess at what level of output the average cost is minimum.
(a) 3 (b) 2
(c) 4 (d) None of the above **(2 Marks)**
Answer: (b) 2

2025-Dec [1] (viii) {C} Choose the correct option from the given alternatives:
An operation of KON Ltd. has a Learning Curve 90% and the first unit produced took 30 minutes. The labour cost is ₹120 per hour. How much should the second unit labour cost?
(a) None of the below options
(b) ₹60
(c) ₹54
(d) ₹48 **(2 Marks)**
Answer: (d) ₹48

PYQ 2026-Jun [1] (viii) {C} Choose the correct option from the four alternatives given:
Ross Ltd., has developed a new product and just completed the manufacture of first four units of the product. If the first unit took 4 hours to manufacture and the first 4 units together took 11.56 hours to produce, the Learning Curve (LC) rate would be
(a) 69.50 %
(b) 75.00 %
(c) 80.10 %
(d) 85.00 % **(2 Marks)**

SECTION-B

01 Concept of Learning Curve

THEORY QUESTIONS

TQ 1.1	PYQ	2017-Jun [8] (d)	SN	4 Marks
Write short notes on the following: Learning Curve Theory.				

Answer:

Learning Curve Theory:

Learning Curve Theory is concerned with the idea that when a new job, process or activity commences for the first time, it is likely that the workforce involved will not achieve maximum efficiency immediately. Repetition of the task is likely to make the people more confident and knowledgeable and will eventually result in a more efficient and rapid operation. Eventually the learning process will stop after continually repeating the job. As a consequence the time to complete a task will initially decline and then stabilize once efficient working is achieved. The cumulative average time per unit is assumed to decrease by a constant percentage every time that output doubles. Cumulative average time refers to the average time per unit for all units produced so far, from and including the first one made.

Learning is the process by which an individual acquires skill, knowledge and ability. When a new product or process is started, the performance of a worker is not at its best and a learning phenomenon takes place. As the experience is gained, the performance of a worker improves, time taken per unit of activity reduces and his productivity goes up. This improvement in productivity of a worker is due to learning effect. Cost predictions especially those relating to direct labour cost must allow for the effect of learning process. This technique is a mathematical technique. It can be very much used to accurately and graphically predict cost.

Learning Curve is essentially a measure of the experience gained in production of an article by an individual or organization. As more units are produced, people involved in production become more efficient than before. Each subsequent unit takes fewer man-hours to produce. The amount of improvement will differ with each type of article produced. This improvement or experience gain is reflected in a decrease in man- hours or cost.

The learning curve ratio can be calculated with the help of the following formula: Learning Curve ratio = Average cost of first 2 units/Average labour cost of first unit.

TQ 1.2	PYQ	2018-Jun [6] (b)	DESC	4+4 = 8 Marks
What is Learning Curve? What factors affect Learning Curve?				

Answer:

A learning curve is the representation in graph form of the rate of learning something over time or repeated experiences.

Learning curves are a **visualization** of the difficulty estimated in learning a subject over a period of time as well as relative progress throughout the process of learning. The learning curve provides a way to show a subject's **learnability**.

The factors that influence learning are listed below together with their appropriate section numbers. The order in which the factors appear bears no relationship to their importance. The factors are:

Factors that Influence the Learning Curve

- Methods improvement
- Worker selection
- Previous experience
- Training Motivation
- Job complexity Number of repetitions (or cycles)
- Length of the task
- Errors
- Forgetting
- Continuous Improvement.

02 Learning Curve Ratio

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2023-Jun [10] (a)	3+2+3=8 Marks

GANGOTRI LTD. is developing a new product. During its expected life, 16,000 units of the product will be sold for ₹ 102 per unit. Production will be in batches of 1,000 units throughout the life of the product. The direct labour cost is expected to reduce due to the effects of learning for the first eight batches, produced. Thereafter, the direct labour cost will remain constant at the same cost per batch as in the 8th batch.

The direct labour cost of the first batch of 1,000 units is expected to be ₹ 55,000 and a 90% learning effect is expected to occur. The direct material and other non-labour related variable costs will be ₹ 50 per unit throughout the life of the product. There are no fixed costs that are specific to the product.

[**Given:** The learning index for a 90% learning curve = 0.152; $8^{-0.152}$ = 0.729; 7^{-0152} = 0.744, $9^{-0.152}$ = 0.716 and $\sqrt[4]{0.4532}$ = 0.8205, $\sqrt[4]{\sqrt{0.3773}}$ = 0.7837, $\sqrt[4]{0.2636}$ = 0.7166]

Required:

(i) Calculate the expected direct labour cost of the 8th batch.

(ii) Assess the expected contribution to be earned from the product over its lifetime.

(iii) Infer the rate of learning required to achieve a lifetime product contribution of ₹ 6,00,000, assuming that a constant rate of learning applies throughout the product's life.

Answer:

(i) Direct labour cost of 8th batch

⇒ First 8 batch $Y = x \times x^5$ ⇒ $55,000 \times 8^{-0.152}$

⇒ $55,000 \times 0.729$

⇒ 40,095 / batch

⇒ First 7 batch ⇒ $55,000 \times 7^{-0.152}$

⇒ $55,000 \times 0.744$

⇒ 40,920 / batch

⇒ For 8th batch = $(40,095 \times 8) - (40,920 \times 7)$

= [34,320] Ans

(ii) Expected contribution

Sales = (102 × 16,000)	= 16,32,000
- DM = (50 × 16,000)	= (8,00,000)
- DI	
1st (8 × 40095)	= (3,20,760)
Next (8 × 34320)	(2,74,560)
Contribution	= 2,36,680 Ans

(iii) Learning rate

Sales	16,32,000
Dm	8,00,000
DI	2,32,000 (b/f)
Contribution	= 6,00,000
⇒ $16 \times r^4 \times 55,000$	= 2,32,000
⇒ $r^4 \times 8,80,000$	= 2,32,000

$$r = \left(\frac{2,32,000}{8,80,000}\right)^{\frac{1}{4}}$$

r = 0.7166

r = 71.66% Ans

CSQ 2.2	PYQ	2023-Dec [7] (b)	7 Marks

Heavy India Shipbuilders produce a special type of boat to be used by a shipping company. A 90% learning curve is expected to apply to production of this type of boat. It is agreed that boats will be supplied at variable cost plus 20%. The variable cost of the first boat to be produced has been estimated as follows:

	₹
Materials	8,000
Labour (1,000 hrs @ ₹ 4 per hour)	4,000
Variable Overhead (200% of direct labour)	8,000

Order will be for a minimum of 2 boats.

(i) Find the average selling price per boat if the order is for 4 boats and 8 boats.

(ii) Also ascertain the separate selling price for 3rd and 4th boats.

Answer:

(i)

Uts	Avg. time
1	1,000
2	900
4	810
8	729

⇒ Average selling price / goal

Average Selling price	4	8
Mc	8,000	8,000
Labour cost	3,240	2,916
	(810×4)	(729×4)
Variable Overhead	6,480	5,882
variable cost	17,720	16,798
Marked	3,544	3,300
Selling price	21,264	20,098

(ii) Avg. time of 3rd & 4th

Total of 1st 4 - $810 \times 4 = 3,240$

1st 2 $2 \times 900 = (1,800)$

$\div 2$ 1,440

Time / hr. - 720

Material	8,000
Direct labour	2,880
Varible Overhead	5,760
	16,640
Marked + 20% =	3,328
Selling price	19,968

04 Pros and cons of the Learning Curve Theory

THEORY QUESTIONS

TQ 4.1	PYQ	2015-Dec [8] (a)	DESC	5 Marks

What are the main uses of knowledge of 'learning curve' in business?

Answer:

Knowledge of learning curve can be useful both in planning and control. Standard cost for new operations should be revised frequently to reflect the anticipated learning pattern.

Its main uses are summarized below:

(i) Helps to analyze Cost-Volume-Profit (CVP) relationship during familiarization phase of product or process. Learning curve can be used as a tool for forecasting.
(ii) Helps in developing budgets and profit planning of the project.
(iii) Helps in development of advantageous pricing policy.
(iv) It helps design engineers in making decisions based upon expected (predictable from past experience) rates of improvement.
(v) It is very useful to the Government in negotiations about the contracts.
(vi) It is quite helpful in setting standards in learning phase.

TQ 4.2	PYQ	2015-Dec [8] (b)	DESC	3 Marks

Mention the names of three industries where learning curve can be applied.

Answer:

Learning curve can be applied in the following industries:

(i) Learning curve theory was first developed in aircraft industry.
(ii) It can be applied even in non-production activities like marketing.
(iii) It can be very effective in labour oriented industries.
(iv) It can be effective with the job which is repetitive in nature particularly with same machinery and tools.

05 Factors affecting Learning Curve

CASE-SCENARIO QUESTIONS

CSQ 5.1	PYQ	2025-Dec [7] (b)	7 Marks

Gamma Electronics which has just developed 100 units of a new type of fire alarm has been asked to quote for a prospective contract. The customer requires separate price quotations for each of the following possible orders:

Order	Number of fire-alarms
First	60
Second	40

The firm had incurred the following costs per unit for the first 100 units, which it has just developed:

Direct Materials	₹500
Direct Labour:	
Department A (Highly automatic)	20 hours @ ₹10 per hour
Department B (Skilled Labour)	40 hours @ ₹15 per hour
Variable Overheads absorbed	20% of Direct Labour
Fixed Overheads absorbed:	
Department A	₹8 per hour
Department B	₹5 per hour

Required:

Calculate the price per unit for each of the two orders, assuming the firm uses a markup of 25% on total costs and allows for an 80% learning curve.

Extract from 80% Learning Curve table is given below:

X	1.0	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
Y (%)	100.0	91.7	89.5	87.6	86.1	84.4	83	81.5	80.0

X represents the cumulative total volume produced to date expressed as a multiple of the initial production of 100 units and Y is the Learning Curve factor for a given X value, expressed as a % of the cost of initial 100 units.

Answer:

Calculation of price per unit for 1st order of 60 units:

Learning will be applicable only in Dept. B

Cumulative output becomes 100 units + 60 units = 160 units i.e. 1.6 times.

From the table, learning rate is 86.1% for 1.6 times.

Therefore, total hours for 160 units = 160 × 40 × 0.861 = 5,510.40 hrs

Hours for 60 units = Hrs for 160 units - Hrs for 100 units

= 5,510.40 - 4,000 = 1,510.40 Hrs

Therefore, hours per unit = 1,510.40/60 = 25.17

Calculation of Selling Price per unit

Particulars	Calculation	Amount (₹)
Direct Materials		500.00
Direct Labour		
Dept. A: 20 hrs @ ₹ 10	200.00	
Dept. B: 25.17 hrs @ ₹ 15	377.55	577.55
Variable Overhead	20% of ₹ 577.55	115.51
Fixed Overhead		
Dept. A: 20 hrs @ ₹ 8	160.00	
Dept. B: 25.17 hrs @ ₹ 5	125.85	285.85
Total Cost		1,478.91
Profit		369.73
Selling Price per unit		1,848.64

Calculation of price per unit for 2nd order of 40 units:

Cumulative output becomes 100 units + 60 units + 40 units = 200 units i.e. 2 times.

From the table, learning rate is 80% for 2 times.

Therefore, total hours for 200 units = 200 × 40 × 0.80 = 6,400 hrs

Hours for 40 units = Hrs for 200 units - Hrs for 160 units

= 6,400 - 5,510.40 = 889.60 Hrs

Therefore, hours per unit = 889.60 / 40 = 22.24

Calculation of Selling Price per unit

Particulars	Calculation	Amount (₹)
Direct Materials		500.00
Direct Labour		

Dept. A: 20 hrs @ ₹ 10	200.00	
Dept. B: 22.24 hrs @ ₹ 15	333.60	533.60
Variable Overhead	20% of ₹ 533.60	106.72
Fixed Overhead		
Dept. A: 20 hrs @ ₹ 8	160.00	
Dept. B: 22.24 hrs @ ₹ 5	111.20	271.20
Total Cost		1,411.52
Profit		352.88
Selling Price per unit		1,764.40

06 The Experience Curve

CASE-SCENARIO QUESTIONS

CSQ 6.1	PYQ	2019-Jun [5] (b)	8 Marks

What do you understand by Learning Curve? What are its different phases? State the possible areas of application of Learning Curve.

Answer:

Learning Curve Theory is concerned with the idea that when a new job, process or activity commences for the first time it is likely that the workforce involved will not achieve maximum efficiency immediately. Repetition of the task is likely to make the people more confident and knowledgeab e and will eventually result in a more efficient and rapid operation. Gradually the learning process will stop after continually repeating the job. As a consequence the time to complete a task will initially decline and then stabilise once efficient working is achieved.

Cost predictions especially those relating to direct labour cost must allow for the effect of learning process. This technique is a mathematical technique. It can be very much used to accurately and graphically predict cost. It is a geometrical progression, which reveals that there is steadily decreasing cost for the accomplishment of a given repetitive operation, as the identical operation is increasingly repeated. The amount of decrease is less and less with each successive unit produced.

The cumulative average time per unit is assumed to decrease by a constant percentage every time that output doubles. Cumulative average time refers to the average time per unit for all units produced so far, from and including the first one made.

The slope of the decision curve can be expressed as a percentage. Experience curve, improvement curve and progress curve are other terms which can be synonymously used. Learning curve is essentially a measure of the experience gained in production of an article by an individual or organization. The improvement or experience gain is reflected in a decrease in man-hours or cost.

Phases in Learning Curve:

The learning curve will pass through three different phases:

In the first phase, there will be gradual increase in production rate until the maximum expected rate is reached and this phase is generally steep.

In the second phase, the learning rate will gradually deteriorate because of the limitations of equipment.

In the third phase, the production rate begins to decrease due to a reduction in customer requirements and increase in costs.

Learning curve is essentially a measure of the experience gained in production of an article by an organization. As more and more units re-produced, workers involved in production become more efficient than before.

The learning curve ratio can be calculated with the help of the following formula:

Learning curve ratio = Average labour cost of first units /Average labour cost of first units

Following are the possible areas of application of Learning Curve:

1. Learning curve suggests great opportunities for cost reduction to be achieved by improving learning.
2. The learning curve concept suggests a basis for correct staffing in continuously expanding production. The curve shows that the work force need not be increased at the same rate as the prospective output.
3. Learning curve concept provides a means of evaluating the effectiveness of training programs.

4. Learning curve is frequently used in conjunction with establishing bid price for contracts.
5. Learning curve is applicable in relation to the working capital required. If the requirement is based on average cumulative unit cost, the revenues from the first few units may not cover the actual expenditures.
6. It affects the rate of production by increasing.
7. Learning curve techniques are useful in exercising control. Specific or average incremental unit cost should be used for this purpose.
8. The learning curve may be used for make-or- buy decisions especially if the outside manufacturer has reached the maximum on the learning curve.

For Notes

For Notes

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 13 — Business Application of Maxima and Minima

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	1	-
2.	Unconstrained Optimization	2	-
3.	Equilibrium of a Firm	12	-
4.	Constrained Optimization	-	-

SECTION-A

PYQ 2023-Dec [1] (xv) {C} Choose the correct option.
Which of the following is not a part of qualitative type of forecasting techniques?
(a) Survey Technique
(b) Barometric Technique
(c) Exponential Smoothing
(d) Delphi Technique **(2 Marks)**
Answer: (c) Exponential Smoothing

PYQ 2024-Dec [1] (xiv) {C} Choose the correct option from the four alternatives given:
In Simple Exponential Smoothing forecast to give higher weightage to recent demand information, the smoothing constant must be close to
(a) -1 (b) 0
(c) 0.3 (d) 1 **(2 Marks)**
Answer: (d) 1

SECTION-B

01 Introduction

CASE-SCENARIO QUESTIONS

CSQ 1.1	PYQ	2019-Dec [3] (a)	3+3+4=10 Marks

A departmental store of Mumbai conducted a study of the demand for men's ties. It found that the average daily demand (D) in terms of price (P) is given by the equation D = 120 — 5P.

You are required to ascertain—

(i) How many ties per day can the store expect to sell at a price of ₹20 per tie?

(ii) If the store wants to sell 40 ties per day what price should it charge?

(iii) What is the highest price anyone would be willing to pay?

Answer:

(i) D = 120 - 5P

D = 120 - (5 × 20)

120 -100 = 20 ties are expected to be sold per day at price of ₹ 20 per tie

(ii) D = 120 - 5P

40 = 120 - 5P

5P = 120 - 40

5P = 80

P = 16 per tie if it wants to sell 40 ties per day

(iii) D = 120 - 5P

1 = 120 - 5P

5P = 120 - 1

5P = 119

P = ₹ 23.80 per tie is the highest price

02 Unconstrained Optimization

CASE-SCENARIO QUESTIONS

CSQ 2.1	PYQ	2017-Jun [3] (a)	4+4=8 Marks

The Cost Function of a particular firm is $C = \left(\frac{1}{3}\right)x^3 - 5x^2 + 75x + 10$.

(i) Find at which level the Marginal Cost attains its minimum.

(ii) What is the marginal cost at this level?

Answer:

$C = (1/3)x^3 - 5x^2 + 75x + 10$

Marginal Cost = $dc/dx = (1/3)3x^2 - 5(2x) + 75 = x^2 - 10x + 75$ (say y)

In order that the MC to be at minimum, its second derivative value must be positive.

$dy/dx = 2x - 10$ or $2x = 10$ or $x = 5$

$d^2y/dx^2 = 2$, which is positive, so that the function will have minimum values, when x = 5.

Therefore, Minimum Marginal Cost = $5^2 - 10 \times 5 + 75 = 25 - 50 + 75 = 50$.

CSQ 2.2	PYQ	2021-Dec [10]	1 Mark

The profit function of ZB & Co. A firm is given by $P = 320x - 2x^2$ in terms of output x, how many outputs should the firm sell to make the maximum profit?

[Sec. B - SAQ]

Answer:

1. **Given Profit Function:**
   - $P = 320x - 2x^2$
2. **First Derivative of the Profit Function:**
   - To find the output that maximizes profit, we need to find the critical points by setting the first derivative equal to zero.

- First derivative of the profit function, P, with respect to xxx is:
- $\frac{dp}{dx} = 320-4x$

3. **Set the First Derivative Equal to Zero and Solve for xxx:**
   - $320-4x = 0$
   - $4x = 320$
   - $x = 80$
4. **Verify the Maximum Profit:**
   - To ensure this is a maximum, we check the second derivative of the profit function.
   - Second derivative of the profit function is:
   - $\frac{d^2p}{dx^2} = -4$
   - Since the second derivative is negative, the function has a maximum at x=80.

Conclusion:
ZB & Co. should sell 80 units of output to make the maximum profit.

03 *Equilibrium of a Firm*

CASE-SCENARIO QUESTIONS

CSQ 3.1	PYQ	2014-Jun [6] (d)	4 Marks
The equation of the demand curve of a firm is p =12 - 0.4q and the equation of the total cost curve is C = 0.6q2 + 4q + 5. Determine price, output, total revenue and profit if the objective of the firm is to maximize profit.			

Answer:
Suppose total revenue = R and total profit = π
So, π = R - C = pq - C
or, π = (12 - 0.4q)q - (0.6q^2 + 4q + 5)

= 12q - 0.4q^2 - 0.6q^2 - 4q-5
= - q^2+ 8q - 5.
The first order condition to maximize π requires, dπ/dq = 0 or, - 2q + 8 = 0
or, 2q = 8
or, q = 4
d2π/dq^2 = - 2 < 0. So the second order condition is also fulfilled.
Now, when q = 4,
p = 12-0.4(4) = 12-1.6= 10.40
R = pq = 10.4(4) = 41.6 and π = -$(4)^2$ + 8(4) - 5
= -16 + 32 – 5 = 11.

CSQ 3.2	PYQ	2016-Jun [II] [1] (c)	4 Marks
The equation of the demand curve of a firm is p = 12 — 0.4q and the equation of the total cost curve is C = 06q^2 + 4q + 5. Determine price, output, total revenue and profit if the objective of the firm is to maximize profit.			

Answer:
It is assumed that total revenue = R and total profit = π
So, π = R - C = pq - C
or, π = (12 - 0.4q)q - (0.6q^2 + 4q – 5)
= 12q - 0.4q^2 - 0.6q^2 - 4q - 5
= - q^2 + 8 q - 5 .
The first order condition to maximize % requires, d/dq = 0 or, - 2q + 8 = 0
or, 2q = 8
or, q = 4
d^2 π/dq^2 = - 2 < 0. So the second order condition is also fulfilled.
Now, when q = 4,
p = 12 - 0.4(4) = 12 - 1.6 = 10.40
R = pq = 10.4(4) = 41.6 and
π = - $(4)^2$ + 8(4)-5 = -16 + 32 - 5 = 11

CSQ 3.3	PYQ	2016-Dec [2] (a)	6 Marks

The demand function of a firm is q = 200 - 10 p and the average cost function is AC = 10 + 25q.
If the firm's objective is to maximise profit, what will be its profit maximising output?

Answer:

Here the equation of the demand curve is —
Q = 200 – 10p
Or, 10p = 200 – q
Or, p= (200 – q)/10 = 20 – q/10
So, total revenue R =pq= 20q – q^2/10
Marginal revenue (MR) = (dR)/ (dq) = 20 – q/5
Again, AC = 10+25q
Total cost (C) = ACxq = 10q + 25q^2
Marginal cost (dC)/(dq) = 10 + 50q
Now, the first order condition for profit maximization requires, MR = MC.20 – q/5 = 10+50q
Or, 20 – 10 = 50q + q/5
Or, 10 = 50q +q/5
Or, $\frac{250q}{5}$= 10
Or, 50 = 250q +q
Or, 251q=50
Or q= 50/251
Hence, to get maximum profit, the firm will produce 50/251 units of output
[**Note -** In this question the average cost function is AC = 10 + 25q, which gives demand q in fraction
If in the above question if the average cost function may be given as AC = 10 + q/25, then the solution of the above problem will be as follows
Here the equation of the demand curve is
q = 200-10p
or, 10p = 200-q
or, p = (200-q)/10 = 20-q/10
So, total revenue (R) = pq = 20q - q^2/10

Marginal revenue (MR) = (dR) / (dq) = 20-q/5
Again, AC = 10 + q/25
Total cost (C) - AC x q = 10q + q^2/25
Marginal cost (dC) / (dq) = 10 + 2q / 25
Now, the first order condition for profit maximization requires, MR = MC.
20-q/5 = 10 + 2q/25
Or, q/5 + 2q/25 = 20-10
Or, 7q/25 = 10
Or, q = (10x25)/7 = 250/7
The second order condition requires that slope of MC > slope of MR.
Now, slope of MR = [d(MR)] / (dq) = - 1/5 < 0
and slope of MC = [d(MC)] / (dq) = 2/25 > 0
So the second order condition is fulfilled.
Hence, to get maximum profit, the firm will produce 250/7 units of output.]

CSQ 3.4	PYQ	2018-Jun [3] (a)	4+8=12 Marks

A firm has a demand function: p = 12 - x^2 and the total cost function: C = -(4/3)x^3 + 4x^2+10 where p = Price per unit (₹ '000) and x = Quantity demanded/produced (units in thousands). On the basis of the information given, answer the following:

(i) Show that the firm is a monopolist firm.
(ii) Determine the quantity the firm should produce to maximize profit. Also, determine the amount of profit.

Answer:

(i) A monopolist firm is one that is having a negatively sloped or downward moving demand curve. We also know that a function is said to be having negative slope when its first derivative is negative. In this problem, dp/dx = -2 x. Since x cannot be negative, it means that derivative is negative; hence, it shows that the firm is a monopolist firm.

(ii) Profit Function (π) is Total Revenue -Total Cost and is defined below:
π= p.x – c
π = (12x - x^3) - (-$\frac{4}{3}$$x^3$ + 4x^2 + 10)

$\frac{d\pi}{dx} = (12 - 3x^2) - (-4x^2 + 8x)$

Putting the first derivative equal to zero, we get -

$(12 - 3x^2) - (-4x^2 + 8x) = 0$

$\Rightarrow 12 - 3x^2 + 4x^2 - 8x = 0$

$\Rightarrow x^2 - 8x + 12 = 0$

$\Rightarrow x^2 - 6x - 2x + 12 = 0$

$\Rightarrow (x - 2)(x - 6) = 0$

X = 2 or x = 6 (in '000 units)

Second order condition:

$\frac{d^2\pi}{dx^2} = 2x - 8$

A function will be maximum when its second derivative is negative; and for x = 2, the above second derivative will be negative while for x = 6 it will be positive. The profit will be maximum when x = 2 (in '000 units). Putting the value of x = 2, in the profit function, we get Profit = 2/3 = 0.67 (₹ in '000) = ₹ 670.

CSQ 3.5	PYQ	2018-Dec [3] (a)	8 Marks
The total cost function for a monopolist is given by TC = 900 + 40 Q^2. The demand function for the goods produced by the monopolist is given by 2 Q = 48 – 0.08 P. What will be the profit maximizing price?			

Answer:

Demand function is given by

2 Q = 48 – 0.08 P

or, 2 Q – 48 = - 0.08 P

or, 48 – 2 Q = 0.08 P

or, P = 600 - 25 Q

TR = PQ

= 600 Q – 25 Q^2

TC is given by,

TC = 900 + 40 Q^2

The first order condition for profit maximization is MR = MC

TR = 600 Q – 25 Q^2

$MR = \frac{dTR}{dQ} = 600 - 50Q$

$MC = \frac{d(TC)}{dQ} = 80Q$

For maximizing profit

MR = MC

i.e. 600 – 50 Q = 80 Q

$Q = \frac{600}{130} = 4.6 \text{units}$

Equilibrium Price =

P = 600 – 25 Q = 600 – 25(4.6)

= 600 – 115

= ₹ 485

i.e. profit maximizing price is ₹ 485

CSQ 3.6	PYQ	2019-Jun [3] (a)	8+2=10 Marks
The total cost function of a firm, C = $\frac{x^3}{3} - 5x^2 + 28x + 10$ where C is total cost and 'x' is the output. A GST @ ₹ 2/- per unit of output is imposed and the producer adds it to his cost. If the demand function is given by D = 2,530 – 5x, where ₹ D is the price per unit of output. Find the profit maximizing output and the price at the level. Also obtain maximum profit.			

Answer:

Given (C) = $\frac{x^3}{3} - 5x^2 + 28x + 10 + 2x$

D = 2,530 – 5x, where ₹ D = Price per unit

Revenue = XD = 2,530X – $5x^2$

Profit (P) = $2{,}530x - 5x^2 + 5x^2 - \frac{x^3}{3} - 28x - 2x - 10$

$P = -\frac{x^3}{3} + 2{,}500x - 10$

In order that maximum Profit is attained.

$\frac{dp}{dx} = 0$ and

$\frac{d^2p}{dx^2}$ = Negative

Derivative w.r.t. x

$\frac{dp}{dx} = \frac{d}{dx}\left(-\frac{x^3}{3} + 2{,}500x - 10\right) = 0$

$= -x^2 + 2{,}500 = 0$

Or, $x^2 = 2{,}500$

$x = \sqrt{2{,}500} = 50$

$\frac{d^2p}{dx^2} = -2x$, which is negative

Maximum profit is at x = 50 units

Price = D = 2,530 – 5 × 50 = 2,280

Profit (P) = $-\frac{x^3}{3} + 2{,}500x - 10$

$= -\frac{1{,}25{,}000}{3} + 2{,}500x50 - 10 =$ ₹ 83,323.33

CSQ 3.7	PYQ	2023-Jun [10] (b)	6 Marks
The total cost function of a firm $C = \frac{x^3}{3} - 5x^2 + 28x + 10$, where C is total cost and 'x' is the output. A GST @ ₹ 2 per unit of output is imposed and the producer adds it to his cost. If the demand function is given by D = 2530-5x, where ₹ D is the price per unit of output. **Required:** Evaluate the profit maximizing output and the price at the level.			

Answer:

1. **Total Revenue (TR):**
   - The price (P) per unit is given by the demand function: P = 2,530 – 5x
   - Total Revenue (TR) is given by: TR = P× X
   - TR = (2,530 – 5x)× X
   - TR = 2,530x – $5x^2$
2. **Total Cost (TC) including GST:**
   - Given Total Cost (C): $C = \frac{x^3}{3} - 5x^2 + 28x + 10$
   - GST: 2x
   - Total Cost including GST: $TC = \frac{x^3}{3} - 5x^2 + 28x + 10 + 2x$
   - $TC = \frac{x^3}{3} - 5x^2 + 30x + 10$
3. **Profit Function (π):**
   - Profit (π) = Total Revenue (TR) – Total Cost (TC)
   - $\pi = (2{,}530x - 5x^2) - \left(\frac{x^3}{3} - 5x^2 + 30x + 10\right)$
   - Simplify the profit function:
   - $\pi = 2{,}530x - 5x^2 - \left(\frac{x^3}{3} - 5x^2 + 30x + 10\right)$
   - $\pi = 2{,}500x - \frac{x^3}{3} - 10$
4. **Find the First Derivative of the Profit Function (π') to Determine the Critical Points:**
   - $\pi' = \frac{d\pi}{dx} = 2{,}500 - x^2$
5. **Set the First Derivative Equal to Zero to Find the Critical Points:**
   - $2{,}500 = x^2 = 0$
   - $x^2 = 2{,}500$
   - $x = \sqrt{2{,}500}$
   - x = 50
6. **Verify if the Critical Point is a Maximum by Using the Second Derivative Test:**
   - π'' = –2x
   - At x = 50, π'' = 2x (–50) = –100 (which is less than zero, indicating a maximum)

7. **Calculate the Price at Maximum Profit:**
   - Use the demand function to find the price: $P = 2,530 - 5x$
   - At $x = 50$, $P = 2,530 - 5 \times 50$
   - $P = 2,530 - 250$
   - $P = 2,280$

CSQ 3.8	PYQ	2023-Dec [8] (a)	7 Marks

ZOXIN Ltd., a manufacturing company is planning to market a new model of a doll. Rather than setting the selling price of the doll based only on production cost estimation, management polls the retailers of the doll to see how many dolls they will buy for various prices. From this survey, it is determined that the unit demand function is $x = 1,500 - 75p$, and the cost function is given by $C = 4x + 1,400$, for the doll, where p is the price per unit and x is the number of units demanded.

Required:

(i) Evaluate how many number of dolls are sold to the retailers to maximize the profit of the company.

(ii) Identify the price the company should charge to retailers in order to obtain maximum profit.

(iii) Assess the maximum profit available to ZOXIN Ltd.

Answer:

Demand Function

The number of dolls demanded, x, depends on the price p.

The demand function is: $x = 1,500 - 75p$.

Revenue Function

Revenue is calculated as Revenue = price × number of units.

Substitute the demand function into the revenue function:

Revenue = $p \times (1,500 - 75p)$.

Simplify: Revenue = $1,500p - 75p^2$.

Cost Function

The cost to produce x dolls is given by: Cost = $4x + 1,400$.

Profit Function

Profit is calculated as Profit = Revenue - Cost.

Substitute the revenue and cost functions:

Profit = $(1,500p - 75p^2) - (4x + 1,400)$.

Since $x = 1,500 - 75p$, replace x:

Profit = $(1,500p - 75p^2) - [4(1,500 - 75p) + 1,400]$.

Simplify: Profit = $1,500p - 75p^2 - 6,000 + 300p - 1,400$.

Further simplify: Profit = $-75p^2 + 1,800p - 7,400$.

Maximize Profit

To find the maximum profit, take the derivative of the profit function with respect to p, set it to zero, and solve for p.

The derivative of Profit is: $-150p + 1,800 = 0$.

Solve for p:

$-150p + 1,800 = 0$.

$150p = 1,800$.

$p = 12$.

Substitute $p = 12$ into the demand function:

$x = 1,500 - 75 \times 12$.

$x = 1,500 - 900$.

$x = 600$.

Substitute $p = 12$ and $x = 600$ into the profit function:

Revenue: $12 \times 600 = 7,200$.

Cost: $4 \times 600 = 2,400 + 1,400 = 3,800$.

Profit: $7,200 - 3,800 = 3,400$.

CSQ 3.9	PYQ	2024-Jun [8] (a)	7 Marks

ZUZOO Ltd., a Mobile manufacturer produces x sets per week at total cost of $x^2 + 78x + 300$. ZUZOO Ltd. is a monopolist and demand function for the product is $x = (600 - P)/8$ when price in rupees is P per set.

Required:

(i) Analyze the Optimal (Profit maximizing) production per week.

(ii) Assess the monopoly price per week.

(iii) Assess the Total Cost and Profit at the optimal production.

Answer:

Total Cost $= x^2 + 78x + 300$

Demand Function x $= (600 - P)/8$

Or P $= 600 - 8x$

Revenue function → Revenue $= x(600 - 8x)$

$= 600x - 8x^2$

1. Profit = Revenue - Cost

$= (600x - 8x^2) - (x^2 + 78x + 300)$

Profit $= -9x^2 + 522x - 300$

Differentiating w.r.t. x we have

$\frac{d(Profit)}{dx} = -18x + 522$

for Maximum Profit $\frac{d(Profit)}{dx} = 0$

$\Rightarrow -18x + 522 = 0$

$\Rightarrow 18x = 522$

$x = \frac{522}{18} = 29$ sets

2. Monopoly Price $= 600 - 8x = 600 - 8 \times 29$

$= ₹ 368$

3. Total Cost $= x^2 + 78x + 300$

Putting x = 29 we have

TC $= (29 \times 29) + (78 \times 29) + 300$

$= ₹ 3,403$

Total Profit $= -9x^2 + 522x - 300$

Putting x = 29 we have

Total Profit $= -(9 \times 29 \times 29) + (522 \times 29) - 300$

$= ₹ 7,269$

(1) Optimal Production per week = 29 sets

(2) Monopoly Price = ₹ 368

(3) Total Cost = ₹ 3,403

Total Profit = ₹ 7,269

CSQ 3.10	PYQ	2025-Jun [8] (a)	7 Marks
ROLEX Ltd., a monopolist can effectively segment the market into two Sub-markets with the demand functions, $P_1 = 400 - 2Q_1$ and $P_2 = 300 - 2Q_2$, where $Q = Q_1 + Q_2$ = Total production of two Sub-markets. Total Cost Function of two Sub-markets are given as C = 3,000 + 60Q. **Required:** If price discrimination is allowed, assess the maximum possible profit that can be earned by the Monopolist (ROLEX Ltd.) from two Sub- markets.			

Answer:

Price Discrimination:

$P_1 = 400 - 2Q_1$

$TR_1 = 400Q_1 - 2Q_1^2$

$MR_1 = d(400Q_1 - 2Q_1^2)/dQ_1 = 400 - 4Q_1$

$P_2 = 300 - 2Q_2$

$TR_2 = 300Q_2 - 2Q_2^2$

$MR_2 - d(300Q_1 - 2Q_2^2)/dQ_2 = 300 - 4Q_2$

Total Cost Function (C) = 3,000 + 60 Q

Where $Q = Q_1 + Q_2$

$MC = d(3,000 + 60Q)/dQ = 60$

To maximize profits, the discrimination monopolist should equate

$MR_1 = MC$ and MR_2 MC

So, $400 - 4Q_1 = 60$

$Q_1 = 85$

Similarly, $300 - 4Q_2 = 60$

So, $Q_2 = 60$

Prices in the sub-markets are

P1 = 400 - (2 x 85)

= 230

P2 = 300 - (2 x 60)

= 180

$Q_1 = 85$ P_1

= 230

$Q_2 = 60$ P_2

= 180

Profit of the discriminating monopolist:

$= (TR_1 + TR_2) - TC$

$= (85 \times 230 + 60 \times 180) - [(3,000 + 60 \times (85 + 60)] = 30,350 - 11,700$

= ₹18,650

The maximum possible profit that can be earned by the monopolist from the two sub-division market with price discrimination is ₹18,650.

CSQ 3.11	PYQ	2025-Dec [8] (a)	7 Marks

SUTON Ltd. (SL) a manufacturing company can sell 'x' items of a product ($x \geq 0$) at a price of $(3x^2 - 3x + 656)$ each, the total cost C(x) of producing 'x' items is, $x^3 + 60x^2 + 8x$, (x being the output)

Required:

(i) Analyze the number of items SUTON Ltd., should sell to make maximum profit.

(ii) Analyze and assess the maximum profit SUTON Ltd., can earn from the product.

Answer:

(i) Total cost $C(x) = x^3 + 60x^2 + 8x$

Total Revenue $R(x) = (3x^2 - 3x + 656)\, x$

$= 3x^3 - 3x^2 + 656x$

Profit $(P) = (3x^3 - 3x^2 + 656x) - (x^3 + 60x^2 + 8x)$

$= 3x^3 - x^3 - 3x^2 - 60x^2 + 656x - 8x)$

$= 2x^3 - 63x^2 + 648x$

For maximization of profit,

$\frac{dp}{dx} = 0$ and $\frac{d^2p}{dx^2} = 0$ = Negative < 0

Derivative w.r. to x

$\frac{dp}{dx} = \frac{d}{dx}(2x^3 - 63x^2 + 648x)$

$\therefore 6x^2 - 126x + 648 = 0$

Or, $x^2 - 21x + 108 = 0$

Or , $x(x - 9) - 12(x - 9) = 0$

$(x-12)(x-9) = 0$

i.e. x =12 or 9

Again,

$\frac{d^2p}{dx^2} = 12x - 126$, at x =9

$\frac{d^2p}{dx^2} = 108 - 126 = -18 < 0$ (Negative)

Therefore, P is maximum at x = 9

At x=12, $\frac{d^2p}{dx^2} = 144 - 126 = 18 > 0$ (Positive)

P is minimum at x = 12

Hence, the SUTON Ltd., should sell 9 items to make Maximum profit.

Alternative Solution:

For maximization of Profit, Marginal Revenue = Marginal Cost

Marginal Revenue (MR) = d/dx (Total Revenue) = d/dx ($3X^3 - 3X^2 + 656X$) = $9X^2 - 6X + 656$

Marginal Cost (MC) = d/dx ($X^3 + 60X^2 + 8X$) = $3X^2 + 120X + 8$

We have MR = MC,

$9X^2 - 6X + 656 = 3X^2 + 120X + 8$

Or, $x^2 - 21x + 108 = 0$

Or, $x(x - 9) - 12(x - 9) = 0$

$(x - 12)(x - 9) = 0$

i.e. x =12 or 9

Again,

$\frac{d^2p}{dx^2} = 12x - 126$, at x = 9

$\frac{d^2p}{dx^2} = 108 - 126 = -18 < 0$ (Negative)

Therefore, P is maximum at x = 9

At x = 12, $\frac{d^2p}{dx^2} - 144 - 126 = 18 > 0$ (Positive)

P is minimum at x = 12

Hence, the SUTON Ltd., should sell 9 items to make Maximum profit

(ii) Profit $(P) = 2x^3 - 63x^2 + 648x$

$= 2(9)^3 - 63(9)^2 + 648(9)$ at x = 9

$= 7{,}290 - 63 \times 81 = ₹\ 2{,}187$

The maximum profit SUTON Ltd., can earn from the product is ₹ 2,187.

CSQ 3.12	PYQ	2026-Jun [8] (a)	7 Marks

Ajooba Ltd. manufactures pen drives. The market research department estimates that the quantity sold per day varies with price per unit as per the following equation:
q = (900-p)/3, where q = quantity sold per day and p= price per unit.
The variable cost per unit is ₹324 and attributable fixed costs are ₹1,000 per day. The Sales Department thinks that maximum profit coincides with maximum revenue but the managing director is not so sure.
As a Management Accountant you are required to analyze the position so as to confirm or refute the sales department's assertion.

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.
Access the LMS using the secret code printed on the first coloured page of this book.
For Your Reflections & Learning Notes:

For Notes

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 14 Business Forecasting Models - Time Series and Regression Analysis

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	-	-
2.	Pros and Cons of Business Forecasting	1	-
3.	Types of Business Forecasts	-	-
4.	Methods or models of Business Forecasting	14	-

SECTION-A

PYQ 2023-Dec [1] {C} Choose the correct option.

(xiii) Which of the following has no relation to Business Intelligence?

(a) A set of business analytics solutions to retrieve, analyse and transform data into useful business sights.
(b) Visualisation Tools are primarily BI Tools.
(c) ABS Glue is a tool used for the purpose of Business Intelligence.
(d) Embedded Analytics is an important part of any Business Intelligence tool. **(2 Marks)**

Answer: (c) ABS Glue is a tool used for the purpose of Business Intelligence.

(xiv) Which of the following is/are the Financial analytics tools?

(a) Hypper Anna (b) Jedox
(c) Net Suite (d) All of the above **(2 Marks)**

Answer: (d) All of the above

PYQ 2024-Jun [1] {C} Choose the correct option from the four alternatives given:

(ix) Which of the following is/are not the features of Jedox tool?
- (a) Deployable in the cloud as well as on premise server or Hybrid.
- (b) BI and Analytics platform.
- (c) Allows users to easily create and share powerful reports within minutes.
- (d) (b) and (c) only

(2 Marks)

Answer: (d) (b) and (c) only

(x) Analysis of a dataset has revealed the fact that profit of a business has reduced for the financial year 2022-23. What category of data analytics it comes under?
- (a) Descriptive Analytics
- (b) Predictive Analytics
- (c) Diagnostic Analytics
- (d) Prescriptive Analytics

(2 Marks)

Answer: (a) Descriptive Analytics

PYQ 2024-Dec [1] {C} Choose the correct option from the four alternatives given:

(xi) Which one of the following is not a Spread Sheet?
- (a) Quip
- (b) MS Excel
- (c) E views
- (d) Google Sheets

(2 Marks)

Answer: (c) E views

(xii) # Script Ends – is related to which type of Programming Language?
- (a) SPSS
- (b) Python
- (c) SAS
- (d) R Programming

(2 Marks)

Answer: (b) Python

PYQ 2025-Jun [1] {C} Choose the correct option from the given alternatives:

(iv) Which of the following is related to Financial Data Analytics?

- (a) Value driver analytics
- (b) Financial ratio analytics
- (c) Predictive sales analysis
- (d) All of the above

(2 Marks)

Answer: (d) All of the above

(v) Python can be used on Linux, Windows, Macintosh, Solaris and many more. What category of language features of Python it comes under?
- (a) Robust
- (b) Embeddable
- (c) High Level Language
- (d) Platform Independent

(2 Marks)

Answer: (d) Platform Independent

SECTION-B

02 Pros and Cons of Business Forecasting

THEORY QUESTIONS

TQ 2.1	PYQ	2013-Dec [4] (b)	DESC	5 Marks
What are the merits of Delphi method of forecasting technique?				

Answer:

Delphi is preferred for the following reasons:

- It involves knowledgeable persons on the subject.
- Members in Delphi exercise come from different backgrounds and therefore the method is able to consider and pool up various aspects of the issue.
- Since the members do not meet each other, their views are not influenced by the views of other.
- No conflict of personality is seen in the process.
- No dominance by any influential expert on the other experts.
- It gives quick results as compared to quantitative techniques and helps in timely decisions.

04 Methods or models of Business Forecasting

THEORY QUESTIONS

TQ 4.1	PYQ	2010-Nov [5] (b)	DESC	5 Marks
Discuss various forecasting methods using time series. *[CA Final Gr. II]*				

Answer:

Forecasting methods using time series:

(i) Mean forecast: In this method we calculate mean of the series for the time period t and take this value as representative of the future time series. $Y_t = Y$

(ii) Naive forecast: This method is based on the assumption that the future will exactly resemble the past. We forecast the value, for the time period t, to be equal to the actual value observed in the previous period t that is, time period (t-1) $Y_t = Y_{t-1}$.

(iii) Linear trend forecast: A linear relationship is established between the time and the variable under study, which may be represented by $Y_t = a + bX$.

Where X will be found from the value of t and a and b are constants.

(iv) Non –linear trend forecast: In this method, a non-linear relationship between the time and the response value has been found again by least squares method. Then the value, for the time period t, will be calculated from the non-linear equation; $Y_t = a + bX + cX^2$.

(v) Forecasting by exponential smoothing: In this method, the forecast value for the time period t is found using exponential smoothing of time series

$Y_t = Y_{t-1} + a (Y_t - Y_{t-1})$ where Y_{t-1} = the forecasted value for time period t

Y_t = the observed value for time period t.

CASE-SCENARIO QUESTIONS

CSQ 4.1	PYQ	2008-Dec [3] (b)				4 Marks
The following is the demand for Product A in 5 towns:						
Population (in lacs):X		9	5	8	5	3
Demand:Y		12	20	15	10	5
Estimate the demand for Product A for a town with a population of 10 lacs.						

Answer:

Computation of Trend Values

Population (in lakhs)	Demand	Squares of the population	Product of the population and demand
X	Y	X^2	X Y
9	12	81	108
5	20	25	100
8	15	64	120
5	10	25	50
3	5	9	15
30	**62**	**204**	**393**

Regression equation of Y on X

$Y = a + bX$

To find the values of a and b, the following two equations are to be solved

$\sum Y = na + b\sum X$ ...(i)

$\sum XY = a \sum X + b \sum_X 2$ ...(ii)

By putting the values we get

$62 = 5a + 30b$ ...(iii)

$393 = 30a + 204b$ ...(iv)Multiplying equation (iii) by 6 and putting it as no (v) we get

$372 = 30a + 180b$ ...(v)

By deducting equation (v) from equation (iv); we get $21 = 24b$

$b = 0.875$

By putting b in equation (iii) we get

$62 = 5a + 30 \times 0.875$

$62 = 5a + 26.25$

$35.75 = 5a$

$a = 7.15$

Now by putting the values of a,b and X(10 Lakhs) in regression equation of Y on X, we get,

$Y = a + bX$

$Y = 7.15 + 10 \times 0.875$

$Y = 15.9 = 16$

CSQ 4.2	PYQ	2009-Jun [2] (c)	4 Marks

The annual sales of TV sets by a dealer in Delhi are as under:

Year	2004	2005	2006	2007	2008
Sales (thousand units)	3	14	36	4	33

Fit a linear trend equation to the sales figure and estimate the sales for the year 2009.

Answer:

Years	Sales	Time Deviation	Square of time deviation	Product of time deviation and sales
	Y	X	X^2	XY
2004	3	-2	4	-6
2005	14	-1	1	-14
2006	36	0	0	0
2007	4	1	1	4
2008	33	2	4	66
n=5	$\Sigma Y=90$	$\Sigma X=0$	$\Sigma X^2= 10$	$\Sigma XY= 50$

Regression equation of Y on X

$Y = a + bx$

For calculating the values of a and b

$a = \frac{\Sigma y}{n} = \frac{90}{5} = 18$

$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{50}{10} = 5$

Hence regression equation is a + bX or 18 + 5X. With the help of this equation, the trend value for 2009 can be calculated as follows:

$Y_{2009} = 18 + 5(3) = 33{,}000$ units.

CSQ 4.3	PYQ	2009-Dec [2] (a)	6 Marks

From the following time series data of sales of refrigerators, project the sales for the year 2010:

Year	2002	2003	2004	2005	2006	2007	2008
Sales (thousand units)	90	100	102	93	104	109	102

Answer:

Years	Sales	Time Deviation	Square of time deviation	Product of time deviation And Sales
	Y	X	X^2	XY
2002	90	-3	9	-270
2003	100	-2	4	-200
2004	102	-1	1	-102
2005	93	0	0	0
2006	104	1	1	104
2007	109	2	4	218
2008	102	3	9	306
n=7	ΣY=700	ΣX=0	ΣX^2= 28	ΣXY= 56

Regression equation of Y on X

$Y = a + bX$

For calculating the values of a and b

$a = \frac{\Sigma y}{n} = \frac{700}{7} = 100$

$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{56}{28} = 2$

Hence regression equation is a + bX or 100 + 2X. With the help of this equation, the trend value for 2010 can be calculated as follows:

Y_{2010} = 100 +2(5) = 1,10,000 units.

CSQ 4.4	PYQ	2010-Jun [2] (a)	6 Marks

It is observed that there exists a relationship between Expenditure on Advertising and the Annual Sales. The details for last six years are as follows:

Year	Expenditure on Advertising (₹ Crore)	Annual Sales (₹ Crore)
2004	1	18
2005	2	23
2006	4	32
2007	3	28
2008	10	38
2009	4	29

Estimate the Annual Sales when Expenditure on Advertising is ₹ 5 Crore.

Answer:

Years	Expenditure on Advertising (₹ Crore)	Annual Sales (₹ Crore)	Square of Expenditure on Advertising	Product of Expenditure on Advertising and Annual Sales
	X	Y	X^2	XY
2004	1	18	1	18
2005	2	23	4	46
2006	4	32	16	128
2007	3	28	9	84
2008	10	38	100	380
2009	4	29	16	116
n=6	ΣX=24	ΣY=168	ΣX^2= 146	ΣXY= 772

$\bar{X} = \frac{24}{6} = 4$ and $\bar{Y} = \frac{168}{6} = 28$

The values a and b are computed as follows: for a linear regression equation

$Y = a + bX$

$b = \frac{\Sigma XY - n\bar{X}\bar{Y}}{\Sigma X^2 - n\bar{X}^2}$

$b = \frac{772 - 6 \times 4 \times 28}{146 - 6 \times 4 \times 4} = \frac{772 - 672}{146 - 96} = \frac{100}{50} = 2$

$a = \bar{Y} - b\bar{X} = 28 - 2 \times 4 = 20$

Thus, the model is y = 20 + 2X.

The Annual Sales when expenditure is 5 crore is

Y = 20 + 2×5 = 30 Crores.

CSQ 4.5	PYQ	2014-Jun [5] (a)	6 Marks

The following data on the exports of an item by a company during the various years fit a straight line, (for the time being, assume that a straight line gives a good fit). Give a forecast for the years 2013 and 2014.

Year	No. of items ('000)
2004	13
2005	20
2006	20
2007	28
2008	30
2009	32
2010	33
2011	38
2012	43

Answer:

Let 'X' represent year and 'T' represent export. In order to use the normal equations for the least square line, we need ΣX, Σy, ΣXy and ΣX^2. To simplify the calculation arrange X in such a way that $\Sigma X = 0$.

Therefore, we call the year 2008 as 0, 2007 as -1 and 2009 as + 1 and likewise for the other years in the data. The rearrangement is shown in the table as follows:

X	Y	X^2	XY
-4	13	16	-52
-3	20	9	-60
-2	20	4	-40
-1	28	1	-28
0	30	0	0
1	32	1	32
2	33	4	66
3	38	9	114
4	43	16	172
$\Sigma X = 0$	$\Sigma Y = 257$	$\Sigma X^2 = 60$	$\Sigma XY = 204$

The normal equations are:

$\Sigma y = a_0 N + a_1 \Sigma X$

$\Sigma XY = a_0 X + a_1 \Sigma X^2$

$\Sigma X = 0$ and $\Sigma y = a_0 N$ and $\Sigma XY = a_1 \Sigma X^2$

Therefore,

$$a_0 = \frac{\Sigma Y}{N} = \frac{257}{9} = 28.56$$

$$a_1 = \frac{\Sigma XY}{\Sigma X^2} = \frac{204}{60} = 3.4$$

The equation of a straight line fitting the data is:

$Y = 28.56 + 3.4 X$

(a) Forecast for 2013, (i.e., X = 5): $Y = 28.56 + 3.4(5) = 45.56$

(b) Forecast for 2014, (i.e., X = 6): $X = 28.56 + 3.4(6) = 48.96$

CSQ 4.6	PYQ	2018-Dec [2] (b)	10 Marks

Answer the following:

With the help of following data, project the trend of sales for the next 5 years:

Years	2002	2003	2004	2005	2006	2007
Sales in Lakhs of Rupees	120	130	135	140	150	165

Answer:

Computation of trend values of sales:

Year	Time deviations from the middle of 2004 and 2005 assuring 5 years = 1	Sales (in lakhs of ₹)	Squares of time deviation	Product of time deviation and sales
	X	Y	X^2	XY
2002	-5	120	25	-600
2003	-3	130	9	-390
2004	-1	135	1	-135
2005	1	140	1	140
2006	3	150	9	450
2007	5	165	25	825
n = 6	$\Sigma x = 0$	$\Sigma y = 840$	$\Sigma x^2 = 70$	$\Sigma XY = 290$

Regression equation of Y on X:

$\Sigma Y = a + bX$

To find the values of a and b:

$a = \Sigma Y/n = 840/6 = 140$

$b = \Sigma XY/\Sigma X^2$

$= 290/70 = 4.143$ approx.

Sales forecast for the next five years, i.e., 2008 to 2012:

$Y_{2008} = 140 + [29/7 \times (+7)] = 169$ lacs

$Y_{2009} = 140 + [29/7 \times (+9)] = 177.28$ lacs

$Y_{2010} = 140 + [29/7 \times (+11)] = 185.57$ lacs

$Y_{2011} = 140 + [29/7 \times (+13)] = 193.85$ lacs

$Y_{2012} = 140 + [29/7 \times (+15)] = 202.14$ lacs

CSQ 4.7	PYQ	2021-Dec [1]	8 Marks

With the help of following of following data, project the trend of sales for the next 7 years:

Years	2005	2006	2007	2008	2009	2010
Sales (In Lakhs ₹)	90	95	100	110	125	140

[Sec. C - One LAQ]

Answer:

Computation of trend values of sales

Year	Time deviations from the middle of 2007 and 2008 assuming 6 months = 1 unit	Sales (in lakh ₹)	Squares of time deviation	Product of time deviation and sales
	X	Y	X^2	XY
2005	-5	90	25	-450
2006	-3	95	9	-285
2007	-1	100	1	-100
2008	1	110	1	110
2009	3	125	9	375
2010	5	140	25	700
n = 6	$\sum X = 0$	$\sum Y = 660$	$\sum X^2 = 70$	$\sum XY = 350$

Regression equation of Y on X:

$Y = a + Bx$

To find the values of a and b

$$a = \frac{\sum Y}{n} = \frac{660}{6} = 110$$

$$b = \frac{\sum XY}{X^2} = \frac{350}{70} = 5$$

Hence regression equation comes to $Y = 110 + 5x$

Sales forecast for the next years, i.e. 2010 to 2014

Y2011 = 110 + 5 (+7) = 110 + 35 = ₹ 145 lakh

Y2012 = 110 + 5 (+9) = 110 + 45 = ₹ 155 lakhs

Y2013 = 110 + 5 (+11) = 110 + 55 = ₹ 165 lakhs

Y2014 = 110 + 5 (+13) = 110 + 65 = ₹ 175 lakhs

Y2015 = 110 + 5 (+15) = 110 + 75 = ₹ 185 lakhs

Y2016 = 110 + 5 (+17) = 110 + 85 = ₹ 195 lakhs

Y2017 = 110 + 5 (+19) = 110 + 95 = ₹ 205 lakhs

CSQ 4.8	PYQ	2023-Dec [8] (b)	7 Marks

The Sales of ZINC in a plant of KHT Ltd. for the years 2014 to 2022 are given below:

Year	2014	2016	2018	2020	2022
Sales of ZINC (in Million ₹)	36	42	46	54	32

Required:

(i) Using the method of least squares, analyse a straight line trend value.

(ii) Assess the sale (in Million ₹) of ZINC for the year 2019 and 2025.

Answer:

Given Data:

Year: 2014, 2016, 2018, 2020, 2022

Sales of ZINC (in Million ₹): 36, 42, 46, 54, 32

Steps to Calculate the Trend Line:

1. Assign x values based on the year, taking the middle year as the origin (2018):
   - Year 2014: x = -4
   - Year 2016: x = -2
   - Year 2018: x = 0
   - Year 2020: x = 2
   - Year 2022: x = 4

2. Corresponding y values are the sales: 36, 42, 46, 54, 32

Calculate the Summations Needed:

- $\sum x = -4 + (-2) + 0 + 2 + 4 = 0$
- $\sum y = 36 + 42 + 46 + 54 + 32 = 210$
- $\sum xy = (-4 \times 36) + (-2 \times 42) + (0 \times 46) + (2 \times 54) + (4 \times 32) = -144 - 84 + 0 + 108 + 128 = 8$
- $\sum x^2 = (-4)^2 + (-2)^2 + 0^2 + 2^2 + 4^2 = 16 + 4 + 0 + 4 + 16 = 40$

Calculate the Slope (b) and Intercept (a) of the Trend Line:

- Slope $b = \sum xy / \sum x^2 = 8 / 40 = 0.2$
- Intercept $a = \sum y / n = 210 / 5 = 42$
- Trend Line Equation: $Y = 42 + 0.2x$

Assess the Sale of ZINC for the Years 2019 and 2025

For Year 2019:

- $x = 2019 - 2018 = 1$
- Substitute $x = 1$ into the trend line equation: $Y = 42 + 0.2 \times 1 = 42.2$
- Sales for 2019: 42.2 Million ₹

For Year 2025:

- $x = 2025 - 2018 = 7$
- Substitute $x = 7$ into the trend line equation: $Y = 42 + 0.2 \times 7 = 43.4$
- Sales for 2025: 43.4 Million ₹

CSQ 4.9	PYQ	2024-Jun [8] (b)	7 Marks

From the following data fit a Straight Line trend by the method of least squares and assess the export turnover in the year 2025.

Year	2015	2016	2017	2018	2019	2020	2021
Exports (Figures in crores)	20	22	25	27	26	30	32

Answer:

Year	x	y (Exports)	x^2	xy
2015	-3	20	9	-60
2016	-2	22	4	-44
2017	-1	25	1	-25
2018	0	27	0	0
2019	1	26	1	26
2020	2	30	4	60
2021	3	32	9	96
n = 7	$\Sigma x = 0$	$\Sigma y = 182$	$\Sigma x^2 = 28$	$\Sigma xy = 53$

$\Sigma y = na + b \Sigma x$

$182 = 7a + 0$

$a = \frac{182}{7} = 26$

$\Sigma xy = a \Sigma x + b \Sigma x^2$

$53 = 0 + 28b$

$b = \frac{53}{28} = 1.893$

Required Equation:

$y = a + bx$ shall be $y = 26 + 1.893x$

For 2025, $x = 7$

$\therefore y = 26 + (1.893 \times 7) = 39.25$

or y = ₹ 39.25 crores.

The required equation of Straight line trend is $y = 26 + 1.893x$

(Origin = 2018, x unit = 1 year)

Export Turnover for Year 2025:

For the year 2025, x=7

So, the estimated no. of exports in the year 2025:

= ₹ 39.25 Crores

CSQ 4.10	PYQ	2024-Dec [8] (b)	7 Marks

On the basis of the quarterly sales (in ₹Lakh) of commodity cumin of BOXIN Ltd., for the year 2020-2024, the following calculations were made.

Trend: $Y = 25 + 0.6t$

With Origin: 1st quarter of 2020; and Scale 1 unit of t = One quarter, where y = Quarterly sales, t = Time units.

Seasonal variations:

Quarter	I	II	III	IV
Seasonal Index	90	95	105	110

Required:
Using the multiplicative model of the time series, estimate the sales for each of four quarters of 2024.

Answer:

As in the Trend equation: Y = 25 + 0.6 t

1st Quarter of 2020 is origin, we have t - 0 for 1st Quarter, Further, since time unit is one Quarter, we have t = 1, 2 and 3 for 2nd, 3rd, 4th Quarters respectively of the year 2020.

Therefore, the value of t for 1st, 2nd, 3rd and 4th Quarters of 2024 are16, 17, 18 and 19 respectively The estimated quarterly Sales for the year 2024 are obtained in the following table.

Quarterly Sales for the Year 2024

Year Quarter 2024	t	Total value (T)	Seasonal Effects (S) Seasonal Index ÷ 100	Expected Sales (₹ in Lakh) (T x S)
3.	16	34.6	0.90	31.14
4.	17	35.2	0.95	33.44
5.	18	35.8	1.05	37.59
6.	19	36.4	1.10	40.04

CSQ 4.11 | PYQ | 2025-Jun [8] (b) | 7 Marks

TONIB Ltd., dealing in logistics business, has a business wing, named Ship Unloading. During the year 2023 and 2024 they have the following quarterly figures (in tonnage) of material unloading from ships:

Year	2023				2024			
Quarter	I	II	III	IV	I	II	III	IV
Material Unloading	200	188	179	195	210	225	200	202

(Use a Smoothing Co-efficient of 0.1)

Required:

If the forecast for the first quarter of 2023 is 195 tons, assess the forecast figure for the first quarter (1) of 2025. (Using Exponential Smoothing).

Answer:

Statement Showing the Forecasted demand of Material unloaded (in Tons)

Year	Quarter of Year	Demand (in tons) (Y_i)	Previous Forecast Ui	Forecast Error ei = (Y_i - U_i)		New Forecast
	(1)	(2)	(3)	(4)	(5)	(6)
				(2 - 3)	(4) x 0.1	(3) + (5)
2023	I	200	195.00	5.00	0.50	195.5
	II	188	195.50	- 7.50	- 0.75	194.75
	III	179	194.75	- 15.75	- 1.575	193.175
	IV	195	193.175	1.825	0.1825	193.3575
2024	I	210	193.3575	16.6425	1.6642	195.0217
	II	225	195.0217	29.9783	2.9978	198.0195
	III	200	198.0195	1.9805	0.1981	198.2176
	IV	202	198.2176	3.7824	0.3782	198.5958
2025	I		198.5958			

Therefore Forecast Figure for 1st quarter of 2025 is 198.5958 i.e. 198.60 Tons

CSQ 4.12 | PYQ | 2025-Dec [8] (b) | 7 Marks

The production of TURMERIC Powder by SONT Ltd., for the years 2022, 2023 and 2024 are given below:

Months \ Years	2022	2023	2024
	(Production in Thousand Tonnes)		
January	15	23	25
February	16	22	25
March	18	28	35
April	18	27	36
May	23	31	36
June	23	28	30
July	20	22	30
August	28	28	34
September	29	32	38

October	33	37	47
November	33	34	41
December	38	44	53

Required:
Assess the Seasonal Indices (monthly) for January to December by Trend Ratio Method assuming a linear trend for the data.

Answer:

Fit a Linear Trend Equation:

First, we tabulate the monthly production data (Y) for the 36 months (n = 36) covering 2022, 2023 and 2024. We assign X is the time variable (X = 1 for Jan. 2022, X = 36 for Dec. 2024).

Month	2022	2023	2024
Jan	15	23	25
Feb	16	22	25
Mar	18	28	35
Apr	18	27	36
May	23	31	36
Jun	23	28	30
Jul	20	22	30
Aug	28	28	34
Sep	29	32	38
Oct	33	37	47
Nov	33	34	41
Dec	38	44	53
Total	294	356	430

Totals:

$\sum Y = 1,080$

$n = 36$

Mean $Y = 1,080/36 = 30$

Compute Trend Equation (Least Squares)

Given:

$\sum X = 666$

$\sum X^2 = 16,206$

$\sum XY = 22,377$

$$b = \frac{n\sum XY - (\sum X)(\sum Y)}{n\sum X^2 - (\sum X^2)}$$

$$b = \frac{36(22,377) - 666(1,080)}{36(16,206) - 666^2}$$

$$b = \frac{8,05,572 - 7,19,280}{5,83,416 - 4,43,556}$$

$$b = \frac{86,292}{1,39,860} = 0.617$$

$a = \bar{Y} - B\bar{X}$

$a = 30 - 0.617(666/36) = 18.58$

Trend Equation

$Y = 18.58 + 0.617x$

Calculate Trend Values (T) and Ratios (A/T × 100)

Example calculations

January

- Jan 2022 (X=1):
  T = 18.58 + 0.617(1) = 19.197
  Ratio = 15 / 19.197 × 100 = 78.14
- Jan 2023 (X =13):
  T = 18.58 + 0.617 (13) = 26.601
  Ratio = 23 / 26.601 × 100 = 86.46
- Jan 2024 (X=25):
  T = 34.005
  Ratio = 25 / 34.005 × 100 = 73.52

Average (Jan):

(78.14 + 86.46 + 73.52)/3 = 79.37

Repeating for all months we have

Month	Avg. Ratio (2022)	Avg. Ratio (2023)	Avg. Ratio (2024)	Average Ratio
Jan	78.14	86.46	73.52	79.37
Feb	80.75	80.83	72.21	77.93
Mar	88.10	100.59	99.32	96.00
Apr	85.52	94.90	100.40	93.61
May	106.16	106.64	98.70	103.83

June	103.22	94.35	80.88	92.82
July	87.34	72.57	79.56	79.82
Aug	119.07	90.54	88.72	99.44
Sept	120.17	101.47	97.58	106.41
Oct	133.33	115.07	118.81	122.40
Nov	130.09	103.75	102.05	111.96
Dec	146.24	131.78	129.93	135.98
Total				**1,199.57**

Final Seasonal Index:

The sum of the average ratios is 1,199.57. Since the sum of Seasonal ratios for 12 months should be exactly 1,200, a minor correction factor (1,200/11,199.57 = 1.00036) is applied.

Month	Seasonal Index	Month	Seasonal Index
Jan	79.40	July	79.85
Feb	77.96	Aug	99.48
Mar	96.03	Sept	106.45
Apr	93.64	Oct	122.44
May	103.87	Nov	112.00
June	92.85	Dec	136.03

[Calculation of final seasonal index has been made by multiplyingb factor with each calculated seasonal index]

Conclusion:

The production of Turmeric Powder is highest in December (136.03) and reaches its lowest point in February (77.96).

Alternative Solution: (if calculation is made up to 3 decimal places)

Method:

Trend Ratio Method (Multiplicative Model)

Fit a Linear Trend Equation y = a + bx

Table 1: Monthly Data and Calculations of Ratio

Month	X	Production (Y)	X^2	XY	Trend T = 18.59 + 0.617 X	Ratio (Y/T) × 100
Jan - 22	1	15	1	15	19.207	78.10
Feb - 22	2	16	4	32	19.824	80.71
Mar - 22	3	18	9	54	20.441	88.06
Apr - 22	4	18	16	72	21.058	85.48
May - 22	5	23	25	115	21.675	106.11
Jun - 22	6	23	36	138	22.292	103.18
Jul - 22	7	20	49	140	22.909	87.30
Aug - 22	8	28	64	224	23.526	119.02
Sep - 22	9	29	81	261	24.143	120.12
Oct - 22	10	33	100	330	24.760	133.28
Nov - 22	11	33	121	363	25.377	130.04
Dec - 22	12	38	144	456	25.994	146.19
Jan - 23	13	23	169	299	26.611	86.43
Feb - 23	14	22	196	308	27.228	80.80
Mar - 23	15	28	225	420	27.845	100.56
Apr - 23	16	27	256	432	28.462	94.86
May - 23	17	31	289	527	29.079	106.61
Jun - 23	18	28	324	504	29.696	94.29
Jul - 23	19	22	361	418	30.313	72.58
Aug - 23	20	28	400	560	30.930	90.53
Sep - 23	21	32	441	672	31.547	101.44
Oct - 23	22	37	484	814	32.164	115.04
Nov - 23	23	34	529	782	32.781	103.72
Dec - 23	24	44	576	1056	33.398	131.74
Jan - 24	25	25	625	625	34.015	73.50
Feb - 24	26	25	676	650	34.632	72.19
Mar - 24	27	35	729	945	35.249	99.29
Apr - 24	28	36	784	1008	35.866	100.37
May - 24	29	36	841	1044	36.483	98.68
Jun - 24	30	30	900	900	37.100	80.86
Jul - 24	31	30	961	930	37.717	79.54
Aug - 24	32	34	1024	1088	38.334	88.69
Sep - 24	33	38	1089	1254	38.951	97.56
Oct - 24	34	47	1156	1598	39.568	118.78

Nov - 24	35	41	1225	1435	40.185	102.03
Dec - 24	36	53	1,296	1,908	40.802	129.90
Total	**∑X 666**	**∑X 1,080**	**∑X² 16,206**	**∑XY 22,377**		

Calculation of Slope (b):

Formula $b^2 = [n\sum XY - (\sum X)(\sum Y)]/[n\sum X^2 - (\sum X)^2]$

Substitution $b = [(36 \times 22,377) - (666 \times 1,080)]/[36 \times 16,206 - (666)^2]$

Calculation $b = (8,05,572 - 7,19,280) \div (5,83,416 - 4,43,556)$

Result $b = (86,292 \div 1,39,860) = 0.6170$

Calculation of Intercept (a):

Formula $a = (\sum Y/n) - b(\sum X/n)$

Substitution $a = (1,080/36) - 0.6170(666/36)$

Calculation $a = 30 - 11.41 = 18.59$

Trend Equation : Y = 18.59 0.617 X

Average of Ratios and Final Indices

The ratios for each specific month across the three years are averaged to find the Seasonal Index. Correction Factor and Adjusted Seasonal Indices

Correction Factor = 1,200/1199.19 = 1.00068

Adjusted Seasonal Index (Adjusted SI) = Raw Seasonal Index × 1.00068

Month	2022 Ratio	2023 Ratio	2024 Ratio	Raw SI (Average)	Adjusted SI
Jan	78.10	86.43	73.50	79.34	79.39
Feb	80.71	80.80	72.19	77.90	77.95
Mar	88.06	100.56	99.29	95.97	96.03
Apr	85.48	94.86	100.37	93.57	93.64
May	106.11	106.61	98.68	103.80	103.87
Jun	103.18	94.29	80.86	92.78	92.84
Jul	87.30	72.58	79.54	79.81	79.87
Aug	119.02	90.53	88.69	99.41	99.48
Sep	120.12	101.44	97.56	106.37	106.44
Oct	133.28	115.04	118.78	122.37	122.45
Nov	130.04	103.72	102.03	111.93	112.01
Dec	146.19	131.74	129.90	135.94	136.03
Total	1,277.59	1,178.60	1,141.39	1,199.19	1,200.00

Conclusion: The production of Turmeric Powder is highest in December (136.03) and reaches its lowest point in February (77.95).

PQ 4.13	PYQ	2026-Jun [8] (b)	7 Marks

My Fashion, a garment manufacturer, has modern outlook and they depend heavily on business forecasting methodology to plan their business activities like manufacturing, marketing, finance etc. At the beginning of the year 2026 they have forecasted data of demand of their products for the month of April as 2,00,000 units. But the actual demand turned out to be 2,10,000 units.

Using a Smoothing Coefficient of 0.1 assess the forecast demand for the following periods when the actual demands are as follows:

Period	May	June	July	August	September	October
Sales(in, 000 units)	214	217	228	235	225	221

Expert insights for this question may be available on our LMS. Answer will be uploaded after release of the Institute's Suggested Answer to ensure accuracy.

Access the LMS using the secret code printed on the first coloured page of this book.

For Your Reflections & Learning Notes:

Chapter Trend Analysis

THE GRAPH

Marks of Objective, Short Notes, Distinguish Between, Descriptive & Case-Scenario Questions

CHAPTER 15 Introduction to Tools for Data Analytics

Topic-Wise Question Frequency

Topic No.	Name of the Topic	Number of Times appeared in PYQ	Model Ques.
1.	Introduction	7	-
2.	Steps in Data Analytics	-	-
3.	Types of Data Analytics	2	-
4.	Tools for Data Analytics	1	-

SECTION-A

2025-Dec [1] (ix) {C} Choose the correct option from the given alternatives:
Which of the following is / are feature(s) of Zoho Analytics Tools?
(a) B1 and Analytics platform
(b) Deployable in the cloud as well as on premises server
(c) Both (a) and (b) of the above
(d) Rich Accounting Solution for small business **[2 Marks]**
Answer: (c) Both (a) and (b) of the above

PYQ 2026-Jun [1] (ix) {C} Choose the correct option from the four alternatives given:
Quick Books is primarily used for:
(a) Data visualization and dashboard creation
(b) Accounting and financial management
(c) Statistical analysis and modeling
(d) Database management **(2 Marks)**

01 Introduction

THEORY QUESTIONS

TQ 1.1	PYQ	2014-Jun [7] (b)	DESC	6 Marks
Explain the concept of DATA WAREHOUSES.				

Answer:

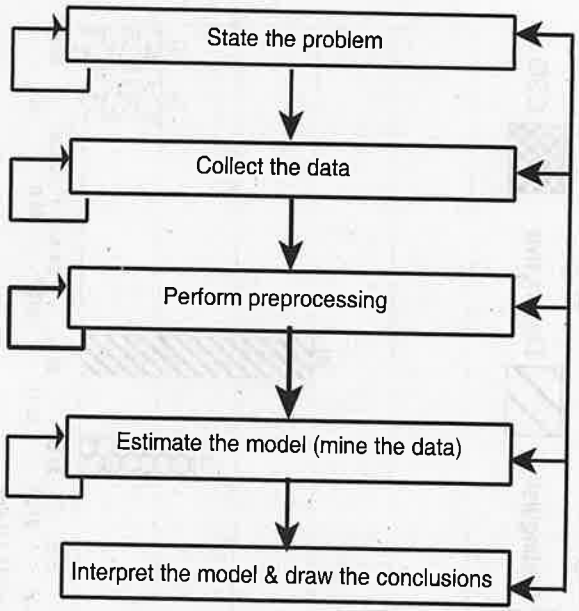
Data Warehouse is a collection of integrated, subject-oriented databases designed to support the decision-support functions (DSF), where each unit of data is relevant to some moment in time. The function of the data warehouse is to store the historical data of an organization in an integrated manner that reflects the various facets of the organization and business. The data in a warehouse are never updated but used only to respond to queries from end users who are generally decision-makers. Typically, data warehouses are huge, storing billions of records. In many instances, an organization may have several local or departmental data warehouses often called data marts. A data mart is a data warehouse that has been designed to meet the needs of a specific group of users. It may be large or small, depending on the subject area.

TQ 1.2	PYQ	2014-Dec [5] (a)	DESC	4 Marks
"Data Mining is a process of discovering various models, summaries and derived values from a given collection of data." Discuss it and state the problem of adoption of Data Mining Process.				

Answer:

Data Mining is a process of discovering various models, summaries and derived values from a given collection of data.

The procedure adapted to data-mining problems involves the following steps:



TQ 1.3	PYQ	2014-Dec [7] (a)	DESC	2+3 = 5 Marks
What is "Spread Sheet"? What are the terms commonly used to refer to parts of the spread sheet?				

Answer:

A spreadsheet is a program designed specifically for processing data in tabular form. These data may be numerical or textual, although most of the functions of a spreadsheet are for the former kind.

The following terms are commonly used to refer to parts of the spreadsheet:

1. **Mouse cursor:** The pointer in Excel takes the form of a cross.
2. **Active cell:** The current or selected cell.
3. **Cell reference:** The unique designator for a cell.
4. **Menu bar:** The horizontal area at the top of the Excel window containing the names of the various "drop-down" menus. In the example at right, the menu bar is shown with the Edit menu activated.

5. **Toolbar:** Two horizontal areas below the menu bar containing buttons, each with an icon representing the operations performed by the tool; these consist of the standard toolbar and the formatting toolbar. Moving the cursor onto the button causes an explanatory caption for it to be displayed briefly.
6. **Formula:** An expression entered into a cell that is designed to be evaluated by the spreadsheet software.
7. **Formula bar:** The horizontal area beneath the toolbar and to the right, where formulas are displayed when they are entered and whenever a cell containing a formula is selected.
8. **Sheet tabs:** The tab-like entities at the bottom of the workbook area, designated by "Sheet 1", "Sheet 2". Clicking on a tab causes the named sheet to be displayed.
9. **Vertical scroll bar:** The bar at the right-hand edge of the Excel window, used for scrolling up and down the sheet; similarly the horizontal scroll bar is used for right and left scrolling.

TQ 1.4	PYQ	2014-Dec [7] (b)	DESC	2+3 = 5 Marks
What do you understand by the term "Business Intelligence"? How you would choose the right business solution?				

Answer:

Business Intelligence (BI) is the ways in which we store and use business information. It encompasses the technologies applications and means for collecting, integrating, analyzing and presenting business data. Using data that has been stored in a data warehouse, software applications are able to use this data to report past business information as well as predict future business information, including trends, threats, opportunities and patterns. Popular BI applications are very complex and experts in this field are in high demand. Some of the currently popular enterprise level systems, which can manage information about all of the business functions and systems, are sold and implemented by Oracle, SAP, IBM and Hewlett Packard (HP). Companies often need in-house experts in these systems to assist with the implementation and the on-going use of these systems, which are quite complex!

Business Intelligence is becoming a critically important tool that can allow your company to better understand your customers and suppliers, or measure the efficiency of your own internal operations. If you are new to BI, try reading our Business Intelligence Overview first. Now, it's time to start planning a new BI project. You will need to design the right BI solution for the kind of analysis you plan to do and evaluate your existing IT infrastructure to ensure that it can support this kind of solution.

Choosing the Right BI Solution: BI tools offer functionality ranging from simple reports to drill-down analytical solutions targeted at specific industries and operational environments. When choosing a Business Intelligence solution, firms need to ask two key questions:

1. What kind of data needs to be analyzed and where does it come from? Many packaged application and database vendors include some BI functionality in their core product and if you plan to source all of your data from the same application or database you may not need to buy additional products. However, this strategy may also limit the analytical range.
2. Who will be doing the analysis and how do they need to receive the results?
   Historically, report or analysis requests would be sent to the IT department, which would then code and generate the report. Today, BI is on the front lines of business and the tools may well be used by executives or sales and marketing professionals. As a result, firms need to know the technical capabilities of the end user upfront.

TQ 1.5	PYQ	2015-Jun [7] (b)	DESC	5 Marks
Explain about the "Dashboard".				

Answer:

Dashboard In information technology:

A dashboard is a user interface that, somewhat resembling an automobile's dashboard, organizes and presents information in a way that is easy to read. However, a computer dashboard is more likely to be interactive than an automobile dashboard (unless it is also computer- based). To some extent, most graphical user interfaces (GUIs) resemble a dashboard. However,

some product developers consciously employ this metaphor (and sometimes the term) so that the user instantly recognizes the similarity.

Some products may aim to integrate information from multiple components into a unified display refer to themselves as dashboards. For example, a product might obtain information from the local operating system in a computer, from one or more applications that may be running, and from one or more remote sites on the Web and present it as though it all came from the same source. Hewlett Packard developed the first such product, which began as a tool for customizing Windows desktops called Dashboard, the HP product was subsequently acquired by Borland and then a company called Starfish, Microsoft's Digital Dashboard tool incorporates Web-based elements (such as news, stock quotes, and so on) and corporate elements (such as e-mail, applications, and so on)into Outlook. Dashboards may be customized in a multitude of ways and named accordingly, generally, for example as a general corporate or enterprise dashboard, or more specifically, as a CIO or CEO dashboard.

TQ 1.6	PYQ	2023-Jun [9] (b) (i)	DESC	2 Marks
What do you mean by Business Intelligence (BI) software?				

Answer:

Business Intelligence (BI) Software is a set of business analytics solutions used by companies to retrieve, analyse and transform data into useful business insights usually within easy -to-read visualization - like charts, graphs and dashboards. Examples of the best BI Tools include data visualization, data warehouses, interactive dashboards and BI reporting tools. A BI Solution pulls internal data produced by a company, into an Analytics platform for deep insights as to how different parts of a business affect one another.

BI software interprets a sea of quantifiable customer and Business actions and queries based on patterns in the data.

TQ 1.7	PYQ	2023-Jun [9] (b) (ii)	DESC	4 Marks
Discuss in brief what are the features of R Programming Language.				

Answer:

Features of R Programming language are stated below:

1. **Statistical features of R Programming Language:**
   - **Basic Statistics:** Most common terms of basic statistics are Mean, Median and Mode which are the Measures of Central Tendency for a dataset. These can be very easily computed using R.
   - **Static Graphics:** R is rich with facilities for creating and developing interesting Static Graphics. R contains functionality for many plot types including graphic maps, mosaic plots, bi-plots and the list goes on.
   - **Probability Distributions:** Probability Distributions play vital role in statistics. By using R various types of problems related to probability distributions (such as Binomial Distribution, Normal Distribution, Student's Distribution, Chi Square Distribution etc.) can be handled very easily.
   - **Data Analysis:** It provides a large, coherent and integrated collection of tools for data analysis. (Any 2)
2. **Programming features of R Programming Language:**
   - **R Packages:** One of the major features of R is the fact that it has a wide availability of libraries. R has CRAN (Comprehensive R Archive Network) which is repository holding more than 10,000 packages.
   - **Distributed Computing:** Distributed computing is a model in which components of a software system are shared among multiple computers to improve efficiency and performance. Packages like ddR and multidplyr are used for distributed programming in R.

03 Types of Data Analytics

THEORY QUESTIONS

TQ 3.1	PYQ	2014-Jun [8] (b)	DESC	6 Marks
Discuss the different types of 'Online Analytical Processing (OLAP)?				

Answer:

Different types of Online Analytical Processing (OLAP) are:

Multidimensional

MOLAP is a "multi-dimensional online analytical processing". "MOLAP" is the 'classic' form of OLAP and is sometimes referred to as just OLAP. MOLAP stores the data in an optimized multi-dimensional array storage, rather than in a relational database. Therefore, it requires the pre-computation and storage of information in the cube - the operation known as processing. MOLAP tools generally utilize a pre-calculated data set referred to as a data cube. The data cube contains all the possible answers to a given range of questions. MOLAP tools have a very fast response time and the ability to quickly write back data into the data set.

Relational

ROLAP works directly with relational databases. The base data and the dimension tables are stored as relational tables and new tables are created to hold the aggregated information. This methodology relies on manipulating the data stored in the relational database to give the appearance of traditional OLAP's slicing and dicing functionality. In essence, each action of slicing and dicing is equivalent to adding a "WHERE" clause in the SQL statement. ROLAP tools do not use pre-calculated data cubes but instead pose the query to the standard relational database and its tables in order to bring back the data required to answer the question. ROLAP tools feature the ability to ask any question because the methodology does not limit to the contents of a cube. ROLAP also has the ability to drill down to the lowest level of detail in the database.

Hybrid

There is no clear agreement across the industry as to what constitutes "Hybrid OLAP", except that a database will divide data between relational and specialized storage. For example, for some vendors, a HOLAP database will use relational tables to hold the larger quantities of detailed data and use specialized storage for at least some aspects of the smaller quantities of more-aggregate or less-detailed data. HOLAP addresses the shortcomings of MOLAP and ROLAP by combining the capabilities of both approaches. HOLAP tools can utilize both pre-calculated cubes and relational data sources.

TQ 3.2	PYQ	2017-Jun [4] (b)	DESC	5 Marks
What is 'OLAP'? Write a brief note on 'OLAP'.				

Answer:

On-line Analytical Processing (OLAP) is a category of software technology that enables analysts, managers and executives to gain insight into data through fast, consistent, interactive access to a wide variety of possible views of information that has been transformed from raw data to reflect the real dimensionality of the enterprise as understood by the user.

OLAP functionality is characterized by dynamic multi-dimensional analysis of consolidated enterprise data supporting end user analytical and navigational activities including:

- Calculations and modeling applied across dimensions, through hierarchies and/ or across members
- Trend analysis over sequential time periods
- Slicing sub-sets for on-screen viewing
- Drill-down to deeper levels of consolidation
- Reach-through to underlying detail data
- Rotation to new dimensional comparisons in the viewing area.

OLAP is implemented in a multi-user client/server mode and offers consistently rapid response to queries, regardless of database size and complexity. OLAP helps the user synthesize enterprise information through comparative, personalized viewing, as well as through analysis of historical and projected data in various "what-if" data model scenarios. This is achieved through the use of an OLAP server.

An OLAP server is a high-capacity, multi-user data manipulation engine, specifically designed to support and operate on multi-dimensional data structures. The OLAP server may either physically stage the processed multidimensional information to deliver consistent and rapid response times to end users, or it may populate its data structures in real-time from relational or other databases, or offer a choice of both. Given the current state of technology and the end user requirement for consistent and rapid response times, staging the multi-dimensional data in the OLAP Server is often the preferred method.

The core of any OLAP system is an OLAP cube (also called as hypercube). It consists of numeric facts called measures which are categorized by dimensions.

04 Tools for Data Analytics

THEORY QUESTIONS

TQ 4.1	PYQ	2021-Dec [2]	SN	3 Marks
Write Short Note on OLAP Server				*[Sec. C - Six LAQ]*

Answer:

OLAP (Online Analytical Processing) Server:

OLAP Server is a high capacity, multi-user data manipulation engine specifically designed to support and operate on multi-dimensional data structures. The design of the server and the structure of the data are optimized for rapid adhoc information retrieval in any orientation, as well as for fast, flexible calculation and transformation of raw data based on formulaic relationships. The OLAP Server may either physically stage the processed multi-dimensional information to deliver consistent and rapid response times to end users or it may populate its data structures in real time from relational or other databases, or offer a choice of both.

For Notes