

ADVANCED MANAGEMENT ACCOUNTING REVISION BOOK

How to effectively use this book:

- ❖ Revision book covers past 11 RTP and exams
- ❖ Past experience indicates that minimum 60 percent of marks are asked from the past RTP and exam questions
- ❖ Please refer to this video to get a better perspective on how to use this revision material - <https://youtu.be/eHgXVUCI5QI>
- ❖ **Stage One:** Please read the theory for every chapter. Theory coverage would be sufficient to cover all practical theory questions and the same can help in answering problems
- ❖ **Stage two:** Start solving problems from individual chapters after completing theory. Try solving the question and in case you are stuck then please refer the summary of adjustments section. Summary of adjustments section has the guidance to solve a question
- ❖ **Stage three:** In case you are still not able to solve the question then please refer institute RTP and suggested answer to understand the question
- ❖ **Revision day before exam:** Please revise theory and summary of adjustments day before exam as the same can help in answering wide variety of questions. Also you can effectively work on various adjustments by quickly revising summary of adjustments section.

Solutions to questions:

- ❖ Below link has the compilation of past 11 RTP and exams. You can search for the question in the attachment and then look at the detailed solution for the same
- ❖ The link for the answer book is given below
<https://drive.google.com/open?id=1tyFQyNuljNOLGnbVBJeTq3Lws0cBw3rP>

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Summary of Syllabus

Old Syllabus	
Chapter 1: Developments in Business Environment	❖ Total Quality Management ❖ Six Sigma ❖ Activity Based Costing ❖ Target Costing ❖ Kaizen Costing ❖ Life Cycle Costing ❖ Value Chain Analysis ❖ Cost Control and Cost Reduction ❖ Just in Time ❖ BPR versus PI ❖ Theory of Constraints
Chapter 2: Decision Making using Cost Concepts and CVP Analysis	❖ Cost classification ❖ Relevant Costing ❖ Basics of Marginal Costing ❖ Marginal costing versus Absorption Costing ❖ Indifference Point and Shut-down Point ❖ Limiting factor ❖ Make or Buy decisions ❖ Differential Selling Prices and Product Mix ❖ Special Orders ❖ Evaluation of multiple alternatives ❖ Further processing decisions ❖ Dropping a product line
Chapter 3: Pricing Decisions	❖ Pricing Decisions ❖ Pareto Analysis
Chapter 4: Budget & Budgetary Control	❖ Flexible Budget ❖ Functional Budgets ❖ Zero based budgeting
Chapter 5: Standard Costing	❖ Cost and Sales Variances ❖ Variances with equivalent units ❖ FOH ratios ❖ Reconciliation of cost and profits ❖ Partial Plan Versus Single Plan ❖ Planning and Operating Variances ❖ Market size and share variances ❖ Reverse working problems ❖ Activity Based Costing and Variance Analysis
Chapter 6: Costing of service sector	❖ Costing of service sector
Chapter 7: Transfer Pricing	❖ Transfer Pricing
Chapter 8: Uniform Costing and Inter-Firm Comparison	❖ Theory based chapter with no problems
Chapter 9: Profitability analysis	❖ Growth, Productivity and Price Recovery variances ❖ Direct Product Profitability / Customer

	profitability Analysis ❖ Balanced Scorecard
Chapter 10: Linear Programming	❖ Simplex Method ❖ Graphical Method ❖ Formulation Problems
Chapter 11: The Transportation Problem	❖ Transportation Problem
Chapter 12: The Assignment Problem	❖ Assignment Problem
Chapter 13 & 14 : CPM & PERT	❖ CPM and PERT
Chapter 15: Simulation	❖ Simulation
Chapter 16: Learning Curve Theory	❖ Learning curve theory

TheoryChapter 1: Developments in the business environmentTotal Quality Management (TQM):

- ❖ TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering, production, customer service) to focus on meeting customer needs and organizational objectives
- ❖ TQM aims at improving the quality of organizational outputs through continual improvement of internal practices
- ❖ TQM's objectives are to eradicate waste and increase efficiency
- ❖ CIMA defines 'Total Quality Management' as "Integrated and comprehensive system of planning and controlling all business functions so that products or services are produced which meet or exceed customer expectations. TQM is a philosophy of business behaviour, embracing principles such as employee involvement, continuous improvement at all levels and customer focus, as well as being a collection of related techniques aimed at improving quality such as full documentation of activities, clear goal-setting and performance measurement from the customer perspective."
- ❖ TQM focuses on doing things right the first time and that defects and waste are eliminated from operations

Quality: It is a measure of goodness to understand how a product meets its specifications. ISO 8402-1986 standard defines quality as "the totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs. Following are the ten dimensions of quality:

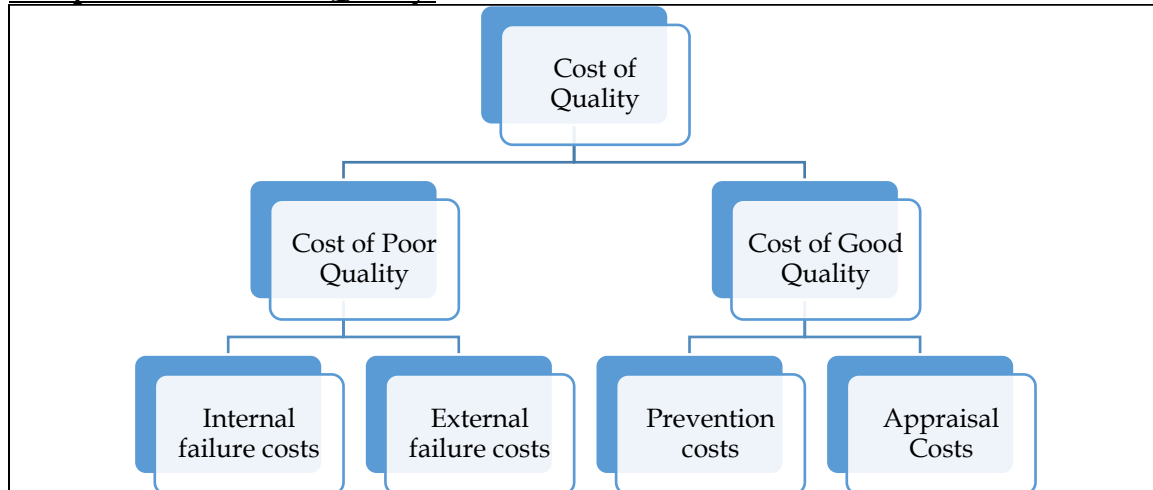
Dimension	Meaning and Example
Performance	Primary product characteristic, such as the brightness of the picture
Features	Secondary characteristic, added features, such as remote control
Conformance	Meeting specifications or industry standards, workmanship
Reliability	Consistency of performance over time, average time for the unit to fail
Durability	Useful life, including repair
Service	Resolution of problems and complaints, ease of repair
Response	Human-to-human interface, such as the courtesy of the dealer
Aesthetics	Sensory characteristics, such as exterior finish
Reputation	Past performance and other intangibles, such as being ranked first

Cost of Quality (COQ)

- ❖ Quality is concerned with conformance to specifications and ability to satisfy customer expectations and value for money
- ❖ $COQ = \text{Cost of control/conformance} + \text{Cost of failure to control/non-conformance}$

Views regarding Cost of Quality:

- ❖ **View 1:** Higher quality means higher cost
- ❖ **View 2:** Resultant savings due to improving quality are greater than the cost of improving quality
- ❖ **View 3:** Quality costs are those incurred in excess of those that would have been incurred if product was built or service performed exactly right the first time

Components of Cost of Quality:

Prevention costs	✓ Costs incurred for <u>preventing the poor quality</u> of products and services are termed as prevention costs ✓ These are <u>planned and incurred before actual operation</u> and associated with the design, implementation and maintenance of the quality management system ✓ <u>Examples:</u> Quality Planning, Quality assurance, Supplier evaluation, New Product review, Error Proofing, Capability evaluations, Quality improvement team meetings, Quality improvement projects, Quality education and training
Appraisal costs	✓ Appraisal costs are cost <u>associated with measuring and monitoring activities related to quality</u> ✓ Appraisal costs are incurred to <u>determine the degree of conformance</u> to quality requirements ✓ <u>Examples:</u> Verification, Quality audits, Supplier rating, Checking and testing purchased goods and services, In-process and final inspection/test, Field testing, Product or process audits, calibration of equipment
Internal failure costs	✓ Internal failure costs are <u>associated with defects found before the customer receives the product or service</u> ✓ These costs occur when the <u>product is not as per design quality standards</u> and they are detected before they are transferred to the customer ✓ <u>Example:</u> Waste, Scrap, Rework, Rectification, Failure analysis, Delays, Re-designing, Shortages, Re-testing, Downtime
External failure costs	✓ External failure costs are <u>occurred to rectify defects discovered by customers</u> ✓ These costs occur when products or services that fail to reach design quality standards <u>are not detected until their transfer to the customer</u> ✓ <u>Example:</u> Repairs and servicing, Warranty claims, Complaints, Returns, Losses due to sales reduction,

Optimal COQ:

- ❖ **Increase expenditure in prevention and appraisal** will result in **substantial reduction in failure costs**. Because of this relationship, there can be an optimum level at which the **combined cost is at minimum**
- ❖ Hence it is **not necessary to get to a zero defect** through a program of continuous improvement **as the combined cost may not be minimum**

Operationalizing TQM:

TQM Beliefs	TQM implementation for accounting function
❖ Owner/customer satisfaction is the measure of quality ❖ Everyone is an owner/customer. ❖ Quality improvement must be continuous. ❖ Analysis of the processes is the key to quality improvement. ❖ Measurement, a skilled use of analytical tools, and employee involvement are critical sources of quality improvement ideas and innovations ❖ Sustained total quality management is not possible without active, visible, consistent, and enabling leadership by managers at all levels ❖ It is essential to continuously improve the quality of products and services that we provide to our owners/customers	❖ Who is the customer? ❖ What does the customer expect from us? ❖ What are the customer's decision-making requirements? ❖ What problems areas do we perceive in the decision-making process? ❖ How do we compare with other organizations? What can we gain from benchmarking? ❖ What does the customer think? ❖ Identification of improvement opportunities ❖ New strategies and elimination of deficiencies

Praise Analysis for Quality improvement:

Step	Activity	Elements
1	Problem identification	❖ Areas of customer dis-satisfaction ❖ Absence of competitive advantage ❖ Complacency regarding present arrangements
2	Ranking	Prioritize problems and opportunities by perceived importance and ease of measurement and solution
3	Analyses	❖ Ask Why to identify possible causes ❖ Keep asking why to move beyond the symptoms and to avoid jumping to premature conclusions ❖ Ask what to consider potential implications ❖ Ask how much to quantify cause and effect
4	Innovation	Use creative thinking to generate potential solutions ❖ Barriers to implementation ❖ Available enablers and ❖ People whose co-operation must be sought
5	Solution	❖ Implement the preferred solution ❖ Take appropriate action to bring about required changes ❖ Reinforce with training and documentation back-up
6	Evaluation	❖ Monitor the effectiveness of actions ❖ Establish and interpret performance indicators to track

		progress towards objectives ❖ Identify the potential for further improvement and return to step 1

Contribution by Deming to TQM:

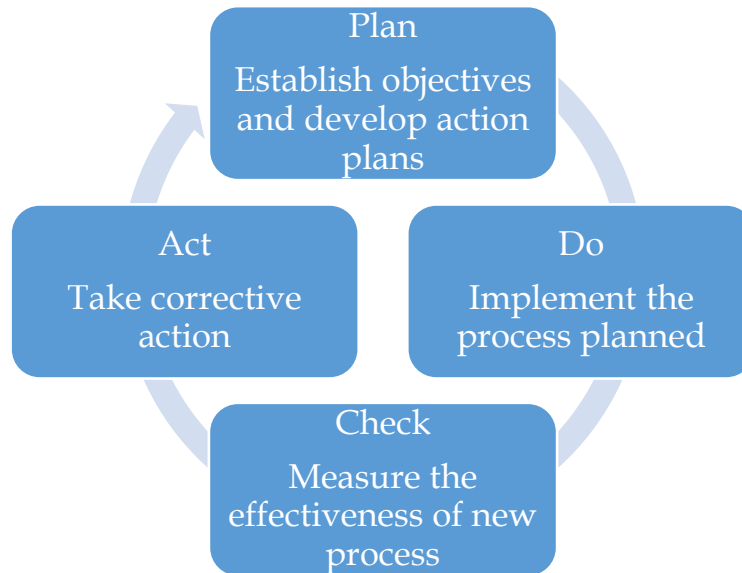
- ❖ William Edwards Deming is considered as the father of Quality Control. A number of elements of Deming's philosophy depart from traditional notions of quality
- ❖ Historically poor quality was blamed on workers. However Deming pointed out that only 15 percent of quality problems are actually due to worker error and the balance 85 percent are caused by processes and systems

Deming's 14 points methodology:

1. "Create constancy of purpose towards improvement". Replace short-term reaction with long-term planning
2. "Adopt the new philosophy". The implication is that management should actually adopt his philosophy rather than merely expect the workforce to do so
3. "Cease dependence on inspection". If variation is reduced, there is no need to inspect manufactured items for defects, because there won't be any
4. "Move towards single supplier for any one item". Multiple suppliers mean variation between feedstock
5. "Improve constantly and forever". Constantly strive to reduce variation
6. "Institute training on the job". If people are inadequately trained, they will not all work the same way, and this will introduce variation
7. "Institute leadership". Deming makes a distinction between leadership and mere supervision. The latter is quota and target-based
8. "Driver out fear". Deming sees management by fear as counter-productive in the long term, because it prevents workers from acting in the organization's best interests
9. "Break down barriers between departments". Another idea central to TQM is the concept of the 'internal customer' that each department serves not the management, but the other department that uses the outputs
10. "Eliminate slogans". Another central TQM idea is that not people who make most mistakes – it's the process they are working within. Harassing the workforce without improving the processes they use is counter-productive
11. "Eliminate management by objectives". Deming saw production targets as encouraging the delivery of poor-quality goods
12. "Remove barriers to pride of workmanship". Many of the other problems outlined reduce worker satisfaction
13. "Institute education and self-improvement"
14. "The transformation is everyone's job"

Plan-Do-Check-Act (PDCA) Cycle:

- ❖ PDCA cycle describes the activities a company needs to perform in order to incorporate continuous improvement in its operation. This cycle is also known as "Deming Wheel"



Six Sigma:

- ❖ Six Sigma is **quality improvement technique** whose objective to eliminate defects in any aspect **that affects customer satisfaction**.
- ❖ The premise of Six Sigma is that by measuring defects in a process, a company can develop ways to eliminate them and practically achieve **“zero defects”**
- ❖ Primary focus of Six Sigma is:
 - Customer satisfaction
 - Decision based on data driven facts
 - Management, improvement and processes
 - Proactive management team
 - Collaboration with in the business
 - Goal for perfection
- ❖ **Sigma is a statistical team that measures how far a process deviates from the perfection. The higher the sigma number, closer the process is to perfection**
- ❖ Six Sigma is 3.4 defects per million or getting things right 99.99966% of the time. The same is explained in the below table:

Sigma Level	Defects per million opportunities (DPMO)	Defective percentage (%)	Percentage yield (%)	Quality/profitability
One	6,91,462	69%	31%	Loss
Two	3,08,538	31%	69%	Non-competitive
Three	66,807	6.7	93.3	Average industries
Four	6,210	0.62	99.38	Above average
Five	233	0.023	99.977	Below maximum productivity
Six	3.4	0.0034	99.99966	Near perfection

Six C's of TQM:

Commitment	✓ Quality improvement should become a normal part of everyone's job ✓ There should be a clear commitment toward quality from the top ✓ Quality improvement should not be delegated to a single person

	<u>but the same should form part of everyone's work.</u> Management should provide necessary training and support for this achievement
Culture	✓ <u>Training lies at the centre of effecting a change in culture and attitudes</u> ✓ Everyone must be encouraged to do individual contributions and to make quality a part of everyone's job
Continuous improvement	✓ <u>TQM is a process and not a programme.</u> Hence we <u>should be committed in the long-term to the never-ending search</u> for ways to do job better
Co-operation	✓ <u>Total Employee Involvement (TEI) principle</u> is of paramount importance ✓ <u>On-the job experience of employees must be fully utilized</u> and their cooperation sought in the development of improvement strategies
Customer focus	✓ <u>TQM should focus on meeting the need of the external customer</u> as well as <u>internal customer</u> ✓ Perfect service with zero defects should be acceptable both at internal or external levels
Control	✓ <u>Documentation, procedures and awareness</u> of current best practice are essential if TQM implementation is to take place appropriately ✓ <u>Some organization over-look need for control mechanism</u> in wake of customer focus. <u>However procedures should be developed to monitor the extent of improvement and correct the deficiencies if required</u>

Criticisms of TQM:

- ❖ TQM focuses **extensively on documentation** of process and ill-measurable outcomes
- ❖ TQM **emphasizes on quality assurance** rather than improvement
- ❖ TQM **emphasizes on internal focus** which is at odds with alleged customer orientation
- ❖ TQM **may not be appropriate for service based industries**, because the standard based approach of 'industry best practice' ignores the culture of the organization

Activity Based Costing

- ❖ CIMA defines 'Activity Based Costing' as "An approach to the costing and monitoring of activities which involves tracing resource consumption and costing final outputs. Resources are assigned to activities, and activities to cost objects based on consumption estimates. The latter utilise cost drivers to attach activity costs to outputs."
- ❖ **Cost Object:** It is an item for which cost measurement is required e.g. a product, a job or a customer.
- ❖ **Cost Driver:** It is the factor that causes a change in the cost of an activity. Instead of using the term 'allocation bases' or 'overhead allocation rates' the term **cost driver** is used in ABC system. They are classified into:
 - **Resource Cost Driver:** It is a measure of the quantity of resource consumed by activity. It is used to assign the **cost of a resource to an activity** or cost pool. An example of a resource cost driver is the percentage of total square feet occupied by an activity. This factor is used to allocate a portion of the cost of operating the facilities to the activity.

- **Activity Cost Driver:** It is a measure of the frequency and intensity of demand, placed on activities by cost objects. It is used to assign activity costs to cost objects. Activity cost drivers can be transaction drivers (e.g. No. of purchase orders processed, no. of customer orders processed, etc.) as well as duration drivers (it represent amount of time required to perform an activity e.g. Setup hours, inspection hours, etc.).

Activities: Activities comprise of units of work or tasks. For example, purchase of materials is an activity consisting a series of tasks like purchase requisition, advertisement inviting quotations, identification of suppliers, placement of purchase order, follow-up etc.

Types of Activities: Activities basically fall into four different categories, known as the manufacturing cost hierarchy. These categories were first identified by Cooper in 1990 and help to determine the type of activity cost driver required. The categories are:

- ❖ **Unit level activities:** These are activities for which the consumption of resources can be identified with the number of units produced. E.g. Use of indirect materials, Inspection or testing of every item produced or say every 100th item produced, Indirect consumables, etc.
- ❖ **Batch level activities:** The costs of some activities (mainly manufacturing support activities) are driven by the number of batches of units produced. These are activities related to setting up of a batch or a production run. The costs of such activities vary with the number of batches made, but is fixed for all units within that batch. E.g. Production scheduling, Material movement, Machine set up costs, Inspection of products – like first item of every batch, etc.
- ❖ **Product level activities:** The costs of some activities (often once only activities) are driven by the creation of a new product line and its maintenance. These are activities performed to support different products in the product line. E.g. Designing the product, Producing parts to a certain specification, Advertising costs, if advertisement is for individual products, etc
- ❖ **Facility level activities:** These are activities necessary for sustaining the manufacturing process and cannot be directly attributed to individual products. E.g. Maintenance of buildings, Plant security, Production manager's salaries, Advertising campaigns promoting the co., etc.

Basic understanding of ABC System:

- ❖ In an ABC system the costs are initially allocated to the various activities and thereafter based on activity cost drivers the same are allocated to the cost objects.
- ❖ For example: Rent of the factory would be allocated to the various activities such as stores department, purchasing department etc. Thereafter the stores department costs would get allocated to the various products (Cost objects) based on the number of stores requisition of each of the materials handled.

ABC System vs Traditional system:

- ❖ Example: A company incurs total overheads of Rs.2,00,000 and manufacture two products A and B. The total machine hours used by A are 5000 and by B is 15000 hours.
- ❖ **Traditional system:** In the traditional system the costs are allocated based on machine hours and a total of Rs.50000 and Rs.150000 is allocated for product A

and B respectively.

- ❖ **ABC System:** In the ABC system the total overheads are subdivided into various major activities and based on the cost driver the costs are allocated to the products. The amount of Rs.2,00,000 can be divided into the following in an ABC System:

- Machine running activity : Rs.1,20,000 ~ Allocated based on machine hours
- Machine set up costs : Rs.40,000 ~ Allocated based on setup hours ; Machine setup hours for A was 4000 and for B was 1000
- Inspection costs of Rs.40,000 ~ Allocated based on inspection time ; Inspection time for A was 2000 hours and for B was 3000 hours.

Step 1: Calculation of cost driver rate:

Activity	Total cost	Cost driver name	Cost driver quantity	Cost driver rate
Machine Running	1,20,000	Machine hours	20000 hours	Rs.6
Machine setup	40000	Setup time	5000 hours	Rs.8
Inspection costs	40000	Inspection time	5000 hours	Rs.8

Step 2: Apportionment of OH

Activity	Product A		Product B	
	CDQ	Amount	CDQ	Amount
Machine Running	5000	30000	15000	90000
Set-up	4000	32000	1000	8000
Inspection time	2000	16000	3000	24000
Total OH allocated		78000		120000

Activity Based Costing versus Absorption Costing:

Activity Based Costing	Absorption Costing
Overheads are related to activities and grouped into activity cost pools	Overheads are related to cost centres/departments
Activities are classified into unit level, batch level, product level and facility level	Only unit level (variable) and facility level (fixed) activities are identified
Costs are related to activities and hence are more realistic	Costs are related to cost centers and hence not realistic of cost behavior
Activity wise cost drivers are identified	Time (hours) are assumed to be the only cost driver governing costs in all departments
Activity wise recovery rates are determined and there is no concept of a single overhead recovery rate	Either multiple overhead recovery rate (for each department) or a single overhead recovery rate may be determined for absorbing overheads
Costs are assigned to cost objects (customers, products, services, departments)	Costs are assigned to cost units (Products or job or hours)
Essential activities can be simplified and unnecessary activities can be eliminated. Thus the corresponding costs are also	Cost centres/departments cannot be eliminated. Hence not suitable for cost control

ABC - A Decision-Making Tool:

- ❖ **Complement to TQM:** ABC is a complement to total quality management (TQM). It provides quantitative data that can track the financial impact of improvements implemented as part of the TQM initiative.
- ❖ **Significant advantage for wholesale distributors:** Wholesale distributors can gain significant advantage in the decision-making process through implementation of ABC concepts. The expansion of line offerings has brought about difficult decisions for the distributor. ABC models the costs back to the activity. The burden created by the new product is correctly reflected. This allows the existing merits while leaving the new line to justify itself.
- ❖ **Facility and resource expansion:** Other decisions that can be assisted by ABC include facility and resource expansion. Often the basis for relocation or opening of a new distribution center is based on cost associations. Reduction in freight or other logistics costs can offset the expense of the new facility, staff or equipment. When the numbers used are enterprise-based, the return might not develop as expected. The ABC model can identify the specific cost elements being targeted, providing a much clearer picture from which management can act.
- ❖ **Decision support for Human Resources:** Where activity, and therefore cost, can be associated to an individual, new levels of financial performance can be determined. This might be appropriate in cases of branch management or sales. Adding or deleting resource slots can be determined based on costs of activities as well. The added data provided through ABC can present a number of options, including outsourcing, productivity improvements through automation, and a determination of employee/revenue ratios.
- ❖ **Cost plus markup method:** Companies who wish to determine price based on cost plus markup basis find ABC method of costing very relevant and are able to determine competitive prices for their products.

Activity Based Cost Management (ABM):

- ❖ The term Activity based management (ABM) is used to describe the Cost Management application of ABC. The use of ABC as a costing tool to manage costs at activity level is known as Activity Based Cost Management (ABM).
- ❖ ABM is a discipline that focuses on the efficient and effective management of activities as the route to continuously improving the value received by customers.
- ❖ 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 organisation and how these activities can be improved to increase the profitability.
- ❖ Consortium for Advanced Management International (CAM) defines ABM as "adds a dynamic, continuous improvement dimension to the more static ABC model". CAM-1 defines ABM as: "A discipline that focuses on the management of activities as the route to improving the value received by the customer and the profit achieved by providing this value. This discipline includes cost driver analysis, activity analysis, and performance measurement. Activity-Based Management draws on Activity-Based Costing as its major source of information."

- ❖ ABM involves the following:
 - Cost Driver Analysis
 - Activity Analysis
 - Performance Analysis

Cost Driver Analysis

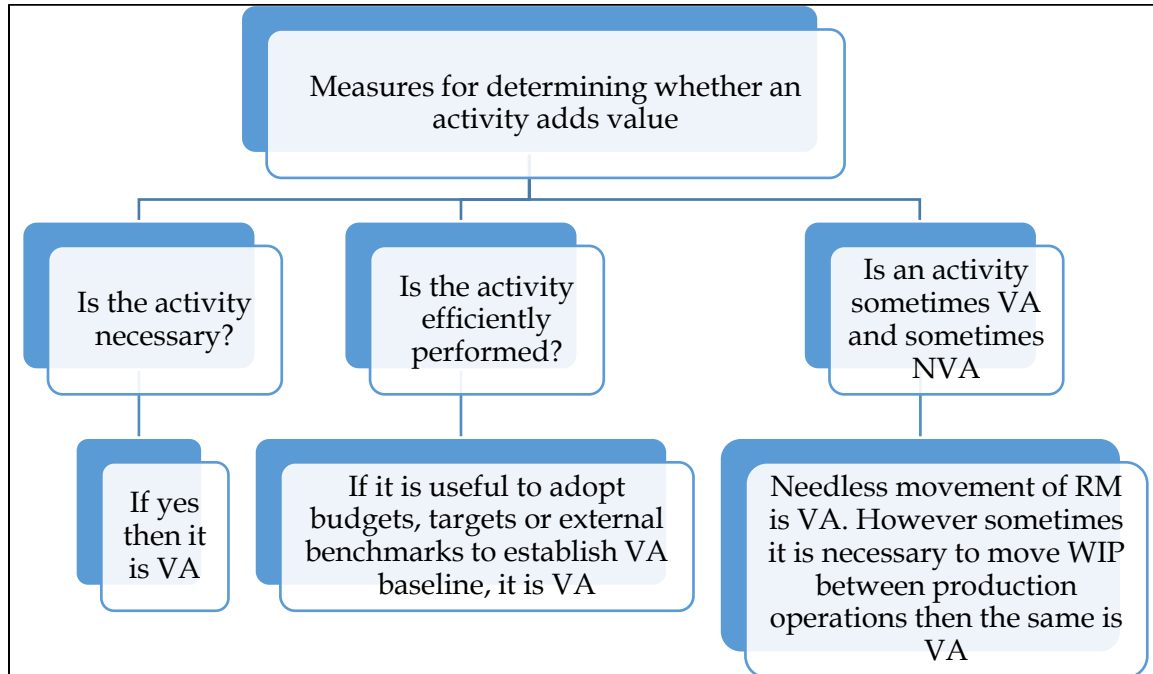
- ❖ The factors that cause activities to be performed need to be identified in order to manage activity costs. Cost driver analysis identifies these causal factors.
- ❖ For Example, a cost driver analysis study might determine that slow processing of customer invoices results largely from lack of training of the customer invoice associates. This lack of training is thus a cost driver of the customer invoice processing activity. The tangible cost savings and intangible benefits from the customer invoice processing improvements should be compared with both the tangible and intangible costs of the new training program in a cost-benefit analysis.
- ❖ The hypothetical customer invoice processing example shows that the identification and analysis of cost drivers (causal factors) is a necessary first step toward improving the cost-effectiveness of activities and cost management through ABM.

Activity Analysis

- ❖ Activity analysis, defined in above section, identifies the activities of an organisation and the activity centres (or activity cost pools) that should be used in an ABC system.
- ❖ Activity analysis also identifies Value Added (VA) and Non- Value Added (NVA) activities. The degree to which activities are grouped together into activity centres depends on the costs and benefits of the alternatives.

Performance Analysis

- ❖ Performance analysis involves the identification of appropriate measures to report the performance of activity centres or other organisational units, consistent with each unit's goals and objectives.
- ❖ Performance analysis aims to identify the best ways to measure the performance of factors that are important to organisations in order to stimulate continuous improvement .

Value Added (VA) Activities / Non-Value Added (NVA) Activities

- ❖ ABM classifies each activity within a process as value-added activities or non-value added activities.
- ❖ **Value-Added Activities:** The VA activities are those activities which are indispensable in order to complete the process. The customers are usually willing to pay (in some way) for these services.
- ❖ **Non-Value-Added Activities:** The NVA activity represents work that is not valued by the external or internal customer. NVA activities do not improve the quality or function of a product or service, but they can adversely affect costs and prices. Non-Value Added activities create waste, result in delay of some sort, add costs to the products or services and for which the customer is not willing to pay.

Ways in which time is spent in manufacturing process:

Process Time	The time during which a product is undergoing conversion activity
Inspection Time	The amount of time spent confirming that the product is of high quality
Move Time	The time spent moving raw materials, WIP or finished goods between operations
Waiting Time	The amount of time that raw material or WIP spend waiting for the next operation
Storage Time	The time during which materials, partially completed units, or finished goods are held in stock before further processing or shipment
Delivery cycle time	It is the average time between receipt of customer order and delivery of the goods
Manufacturing cycle time	It is the total amount of production time required per unit
Velocity	Velocity is defined as the number of units produced in a given

	time
Manufacturing cycle efficiency	$\text{Processing Time} / (\text{Processing Time} + \text{Inspection Time} + \text{Waiting Time} + \text{Move Time})$

Business Applications of ABM

- ❖ The goal of the ABCM is to make customer needs to be satisfied while making fewer demands for resources.
- ❖ Current research suggests that customers have perceived needs in four areas, all of which must be satisfied simultaneously. The customers require- lower costs, higher quality, faster response time & greater innovation.
- ❖ To satisfy these needs ABM currently being used for a variety of business applications.

Cost Reduction:

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

Activity Based Budgeting (ABB):

- ❖ ABB analyse the resource input or cost for each activity. It provides a framework for estimating the amount of resources required in accordance with the budgeted level of activity.
- ❖ Actual results can be compared with budgeted results to highlight both in financial and non-financial terms those activities with major discrepancies from budget for potential reduction in supply of resources.
- ❖ It is a planning and control system which seeks to support the objectives of continuous improvement.
- ❖ It means planning and controlling the expected activities of the organization to derive a cost-effective budget that meet forecast workload and agreed strategic goals.
- ❖ The three key elements of activity based budgeting are as follows:
 - Type of work to be done
 - Quantity of work to be done
 - Cost of work to be done

Business Process Re-engineering:

- ❖ Business Process Re-engineering involves examining business processes and making substantial changes to how organisation currently operates.
- ❖ ABM is a powerful tool for measuring business performance, determining the cost of business output and is used as a means of identifying opportunities to improve process efficiency and effectiveness. A business process consists of linked set of activities.

Benchmarking

- ❖ Benchmarking is a process of comparing of ABC derived activity costs of one segment of company with those of other segments. It requires uniformity in the definition of activities and measurement of their costs.

Performance Measurement:

- ❖ Many organisations are now focusing on activity performance as a means of facing competitors and managing costs by monitoring the efficiency and effectiveness of activities.
- ❖ Activity performance measures consist of measures relating to costs, time, quality and innovation.

Steps for Implementing ABM

1	Decide what are the organisation's most important issues and what types of information would be required to address those issues.
2	Top Management support is cited to identify critical information needs.
3	Incorporate ABC methods into organization's financial reporting process.
4	Implementation team should be represented by the people who will be actual users of the ABM information.
5	The existing information system should easily support input requirements.
6	If integrating ABC into the main cost reporting system is not feasible, consider developing a separate ABC system.
7	Implement ABM at a high level in order to get concepts across.

Benefits of Activity Based Cost Management

- ❖ Provision of excellent basis and focus for cost reduction.
- ❖ Provides operational management with a clear view of HOW to implement an Activity Based Budget?
- ❖ Provision of clear understanding of the underlying causes of business processing costs.
- ❖ Provision of excellent basis for effectiveness of management decision making.
- ❖ Identification of key process waste elements, permit management prioritisation and leverage of key resources.

Difference between ABC and ABM :

- ❖ The ABC refers to the technique for determining the cost of activities and the output that those activities produce. It is the logical distribution of overhead i.e. overhead should be distributed on the consumption of resources consumed by goods and services. The aim of ABC is to generate improved cost data for use in managing a company's activities.
- ❖ The ABM is a much broader concept. It refers to the management philosophy that focuses on the planning, execution and measurement of activities as the key to competitive advantage.

ACTIVITY BASED BUDGETING (ABB)

- ❖ Activity Based Budgeting is a process of planning and controlling the expected activities for the organisation to derive a cost-effective budget that meets forecast workload and agreed strategic goals.
- ❖ An activity based budget is a quantitative expression of the expected activities of the firm, reflecting management's forecast of workload and financial and non-financial requirements to meet agreed strategic goals and planned changes to improve performance.
- ❖ Thus, the key elements of ABB are:
 - Type of work/activity to be performed;

- Quantity of work/activity to be performed; and
- Cost of work/activity to be performed.
- ❖ ABB is a technique for enhancing the accuracy of financial forecasts and increasing management understanding. When automated, ABB can rapidly and accurately produce financial plans and models based on varying levels of volume assumptions.
- ❖ Traditional, functional- based budgeting is concerned with budgeting the costs of resources associated with organizational units, such as departments and plants. Firms that have implemented an activity-based costing system may also wish to install an activity-based budgeting system.
- ❖ An activity-based budgetary approach can be used to emphasize cost reduction through the elimination of wasteful activities and improving the efficiency of necessary activities
- ❖ As with traditional, functional-based budgeting, ABB begins with sales and production budgets. Direct materials and direct labor budgets also are compatible with an ABC framework because these production inputs are directly traceable to the individual products. The major differences between functional and activity-based budgeting are found within the overhead and selling and administration categories. In a functional- based approach, budgets within these categories typically are detailed by cost elements. These cost elements are classified as variable or fixed, using production or sales output measures as the basis for determining cost behavior. ABB, on the other hand, identifies the overhead, selling, and administrative activities and then builds a budget for each activity, based on the resources needed to provide the required activity output levels. Costs are classified as variable or fixed with respect to the activity output measure.

Target Costing:

- ❖ Target costing can be defined as “a structured approach to 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”
- ❖ Target costing is almost the exact opposite of cost plus margin modeling where a company produces a product with no cost structure in mind. Once the product is built they add a profit margin on top to arrive at the final price

Steps in Target costing:

- ❖ **Setting of target selling price:** The setting of target selling price of a product which customers are prepared to pay, depend on many factors like design specifications of the product, competitive conditions, customer's demand for increased functionality and higher quality projected production volume, sales forecasts etc. A concern can set its target selling price after taking into account all of the aforesaid factors.
- ❖ **Determination of target costs:** Target profit margin may be established after taking into account long-term profit objectives and projected volume of sales. On deducting target profit margin from target selling price, target cost is determined.
- ❖ **Estimate the actual cost of the product:** Actual cost of the product may be determined after taking into account the design specifications, material cost and other costs required to produce the product.
- ❖ **Comparison of estimated cost with actual cost:** In case the estimated cost of the product is higher than that of the target cost of the product then the concern should

resort to cost reduction methods involving the use of Value Engineering / Value Analysis tools.

Advantages of Target Costing:

- ❖ Proactive approach to cost management.
- ❖ It reinforces top-to-bottom commitment to process and product innovation, and is aimed at identifying issues to be resolved, in order to achieve some competitive advantage.
- ❖ Target costing starts with customer's study or market study. It helps to create a company's competitive future with market-driven management for designing and manufacturing products that meet the price required for market success.
- ❖ It uses management control systems to support and reinforce manufacturing strategies; and to identify market opportunities that can be converted into real savings to achieve the best value rather than simply the lowest cost.
- ❖ Target costing ensures proper planning well ahead of actual production and marketing.
- ❖ Implementation of Target Costing enhances employee awareness and empowerment.
- ❖ Foster partnership with suppliers.
- ❖ Minimize non-value-added activities.
- ❖ Encourages selection of lowest cost value added activities.
- ❖ Reduced time to market.
- ❖ Target Costing takes a market - driven approach towards cost, in which value is defined not only by what customers demand but also by what they are willing to pay for

Main features of Target Costing System:

- ❖ Target costing is viewed as an integral part of the design and introduction of new products
- ❖ For any given product, a target selling price is determined using various sales forecasting techniques. Critical to setting the target selling price are the design specifications (reflecting certain levels of functionality and quality) of the new product
- ❖ Integral to setting the target selling price is the establishment of target production volumes, given the relationship between price and volume. The expected targets volumes are also critical to computing unit costs, especially with respect to capacity-related costs (such as tooling costs), as product costs are dependent upon the production levels over the life cycle of the product
- ❖ Establishing Cost Reduction Targets
- ❖ It should be noted that a fair degree of judgement is needed where the allowable cost and the target cost differ. As the ideal is to produce at the allowable cost, it is important that the difference is not too great. Once the product-level target cost is set, however, it generally cannot be changed, and the challenge for those involved is to meet this target.

Components of Target Costing System:

- ❖ Value Analysis is a planned, scientific approach to cost reduction which reviews the material composition of a product and production design so that modifications and improvements can be made which do not reduce the value of the product to the customer or to the user.

- ❖ Value Engineering is the application of value analysis to new products. Value engineering relates closely to target costing as it is cost avoidance or cost reduction before production. Value analysis is cost avoidance or cost reduction of a product already in production; both adopt the same approach i.e. a complete audit of the product
- ❖ The company can perform value analysis/value engineering by answering the following questions:
 - Can we eliminate functions from the production process?
 - Can we eliminate some durability or reliability?
 - Can we minimize the design?
 - Can we design the product better for the manufacturing process?
 - Can we substitute steps?
 - Can we combine steps?
 - Can we take supplier's assistance?
 - Is there a better way?

Kaizen costing Versus value engineering:

- ❖ The initial value engineering may not uncover all possible cost savings. Thus, Kaizen Costing is designed to repeat many of the value engineering steps for as long as a product is produced, constantly refining the process and thereby stripping out extra costs
- ❖ The cost reductions resulting from kaizen costing are much smaller than those achieved with value engineering but are still worth the effort since competitive pressures are likely to force down the price of a product over time, and any possible cost savings allow a company to still attain its targeted profit margins while continuing to reduce cost.

Problems with Target Costing:

- ❖ The development process can be lengthened to a considerable extent since the design team may require a number of design iterations before it can devise a sufficiently low-cost product that meets the target cost and margin criteria
- ❖ A large amount of mandatory cost cutting can result in finger-pointing in various parts of the company; especially if employees in one area feel they are being called on to provide a disproportionately large part of the savings
- ❖ Representatives from number of departments on the design team can sometimes make it more difficult to reach a consensus on the proper design because there are too many opinions regarding design issues
- ❖ Effective implementation and use requires the development of detailed cost data
- ❖ Use of target costing may reduce the quality of products due to the use of cheap components which may be of inferior quality
- ❖ For every problem area outlined have the dominant solution is retaining strong control over the design teams, which calls for a good team leader

Management Accountant's Role in Target Costing Environment:

- ❖ The management accountant should be able to provide for the other members of the design team a running series of cost estimates based on initial designs sketch, activities based costing reviews of production processes, and "best guess" costing information from suppliers based on estimated production volumes.
- ❖ The management accountant should also be responsible for any capital budgeting requests generated by the design team since he or she has the knowledge of the capital budgeting process, how to fill out the required forms,

and precisely what types of equipment are needed for the anticipated product design

- ❖ The management accountant should work with the design team to help it understand the nature of various costs (such as cost allocations based on an activity-based costing system), as well as the cost-benefit trade-offs of using different design or cost operations in the new product
- ❖ Management accountant is responsible for tracking the gap between the current cost of a product design and the target cost that is the design team's goal, providing an itemization of where cost savings have already been achieved and where there has not been a sufficient degree of progress
- ❖ Management accountant must continue to compare a product's actual cost to the target cost after the design is completed, and for as long as the company sells the product

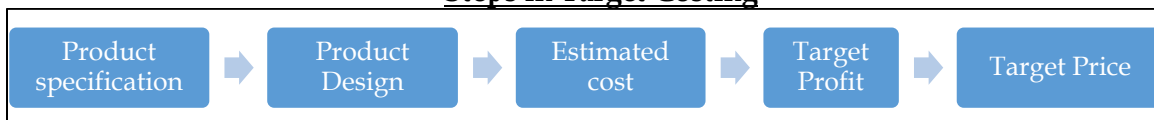
Impact of Target Costing on Profitability:

- ❖ Target costing can have a startlingly large positive impact on profitability, depending on the commitment of management to its use, the constant involvement of management accountants in all stages of a product's life cycle, and the type of strategy a company follows
- ❖ Target costing improves profitability in two ways:
 - It places a detailed continuing emphasis on product costs throughout the lifecycle of every product
 - It improves profitability through precise targeting of the correct prices at which the company feels it can field a profitable product in the marketplace that will sell in a robust manner

Target Costing versus Traditional Costing



Steps in Target Costing



Steps in Traditional Costing

Target Costing data flow:

- ❖ Data can be obtained from central accounting data base carefully stocked from such a variety of sources as accounts payable, billing, bills of materials and inventory records
- ❖ In initial stages of product design, the cost accountant must make the best possible guesses regarding the cost of proposed designs
- ❖ The cost accountant may include the best estimate an additional estimate of the highest possible cost that will be encountered
- ❖ Data can also be obtained from competitor's information collected by the marketing staff or an outside research agency
- ❖ Sometimes information is compiled by a combined effort of the marketing and engineering staffs through a process called reverse engineering
- ❖ Engineering staff also compiles their own cost data relating to different designs/components.

- ❖ The final database available to the cost accounting member of a design team contains information regarding the previous quality, cost and on-time delivery performance of all key suppliers, as well as the production capacity of each one.

Most useful situations for target costing: Target costing is most useful in situations where the majority of product costs are locked in during the product design phase. This is the case with manufactured products but few services. Some companies, which seem to benefit most from target costing, are those, which maintain the following criteria

- ❖ Assembly-oriented industries, as opposed to repetitive-process industries that produce homogeneous products
- ❖ Involved heavily with the diversification of the product lines;
- ❖ Use technologies of factory automation, including computer-aided design, flexible manufacturing systems, office automation, and computer-aided manufacturing
- ❖ Have experienced shorter product life cycles where the pay-back for factory automation typically must be achieved in less than eight years
- ❖ Must develop systems for reducing costs during the planning, design and development phases of a product's life cycle
- ❖ Are implementing management methods such as just-in-time, value engineering

Target costing control points:

- ❖ **Identification of Principal Control Point:** Experience shows that there always comes a point, where the cost of maintaining the design team exceeds the savings garnered from additional iterations. It is also necessary that most products should be launched within a reasonably short time or they will miss the appropriate market, where they will beat the delivery of competing products to the market
- ❖ **Point of Go/No Go Decision:** If target costing is not reached, management retains power to abandon the design project. There comes a point, when actual performance is very close to expected performance in matter of cost incurrence
- ❖ **Milestone can be in terms of Timer or Points:** A milestone can be in terms of time, say one month. It can also be on the points in design process, at which specific activities are completed

Implementing a target costing system:

- ❖ **Create a project charter:** The target costing effort should begin with a document, approved by senior management that describes its goals and what it is authorized to do. This document, known as the project charter, is essentially a subset of the corporate mission statement and related goals as they pertain to the target costing initiative
- ❖ **Obtain a management sponsor:** The next step is to obtain the strongest possible support from a management sponsor. This should be an individual who is well positioned near the top of the corporate hierarchy
- ❖ **Obtain a budget:** The target costing program requires funds to ensure that one or more well-staffed design teams can complete target costing tasks
- ❖ **Assign a strong team member:** The best way to ensure that the team functions properly is to assign to the effort a strong team manager skilled in dealing with management, the use of project tools, and working with a diverse group of people

- ❖ **Enroll full-time participants:** A target costing team member puts the greatest effort into the program when he or she is focused only on target costing. Thus, it is essential that as many members of the team as possible be devoted to it full-time rather than also trying to fulfill other commitment elsewhere in the company at the same time
- ❖ **Use Project Management Tools:** Target costing can be a highly complex effort especially for high-cost products with many features and components. To ensure that the project stays on track, the team should use all available project management tools, such as Microsoft Project (for tracking the completion of specific tasks), a company database containing various types of costing information, and a variety of product design tools

Life Cycle Costing:

- ❖ Life Cycle Costing involves identifying the costs and revenue over a product's life i.e. from inception to decline
- ❖ Life cycle costing aims to maximize the profit generated from a product over its total life cycle

Product Life Cycle:

- ❖ **Stage I – Introduction Stage:** Stage one is where the new product is launched in the market. As the product is novel, there is minimal awareness and acceptance of it. Competition is almost negligible and profits are non-existent
- ❖ **Stage II: Growth Stage:** Sales begin to expand rapidly because of greater customer awareness. Competitors enter the market often in large numbers. As a result of competition, profit starts declining near the end of the growth stage
- ❖ **Stage III: Maturity Stage:** During the stage of maturity sales continue to increase, but at a decreasing rate. When sales level off, profits of both producers and middlemen decline. The main reason is intense price competition; some firms extend their product lines with new models. This stage poses difficult challenges
- ❖ **Stage IV: Decline Stage:** Decline in sales volume characterizes this last stage of the product life cycle. The need or demand for product disappears. Availability of better and less costly substitutes in the market accounts for the arrival of this stage.

Characteristics and strategies of 4 Stages:

	Introduction	Growth	Maturity	Decline
Characteristics				
Objectives	Create product awareness and trial	Maximize market share	Maximize profits while defending market share	Reduce expenditures & milk the brand
Sales	Low sales	Rapidly rising	Peak sales	Declining sales
Costs per customer	High cost per customer	Average cost per customer	Low cost per customer	Low cost per customer
Profits	Negative	Rising profits	High profits	Declining profits
Customers	Innovators	Early adopters	Middle majority	Laggards
Competitors	Few	Growing number	Steady number beginning to decline	Declining number
Strategies				

Product	Offer basic product	Offer product extensions, service and warranty	Diversify brands and models	Phase out weak items
Price	Cost plus profit	Price to penetrate market	Price to match or beat competitors	Price cutting
Advertising	Build product awareness amongst early adopters & dealers	Build awareness & interest in mass market	Stress on brand differences and benefits	Reduce level to keep hard core loyalty
Distribution	Build selective distribution	Build intensive distribution	Build more intensive distribution	Go selective; phase out unprofitable outlets
Sales promotion	Use heavy sales promotion to entice trial	Reduce to take advantage of heavy consumer demand	Increase to encourage brand switching	Reduce to minimal level

Characteristics of Product Life Cycle:

- ❖ The products have finite lives and pass through the cycle of development, introduction, growth, maturity, decline and deletion at varying speeds.
- ❖ Product cost, revenue and profit patterns tend to follow predictable courses through the product life cycle
- ❖ Profit per unit varies as products move through their life cycles.
- ❖ Each stage of the product life-cycle poses different threats and opportunities that give rise to different strategic actions.
- ❖ Products require different functional emphasis in each stage-such as an R&D emphasis in the development stage and a cost control emphasis in the decline stage.
- ❖ Finding new uses or new users or getting the present users to increase their consumption may extend the life of the product.

Benefits of Product Life Cycle Costing:

- ❖ The product life cycle costing results in earlier actions to generate revenue or to lower costs than otherwise might be considered.
- ❖ Better decisions should follow from a more accurate and realistic assessment of revenues and costs, at least within a particular life cycle stage.
- ❖ Product life cycle thinking 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.
- ❖ It is an approach used to provide a 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.
- ❖ Product life cycle costing traces research and design and development costs etc., incurred to individual products over their entire life cycles, so that the total

magnitude of these costs for each individual product can be reported and compared with product revenues generated in later periods

Uses of Product Life Cycle:

- ❖ As a Planning tool, it characterizes the marketing challenges in each stage and poses major alternative strategies, i.e. application of kaizen.
- ❖ As a Control tool, the PLC concept allows the company to measure product performance against similar products launched in the past.
- ❖ As a Forecasting tool, it is less useful because sales histories exhibit diverse patterns and the stages vary in duration.

Value Chain Analysis:

- ❖ VCA is a process by which firm identifies & analyses various activities that add value to the final product.
- ❖ VCA focuses on identifying those activities that do not add value to the final products/services and eliminate such non-value added activities
- ❖ Michael Porter was the first to suggest the idea of value chain in 1985. Michael Porter has classified the activities into Primary and Support activities
- ❖ Value chain has been defined as the internal processes or activities a company performs to design, produce, market, deliver and support its product.

Primary Activities	Support Activities
• Inbound Logistics (Raw Materials, Handling and Warehousing) • Operations (Machining, Assembling, Testing Products) • Outbound Logistics (Warehousing and Distribution of Finished Products) • Marketing & Sales (Advertising, Promotion, Pricing, Channel Relations) • Service (Installation, Repair Parts)	• Firm Infrastructure (General Management, Accounting, Finance, Strategic Planning) • Human Resource Management (Recruiting, Training, Development) • Technology Development (R&D, Product and Process Improvement) • Procurement (Purchasing of Raw Materials, Machines & Supplies)

Superior Performance and Competitive advantage:

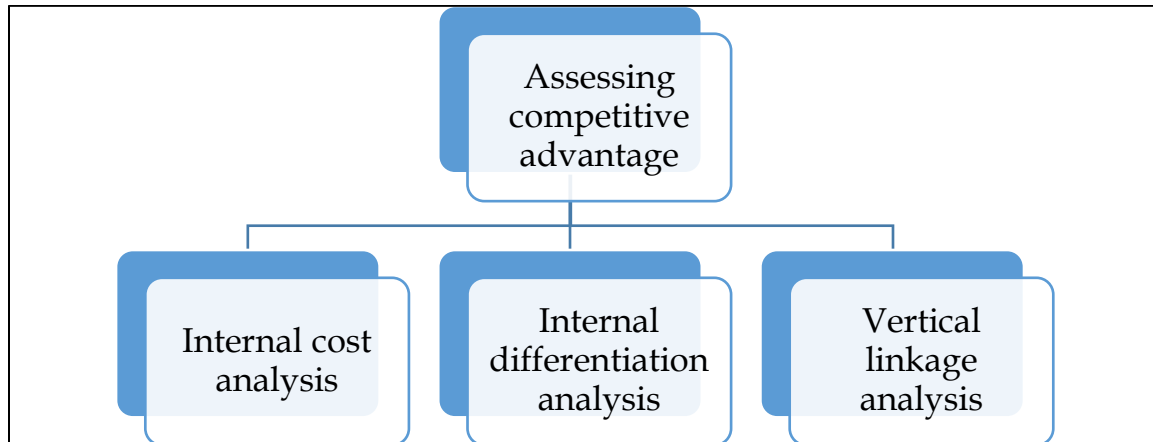
- ❖ A company's profitability is improved with superior performance which leads to the maximisation of shareholder's wealth
- ❖ A company needs to do the following in order to survive and prosper in an industry
 - They must supply what customers want to buy and
 - They must survive competition
- ❖ Distinctive competencies can take any of the following two forms:
 - An offering or differentiation advantage – Example: Apple
 - Relative low-cost advantage – Example: Xiaomi

Differentiation advantage (Product Differentiation):

- ❖ Differentiation advantage occurs when customers perceive that a business unit's product offering is of higher quality, involves fewer risks and/or outperforms products offered by competitors
- ❖ Differentiation may include a firm's ability to deliver goods and services in a timely manner, to produce better quality, to offer the customer a wider range of goods and services and other factors that create unique customer value
- ❖ Differentiation advantage can be achieved by adopting the following techniques:
 - Superior Quality
 - Superior Innovation
 - Superior customer responsiveness
- ❖ Differentiation can help the company in charging a higher price while maintaining its current market share or charge a price below the "full premium" in order to build market share

Low cost advantage (Cost leadership):

- ❖ A firm enjoys relative cost advantage if its total costs are lower than those of its competitors
- ❖ Cost leadership can help the company in charging the same price as competitor to maintain its market share while improving profitability. It can also help the firm to charge a lower price than its competitors to increase its market share
- ❖ Low cost advantage can arise from access to low-cost raw materials, innovative process technology, low-cost access to distribution channels or customers and superior operating management
- ❖ Disadvantage of this strategy is that competitors can find ways to reduce cost and hence the company should continuously find ways to reduce its cost. Company can do value chain analysis to find ways to reduce costs.

Value-chain approach for assessing competitive advantage:**Internal cost analysis:**

- ❖ **Identify the firm's value creating processes:** The companies should identify their value creating processes and their contribution to the firm's competitive advantage.
- ❖ **Determine the proportion of the total cost of the product or service attributable to each value creating process:** The next step would be to calculate the cost of the various processes. The company should also allocate costs of various support activities to primary activities using suitable basis
- ❖ **Identify the cost drivers for each process:** Company identify the factors which drive costs. A change in cost driver leads to change in total cost. Companies are currently using ABC system to gain a better understanding of the resources consumed and costs incurred for certain activity. Structural and executional cost drivers **involve strategic and operational decisions** that affect the relationship between cost drivers and total cost. Structural cost drivers **facilitate strategic decision making because they involve plans and decisions that have long term effects**. It involves choices by the firm that drive product cost. Scale, experience, technology and complexity are considered to improve a firm's competitive position. **Executional cost drivers facilitate operational decision making by focussing on short-term effects**. These are the determinants of a firm's cost position that hinge on its ability to execute successfully. Workforce involvement, design of production process, efficiency of plant layout, importance of TQM, supplier relationships among others are considered in an attempt to reduce costs
- ❖ **Identify the links between processes:** Value chain analysis consider activities as separate and discrete. However the individual activities are interdependent and hence the linkages between processes is to be understood. Cost improvement programs in one value chain may lower or increase the cost in other processes.
- ❖ **Evaluate the opportunities for achieving relative cost advantage:** Traditionally firms have adopted across the board cost reduction under all heads. However a forceful reduction in some activities like marketing can impact sales. Value chain analysis involves understanding of various activities and attempts to lower cost and improve efficiency within each value creating process.

Internal differentiation analysis:

- ❖ **Identify the firm's value creating processes:** Companies must identify the various activities in its value chain which are undertaken to deliver product/service.

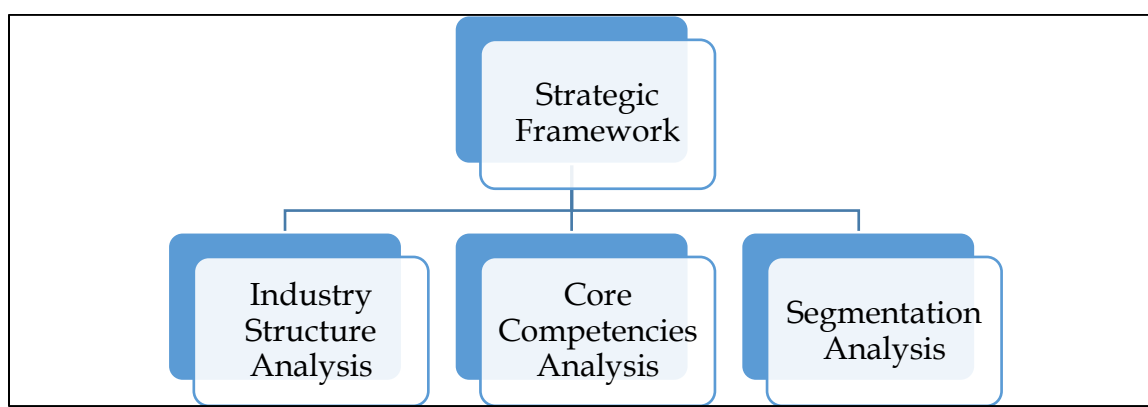
Differentiation can come from the way various activities are performed and the way in which value chains is structured.

- ❖ **Evaluate differentiation strategies for enhancing customer value:** The companies can implement the following to enhance customer value
 - Superior features in product
 - Effective marketing and distribution channels
 - Excellent customer service
 - Superior brand image
 - Better quality product at competitive prices
- ❖ **Determine the best sustainable differentiation strategies:** Company must identify various activity which can enhance differentiation and select the strategy which can create sustainable product/service differentiation

Vertical Linkage Analysis:

- ❖ A company **can earn competitive advantage** not only through linkage between various **internal activities but also through linkages between a firm's value chain and that of suppliers or users**
- ❖ Vertical linkage analysis **includes all upstream and downstream activities throughout the industry**
- ❖ A company might **not carry out all activities in the entire value chain of an industry**. Hence it might not be in a position to obtain information relating to costs or revenues for each process. However it is necessary to **carry out a vertical linkage analysis to identify the sources of competitive advantage**
- ❖ **Example:** A company manufactures cars using various components like chassis, steering wheel, tyres, axles etc. The company does not manufacture all components and assembling is its core competency. However certain parts which are critical are manufactured in-house

Strategic Frameworks for Value Chain Analysis:



Industry Structure Analysis [Porter's 5 forces Analysis]

Bargaining Power of Buyers	✓ Bargaining power of buyers <u>determines the ability of buyer to push the price down</u> . This happens when the buyers are concentrated or when the volume purchased by buyers is very high ✓ Buyer also have higher bargaining power if the cost of switching suppliers is very low ✓ Higher <u>bargaining power results in lower profitability</u>
Bargaining Power of Suppliers	✓ Bargaining Power of Suppliers is <u>relatively higher when the</u>

Suppliers	<u>input is important to the buying firm</u> or when there are few suppliers of the input ✓ Suppliers also dictate terms if the input supplied is not replaceable or when an alternate input is not available ✓ <u>Profitability of the companies can shrink if suppliers have a higher bargaining power</u>
Threat of substitute products or services	✓ <u>Multiple and closer substitutes can make customers to switch the suppliers easily</u>. Hence a firm should resort to competitive pricing to retain its customers ✓ When few substitutes exist for a product, consumers are willing to pay a potentially high price. If close substitutes for a product exist, then there is a limit to what price customers are willing to pay ✓ <u>A company should strive to build its brand and customer loyalty to prevent the threat of substitutes</u>
Threat of new entrants	✓ <u>Threat to new entrants largely depends on the barrier to entry and perceived profitability</u> in an industry ✓ Some examples of barriers to entry are intensive capital equipment, sophisticated technology, legal factors, limited access to raw material and labour ✓ <u>An industry where threat of new entrants is low is more profitable than an industry where new entrants can easily enter the industry</u>
Intensity of competition / rivalry amongst firms	✓ In Highly competitive markets, <u>firms resort to cut-throat competition to win more customers</u> ✓ The competitive rivalry is higher when an industry has high number of firms and lower when there are few large players dominating the market ✓ Intensity of competition is influenced by number of firms, existence of extra capacity, difficulty in differentiation of products, high exit barriers and higher fixed costs

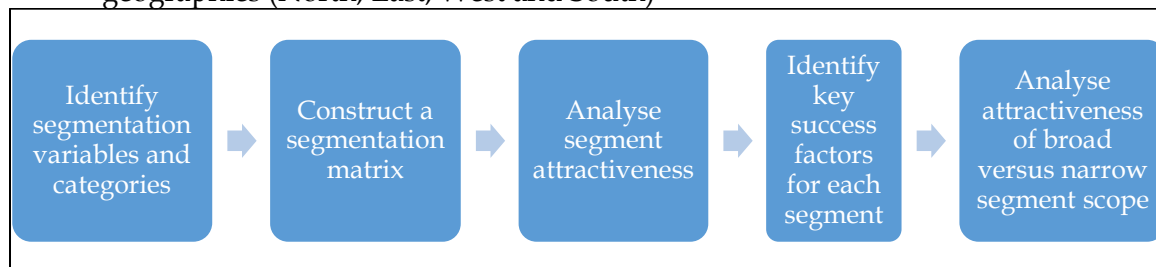
Core Competencies Analysis:

- ❖ Core competency is a **distinctive or unique skill** that creates distinctive customer value
- ❖ Core competencies are a **function of the collective skillset of people, organisation structure resources & technological knowhow**
- ❖ Core competence is the **primary source of an organization's competitive advantage**. The competitive advantage could result from cost leadership or product differentiation
- ❖ **Loss of core competence can prove disaster for firms. Example: Nokia** was a leader in feature phone segment till smart phones were introduced. The changing dynamics of industry meant that Nokia lost top position in mobile phone market
- ❖ Core competencies stem from two sources:
 - **Resources** – Resources **are factors that enable a company to create value for customers. They can be tangible** (land, buildings, inventory, machinery, money) **or intangible** (employee's skills, brand, patent, technology)
 - **Capabilities** – **Capabilities refer to the company's ability to co-ordinate resources and put them to productive use**. Availability of resources does not guarantee core competency and success. Capabilities stem from organisational structure, processes and control systems

- ❖ **Value chain approach can be applied to core competencies for creating competitive advantage** using the following steps:
 - **Validate** core competencies in **current businesses**
 - **Leverage competencies** to the value chains of **other existing businesses**
 - Use core competencies to **reconfigure the value chains** of existing businesses
 - Use core competencies to **create new value chains**

Segmentation Analysis:

- ❖ **A single industry might be a collection of different market segments.** Example: Motor Vehicle industry can be seen as a composite of tyre, glass, battery, metals among others
- ❖ Segmentation analysis involve analysis **structural characteristics of different industry segments**
- ❖ A firm can use the segmentation analysis information to decide **to exit the segment, to enter a segment, reconfigure one or more segments**, or embark on cost reduction/differentiation programs
- ❖ **Market segmentation can be done on the basis of demographics** (Age, Gender, Marital Status, Income, Education), **Geographic, Lifestyle, Benefit** (convenience, status, value, quality) among others. Example: ITC could create a segmentation matrix on the basis of nature of products (cigarettes, hotels, textile, paper) and geographies (North, East, West and South)



Limitations of value chain analysis:

- ❖ **Non-availability of data:** Internal data on costs, revenues and assets used for value chain analysis are derived from financial information of a single period. For long term strategic decision making, changes in cost structures, market prices and capital investments etc. may not be readily available.
- ❖ **Identification of stages:** Identifying stages in an industry's value chain is limited by the ability to locate at least one firm that participates in a specific stage. Breaking a value stage into two or more stages when an outside firm does not complete in these stages is strictly judgment.
- ❖ **Ascertainment of cost, revenues and assets:** Finding the costs revenues and assets for each value chain activity poses/gives rise to serious difficulties. There is no scientific approach and much depends upon trial and error and experimentation methods.
- ❖ **Identification of cost drivers:** Isolating cost drivers for each value-creating activity, identifying value chain linkages across activities and computing supplier and customer profit margins present serious challenges.
- ❖ **Resistance from employees:** Value chain analysis is not easily understandable to all employees and hence may face resistance from employees as well as managers.

- ❖ **Science vs. Art:** Value chain analysis is not exact science. It is more “art” than preparing precise accounting reports. Certain judgments and factors of analysis are purely subjective and differ from person to person.

Cost Control/waste control and cost reduction [Conquer your costs before they conquer you]

Cost Control:

- ❖ Cost Control implies **regulation of cost** by **executive action**. For this purpose, the executives **are provided with some yard stick** such as **standards or budgets** with which the actual costs and performances are compared to ascertain the degree of achievement made.
- ❖ Cost Control involves **continuous comparisons of actual with the standards** or budgets to regulate the former.
- ❖ Cost Control is **possible only when an organization has an effective Cost Accounting System** to provide relevant information.
- ❖ Costs should be categorized into controllable and non-controllable. The organizations are divided into responsibility centres. Every executive is made responsible for the performance of the centre under his control

Cost Reduction:

- ❖ Cost Reduction is the achievement of **real and permanent reduction** in unit cost of products manufactured. It, therefore, **continuously attempts to achieve genuine savings in cost** of production distributing, selling and administration.
- ❖ It **does not accept a standard or budget**. It rather challenges the standards/budgets continuously to make improvement in them.
- ❖ It **attempts to excavate, the potential savings buried in the standards** by continuous and planned efforts.
- ❖ Cost Control relax that dynamic approach, it usually dealt with variances leaving the standards intact.

Cost reduction versus cost control:

Cost Reduction	Cost Control
Cost reduction is the achievement of real and permanent reduction in the unit cost of products manufactured	Cost control involves a comparison of actual with standards or budgets to regulate the actual costs
Realistic savings in cost	There could be temporary savings in cost
Product's utility, quality and characteristics are retained	Quality maintenance is not a guarantee
It is not concerned with maintenance of performance according to standards	The process involves setting up a target, investing variances and taking remedial measures to correct them
Continuous process of critical examination includes analysis and challenge of standards	Control is achieved through compliance with standards. Standards by themselves are not examined
Fully dynamic approach	Less dynamic than cost reduction
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
Emphasis here is partly on present costs and largely on future costs	Emphasis on present and past behavior of costs

The function of cost reduction is to find out substitute ways and new means like waste reduction, expense reduction and increased production	Cost control does competitive analysis of actual results with established standards
Cost reduction is a corrective measure	Cost control is a preventive measure

Focus areas for cost reduction:

Area	Explanation
Product Design	❖ Product design being the <u>first step in manufacturing of a product</u> and the impact of the proper design can be seen in the entire manufacturing chain ❖ <u>Efficient designing for a new product or improving the design</u> for an existing product can help the company in reducing the cost in multiple ways such as: ○ <u>Cheaper substitute, higher yield and less quantity</u> and varieties of materials, cause cost reduction ○ Reduced time of operation and <u>increased productivity</u> ○ <u>Standardization and simplification</u> in variety increases productivity and reduces costs ❖ <u>Example: Tata Motors had made an ambitious plan of manufacturing a car at Rs.1,00,000.</u> The company made this plan due to its product design wherein they had focused on cutting unnecessary parts such as simplicity of the interiors, simple exterior such as one wiper, removal of left side mirror, using plastic exterior parts among others.
Organisation	❖ Proper assignment of task and delegation of responsibility to avoid <u>overlapping</u> ❖ Removal of <u>doubts and fiction</u> ❖ <u>Encouragement to employees</u> for cost reduction
Factory layout equipment	❖ Proper factory layout and utilization of the existing equipment to determine whether there is any scope for cost reduction by elimination of <u>wastage of men, materials and maximum utilization of available facilities</u>
Production plan programme and method	❖ Production control ensures <u>proper planning of work by installing and efficient procedure</u> and programme ordering correct machine and proper utilization of materials, manpower and resources ❖ Production control to be analyzed to ensure the following: ○ <u>Wastage of manpower</u> is kept to <u>minimum</u> ○ Scope for <u>reducing idle capacity</u> ○ <u>Efficient control of stores</u> and maintenance services ○ <u>Reduction of labour wastage and increased productivity</u> by eliminating faulty production method

Tools and techniques of cost control and cost reduction:

- ❖ Value analysis
- ❖ Inventory management (Just in Time, EOQ)
- ❖ Business Process Re-engineering
- ❖ Target costing
- ❖ Kaizen costing

Computer-aided manufacturing:

- ❖ The manufacturing process is carried out by a range of machinery that, together with its concomitant software, comes under the collective heading of computer-aided manufacturing (CAM).
- ❖ Maximum elements of CAM are computer numerical control (CNC) and robotics.

Just-In-Time (JIT):

- ❖ **"Just-in-time (JIT):** System whose objective is to produce or to procure products or components as **they are required by a customer** or for use, rather than for stock. It is a Pull system, which responds to demand, in contrast to a push system, in which stocks act as buffers between the different elements of the system such as purchasing, production and sales".
- ❖ **"Just-in-time production:** Production system which is **driven by demand for finished products**, whereby each component on a production line is produced only when needed for the next stage".
- ❖ **"Just-in-time purchasing:** Purchasing system in which **material purchases are contracted so that the receipt and usage of material, to the maximum extent possible, coincide**"
- ❖ Following are some of the steps in JIT system:

Spare Parts/ Materials from suppliers on <u>the exact date and at the exact time</u> when they are needed	<u>Straight delivery</u> to the production floor for immediate use in manufactured products	<u>Visit of engineering staff at supplier sites</u> to examine supplier's premises
<u>Installation of EDI system</u> that tells suppliers exactly how much of which parts are to be sent	Dropping off <u>products at the specified machines</u>	<u>Shorten the setup times</u>
<u>Eliminating the need for long production runs/</u> Streamlined flow of parts from machine to machine	<u>Training to employees</u> how to operate a multitude of different machines, perform limited maintenance	Several alterations in the <u>supporting accounting systems</u>

Features of JIT System:

- ❖ Organize production in manufacturing cells, a grouping of all different types of equipment used to make a given product. Materials move from one machine to another where various operations are performed in sequence. **Material-handling cost is reduced.**
- ❖ Hire and retain workers who are multi-skilled so that they are capable of performing a variety of operations, including repairs and maintenance tasks. **Thus, labour idle time gets reduced.**
- ❖ Apply TQM to eliminate defects. As, there are tight link stages in the production line, and minimum inventories at each stage, defect arising in one stage can hamper the other stages. **JIT creates urgency for eliminating defects as quickly as possible.**
- ❖ Place emphasis on reducing set-up time which makes production in smaller batches economical and reducing inventory levels. **Thus, company can respond to customer demand faster.**
- ❖ Carefully selected suppliers capable of delivering high quality materials in a timely manner directly at the shop - floor, **reducing the material receipt time.**

Pre-requisites of JIT System:

- ❖ Low variety of goods
- ❖ Vendor reliability
- ❖ Good communication
- ❖ Demand stability
- ❖ TQM
- ❖ Defect free materials
- ❖ Preventive maintenance

Impact of JIT System:

- ❖ **Waste costs:** Characteristic of the JIT system is its continuous focus on eliminating all waste from a system. It can reduce waste of material, time, unused assets, obsolete inventory, defective products, rework among others
- ❖ **Overhead costs:** Cost of material handling, facilities, quality inspection are significantly reduced in JIT System. Furthermore there is a reduction of space requirement for maintaining inventory and hence all costs related to warehouse is also significantly reduced
- ❖ **Product prices:** When a company achieves a higher level of product quality, along with its ability to deliver products on the dates required, customers may be willing to pay a premium. Hence JIT can present an opportunity to increase prices. However if customers do not pay major importance to timely delivery and quality, then there will be no scope for price increase.

Performance Measurements in JIT System versus Traditional System:

Measure	Traditional system	JIT System
Machine utilization	Machine utilization refers to the rate at which every asset is utilized. <u>In the traditional system, companies will focus on ensuring maximum capacity utilization.</u> However this will lead to higher production and consequently higher inventory	JIT focuses on producing only what is needed. <u>Hence machine utilization measurement is discarded in JIT System</u>
Piece rate	<u>Companies pay a higher piece rate when the efficiency exceeds 100%.</u> Employees would be motivated to produce more as their earnings is proportionate to units produced	<u>Concept of Piece rate system is scrapped in JIT System.</u> JIT focuses on producing what is needed and hence employee performance is measured with factors such as number of suggestions for improving system/quality
Labour efficiency	Traditional system <u>pays utmost importance on measuring labour efficiency</u> to ensure maximum production	<u>JIT system does not focus on how fast an employee works.</u> It focuses on the quality of the products manufactured. Furthermore labour efficiency calculation would need time-keeping and time-booking techniques which are considered as non-value added activity

Performance measures of JIT System:

Inventory turnover	✓ Companies installing JIT system should <u>experience extraordinarily high inventory turnover</u>
Setup time	✓ <u>Shortest possible setup times</u> are crucial for the success of short

reduction	production runs and so this is a major JIT measurement
Customer complaints	✓ JIT is based on premise that <u>product quality is superb</u> . Hence any customer suggestion of a product issue should be greeted with gravest concern and investigated immediately
Scrap	✓ Little waste should be generated by JIT system, which means that <u>material scrap should be driven down to exceedingly low levels</u>
Cost of quality	✓ Focus of JIT is <u>to produce high-quality products</u> and hence the managers would like to track the full cost of quality. The company should take-up measures to reduce quality cost
Customer service	✓ This has various sub-measures such as <u>delivering products on the dates prescribed by customer, shipping full orders, not having returns due to poor quality</u>
Ideas generated	✓ <u>JIT system works well when employees pitch in with hundreds of suggestions for improvement</u> . It can be measured as ideas per worker, total number of ideas generated, number of ideas implemented of the proportion of ideas suggested that are implemented

Back-flushing in a JIT System:

- ❖ Backflushing requires **no data entry of any kind until a finished product is completed**. At that time the total amount finished is entered into the computer system, which multiplies it by all the components listed in the bill of materials for each item produced.
- ❖ This yields a **lengthy list of components that should have been used in the production process and which are subtracted from the beginning inventory balance** to arrive at the amount of inventory that should now be left on hand.
- ❖ Given the **large transaction volumes associated with JIT, this is an ideal solution to the problem**.
- ❖ Companies should consider the following before implementing a back-flushing system:
 - **Production reporting** - Employees must be trained to report accurate production. In case the reporting is incorrect, it will lead to wrong component types and quantities being deducted from stock
 - **Scrap reporting** - All abnormal scrap must be diligently tracked and recorded; otherwise these materials will fall outside the back-flushing system and will not be charged to inventory
 - **Lot tracing** - Lot tracing is impossible under back-flushing system. It is required when a manufacturer need to keep records of which production lots were used to create a product in case all the items in a lot must be recalled
 - **Inventory accuracy** - Inventory balance may be very high at all times because the transactions are recorded only once in a day, during which time other inventory is sent to production premises. Hence it is not possible to maintain accurate inventory

Theory of Constraints (TOC):

- ❖ TOC **focuses on revenue and cost management** when faced with bottlenecks. It advocates the use of three measures
- ❖ The objective of management can be expressed as **increasing throughput, minimizing investment and decreasing operating expenses**

Throughput

- Measures rate of generating money in an organization through sales
- $\text{Throughput} = (\text{Sales} - \text{unit level variable expense}) / \text{Time}$
- Direct labour cost is viewed as fixed cost and hence is not included while calculating throughput

Investment

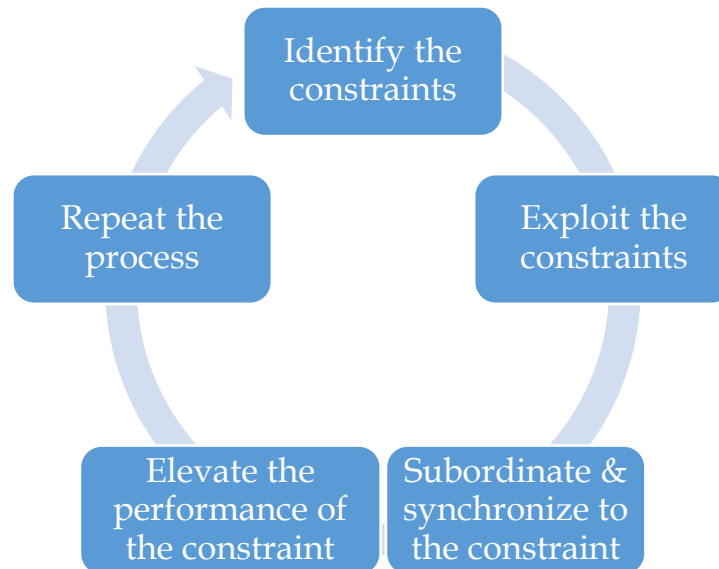
- Money associated with turning materials into throughput and do not have to be immediately expensed
- Includes assets such as facilities, equipment, fixtures, computers and Research & Development expense

Operating expense

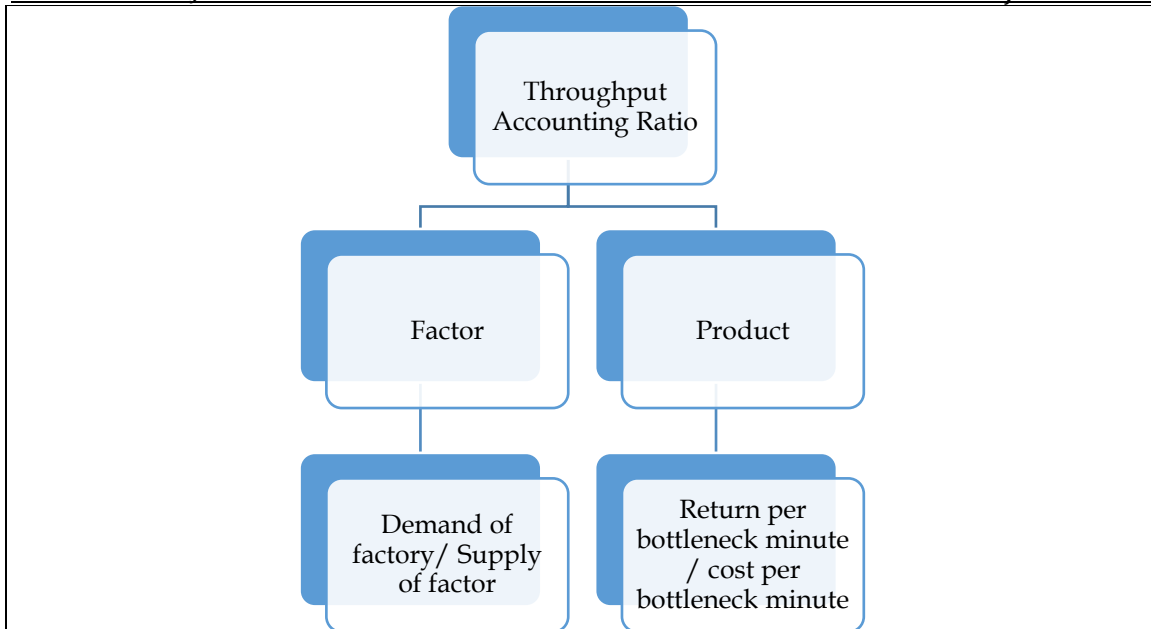
- Money spent in turning investment into throughput and therefore represent all other money that an organization needs
- Includes direct labour and all operating and maintenance expense

Goldratt's five step method for improving performance:

- ❖ TOC describes the process of identifying and taking steps to remove the bottlenecks that restrict output. The key steps in managing bottleneck resources are:



Throughput Accounting Ratio:

**Note:**

- ❖ TA ratio of more than 100 percent for an input factor indicates bottleneck resource
- ❖ TA ratio of more than 100 percent for a product indicates profitable product

Advantages and disadvantages of TOC:

Advantages	Disadvantages
• Reduction in inventory • More productive machines • Ability to meet shorter lead times • More flexible • Better customer service • Better product mix • Better customer relationship	• Focus on short-term goals • Main emphasis on increasing sales and volume, not quality as opposed to TQM • Might result in loss of overall picture • Focuses on push approach as opposed to pull approach of JIT • Valid only if applied to total supply chain process including management, production, resources and support

Chapter 2: Decision Making Using Cost Concepts and CVP Analysis**Introduction:**

- ❖ Relevant means pertinent to the decision at hand.
- ❖ Relevant costs are those expected future costs that are essential but differ for alternative courses of action
- ❖ Relevant cost is a future cost that would arise as a direct consequence of the decision under review

Rules of relevance:

- ❖ **Opportunity cost** refers to the value of sacrifice made or benefit of opportunity foregone by selecting one particular alternative in preference to the other alternative. **All opportunity costs are considered to be relevant costs.**
- ❖ **All variable costs are generally considered to be relevant** unless the costs do not vary between alternative courses of action.
- ❖ **All fixed costs are generally considered to be irrelevant** unless the costs vary between alternative courses of action.
- ❖ Sunk or historical costs are irrelevant

Committed fixed cost versus discretionary fixed cost:

- ❖ Committed fixed costs are those that arise from the possession of asset and are normally unaffected by any short-term changes in volume of production. Example: Rent of factory, Insurance. **Committed fixed costs are otherwise known as unavoidable fixed costs.**
- ❖ Discretionary fixed costs are incurred as result of management discretion/decision. Example: Advertising. **Discretionary fixed costs are otherwise known as avoidable fixed costs.**

Opportunity costs:

- ❖ The opportunity cost of the value of opportunity foregone is taken into consideration when alternatives are compared.
- ❖ Opportunity Cost is the value of the next best alternative. In other words, it is the opportunity cost lost by diversion of an input factor from one use to another. It is the measure of the benefit of opportunity foregone.

Notional Cost:

- ❖ As per CIMA terminology 'Cost used in product evaluation, decision making and performance measurement to reflect the use of resources that have no actual (observable) cost'

Avoidable costs:

- ❖ Avoidable costs are cost that can be skipped if the decision on activity in consideration will not been taken up.
- ❖ As per CIMA terminology avoidable costs are the 'Specific cost of an activity or sector of a business that would be avoided if the activity or sector did not exist'

Historical costs:

- ❖ Cost that has been already incurred in the past is called historical cost.

Sunk costs:

- ❖ Costs which do not change under given circumstance and do not play any role in decision making process are known as sunk costs.

- ❖ These are the costs which have been incurred by a decision made in past and cannot be changed by any decision made in the future

Out of pocket cost:

- ❖ This is that portion of costs which involves payments to outsiders i.e. it gives rise to cash expenditure as opposed to such costs as depreciation, which do not involve any cash expenditure

Shut-down cost:

- ❖ When an organization suspends its manufacturing, certain fixed expenses can be avoided and certain extra fixed expenses may be incurred depending upon the nature of the industry.
- ❖ By closing down the manufacturing, the organization will save variable cost of production as well as some discretionary fixed costs. This particular discretionary cost is known as shut-down cost

Engineered cost:

- ❖ Engineered costs results from a defined mathematical relationship with the cost object and resources consumed to produce an output. Example: Raw material, labour and machine hours

Inventoriable costs:

- ❖ Costs that are considered as part of merchandise and considered as asset when these are incurred and these costs become cost of goods sold when the final output is sold.
- ❖ In other words inventoriable costs are cost of purchase plus cost expended to make final product in saleable condition

Period costs:

- ❖ Period costs are all costs other than cost of goods sold and treated as expense in income statement.

Differential cost, Incremental cost and Incremental revenue:

- ❖ Differential cost (which may be incremental or decremental cost) is the difference in total cost that will arise from the selection of one alternative instead of another. It involves the estimation of the impact of decision alternatives on costs and revenues.
- ❖ The two basic concepts which go together with this type of cost analysis are incremental revenue and incremental costs.
- ❖ Incremental revenue is the change in the total income resulting from a decision.
- ❖ Incremental costs represent a change in the total costs resulting from a decision
- ❖ Concept of incremental/differential cost techniques can be used for the following decisions:
 - Whether to process a further product or not
 - Dropping or adding a product line
 - Making the best use of investment made
 - Acceptance of an additional order from a special customer at lower than existing price
 - Opening of new sales territory and branch
 - Make or buy decisions

- Submitting tenders
- Lease or buy decisions
- Equipment replacement decisions

Marginal Costing:

- ❖ Marginal costing is a technique of decision-making which involves
 - Ascertainment of total costs
 - Classification of costs into fixed and variable and
 - Use of such information for analysis and decision making
- ❖ Marginal costing is also known as CVP (cost volume profit) analysis as it seeks to measure the impact of change in volume on company's cost and profits

Types of costs:

- ❖ Variable cost is that portion of cost which **varies proportionately with volume**. Variable cost per unit remains constant and any change in variable cost is to be interpreted as change in variable cost per unit
- ❖ Fixed costs are costs which are assumed to **remain constant for a given period of time** irrespective of the change in output. Fixed cost per unit is inversely proportional to volume. Any change in fixed cost has to be interpreted as change in total fixed cost.
- ❖ Semi-variable costs are those costs that exhibit characteristics of fixed and variable costs. Semi-variable costs can be split into variable cost and fixed cost using the following formula:
 - Variable cost per unit = Change in cost / Change in units
 - Total fixed cost = Total cost – total variable cost

Format of marginal cost statement:

Particulars	Per Unit	Total
Sales	XXX	XXX
Less: Variable Costs	(XXX)	(XXX)
Contribution	XXX	XXX
Less: Fixed Costs		(XXX)
Profit		XXX

Note:

1. The profit of the company does not vary proportionately with the change in sales on account of fixed costs. Hence therefore **change in contribution = change in profit**.
2. The cost does not vary proportionately with volume because of existence of fixed costs. Hence **change in total cost = change in variable cost**

Profit-Volume Ratio (PVR):

- ❖ PVR measures the extent of change in contribution/profit on account of change in sales. Net profit ratio keeps on changing for different sale amounts whereas PVR is constant.
- ❖ PVR is the true indicator of the profitability of the product

PVR = Contribution / sales	PVR = Change in contribution / Change in sales
PVR = Contribution per unit / SP	PVR = Change in profit / change in sales

Break-even point (BEP):

- ❖ BEP refers to the sales level at which the company earns no profit and no loss. This can be either expressed in units or rupees.
- ❖ If expressed in units it is called BEP and if expressed in rupees it is called Break even sales.
- ❖ Moreover at BEP, contribution = fixed cost and sales = total cost

BEP in units = Fixed cost / Contribution per unit	BEP in Rs. = Fixed cost / PVR
BEP in Rupees = BEP in units * Selling Price	

Margin of safety (MOS):

- ❖ MOS is the difference between the actual sales and break even sales. It is the extent of allowable drop in sales before the company starts incurring losses
- ❖ MOS can be expressed in rupees or in units or as a percentage of total sales

MOS in units = Profit / Contribution per unit	MOS in Rs. = Profit / PVR
MOS in Rupees = MOS in units * Selling Price	
Sales in rupees = BEP in rupees + MOS in rupees	

Sales to achieve desired profit and profit at desired sales level:

1. Sales to earn desired profit = $\frac{\text{Target Profit} + \text{Total fixed cost}}{\text{PVR}}$
2. Profit at sales level = (Sales * PVR) - Total fixed cost

Note: For BEP, MOS, Sales, the answer would be in rupees if the denominator is PVR and the answer would be in units if the denominator is contribution per unit

Break-even point for multiple products:

- ❖ BEP is computed using fixed cost and PVR/Contribution per unit. However in case of multiple products there will be multiple PVR/Contribution per unit
- ❖ BEP for multiple products (in units) = TFC/Contribution per set. It would be assumed that one set would contain the product mix as given in the question
- ❖ BEP for multiple products (in rupees) = TFC/Composite PVR. Composite PVR would be calculated as overall contribution/overall sales

Steps for solving multiple break-even point problems:

Step 1: Identify class intervals

A new class interval will emerge whenever there is a change in fixed cost or variable cost per unit or selling price for the additional units.

Class Interval	Selling Price	VC/unit	Cont./unit	Total fixed cost

Step 2: Calculate BEP using the following format:

Class Interval (CI)	Fixed cost of CI	FC recovery till previous CI	FC to be recovered	Contribution per unit	Units to be sold	Final BEP
Step 1	Step 1	Contribution earned till previous CI	Col 2 - Col 3	Step 1	Col 4 / Col 5	

BEP with semi-variable costs:

- ❖ Assume the Semi-variable cost as variable cost and calculate contribution per unit
- ❖ Use the contribution per unit and calculate tentative BEP
- ❖ Use the BEP format and calculate BEP for one range above tentative BEP and one range falling in tentative BEP.

Marginal costing and absorption costing:

- ❖ Marginal costing and absorption costing are the two properly used methods of computing profits
- ❖ **Marginal costing consider only variable manufacturing costs for stock valuation whereas absorption costing consider both variable and fixed manufacturing costs for valuing inventory**

Profit statement under absorption costing:

Particulars	Calculation	Amount
Variable manufacturing costs	Units produced * Cost per unit	XXX
Fixed manufacturing costs (absorbed)	Units produced * OAR	XXX
Cost of production		XXX
Add: Opening FG	Units * Cost per unit	XXX
Less: Closing FG	Units * Cost per unit	(XXX)
Cost of goods sold		XXX
Variable non-manufacturing costs	Units sold * Cost per unit	XXX
Fixed non-manufacturing costs		XXX
Cost of sales		XXX
Add/Less: Under/over absorbed overheads		XXX
Revised cost of sales		XXX
Profit (Balancing figure)		XXX
Sales		XXX

Profit statement under marginal costing:

Particulars	Calculation	Amount
Sales	Units sold * Selling Price	XXX
Less: Variable costs	Note 1	(XXX)
Contribution		XXX
Less: Fixed costs	Fixed manufacturing + fixed non-manufacturing costs	XXX
Profit		XXX

Note 1: Calculation of variable costs:

Particulars	Calculation	Amount
Variable manufacturing costs	Units produced * Cost per unit	XXX
Add: Opening FG	Units * Cost per unit	XXX
Less: Closing FG	Units * Cost per unit	(XXX)
Variable cost of goods sold		XXX
Add: Variable non-manufacturing costs	Units sold * Cost per unit	XXX
Total costs		XXX

Reconciliation of profits:

- ❖ Profits as per marginal costing and absorption costing statement will be different due to different base for valuation of inventory

- ❖ Profit reconciliation under both methods can be done with the help of following format:

Particulars	Amount
Profit as per marginal costing	XXX
Add: Excess valuation of closing stock in absorption costing	XXX
Less: Excess valuation of opening stock in absorption costing	(XXX)
Profit as per absorption costing	XXX

BEP under marginal and absorption costing:

1. BEP under Marginal costing = $TFC / \text{Contribution per unit}$
2. However BEP under absorption costing cannot be $TFC / \text{Contribution per unit}$ on account of existence of stocks as some portion of fixed costs would be recovered in the next year with stocks absorbing a certain part of fixed costs.
3. BEP under absorption costing
 - a. When stock info is given = $\frac{TFC - \text{Fixed cost inside net stock (Note 1)}}{\text{Contribution per unit}}$
 - b. When production is given = $TFC - \left\{ \frac{\text{FMOH} * \text{Units produced}}{\text{Normal Production}} \right\}$
 $\text{SP} - \text{VC} - \left\{ \frac{\text{FMOH}}{\text{Normal production}} \right\}$

Note 1: If the net stock is opening then add the fixed cost in the net stock to the total fixed cost

Indifference point:

1. In case of two different alternatives indifference point refers to a level wherein the two alternative decisions would provide the same result
2. For level below the indifference point, the alternative with lower fixed cost is preferable and for level above the indifference point, the alternative with higher fixed cost is preferable
3. Indifference point = $\frac{\text{Difference in Fixed costs}}{\text{Difference in VC per unit or difference in VCR or difference in PVR}}$

Shut-down point:

1. In case of adverse economic conditions a company might have to make a decision on whether to continue their business or temporarily shut the business unless the demand revives
2. Shut-down point (in units) = $\frac{\text{Normal Fixed costs} - (\text{FC during shutdown} + \text{Add. FC for shutdown})}{\text{Contribution per unit}}$
3. Shut-down point (in Rs.) = Same Numerator / PVR
4. If the expected sales volume is less than the shutdown point then the company should close their business or else continue producing

Limiting factor:

1. Limiting factor is one which acts as a bottleneck and limits the company's ability to serve the demand of the external market
2. Limiting factor is a situation where in the demand for the limiting factor is always greater than the supply for the limiting factor

Steps for solving Limiting factor problems:

1. Identify the limiting factor – Limiting factor is one whose demand is more than supply
2. Calculate the contribution per unit of limiting factor and rank the products with maximum contribution being top ranked product

Particulars	Product A	Product B	Product C
Selling Price	XXX	XXX	XXX
Less: Variable cost	(XXX)	(XXX)	(XXX)
Contribution per unit (A)	XXX	XXX	XXX
No. of limiting factors required per unit (B)	XXX	XXX	XXX
Contribution per unit of limiting factor (A/B)	XXX	XXX	XXX
Rank	XXX	XXX	XXX

3. Use the following format for allocation of resources:

Product	No. of units	Units of limiting factor per unit	Limiting factor consumed	Total contribution

Concept: Make or Buy Decisions and Subcontracting decisions

1. A company on account of capacity constraints would not be able to meet the full demands of the external customers. Hence it becomes imminent for the companies to go for either subcontracting or buying the products from outside.
2. **Make or buy decision:** The Company should compare the purchase cost of a product with the variable costs of production and not the total costs of manufacture. If the variable cost of production is more than the purchase cost then the company should buy the product or else make it in house.
3. **Subcontracting decision:** We should compare the variable cost of production with the subcontracting cost and make the decision on the subcontracting. If the variable cost of production is more than the subcontracting cost then the company should subcontract the part or else make it in house
4. In order to solve these type of problems prepare statement of comparative cost showing manufacturing cost and purchase cost. (Only the relevant costs should be mentioned in these statements)

Limiting factor in subcontracting decision or make vs. buy decision:

Particulars	A	B	C	D
Variable Manufacturing cost				
Less: Purchase cost				
Saving in manufacturing (A)				
Units of limiting factor per unit (B)				
Saving per unit of limiting factor (A/B)				
Ranking				

Chapter 3: Pricing Decisions**Pricing Decision:**

- ❖ A pricing decision is one of the **most crucial & difficult** decision that a firm has to make. Such a decision **affects the long-term survival** of any profit oriented enterprise
- ❖ Firms can fix the **price based on cost information by adding a suitable profit margin**. In other cases an established market prices is accepted
- ❖ Pricing policy are based on the objectives of an organization and the same could be either to **maximize profit/sales/output/utilization of resources**

Theory of Price:

- ❖ One of the basic assumption of pricing theory is that **firm's main objective is to maximize profits**. Optimum price is the one which yields the maximum profits.
- ❖ Firm should also take into account the position of **demand and cost functions while fixing on the price**
- ❖ If a firm sells unlimited number of units, total revenue will be a straight line arrived at by $TR = mx$; TR = Total revenue line; m = Quantity of units sold; x = Price per unit
- ❖ However in market situations, **additional units can be solved only by reducing the price**. This would mean that although total sales will increase as more and more units are sold, the increase in total revenue will gradually decrease
- ❖ Company can **identify the optimum price by finding a level at which Marginal revenue is equal to Marginal cost**. Any attempts of increasing the output beyond this level will lead to reduction in profits

Profit Maximization Model:

- ❖ Profit is said to be **maximum at a level of output where Marginal revenue (MR) is equal to Marginal cost (MC)**
- ❖ Basic price equation which is used to determine the price at which profit is maximum is given below:

$$P = a - bQ$$

Where P = Price; b = Slope of demand curve [Change in Price/Change in Quantity]; Q = Quantity demanded; a = Price at which demand is zero

- ❖ Marginal revenue equation = $a - 2bQ$
- ❖ **Marginal cost is equated with Marginal revenue to identify the optimum quantity and based on that optimum price is derived**

Pricing under different market structures:**Perfect competition:**

- ❖ Under perfect competitive market, there are **large number of sellers selling a homogenous product using identical production process** and all of them have perfect competition about the market and price
- ❖ Perfect market allows **free entry and exit of firms** into and out the industry
- ❖ There is no pricing policy under this market and the firms have to be price takers
- ❖ **Under this market the Total revenue will be a straight line but the marginal cost will increase with every level of output**. Hence company should continue to produce and sell as long as marginal cost is lower than marginal revenue

Monopoly:

- ❖ Monopoly is a market condition where **there is only one supplier or producer of a homogenous product** for which there is no close substitute but has many buyers
- ❖ Under this market, **a firm is a price setter**. It **can fix any price but it has to take into account elasticity of demand** and fix a price at which it can make maximum profits

Monopolistic competition:

- ❖ Under monopolistic competition **there are large number of firms producing similar but no identical products**. Since there is a limit to the growth of competitors the excess profit earned by monopolistic situation attracts new competition
- ❖ **Under monopolistic competition consumers may buy more at a lower price than at higher price**. The profit may be maximized by equating marginal revenue with marginal cost

Oligopoly:

- ❖ A market structure **where there are few firms producing or selling homogenous or identical product**
- ❖ In this type of market structure the firms are aware of the mutual interdependence of investment, production process, advertising and sales plan of its rival firm
- ❖ **In this market, the price is determined not only based on demand but also the reactions of the other firms in the industry to any action or decision it may take**
- ❖ Following price strategies can be used in this market:
 - **Predatory Pricing** – Keep price artificially low which is below full cost of production
 - **Limit-pricing strategy** – This can be used to discourage entrants
 - **Cost-plus pricing**
 - **Players can collude and raise price together**, but this can attract new entrants

Pricing Policy:

- ❖ Pricing policy plays an important role in a business because the **long run survival of a business depends upon the firm's ability to increase its sales** and derive maximum profit from the existing and new capital investment
- ❖ Although **cost is an important aspect of pricing, consumer demand and competitive environment are far more significant** in pricing decisions
- ❖ Pricing policy should ensure the following:
 - **Provide an incentive for adopting improved technology** and maximizing production
 - **Work towards better balance** between demand and supply
 - Avoid adverse effects on the rest of the economy
 - Encourage optimum utilization of resources
 - Promote export

Principles of Product Pricing:

Price customization: Pricing of a product is some **time customized keeping taste, preference and perceived value of a consumer into consideration**. Price customization is done in various ways:

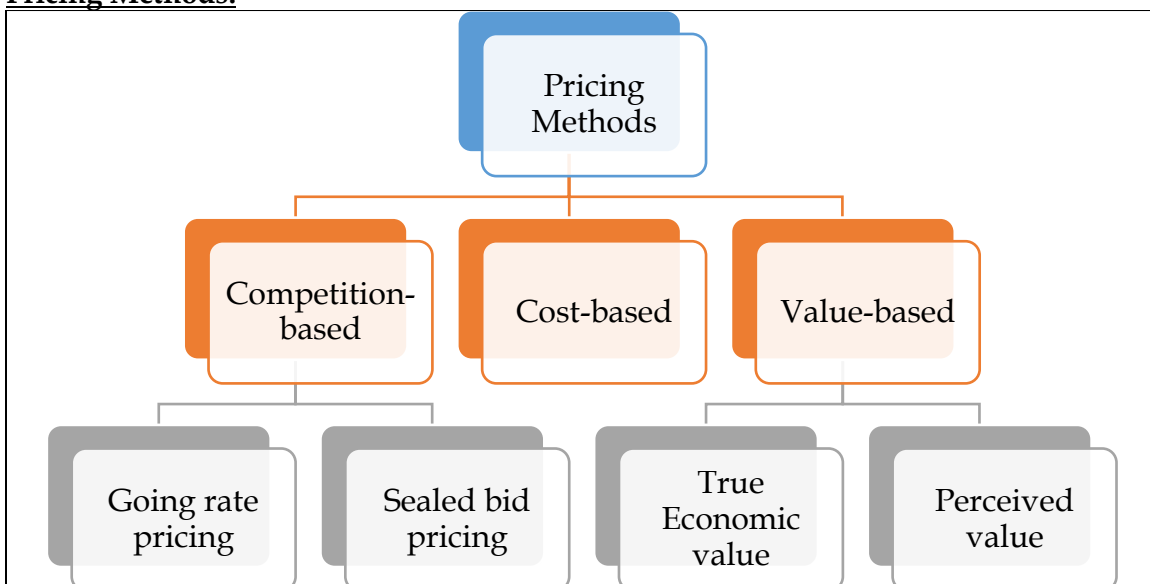
- ❖ **Based on Product Line:** Pricing can be different for a phone having 16GB memory as compared to a phone having 32GB memory
- ❖ **Based on customer's past behavior:** Customer with good payment track record can be given more discounts as compared to others

- ❖ **Based on demographics:** Different pricing can be based on age and social status. Example: Railway concession can be given for senior citizens and military personnel
- ❖ **Based on time differential:** Pricing for a product or service is also done on the basis of time differential i.e. different price for different time period

Price sensitivity: It measures the customer's behavior to change in price of a product. Sensitivity of the product can be measured through controlled experimentation wherein customers are offered different brands at different prices and customer's responses are obtained. Then the company change the price of its product and assess the consumption pattern. The price at which the demand for the product starts declining is the level where price sensitivity begins and based on the response level, sensitivity can be measured. Following are the nine factors which can impact price sensitivity:

- ❖ **Unique value effect** – More unique the product lower is price sensitivity
- ❖ **Substitute awareness effect** – High sensitivity if the buyers are aware of close substitutes
- ❖ **Difficult comparison effect** – Price sensitivity will be low if the buyers have difficulty in comparing two alternatives
- ❖ **Total expenditure effect** – If the expenditure is a very low proportion of total expenditure then price sensitivity will be less
- ❖ **End-benefit effect** – Buyers are less price sensitive where the expenditure on the product is low compared to total cost of the end product
- ❖ **Shared cost effect** – If the cost of the product is shared by another party, the buyer will have less prone to price sensitivity
- ❖ **Sunk investment effect** – Price sensitivity is low when products are used along with assets previously bought
- ❖ **Price quality effect** – Higher the perceived quality of the product, lower the price sensitivity
- ❖ **Inventory effect** – If the product cannot be stored, the buyer will be less price sensitive

Pricing Methods:



Cost-based pricing method:

- ❖ This is the most commonly used method wherein the company estimates the cost of the product & fix a margin of profit

- ❖ The term **cost would mean full cost** and include all fixed costs, allocated costs, labour costs among others
- ❖ Pricing based on total costs is subject to the following limitations:
 - **Allocation of inter-departmental overheads** is based on arbitrary basis and
 - **Allocation of overheads will require estimation of normal output** which often cannot be done precisely
- ❖ In order to avoid these two limitations firms can fix the price by adding **a suitable markup to variable costs**. The markup should cover the fixed cost and profit
- ❖ Sometimes instead of arbitrarily adding a percentage on cost, **the firm can determine the mark-up on the basis of required rate of return on investment**

Competition based pricing methods: When a company sets its price **mainly on the consideration of what its competitors are charging**, its pricing policy under such a situation is called competitive pricing or competition-oriented pricing. The price under this system is altered **based on competitor's action and not based on own costs/demand**. Following are the different types of competitive pricing in practice:

Going Rate Pricing:

- ❖ It is a competitive pricing method under **which a firm tries to keep its price at the average level charged by the industry**
- ❖ Going rate pricing is especially useful where it is difficult to measure costs
- ❖ Going rate pricing can lead to fair return and the same would be least disruptive for industry's harmony
- ❖ Going rate pricing is suitable for highly competitive conditions in a homogenous product market (food, raw materials and textiles)
- ❖ Going rate pricing is used in pure oligopoly wherein a few large concerns dominate the industry and hence the players have to fix price based on what the competitors charge

Sealed-bid pricing:

- ❖ **Competitive pricing also dominates in those situations where firms compete on the basis of bids, such as original equipment manufacturer and defense contract work**
- ❖ Bid is the firm's offer price and is a prime example of fixing the price based on how competitors will price rather than on a rigid relation based on concern's own costs or demand

Value-based Pricing Methods: There is an increasing trend to price the product on the basis of customer's perception of its value. This method helps the firm in reducing the threat of price wars. It is based on:

Objective value or true economic value:

- ❖ **This is a measure of benefits that a product is intended to deliver to the consumers relative to the other products without giving any regard whether consumer can recognize the benefits or not**
- ❖ **True Economic value = Cost of the next best alternative + Value of Performance differential**
- ❖ Cost of the next best alternative is the price of the competitors whereas value of performance differential is the value of additional features provided by a seller of a product

Perceived value:

- ❖ **This is the value that consumer understands the product deliver to it.** It is the price of a product that a consumer is willing to spend to have that product
- ❖ **Fixing the price below perceived value but above cost of production can be a win-win situation for both buyer and seller. Buyer's benefit = Perceived value - Price; Seller's benefit = Price - Cost of production**
- ❖ A firm focuses on creating value for its customers. The value can be created using the following strategies:
 - It should develop a product that satisfy the wants and needs of the customers
 - After identification and development, it should design a promotion program to convey the value of the products to the customers
 - Choosing the right distribution channel through which its product will reach to the customers
 - Design a pricing strategy that creates incentive to purchaser to buy the product and to seller to sell the product

Pricing in periods of recession: In periods of recession a firm may sell its articles at a price less than the total cost but above the marginal cost for a limited period. The advantage of this practice are:

- ❖ Firm can **continue to produce and use the services of skilled employees** who are well trained and will be difficult to re-employ later if discharged
- ❖ **Plant and machinery can be prevented from deterioration** through idleness
- ❖ Business would be ready to take **advantage of improved business conditions**
- ❖ **Avoids competition** of securing the business of the firm

Pricing below marginal cost: Firm may also be justifiable to sell the product at a price below marginal cost for a limited period provided the following conditions prevail:

- ❖ Where materials are of **perishable nature**
- ❖ Where stocks **have been accumulated in large quantities** and the market prices have fallen. This will save the cost of carrying stocks
- ❖ To **popularize a new product**
- ❖ Where such reduction **enables the firm to boost the sales of other products having larger profit margin**

Strategic pricing of new products: Pricing of a new product poses a bigger problem because of the **uncertainty involved in the estimation of the demand**. Pricing of a new product is very critical issue which should be decided after a thorough market study and consumer behavior analysis. A new product is analyzed into three categories for the purpose of pricing:

- ❖ **Revolutionary Product:** A product is said to be revolutionary when it **is new for the market and has the potential to create its own value**. This type of product has revolutionary impact on the market and consumer behavior. Revolutionary product may enjoy the premium price as a reward for its innovation and taking first initiative
- ❖ **Evolutionary Product:** A product introduced **with upgraded version with few additional characteristics of the product is known as evolutionary product**. Evolutionary product may be priced taking cost-benefit, competitor and demand for the product
- ❖ **Me-too product:** A product is said to be **me-too product when its emergence is a result of the success of a revolutionary product**. These type of products are very similar to revolutionary and/or evolutionary products of other firms. The me-too

products are price takers as the price is determined by the market mainly by the competitive prices

Market entry strategies:

Skimming Pricing: It is a **policy of high prices during the early period** of product's existence. This can be synchronized with high promotional expenditure and in later years the prices can be gradually reduced. The reasons for following such policy are:

- ❖ Demand is likely to be **inelastic**
- ❖ Charge of high price in the initial period **serves the cream of the market that is relatively insensitive to price**
- ❖ Method is preferred in the beginning because in the initial periods when the demand for the product is not known **the price can cover the initial cost of production**
- ❖ **High initial capital outlays and high promotional advertising expenditure** is incurred in the beginning. Hence it is necessary to charge high prices

Penetration pricing: It is **a policy in favor of using a low price as the principal instrument for penetrating mass markets early**. It is opposite to skimming price. Penetration pricing is to be distinguished from predatory pricing. Predatory pricing is the practice of selling a product or service at a very low price, intending to drive competitors out of the market. Following are the circumstances under which penetration pricing can be used:

- ❖ Demand is said to be **elastic**
- ❖ Substantial savings due to **large scale production**
- ❖ When there is a **threat of competition**. Prices fixed at a low level becomes an entry barrier

Pricing and Product Cycle:

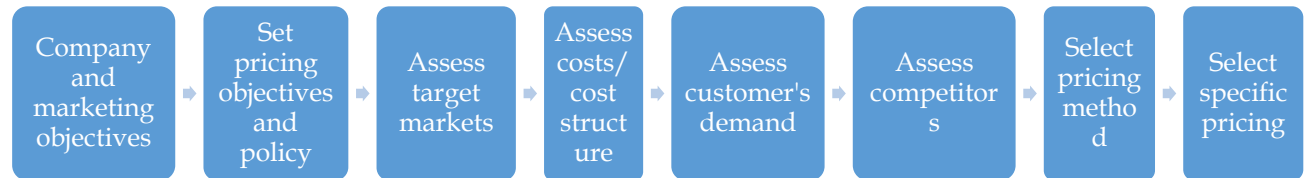
Introduction Stage	Growth Stage	Maturity Stage	Decline stage
Skimming policy with high prices, but low profit margin due to high fixed costs	Reduce price to penetrate market further	Price to match or beat competitor	Cut price if not repositioning
Penetration pricing to enter the market and gain a high share quickly or to prevent competitors from entering		Retain higher prices in some market segments	Some increases in price may occur in the late decline stage

Price adjustment policies: **These are tools to change the prices for various customer differences** and changing situations.

- ❖ **Distributor's discounts:** It means price deductions that systematically make the net price vary according to buyer's position in the chain of distribution. Discounts vary on the basis of marketing functions (wholesaler, retailer, dealer) performed by them different prices for different customers and hence are also called as functional discounts
- ❖ **Quantity discounts:** Quantity discounts are price reductions related to the quantities purchased. This can be based on quantity per order or value of purchases
- ❖ **Cash discounts:** Cash discounts are price reductions based on promptness of payment. It is a convenient device to identify and overcome bad credit risks
- ❖ **Price discrimination:** Price discrimination means charging different prices and it takes various forms according to whether the basis is customer, product, place or time. Price discrimination is possible if following conditions are satisfied:
 - Maker must be capable of being segmented for price discrimination

- Customer should not be able to resell the product of the segment paying higher price
- Change of competitor's underselling in the segment of higher prices should not be possible
- ❖ **Geographic Pricing:** Seller should consider the cost of shipping goods to the buyer and hence the pricing can vary based on geography due to the freight costs

Structured approach to pricing decisions:



Sensitivity analysis in pricing decisions:

- ❖ Sensitivity analysis is **very significant in making pricing decisions, and striking the right balance in which the price is good-looking enough to generate enough sales, yet also profitable for the firm**
- ❖ Sensitivity analysis can also be used in determining how much can be spent on development or marketing
- ❖ **Product pricing decisions must be balanced against cost and competitive market conditions.** Sensitivity analysis is required to determine how sales and costs will respond to changes in the market conditions
- ❖ Sensitivity analysis is performed by **choosing the critical parameters upon which the proforma computations are done and systematically changing them to assess how the changes will impact the overall outcome.** This analysis is important towards understanding how the company will withstand external changes
- ❖ Sensitivity analysis can be based on market demand, changes in market price, exchange rate fluctuation, Initial outlay, R&D, Production cost, Marketing costs, Introduction dates, product prices among others

Pareto Analysis:

- ❖ Pareto Analysis is a rule that recommends focus on the most important aspects of the decision making in order to simplify the process of decision making.
- ❖ It is based on the 80:20 rule or 70:30 rule. The management can use it in a number of different circumstances to direct management attention to the key control mechanism or planning aspects. It helps to clearly establish top priorities and to identify both profitable and unprofitable targets

Usefulness of Pareto Analysis:

- ❖ Prioritize problems, goals and objectives to identify root causes
- ❖ Select and define key quality improvement programs.
- ❖ Select key customer relations and service programs.
- ❖ Select key employee relations improvement programs.
- ❖ Select and define key performance improvement programs.
- ❖ Allocate physical, financial and human resources

Application of Pareto Analysis:

- ❖ **Pricing of a product:** In the case of a firm having multiple products, 20% of the products may account for 80% of the revenues. Pareto Analysis can help in focusing management's attention to 20 percent of the products and the pricing decision for balance 80% of its products can be delegated to lower levels of management
- ❖ **Customer profitability analysis:** Instead of analyzing products, customers can be analyzed for their relative profitability to the organization. Again here it has been observed that 20% of the customers would contribute to 80 percent of the profits and hence Pareto analysis can help in finding the target customers and focusing on them
- ❖ **ABC analysis - Stock control:** Pareto Analysis can also be used in stock control wherein it has been observed that only a few goods in stock make up for most of the value
- ❖ **Application in Activity Based costing:** 20% of the organization cost drivers are responsible for 80% of the total cost. Companies can focus on major cost drivers for better cost management
- ❖ **Quality control:** Pareto analysis seeks to discover from an analysis of defect report or customer complaints which "vital few" causes are responsible for most of the reported problems. By concentrating once efforts on rectifying the vital 20%, one can have the greatest immediate impact on product quality. The purpose of the analysis is to direct management attention to the area where the best returns can be achieved by solving most of quality problems, perhaps just with a single action.

Chapter 4 – Budget & Budgetary Control**Strategic Planning, Budgetary Planning and Operational Planning:**

- ❖ **Strategic Planning:** Strategic planning is concerned with preparing long-term action plans to attain the organization's objectives by considering the changes at horizon
- ❖ **Budgetary Planning:** Budgetary planning is mainly concerned with preparing the short to medium term plan of the organisation. It will be carried out within the framework of the strategic plan as already set
- ❖ **Operational planning:** It concerns with the short-term or day-to-day planning process. It plans the utilisation of resources and will be carried out within the framework of the budget

Preparation of budgets: The process of preparation of budgets differ from organization to organization. However following are the key requirements of budgeting:

- ❖ **Co-ordination:** Budgets provide a means of co-ordination of the business as a whole. In the process of establishing budgets, the various factors like production capacity, sales possibilities, and procurement of material, labour, etc. are balanced and co-ordinates so that all the activities proceed according to the objective. For this purpose a budget committee is formed which includes all the departmental heads together to solve a common problem
- ❖ **Budget Manual:** Effective budgetary planning relies on the provision of adequate information to the individuals involved in the planning process. Many of these information needs are contained in the budget manual. A budget manual is a collection of documents that contains key information for those involved in the planning process.
- ❖ **Identification of the 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. Alternatively, machine capacity may be limited for the forthcoming period and therefore machine capacity is the principal budget factor.

Zero base budgeting:

- ❖ ZBB is defined as 'a method of budgeting which requires each cost element to be specifically justified, as though the activities to which the budget relates were being undertaken for the first time. Without approval, the budget allowance is zero'
- ❖ Zero - base budgeting is so called because it requires each budget to be prepared and justified from zero, instead of simple using last year's budget as a base.

Characteristics of Zero-base budgeting:

- ❖ Manager of a decision unit has to completely justify why there should be at all any budget allotment for his decision unit. This justification is to be made a fresh without making reference to previous level of spending in his department.
- ❖ Activities are identified in decision packages.
- ❖ Decision packages are ranked in order of priority.
- ❖ Packages are evaluated by systematic analysis.

- ❖ Under this approach there exist a frank relationship between superior and subordinates.
- ❖ Management agrees to fund for a specified service and manager decision of the decision unit clearly accepts to deliver the service.
- ❖ Decision packages are linked with corporate objectives, which are clearly laid down.
- ❖ Available resources are directed towards alternatives in order of priority to ensure optimum results.

Performance Budgeting:

- ❖ Performance Budgeting provide a meaningful relationship between estimated inputs and expected outputs as an integral part of the budgeting system.
- ❖ 'A performance budget is onewhich presents the purposes and objectives for which funds are required, the costs of the programmes proposed for achieving those objectives, and quantities data measuring the accomplishments and work performed under each programme.
- ❖ Thus PB is a technique of presenting budgets for costs and revenues in terms of functions (**objectives**). Programmes and activities are correlating the physical and financial aspect of the individual items comprising the budget.

Chapter 5: Standard Costing**Introduction:**

1. Standard costing system reconciles budgeted profit and actual profit
2. Standard costing is also known as variance analysis because it analyzes the cost and sales variances into various components and fixes up the responsibility for variances
3. The variance is analyzed as:
 - a. Sales Variances
 - b. Cost variances
 - i. Material cost variances
 - ii. Labour cost variances
 - iii. Overhead cost variances
 1. Variable overhead variances
 2. Fixed Overhead Variances
4. If a variance increases actual profit it is called "favorable" (F) and if it decreases actual profits it is called "adverse" (A)

Understanding different costs:

1. Budgeted cost refers to the cost to be incurred for the budgeted output
2. Standard cost refers to the allowable cost for the actual output. In short standard cost is nothing but budgeted cost flexed to actual output.
3. Actual cost refers to the cost incurred by the company in producing the output
4. Cost variance is the difference between standard cost and actual cost and not the budgeted and actual cost

Fill the following:

Budgeted output = 20000 units Standard cost p.u = 20 Actual output = 12000 units and Actual cost = 2,88,000

1. Budgeted cost =
2. Actual cost =
3. Standard cost =
4. Cost variance =

Material Variances:

1. In order to compute the material variances we require the following information
 - a. Standard Quantity - This is the budgeted quantity flexed for actual output
 - b. Revised standard quantity - This is the total of the actual quantity apportioned in the standard mix. This is applicable only when there is more than one material
 - c. Actual quantity - Actual quantity used and this is normally directly given in the problem
 - d. Standard price - This is the budgeted price to be paid for procuring the material
 - e. Actual price - This refers to the actual price paid for procuring the raw materials
2. The objective of variance analysis is to fix responsibility and take corrective action wherever required. They are attention seekers rather than the problem solvers
3. Material variances compute the difference between the standard material cost and the actual material cost and fix the responsibility for the variances. The variance can either occur on account of quantity or price variances

Computation table for Material Variances calculation:

SP * SQ	SP * RSQ	SP * AQ	AP * AQ
Standard material cost			Actual Material cost

Note: In case there is only one material SP* RSQ is not to be computed as there cannot be mix variance and the variance computed are only cost, price and usage variance

Types of problems under material variances:

- Single material
- Multiple material

Labour Variances:

- In order to compute the labour variances we require the following information
 - Standard Hours – This is the budgeted hours flexed for actual output
 - Revised standard hours – This is the total of the actual hours worked (**not actual hours paid**) apportioned in the standard mix. This is applicable only when there is more than one grade of labour
 - Actual hours worked – This refers to the number of hours actually worked.
AHW = Actual hours paid – Idle time
 - Actual Hours paid – This refers to the number of hours for which the company is paying. Actual hours worked and actual hours paid are different only when there is idle time because idle time refer to hours paid but not worked
 - Standard rate – This is the budgeted rate to be paid to the labour
 - Actual rate – This refers to the actual rate paid for using the labour
- Labour variances compute the difference between the standard labour cost and the actual labour cost and fix the responsibility for the variances. The variance can either occur on account of efficiency or rate variances

Computation table for labour Variances:

SR * SH	SR * RSH	SR * AHW	SR * AHP	AR * AHP
Standard labour cost				Actual labour cost

Types of problems under labour variances:

- Single labour without idle time (Column 2 & Column 4 are not applicable)
- Single labour with idle time (Column 2 is not applicable)
- Multiple labour without idle time (Column 4 is not applicable)
- Multiple labour with idle time (All columns are applicable)

Variable overhead Variances:

- In order to compute the Variable OH variances we require the following information
 - Standard Hours – This is the budgeted hours flexed for actual output
 - Actual Hours– This refers to the number of hours actually worked. It does not include idle time as it is assumed that the company does not incur variable overheads during idle time

- c. Standard rate per hour – This is the budgeted rate to be incurred every hour and is calculated by dividing the budgeted hours from budgeted variable overheads. {SR. per hour = Budgeted VOH / BH}
- d. Actual rate per hour – This refers to the actual rate incurred on variable overheads
2. VOH variances compute the difference between the standard VOH cost and the actual VOH cost and fix the responsibility for the variances. The variance can either occur on account of efficiency or rate variances

Computation table for VOH Variances:

SR * SH	SR * AH	AR * AH
Standard VOH cost		Actual VOH Cost

Conversion factor when information on output is given but hours not directly available:

- $SR/\text{per hour} * SH = SR/\text{per unit} * AO$
- $SR/\text{per hour} * AH = SR/\text{per unit} * SO$

Note:

- $SR/\text{per unit} = \text{Budgeted VOH} / \text{Budgeted units}$
- **Logic behind conversion:** The standard hours are always calculated with the help of the actual output and hence they standard hours are equated to actual output.

Fixed overhead Variances:

1. In order to compute the Fixed OH variances we require the following information
 - a. Actual output or standard hours
 - b. Actual Hours or standard output
 - c. Standard rate per hour – This is the budgeted rate to be incurred every hour and is calculated by dividing the budgeted hours from budgeted variable overheads. {SR. per hour = Budgeted FOH / BH}
 - d. Actual rate per hour – This refers to the actual rate incurred on fixed overheads
 - e. Possible FOH = BFOH * AD/BD

Computation table for FOH Variances:

AO * SR	AFOH	BFOH	AH * SR	PFOH
FOH absorbed	FOH incurred			

FOH ratios:

1. Volume or activity ratio = $\text{Standard hours} / \text{Budgeted hours} * 100$
2. Efficiency ratio = $\text{Standard hours} / \text{actual hours} * 100$
3. Capacity ratio = $\text{Actual hours} / \text{Possible hours} * 100$
4. Calendar ratio = $\text{Possible hours} / \text{Budgeted hours} * 100$

Sales Variances:

1. In order to compute the sales variances we require the following information
 - a. Budgeted Quantity – This is the budgeted quantity expected to be sold at the beginning of the period
 - b. Revised budgeted quantity – This is the total of the actual quantity apportioned in the standard mix. This is applicable only when there is more than one material

- c. Actual quantity – Actual quantity sold and this is normally directly given in the problem
- d. Budgeted price – This is the price at which the product was expected to be sold at the beginning of the period
- e. Actual price – This refers to the price at which the products are actually sold.

Computation table for Sales Variances calculation:

BP * BQ	BP * RBQ	BP * AQ	AP * AQ
Budgeted sales			Actual sales

Note: In case there is only one material BP* RBQ is not to be computed as there cannot be mix variance and the variance computed are only total sales, price and volume variance

Margin approach:

The above indicated method is called as total approach which finds out the impact on the topline and margin approach is used to find the impact on the bottom-line. Here BP is replaced with BM and AP is replaced with AM and the calculation for BM and AM is provided below:

- Absorption costing: $BM = SP - SC$ & $AM = AP - SC$ (not actual cost)
- Marginal costing: $BM = SP - SVC$ & $AM = AP - SVC$ (not actual VC)

Marginal Costing vs. absorption costing:

1. Stocks are valued at cost and those costs that are considered for stock valuation are called product costs and others are called period costs.
2. Period costs expires fully in the current accounting period whereas product cost expires only to the extent of COGS; and remains unexpired to the extent of closing stock (i.e.) credited in this year's account and carried forward to the next year
3. All non-manufacturing costs are period costs and in marginal costing system fixed manufacturing costs is also called period costs.
4. In Marginal costing system stock is valued at variable manufacturing cost whereas in absorption costing system, stock is valued at full manufacturing cost (including fixed manufacturing cost)
5. For calculating fixed cost per unit absorption costing system uses pre-determined rates or standard rates. Pre-determined rate / unit = BFO/BO. For denominator consider normal activity or capacity. In absence of details use 100% capacity as denominator
6. Due to use of pre-determined rates the fixed OH charged to cost or production will be $AO * SR$. This is called absorbed OH.
7. When the actual OH is different from absorbed OH we would have under/over absorption which needs to be adjusted while calculating absorption costing profit.
8. In absence of info we can assume BFOH to be same as AFOH.

Income statement under marginal costing:

Particulars	Amount
Sales	XXX
Less: Variable manufacturing cost of goods sold:	
- Opening stock (VMC) XXX	
- Add: Variable cost of production XXX	
- Less: Closing stock (VMC) (XXX)	(XXX)
Gross contribution	XXX

Less: Variable administration and selling OH	(XXX)
Contribution	XXX
Less: Fixed manufacturing, admin & selling exp	(XXX)
Profit	XXX

Income statement under absorption costing:

Particulars	Amount
Sales	XXX
Less: COGS	
- Opening stock (FMC) XXX	
- Add: Cost of production XXX	
- Less: Closing stock (FMC) (XXX)	(XXX)
Gross Profit	XXX
Less: Admin & selling exp	(XXX)
Less: Under/over absorption of OH	(XXX)
Profit	XXX

Reconciliation:

1. Reconciliation statement is prepared in order to reconcile the budgeted profit as against the actual profit earned by the company
2. Following are the various approaches for profit reconciliation:
 - a. Budgeted profit to actual profit – Absorption costing system
 - b. Standard profit to actual profit – Absorption costing system
 - c. Budgeted profit to actual profit – Marginal costing system
 - d. Standard profit to actual profit – Marginal costing system

Reconciliation statement under various approaches:**Budgeted profit to actual profit – Absorption costing system**

Particulars	Amount Favorable variance	Amount Adverse variance	Amount
Budgeted profit			XXX
Material price variance	XXX	XXX	
Material mix variance	XXX	XXX	
Material yield variance	XXX	XXX	
Labour rate variance	XXX	XXX	
Labour mix variance	XXX	XXX	
Labour revised eff. Variance	XXX	XXX	
VO Expenditure variance	XXX	XXX	
VO Efficiency variance	XXX	XXX	
FO Expenditure variance	XXX	XXX	
FO Capacity variance	XXX	XXX	
FO calendar variance	XXX	XXX	
FO Efficiency variance	XXX	XXX	
Sales Margin price variance	XXX	XXX	
Sales Margin qty variance	XXX	XXX	
Sales Margin mix variance	XXX	XXX	
Actual profit			XXX

Standard profit to actual profit – Absorption costing system

Particulars	Amount	Amount	Amount

	<u>Favorable variance</u>	<u>Adverse variance</u>	
Budgeted profit			XXX
Less: Sales volume variance			XXX
Standard profit			XXX
Material price variance	XXX	XXX	
Material mix variance	XXX	XXX	
Material yield variance	XXX	XXX	
Labour rate variance	XXX	XXX	
Labour mix variance	XXX	XXX	
Labour revised eff. Variance	XXX	XXX	
VO Expenditure variance	XXX	XXX	
VO Efficiency variance	XXX	XXX	
FO Expenditure variance	XXX	XXX	
FO Capacity variance	XXX	XXX	
FO calendar variance	XXX	XXX	
FO Efficiency variance	XXX	XXX	
Sales Margin price variance	XXX	XXX	
Sales Margin qty variance	NA	NA	
Sales Margin mix variance	NA	NA	
Actual profit			XXX

Budgeted profit to actual profit - Marginal costing system

<u>Particulars</u>	<u>Amount</u> <u>Favorable variance</u>	<u>Amount</u> <u>Adverse variance</u>	<u>Amount</u>
Budgeted profit			XXX
Material price variance	XXX	XXX	
Material mix variance	XXX	XXX	
Material yield variance	XXX	XXX	
Labour rate variance	XXX	XXX	
Labour mix variance	XXX	XXX	
Labour revised eff. Variance	XXX	XXX	
VO Expenditure variance	XXX	XXX	
VO Efficiency variance	XXX	XXX	
FO Expenditure variance	XXX	XXX	
FO Capacity variance	NA	NA	
FO calendar variance	NA	NA	
FO Efficiency variance	NA	NA	
Sales Margin price variance	XXX	XXX	
Sales Margin qty variance	XXX	XXX	
Sales Margin mix variance	XXX	XXX	
Actual profit			XXX

Standard profit to actual profit - Marginal costing system

<u>Particulars</u>	<u>Amount</u> <u>Favorable variance</u>	<u>Amount</u> <u>Adverse variance</u>	<u>Amount</u>
Budgeted profit			XXX
Less: Sales volume variance			XXX
Standard profit			XXX
Material price variance	XXX	XXX	

Material mix variance	XXX	XXX	
Material yield variance	XXX	XXX	
Labour rate variance	XXX	XXX	
Labour mix variance	XXX	XXX	
Labour revised eff. Variance	XXX	XXX	
VO Expenditure variance	XXX	XXX	
VO Efficiency variance	XXX	XXX	
FO Expenditure variance	XXX	XXX	
FO Capacity variance	NA	NA	
FO calendar variance	NA	NA	
FO Efficiency variance	NA	NA	
Sales Margin price variance	XXX	XXX	
Sales Margin qty variance	NA	NA	
Sales Margin mix variance	NA	NA	
Actual profit			XXX

Few equations between various variances:

1. **Absorption costing approach:** Sales Margin volume variance = Total sales volume variance * NP Ratio
2. **Marginal costing approach:** Sales margin volume variance = Total sales volume variance * PVR
3. **Marginal costing approach:** Sales margin volume variance = Sales margin volume variance under absorption costing + FOH Volume variance
4. Budgeted profit under absorption costing = Budgeted units * Budgeted profit per unit
5. Standard profit under absorption costing = Actual units * Budgeted profit per unit
6. Budgeted profit under marginal costing = Budgeted units * Budgeted cont. per unit - Budgeted Fixed Overheads
7. Standard profit under marginal costing = Actual units * Budgeted cont. per unit - Budgeted Fixed overheads

Partial plan vs. single plan of recognizing variances:

Partial Plan	Single Plan
Raw material stock valued at actual cost and WIP and FG valued at standard cost	All the 3 stocks are valued at standard cost
WIP account debited with actual cost	WIP account debited with standard cost
All variances originate from WIP accounts	All variances originate from their respective accounts
Material price variance computed at the time of consumptions	Material purchase price variance computed at the time of purchase
AQ for price variance means AQ consumed	AQ for price variance means AQ purchased

Single Plan and partial plan accounting:

- In partial plan accounting the WIP is first debited with actual cost and thereafter the variance are debited or credited. When the variances are adjusted the WIP value is brought to the standard cost.
- In single plan accounting the WIP is debited with the standard cost and the variances are adjusted in the respective ledger accounts.

Journal Entries (all entries are made assuming adverse variances. In case the variance is favorable then it will be the reverse entry)

Transaction	Single	Partial
Purchase of RM	RM Control A/c MPV A/C To GL Adjustment A/c	RM Control A/c To GL Adjustment A/c
Issue of raw material to stores	WIP Control A/c MUV A/c To RM Control A/c	WIP Control A/c To RM Control A/c
Recognition of MPV and MUV	Already recognized	MPV A/c MUV A/c To WIP Control A/c
Disposal of MPV and MUV	Costing P & L A/c To MPV A/c To MUV A/c	Costing P & L A/c To MPV A/c To MUV A/c
Payment of wages	Wages control A/c LRV A/c To GL Adjustment A/c	Wages control A/c To GL Adjustment A/c
Transfer of wages to WIP	WIP Control A/c LEV A/c To Wages Control A/c	WIP Control A/c To Wages Control A/c
Recognition of LRV and LEV	Already recognized	LRV A/c LEV A/c To WIP Control A/c
Disposal of LRV and LEV	Costing P& L A/c To LRV A/c To LEV A/c	Costing P& L A/c To LRV A/c To LEV A/c

Note: Similar entries are to be recorded for overheads

Planning and operating variances:

1. When the scenario at the time of implementing the budget has drastically changed as compared to the prevailing during budget preparation to properly measure the performance, the company should revise the budget.
2. The difference between the original and revised budget is called as PLANNING variances and the difference between the revised and actual is called as OPERATING variances.
3. The responsibility should be fixed only for the operating variances.
4. While calculating planning variances, standard means original budget and actual means revised budget; For operating variances standard means revised budget and actual means actual performances

Market size and share variance:

1. Market size variance measures the impact on the quantity sold due to change in the market size. It is similar to planning variance.
2. Market share variance measures the impact on the quantity sold due to change in the company's share in the overall market. It is similar to operating variance

Possible interdependence between variances: It is a term used to express the way in which the cause of one variance may be wholly or partially explained by the cause of another variance. For control purposes, it might therefore be essential to look at several

variances together and not in isolation. Some examples of interdependence of variances are listed below

- ❖ Use of cheaper material which is poorer quality, the material price variance will be favourable, but this can cause more wastage of materials leading to adverse usage variance.
- ❖ Using more skilled labour to do the work will result in an adverse labour rate variance, but productivity might be higher as a result due to experienced labour.
- ❖ Changing the composition of a team might result in a cheaper labour mix (favourable mix variance) but lower productivity (adverse yield variance).
- ❖ Workers trying to improve productivity (favourable efficiency variance) in order to get bonus (adverse rate variance) might use materials wastefully in order to save time (adverse materials usage).
- ❖ Cutting sales prices (adverse sales price variance) might result in higher sales demand from customers (favourable sales volume variance).
- ❖ Similarly, favourable sales price variance may result in adverse sales volume variance

Causes of variances:

Material Price Variance

- ❖ Might be caused due to the use of a different supplier.
- ❖ Order size can result in variance.
- ❖ Any form of unexpected increase in buying costs such as higher delivery charges.
- ❖ Efficiency or inefficiency associated with the buying procedure adopted.
- ❖ Lack of appropriate inventory control can result in emergency purchase of material resulting in adverse variance.

Material Usage Variance

- ❖ Purchase of inferior quality material.
- ❖ Implementation of better quality control.
- ❖ Increased efficiency in production can help in bringing down wastage rate.
- ❖ Changes made in the material mix.
- ❖ Careless way of handling material by production department.
- ❖ Change in method of production/ design.
- ❖ Pilferage of material from the production department.
- ❖ Poor inspection.

Labour Rate Variance

- ❖ Unexpected increase in the pay rate of labour.
- ❖ Level of experience of the labour can impact the direct cost of labour.
- ❖ Payment of bonuses added to the direct labour costs.
- ❖ Change in the composition of the workforce can impact direct labour costs.

Labour Efficiency Variance

- ❖ Improvement in work or productivity efficiency.
- ❖ Workforce mix can have an impact upon labour efficiency levels.
- ❖ Industrial action in relation to workforce.
- ❖ Poor supervision of the workforce.
- ❖ Learning curve effect upon the labour efficiency levels.
- ❖ Resource shortages causing an unexpected delay and lowering of labour efficiency levels.

- ❖ Using inferior quality of material.
- ❖ Introduction of new machinery resulting in improvement of labour productivity levels.

Overhead Variances

- ❖ Fixed Overhead Expenditure Variance (adverse) are caused by spending in excess of the budget.
- ❖ Fixed Overhead Volume Variance is caused by changes in production volume.
- ❖ Variable Overhead Expenditure Variance are often caused by changes in machine running costs.
- ❖ Variable Overhead Efficiency Variances- Causes are similar to those for a direct labour efficiency variance.

Sales Price Variance

- ❖ Higher discounts given to customers in order to encourage bulk purchases.
- ❖ The effect of low price offers during a marketing campaign.
- ❖ Poor performance by sales personnel.
- ❖ Market conditions or economic conditions forcing changes in prices across the industry.

Sales Volume Variance

- ❖ Successful or unsuccessful direct selling efforts.
- ❖ Successful or unsuccessful marketing efforts (for example, the effects of an advertising campaign).
- ❖ Unexpected changes in customer preferences and buying patterns.
- ❖ Failure to satisfy demand due to production difficulties.
- ❖ Higher demand due to a cut in selling prices, or lower demand due to an increase in sales prices.

Reporting of variances through variance reports:

Variance reports should give due regard to the following points :-

- ❖ The concerned executives should be informed about what the cost performance should have been.
- ❖ How close the actual cost performance is with reference to standard cost performance.
- ❖ The analysis and causes of variances.
- ❖ Reporting should be based on the principle of management by exception.
- ❖ The magnitude of variances should also be stated.

Behavioural issues:

- ❖ Variance analysis may encourage short-termism due to their inherent tendency towards short-term, quantified objectives and results.
- ❖ A negative perception of an organization's variance analysis process can also encourage other sub-optimal behaviour among employees such as attempts to include budget slacks.
- ❖ The behavioural issues connected with variance analysis could be managed by participating employees during budget setting so that they do not assess the procedure as biased. It is also vital for an organization's performance measurement system to be based on an extensive range of quantitative and qualitative measures so as to encourage management to adopt a long-term view that is aligned with an organization's strategic direction.

Chapter 6: Costing of Service Sector**Service Sector:**

- ❖ Service sector companies provide their customers with services or intangible products.
- ❖ The activities of service sector may be used for both: (i) Provision of services to outside customers (ii) Provision of services internally (i.e. captive consumption).
- ❖ The types of services that may be provided, by service sector are of diverse nature and have their own peculiarities and requirements in respect of the cost accounting treatment, however, the general principles of costing discussed in earlier chapters relating to manufacturing sector also apply to service sector.

Characteristics of service sector:

- ❖ Activities are labour intensive
- ❖ Cost-unit is difficult to define – Selection of cost unit is difficult to ascertain as compared to the selection of cost unit for the manufacturing sector. Some of the cost-units for different industries are provided as under:
 - School – Student hours, full time students
 - Hospital – Patient per day, room per day
 - Accounting firm – Charged out client hours
 - Transport – Passenger KM, Tonne KM
 - Staff canteen – Meals provided, no of staff
 - Machine maintenance – Maintenance hours
 - Computer department – Computer time

Costing methods used in service sector:

- ❖ Job costing method – Used for customized service. Example: Accountancy firms
- ❖ Process costing method – Cost is charged to masses of similar unit and then computing cost on an average basis. Example: Retail banking
- ❖ Operating costing method
- ❖ Hybrid costing method – Combination of multiple methods

Pricing of services

- ❖ When services are uniquely tailored to each customer's needs, the pricing cannot be easy. **Each service transaction is likely to have distinct pricing pressure**
- ❖ In certain services the customer's participation is essential. **Hence the customer may have to incur certain intangible costs over and above monetary cost while making use of the service.** The company should consider these intangible costs that a customer has to bear while fixing the price
- ❖ Some services like **education, healthcare, transport fall within the ambit of Government** and hence the price tends to be regulated
- ❖ Services pricing can **also be determined in a collective manner.** Trade association, professional bodies or other institutions may impose certain guidelines for fixing price

Chapter 7: Transfer Pricing**Transfer pricing:**

- ❖ Transfer pricing refers to the price charged by one division to another division. Divisions either could be departments within a company or a group companies of a parent organization
- ❖ Transfer pricing serves the following utilities:
 - Performance evaluation
 - Employee engagement and compensation
 - Resource allocation
 - Taxation and profit remittance

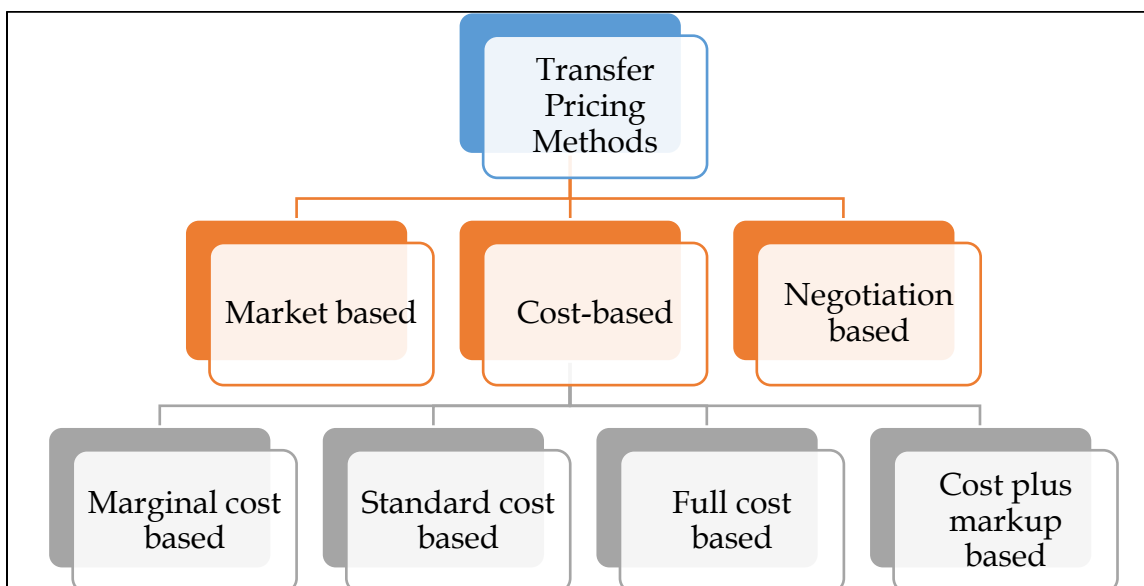
Transfer Pricing and Fair Value:

- ❖ Transfer Pricing is often associated with the term “arms-length” price. This implies that the price for inter-divisional transfer has to be fair and competent enough as if dealing with a third party
- ❖ Application of concept of arms-length price is more from taxation perspective
- ❖ Transfer pricing is revenue from one division and is a cost for other division. The companies should fix the transfer price in such a way that it is a good-deal for both divisions. Hence fair value depends on how each division finds the price compatible with its profit targets

Examples:

Division A produces goods at a cost of Rs.10 p.u. and transfers the goods to Division B which has additional costs of Rs.5 p.u. Division B sells externally at Rs.16 p.u. The company has a policy of setting transfer prices at cost + 20%.

- ❖ Profit of each division and the overall profit the company made.
- ❖ Write a brief analysis of the results.

**Market based transfer price:**

- ❖ Transfer price is based on market price of good or services adjusted for any costs that can be saved by internal transfer
- ❖ **Advantages:**
 - Unbiased,

- Less ambiguous and cannot be manipulated as compared to cost-plus method and
- Divisional performance can be measured objectively
- ❖ Disadvantages:
 - Market Price may not be completely unbiased due to distress sale scenario or manipulative pricing strategies,
 - Not suitable when market prices have wide fluctuation
 - Not suitable for intermediate goods

Shared profit relative to cost based transfer price:

- ❖ Shared profit relative to cost method is an alternative to market price method. In this method the profit of the organization is split on the basis of the amount of value addition by the processes
- ❖ Transfer Price = Cost of division + Profit based on value addition
- ❖ Profit of supplying division = (Cost of supplying division / Total costs) * Profit of company

Cost based transfer price:

- ❖ Cost based pricing models are based on internal cost records of the company. This method can be used when the information on market price is unavailable or if the management wants to benchmark division's performance based on cost targets
- ❖ Cost based transfer price may consider variable cost, standard cost, full cost and full cost plus mark-up
- ❖ **Advantages:**
 - Performance can be benchmarked against internal cost targets
 - Information is more readily available as compared to market price
- ❖ **Disadvantages:**
 - Cost basis on which transfer price is to be fixed can be subjective
 - Since cost is passed on to the next division, there will be little incentive for the supplying division to reduce costs

Method	Basis	Advantages	Disadvantages
Marginal cost based transfer price	TP is calculated based on margin cost (additional cost)	Useful when supplying division has spare capacity	No fixed cost or mark-up is allowed and hence supplying division will not have any incentive to do transfer
Standard cost based transfer price	TP is recorded based on pre-determined cost	Performance evaluation can be done against budgeted cost targets	Profit performance measurement is centralized and hence cannot be measured for individual divisions
Full cost based transfer price	TP is based on full cost of goods which will also include fixed costs	Full cost of goods is transferred and hence supplying division will not show loss	No mark-up is charged and hence supplying division will not have any incentive to do transfer as the transfer will not add to profit
Cost plus a mark-up based transfer	TP is based on full cost plus mark-up. Mark-up can be a percent of cost or	Supplying division makes profit and hence this addresses the disincentive	Under this method TP may be nearer to the market price. However there are cost savings on internal transfer

price	capital employed	problem of supplying division	and the same should be factored in while fixing TP

Negotiation based transfer price:

- ❖ Under this method managers of supplying and receiving division independently negotiate and arrive at a mutually agreeable transfer price
- ❖ **Advantage:** Managers are given full autonomy to decide whether to purchase from its sister unit or source from external market
- ❖ **Disadvantage:** Information on external market price, cost price, terms of trade etc. is required to negotiate a reasonable price

Transfer Pricing and Goal Congruence:

- ❖ Internal transfer pricing develops a competitive setting for managers of each division, it is possible that they may operate in the best interest of individual performance. This can lead to sub-optimal capacity utilization of resources
- ❖ Transfer pricing policy may be established to promote goal congruence and the same is presented below:

Minimum Transfer Price (determined by supplying division)	❖ Additional outlay cost per unit + Opportunity cost per unit ❖ Additional outlay cost = Marginal cost + Any additional costs incurred by the supplying division ❖ Opportunity cost = Benefit foregone
Maximum Transfer Price (determined by receiving division)	❖ Lower of Net Marginal Revenue and external purchase price (adjusted for saving/increase in costs) ❖ Net Marginal Revenue = Marginal revenue - Marginal cost of purchasing division

Transfer Pricing Decision under different circumstances:

Supplying division has excess capacity	❖ Minimum Transfer Price = Marginal cost per unit ❖ Maximum Transfer Price = Lower of Net Marginal Revenue and external purchase price
Supplying division operating at full capacity	❖ Minimum Transfer Price = Marginal cost per unit + Opportunity cost per unit ❖ Maximum Transfer Price = Lower of Net Marginal Revenue and external purchase price

Proposal for resolving transfer pricing conflict:

Conflict of interest between interests of individual divisions and the company can also be addressed by following the following systems for transfer pricing:

- ❖ **Dual Rate Transfer Pricing System:** Supplying division can record transfer price by including a normal profit margin whereas purchasing division will record the same at cost. This will allow for better evaluation of each division's performance and can promote goal congruence. However this can complicate the accounting records and it will lead to scenario of showing artificial profits which can be used only for internal evaluation
- ❖ **Two part transfer pricing system:** Under this method transfer price is equal to marginal cost of production + Lump-sum charge (two parts to pricing). Under this method, supplying division will be able to recover entire marginal cost and the lump-sum portion will contribute to recovery of fixed cost. Similarly the purchasing division can purchase the goods at a lower rate compared to the market price

International Transfer Pricing:

- ❖ Transactions between divisions of multi-national companies can involve transfer of goods, provision of services or use of intangible assets involving royalty payments
- ❖ Taxation, profit repatriation and transfer prices are critical considerations to the senior management of multi-national companies
- ❖ Multi-national organizations try to maximize profits by using transfer pricing as a tool to reduce the tax impact on earnings.
- ❖ Where, the supplying division is in a country with higher tax rate, the transfer price will be set lower in-order to reflect higher earnings (resulting from lower purchase cost) in the purchasing division, which has a lower tax rate.
- ❖ Likewise, supply from lower tax rate countries may be priced higher, in order to reflect higher earnings for that unit, thereby reducing the tax impact
- ❖ Furthermore profits can also be impacted by currency movements. A multinational company might be keen to set transfer prices in a currency such that any currency losses arise in the subsidiary in the high-tax country, and currency profits arise in the country with the lower tax rate if it is fairly - certain about exchange rate movement in the future

Chapter 8: Uniform costing and inter firm comparison**Uniform costing:**

- ❖ Uniform Costing is not a distinct method of costing. In fact, when several undertakings start using the same costing principles and/or practices they are said to be following uniform costing.
- ❖ The basic idea behind uniform costing is that the different concerns in an industry should adopt a common method of costing and apply uniformly the same principles and techniques for better cost comparison and common good.

Objectives of uniform costing:

- ❖ Facilitate comparison
- ❖ Eliminates unhealthy competition
- ❖ Improves efficiency
- ❖ Provides relevant data
- ❖ Ensures standardization
- ❖ Reduces cost

Essential requisites for the installation of uniform costing:

- ❖ The firms in the industry should be willing to share/furnish relevant data/information
- ❖ A spirit of cooperation and mutual trust should prevail among the participating firms
- ❖ Mutual exchange of ideas, methods used, special achievements made, research and know how etc. should be frequent
- ❖ Bigger firms should take the lead towards sharing their experience and know-how with the smaller firms to enable the latter to improve their performance

Advantages of uniform costing:

- ❖ The management of each firm will be saved from the exercise of developing and introducing a costing system of its own.
- ❖ A costing system devised by mutual consultation and after considering the difficulties and circumstances prevailing in different firms is readily adopted and successfully implemented.
- ❖ It facilitates comparison of cost figures of various firms to enable the firms to identify their weak and strong points besides controlling costs.
- ❖ Optimum achievement of efficiency is attempted by all the firms by utilising the experience of other concerns in the industry.
- ❖ Standing in the industry of each firm will be known by making a comparison of its cost data with others.
- ❖ Services of cost consultants or experts may be available jointly to each firm in the industry by sharing their experiences and expenses.
- ❖ Research and development benefits of bigger firms may be made available to smaller firms.
- ❖ It helps in the reduction of labour turnover, as a uniform wage system is the pre-condition of a uniform costing system.
- ❖ It helps Trade Associations in negotiating with the Government for any assistance or concession in the matters of taxation, exports, subsidies, duties and prices determination etc

Limitations of uniform costing:

- ❖ Sometimes it is not possible to adopt uniform standards, methods and procedures of costing in different firms due to differing circumstances in which they operate. Hence, the adoption of uniform costing becomes difficult in such firms.
- ❖ Disclosure of cost information and other data is an essential requirement of a uniform costing system. Many firms do not wish to share such information with their competitors in the same industry.
- ❖ Small firms in an industry believe that uniform costing system is only meant for big and medium size firms, because they cannot afford it.
- ❖ It induces monopolistic trend in the business, due to which prices may be increased artificially and supplies withheld

Inter-firm comparison:

- ❖ It is technique of evaluating the performance, efficiency, costs and profits of firms in an industry.
- ❖ It consists of voluntary exchange of information/data concerning costs, prices, profits, productivity and overall efficiency among firms engaged in similar type of operations for the purpose of bringing improvement in efficiency and indicating the weaknesses. Such a comparison will be possible where uniform costing is in operation
- ❖ An inter-firm comparison indicates the efficiency of production and selling, adequacy of profits, weak spots in the organisation, etc. and thus demands from the firm's management an immediate suitable action

Requisites of inter-firm comparison:

- ❖ Centre for inter-firm comparison
- ❖ Membership
- ❖ Nature of information to be collected
- ❖ Method of collection and presentation of information

Advantages of inter-firm comparison:

- ❖ Gives an overall view of the industry as a whole to its members
- ❖ Helps a concern in knowing its strengths or weaknesses in relation to others
- ❖ Ensures an unbiased specialized reporting on particular members
- ❖ Develops cost consciousness among the members
- ❖ Helps Government in effecting price regulation
- ❖ Helps improve the quality of products manufactured and to reduce the cost of production

Limitations of inter-firm comparison:

- ❖ Top management feels that secrecy will be lost
- ❖ Middle management is usually not convinced with the utility of such a comparison.
- ❖ In the absence of a suitable Cost Accounting System, the figures supplied may not be reliable for the purpose of comparison.
- ❖ Suitable basis for comparison may not be available.

Chapter 9: Profitability analysis-Product wise/ segment wise/ customer wise**Profitability Analysis**

- ❖ Porter in its generic strategy theory has suggested that a firm can **survive profitably in the long term** if it chooses its **generic strategy according to the environment** in which it operates
- ❖ A firm would be profitable if it is either a **cost leader** or if it produces its products with some peculiar features which make it different from others.
- ❖ To achieve its objectives, it has to put some **performance measurement mechanism** into place so that any deviation can be measured and corrective action can be taken.
- ❖ Profitability Analysis can be useful to **measure the performance of a firm against the acceptable standards**.
- ❖ Profitability can be analysed as per the requirement of the management, to assist them to identify the critical success factors and to take appropriate decisions.

Operating Profit Analysis:

- ❖ Operating Profit of a firm is affected by various components which are responsible for changes in the revenue and costs.
- ❖ A change in the profit may be due to **revenue or costs or both the factors**.
- ❖ For analyzing operating income, we spread our analysis into three main areas or components which are
 - Growth Component
 - Price Recovery Component and
 - Productivity Component.
- ❖ **Growth Component** measures the change in **the quantity of output sold**. The growth component of the change in the operating income measures the increase/decrease in revenue and in costs due to selling more/ less quantity units from the previous period.
- ❖ **Price Recovery Component** of change in operating income measures the changes in the revenue and costs solely **due to changes in prices**.
- ❖ **Productivity Component** measures the change in the operating income due to changes in the **product mix and/or yield of inputs** as compared with the last year. This component uses current year's prices of input to measure the changes in costs only.

Profitability Analysis through ABC:

- ❖ A well designed and implemented ABC system is a powerful aid to management evaluation and decision making, thereby improving organizational performance.
- ❖ In service sector, direct costs are generally low and overheads tend not to be volume related or capable of being easily attributed to product/ service/ customer being supplied.
- ❖ In this situation, ABC, with its emphasis on activities and their cost drivers, helps cost to identify more easily and managed more effectively.
- ❖ In addition, because the resource consumption by different products, customers or segments of the business is more accurately measured, activity-based profitability analysis is likely to provide more useful information to management.

Direct Product Profitability (DPP):

- ❖ A firm which has a portfolio of profitable products enjoys high profitability. However, it is very important to know the relative profitability of an individual product so that management can concentrate on the profitable products and weed out the loss-making products from the products' portfolio.
- ❖ Direct Product Profitability is one among the various analytical methods which analyse the profitability for each product or segment of products separately.
- ❖ DPP is generally used in the retail trade to determine profitability from an individual product.
- ❖ CIMA describe DPP "used primarily within the retail sector, DPP involves the attribution of both the purchase price and other indirect costs (for example distribution, warehousing and retailing) to each product line. Thus, a net profit, as opposed to a gross profit, can be identified for each product. The cost attribution process utilizes a variety of measures (for example warehousing space and transport time) to reflect the resource consumption of individual products."

Benefits of DPP

- ❖ Better cost analysis.
- ❖ Better pricing decisions.
- ❖ Better management of stores and warehouse space.
- ❖ The rationalisation of product ranges.

Direct Product Profitability Statement

- ❖ Retail organisations traditionally deducted the bought in cost of goods from the selling price to give a gross margin. A method was needed which relates the indirect costs to the goods according to the way the goods uses or creates these costs.
- ❖ Indirect costs, for DPP may be analysed into basic cost categories as follows:
 - Overhead Cost: This is incurred through an activity that is not directly linked to a particular product.
 - Volume Related Cost: The cost is incurred in relation to the space occupied by products. This includes storage and transport costs.
 - Product Batch Cost: This cost is often a time-based cost. If product items (that is a number of identical products which are handled together as a batch) are stocked on shelves a labour time cost is incurred.
 - Inventory Financing Costs: This is the cost of tying up money in stock and is the cost of the product multiplied by interest rate per day or per week.

Customer Profitability Analysis

- ❖ In many organisations it is just as important to cost customers as it is to cost products. Different customers or groups of customers differ in their profitability.
- ❖ This is a relatively new technique that ABC makes possible because it creates cost pools for activities.
- ❖ Customers use some activities but not all, and different groups of customers have different 'activity profiles'. Service organisations, such as a bank or a hotel, in particular need to cost customers.

Benefits of Customer Profitability Analysis

- ❖ It helps the supplier to identify which customers are eroding overall profitability and which customers are contributing to it.
- ❖ It can help to provide a basis for constructive dialogue between buyer and seller to improve margins.

Balanced Scorecard:

- ❖ The balanced scorecard is a method which displays organisation's performance into four dimensions namely financial, customer, internal and innovation
- ❖ The four dimensions acknowledge the interest of shareholders, customers and employees taking into account of both long-term and short-term goals

Four perspectives of balanced scorecard:**Financial Perspective – How do we look to shareholders?**

- ❖ Manager of a division or a unit, links its business objectives to the corporate strategy of the company as a whole. Financial performance measures indicate whether the company's strategy implementation and execution are contributing to its revenue and earnings
- ❖ Financial objectives chosen at the onset of the balanced scorecard implementation should serve two purposes:
 - To provide definite performance that was expected at the time of strategies selection.
 - To provide a focus for objectives and appropriate measures in each of the other three perspectives.

Customer Perspective – How do customers view us?

- ❖ Managers identify the lead indicators which make a particular business unit or product different from that of others.
- ❖ Lead indicator may vary from customer to customer or market segment. If for example, a customer values on-time delivery then on-time delivery becomes a lead indicator. Some of the lead-indicators are on-time delivery, on-site service, after sales support, defects per order, cost of the product, free shipments etc

Internal Business Perspective – At what must we excel?

- ❖ Companies identify objectives and processes which are necessary to achieve objectives set at financial and customer perspective stage
- ❖ These objectives may be achieved by reassessing the value chain and making necessary changes to the existing operating activities

Learning and growth perspective – How do we continue to improve and create value?

- ❖ Companies determine the activities and infrastructure that the company must build to create long term growth, which are necessary to achieve the objectives set in the previous three perspectives.
- ❖ Organizational learning and growth comes from the following three sources:
 - People (employee capabilities)
 - Systems (information system capabilities) and
 - Organizational procedures (motivation, empowerment and alignment)

Benefits of Balanced scorecard:

- ❖ The ultimate result of using the Balanced Scorecard approach should be an improved long term financial performance. Since the scorecard gives equal importance to the relevant non –financial measures, it should discourage the

short termism that leads to cuts in spending on new product development, human resource development etc which are ultimately detrimental for the future prospects of the company.

Reasons for failure of balanced scorecard:

- ❖ Managers mistakenly think that since they already use non – financial measures, they already have a Balanced Scorecard.
- ❖ Senior executives misguidedly delegate the responsibility of the Scorecard implementation to middle level managers.
- ❖ Company's try to copy measures and strategies used by the best companies rather than developing their own measures suited for the environment under which they function.
- ❖ There are times when Balanced Scorecards are thought to be meant for reporting purposes only. This notion does not allow a Business to use the Scorecard to manage Business in a new and more effective way.

Chapter 10: Linear Programming**Meaning of LPP:**

A Linear Programming Problem (LPP) is a mathematical model dealing with the use or allocation of certain scarce resources (i.e. key factor like raw materials, labour hours, machine time, capital availability etc.) in the best possible manner in order to maximize profit or minimize cost.

Methods of solving LPP:

Method	Condition for applicability
Graphical Method	Number of variables should be Two (since there are only two axes x and y on the graph sheet). Any number of constraints / inequalities are permitted, but the feasible region may not be easily identified if numerous constraints are introduced
Trial and Error Method	Number of variables = Number of constraints. For example, two equations in two variables can be solved. However, as more variables and constraints are introduced, solving algebraic equations may become comparatively difficult
Simplex Method	No restrictions as to number of variables and constraints

Steps involved in simplex method:

Step 1: Objective: Determine the objective function (denoted by Z). (either maximisation or minimisation)

Step 2: Constraints: List the constraints applicable for the objective. For maximisation objective, atleast one constraint should bear $\leq$ sign. For minimization objective, atleast one constraint should bear $\geq$ sign.

Step 3: Conversion of inequalities into equalities: Convert inequalities into equalities as below:

Particulars	Slack Variable	Surplus variable	Artificial variable
Meaning	Idle or unused resources	Excess amount of resources utilized	No physical or economic meaning. It is fictitious.
When used	' $\leq$ ' inequality	' $\geq$ ' inequality	' $\geq$ ' and ' $=$ ' constraints
Co-efficient in the constraint	+1	-1	+1
Co-efficient in the objective function	0	0	+M for minimisation and -M for maximisation
Used as initial program variable	Used as starting point (initial table)	Cannot be used since unit matrix condition is not satisfied	Initially used but later eliminated
Presence in the optimal table	Helps to interpret idle & key resources	-	Indicates "No feasible" solution

Step 4: Revised objective: Redraft the objective function by including the variable in this order –

- (a) Regular variables as given in the objective
- (b) Slack variables with zero co-efficient
- (c) Surplus variable with zero co-efficient and
- (d) Artificial variables with +M for minimization and -M for maximisation

Step 5: Initial table: The format of the table is as under:

Fixed Ratio	Program Variable	Profit / cost	Quantity	Variables column				Replacement ratio
				A	B	S ₁	S ₂	
	Row 1							
	Row 2 etc.							
			Z					
			C					
			NER = Z - C					

Notes:

- Select slack variables as initial program variable. In case of minimization objective, slack and artificial variables constitute the initial program, forming a unit matrix of co-efficients.
- Fill up profit/cost of the program variable as per objective function
- Fill up quantity = RHS of constraints
- Fill-up co-efficients of various variables as per the constraints, in the respective columns
- Fill up values of Z against each variable as per objective function
- Compute C = Profit/cost * co-efficient of each variable
- Compute net evaluation row (NER) = Z - C
- Select maximum positive NER (Z - C) for maximisation objective and circle key column. Corresponding variable is the incoming variable. In case of minimisation objective, select worst negative NER
- Compute replacement ratio = Quantity / key column element
- Select minimum non-negative replacement ratio and circle key row. In case RR = 0, it shall be selected as minimum non-negative. In case of tie, arbitrary selection shall be made
- Identify pivot element. Junction of key row and key column is called as pivot element
- Fixed ratio is not applicable for key row. For other rows (non-key rows), Fixed ratio is calculated as = Key column element / pivot element
- Determine replacement decision: (a) Incoming variable = key column and (b) Outgoing variable = key row.

Step 6: Second and subsequent table:

- Fill up program variables by replacement decision as per earlier table
- Fill up profit/cost of the program variables based on objective function
- Update key rows by the transformation rule, previous table key row element / pivot element
- Update non-key rows by the transformation rule = (Previous table corresponding row element) Less (Key row element * fixed ratio)
- Fill up values of Z against each variable, as per objective function
- Compute C = Profit * Co-efficient of each variable

- Compute $NER = Z - C$
- Repeat the selection and reallocation procedure till all $Z-C \leq 0$ for maximization, and all $Z-C \geq 0$ for minimization objective

Procedure for minimisation objective:

- Introducing surplus variables, the constraint functions are to be re-written
- However, since these variables when introduced as initial program, violate the non-negativity assumption, artificial variables "M" of heavy cost (close to infinity) are introduced and the constraints and objective function are re-written
- Initial program is commenced using artificial variables only (since it satisfies the unit matrix condition)
- An artificial variable once eliminated (i.e. selected as key row) will never re-enter the simplex table in the subsequent iterations
- If artificial variable exists in the optimal table the solution is not optimal. There is no feasible solution for that case.

Treatment in special cases:

Situation	Treatment
Degeneracy	• It occurs if there is a tie in the minimum non-negative replacement ratio • In case of degeneracy, the outgoing variable should be selected on an arbitrary basis • The variable not selected as outgoing, will bear "0" in the quantity column in the subsequent table
Equality Constraints	• Artificial variable is introduced to the constraint
Multiple optimal solutions	• For any optimal solution, $NER = 0$ for all program variables • LPP is said to have alternative solutions if in the optimal table, a non-program variable has $NER = 0$ • The alternative solutions can be obtained by identifying such non-program variable (bearing $NER = 0$) as the incoming variable
No feasible solution	• Artificial variable, once eliminated, should not re-enter subsequent iterations (tables) • If artificial variable persists in the "optimal" table, there is no feasible solution
Unbounded solution	• Outgoing variable is selected on the basis of minimum non-negative replacement ratio • If all replacement ratios are negative, the outgoing variable cannot be identified • The LPP is said to have unbounded solution in such cases, when all RR are negative.

Chapter 11: The Transportation Problem**Introduction:**

Transportation applications relate to a LPP where goods are to be transported from “m” production locations (factories) to “n” sales locations (warehouses). The objectives are:

- To meet the differing availabilities and requirements of these locations and
- To minimize the total transportation costs

Steps in case of transportation:

Step 1: Verify the following in the question:

- Verify **objective = Minimization**. In case of maximization, convert the same into opportunity loss matrix by subtracting each number from highest number in the matrix.
- Verify **Nature of data = Balanced**. Data is said to be balanced if Total Availability = Total Requirement. In case of unbalanced data, a dummy column or row is to be introduced with zero transportation costs

Step 2: Deriving Initial Basic Feasible Solution (IBFS)

IBFS can be determined using any of the following methods:

- Northwest Corner Rule
- Least Cost Method and
- Vogel's Approximation Method (VAM)

Step 3: Optimality test (explained later)

Different methods for arriving IBFS**Northwest Corner Rule Method:**

Step 1: Go to the top left hand corner of the matrix. Compare the availability and requirement, and allocate whichever is less, to that cell. Cancel the row/column where availability or requirement/condition is satisfied

Step 2: Go to top left hand corner cell of the resultant matrix (after cancellation of row or column in step 1). Repeat Step 1 till all the row availability and column requirements are satisfied.

Least cost Method:

Step 1: Identify the cell with lowest cost. In case of tie, arbitrary selection may be made. Compare the availability and requirement, and allocate whichever is less, to that cell. Cancel the row or column where availability or requirement condition is satisfied.

Step 2: Identify the next lowest cell in the matrix. Repeat Step 1 procedure till all row availability and column requirements are satisfied.

VAM:

Step 1: Compute the cost differences of each row and column. Cost difference is the difference between the least cost and the next least cost in that row/column. In case of tie in least cost, cost difference = 0

Step 2: Ascertain the maximum of cost differences and select that row or column for allocation

Step 3: Choose the least cost cell in the selected row or column for allocation. Compare the availability and requirement for that cell, and allocate whichever is less to that cell. Cancel the row or column where availability or requirement condition is satisfied.

Step 4: Repeat step 1, 2 & 3 till all row availability and column requirements are satisfied.

Optimality test:

Optimality test involves the following steps:

- **Table 1: $U_i + V_j$ for allocated cells:**

- Select the row/column with maximum number of allocations
- For that row/column, U_i/V_j is equal to zero [U_i for Rows & V_j for columns]
- The other set of numbers U_i/V_j are computed in such a way that $U_i + V_j = \text{Cost of allocated cells}$

Note: $U_i + V_j$ table can be computed only if the IBFS is non-degenerate. IBFS is said to be degenerate if number of allocations $< \{\text{No. of rows} + \text{No. of columns} - 1\}$. In case of degeneracy, a dummy allocation “e” (a number very close to zero) is made in the least cost independent unallocated cell. An independent unallocated cell is one which does not result in creation of loop when allocated.

- **Table 1: $U_i + V_j$ for unallocated cells:**

- Draw a matrix for the given rows and columns.
- Block out the allocated cell
- Compute $U_i + V_j$ (total of margin numbers) for all unallocated cells

- **Table 3: Δ Table or Decision table = Table 1 - Table 2**

- Draw a matrix for given rows and columns.
- Block out allocated cell
- Compute cost difference for all unallocated cells. Cost difference = Table 1 minus Table 2

Decision/Interpretation Table:

If all numbers of cost difference table are positive and greater than zero	IBFS is optimal and unique
If all numbers are non-negative and one or more of the cells contains zero	IBFS is optimal but not unique. As many zeroes, that many alternative solutions exist
If any one number is negative	Solution is not optimal. Re-allocation should be made to determine Alternative Basic Feasible Solution (ABFS)

How is Alternative Basic Feasible Solution determined?

- Identify the worst negative in Table 3. If there is a tie, choose the least cost cell. (Call this as “Origin”)
- Draw a loop with the following principles
 - Loop should commence from and end in the selected worst negative cell i.e. the Origin
 - It should have allocated cells as its other corners. But Loop can cross over allocated/unallocated cells
 - Only horizontal and vertical lines (not diagonal) can be used
 - Loop should result in an even sided figure
- Put positive (+) sign and negative (-) sign to the corners of the loop alternatively, with origin as +ve corner
- Re-allocation is done as under:
 - Identify the allocations to the negative corners of the loop (i.e. corners with (-) sign)

- Select the minimum quantity out of the above allocations. Let this quantity be called **Selected Quantity**
- Add this selected quantity to (+) corners and subtract this selected quantity from (-) corners. Other allocated and unallocated cells will remain unaffected
- This ABFS is tested for optimality using the same procedure as done in case of IBFS. In case there are negatives still arise in Table 3, then the re-allocation procedure should be continued further.

Treatment in special cases:

Situation	Treatment
Total availability not equal to total requirement	It is called unbalanced transportation problem. Introduce dummy row or column to balance availability and requirement. All entries (costs) of the dummy row/column shall be zeroes
Maximization objective	Select the highest element of profit in the matrix. Subtract each element from the maximum element. Take the resultant opportunity cost matrix with minimization objective, for allocation procedure
Degeneracy	Optimality test can be done only if number of allocations = (No. of rows + No. of columns - 1). If number of allocations < m+n-1, all U_i and V_j numbers cannot be computed. This situation is called degeneracy. If IBFS is degenerate, introduce a dummy allocation (e) in the least cost independent unallocated cell
Existence of zeroes in the cost difference table	Zero in the cost difference table indicates the availability of alternative solutions. The alternative optimal solutions can be determined by drawing a loop commencing from such cell having zero. Re-allocation would be based on loop drawing procedures
Prohibited routes	Sometimes some routes may not be available due to reasons like bad conditions, strike among others. Such prohibited routes are identified with a high cost represented by "M", a very large cost close to infinity. Due to assignment of very large cost, such routes would automatically be eliminated in the final solution

Chapter 12: The Assignment Problem**Introduction:**

Assignment Problem is a special type of Linear Programming Problem, with the following features:

- **Objective:** The objective is either to maximize Profit/Revenue/Sales or to Minimize cost/time
- **Nature of Data:** 'm' jobs/products are to be assigned to 'n' persons/facilities. It is not always necessary that $m=n$. If they are equal, data is said to be **balanced**, otherwise, data is said to be **unbalanced**
- **Condition:** Assignment should be on a **one-to-one** basis (two jobs cannot be assigned to the same person, and two persons cannot be assigned the same job)

Steps:

Step 1: Verify **Objective = Minimisation**. In case of Maximisation objective, convert the same into an opportunity loss matrix, by subtracting each number from highest number in the matrix.

Step 2: Verify **Nature of data = Balanced**. Data is balanced if number of rows equal to number of columns. In case of unbalanced data, add a dummy row or column as required, with all elements being Zero.

Step 3: Perform **Row operations**. Subtract the smallest number in each row from all elements of that row.

Step 4: Perform **column operations**. In the resultant matrix from Step 3, subtract the smallest number in each column from all elements of that column.

Step 5: Draw the minimum number of Horizontal and vertical lines to cover all zeroes in the matrix. Optimal assignment is possible only if **number of lines = order of the matrix**

Step 6: In case number of lines < order of the matrix, increase the number of zeroes as under:

- Select the smallest number not covered by the lines and call it as **Least Open Element (LOE)**
- Rewrite the matrix with the following adjustments:
 - Open Elements – Not covered by any line – Previous element **less** LOE
 - Covered elements – Covered by one line only – **No change**
 - Junction elements – Covered by intersection of two lines – Previous element **plus** LOE

Repeat Step 5 for such matrix till Number of lines = Order of the matrix

Step 7: Optimal assignment is made in the following manner

- Go row-wise, identify a row with one zero
- Select this zero as an assignment drawing a box around it
- Cancel all zeroes in that column since the same job cannot be assigned to a different facility
- Continue this procedure with columns and complete the assignment

In case of multiple optimal solutions or ties upto the last stage, arbitrary assignment can be made.

Treatment in special cases:

Situation	Treatment
Maximisation Objective	• Identify the Highest Element in the given maximization matrix • Subtract each element in the matrix from the highest

	element. This is called as Opportunity Loss Matrix. Continue the Assignment procedure in this matrix
Unbalanced Matrix	• Insert a dummy row or column, with all entries equal to Zero. Insert dummy only after converting into Opportunity Loss matrix, if required
Prohibited Assignment (Restrictive Condition)	• Where a particular job cannot be assigned to a particular individual, it is called Prohibited Assignment • Such routes are given a high cost "M" where M = Infinity
Condition Assignment (Facilitative condition)	• Where a particular job should be assigned only to a particular individual, it is called as facilitative condition • Delete that row and column and reduce the matrix and continue the procedure

Chapter 13 & 14 – CPM and PERT**Introduction:**

- Network analysis (CPM and PERT) is used in managing the progress of a project.
- A project is a set of activities or jobs that are performed in a certain sequence to accomplish a given objective.
- These activities or jobs are to be completed within a specified time and within a specified cost. It should also meet the performance standards.

Steps in Network Analysis:

- **Step 1:** Analyse and break down the project in terms of specific activities and/or events
- **Step 2:** Determine the inter-dependence and sequence of specific activities and prepare a network diagram
- **Step 3:** Assign estimates of time, cost or both to all the activities of the network
- **Step 4:** Identify the longest or critical path through the network
- **Step 5:** Monitor, evaluate and control the progress by re-planning, rescheduling and reassignment of resources

Term	Meaning
Critical Path	The longest path through the network is called as the critical path. The length of the critical path determines the minimum duration in which the project can be completed.
Network	A network is a graphical representation of a project, depicting the flow as well as the sequence of well-defined objectives and events and their inter-relationships. They are also called Arrow Diagrams.
Activity	An activity is any portion of a project/network which consumes time or resources and has a definite beginning and ending. Activities are graphically represented by arrows and denoted by alphabets
Event	The beginning and ending points of an activity are called events. They are represented graphically by a numbered circle
Tail Event or Preceding events	All activities in a network must commence from some event called Tail Events. Since the arrow diagram is always drawn from left to right, the LHS node/event is called as Tail Event
Head event	All activities in a network must have terminal points called the Head event. The RHS node/event is called as Head event
Dummy activity	Dummy activity is a hypothetical activity which consumes no resource and time. It is represented by dotted lines in the network diagram.

Conventions used in network diagram:

- Activities are represented by arrows. They are designated by alphabets.
- Events are represented by Numbered circles called nodes. They are designated by numbers
- Time flows from left to right. Hence the activities can be indicated from left to right by way of straight horizontal lines/vertical lines, or diagonal lines also
- Every subsequent activity should be depicted to the right hand side of the preceding event. This will facilitate scheduling computations for each event
- Each event/node should be numbered without any ambiguity. The numbers should be assigned to events in such a way that the number assigned to the head event of an activity is greater than the number assigned to the tail event of that activity

- Each activity should be bound by two events. No activity should hang or dang loosely in the network. Moreover no two activities should have same head and same tail event
- Arrows that cross each other should be avoided to the extent possible. Where crossing of arrows is unavoidable, bridging may be done

Errors while drawing network diagram:

- **Looping:** Generally the arrow point from left to right, since time flows in that direction. If that convention is not followed the result is illogical looping
- **Dangling:** This represents a situation when an event is not continued further i.e. it hangs abruptly in the middle of the network without being connected to completion stage
- **Duplication:** Activities that have the same head and tail event are called duplicate activities. Duplication can be corrected by the introduction of the dummy activity

Scheduling computations:

The basic scheduling computations involve a forward pass and then a backward pass through the network. The process of tracing the network from START to END is called forward pass and from END to START is called backward pass. The forward pass computations give Earliest Start and Finish Times for each activity. The backward pass computations give the latest allowable start and finish times for each activity.

Forward Pass computation	• For the Initial Event $EST = 0$. For every subsequent event, $EST = EST \text{ of Tail event} + \text{Activity duration}$. For merge event, the EST shall be the maximum of the EST computed for each activity. • $EFT = EST + \text{Duration of activity}$
Backward Pass computations	• For the terminal event, $LFT = EST$ as computed by forward pass. For every preceding event, $LFT = LFT \text{ of Head event} - \text{activity duration}$. For Burst event, the LFT shall be the minimum of the computed LFT. • $LST = LFT - \text{Duration of activity}$

Floats:

Non-critical activities have some flexibility i.e. they can be delayed for some time without affecting the project duration. This flexibility is called as float for activities and slack for events.

Slack time for an event	Difference between the latest event time and earliest event time. Slack = L value less E value as derived by scheduling computations
Total Float	Activity Float = $LST - EST$ (or) $LFT - EFT$. For all critical activities total float = 0 as they cannot be delayed
Free Float	Portion of total float within which an activity can be delayed without affecting the float of succeeding activities. Free Float = Total Float minus head event slack. If a negative value is obtained then the free float is taken to be zero
Independent float	Portion of free float within which an activity can be delayed without affecting the float of the preceding activities. Independent float = Free float less tail event slack

Time estimates used in PERT:

- Optimistic time estimate is the shortest possible time in which an activity can be completed. This is denoted by t_o
- Pessimistic time estimate is the maximum possible time which an activity could take to accomplish the job. It is denoted by t_p .

- Most likely time estimate lies between optimistic and pessimistic time estimates. It presumes normal conditions and is denoted by t_m .

Time estimates used in PERT:

Expected time	$(t_o + t_p + 4 t_m) / 6$
Range	$t_p - t_o$
SD	$(t_p - t_o) / 6$
Variance	SD^2

Probability analysis in achieving project completion:

- A project as a whole consists of several activities and will have a normal distribution. Hence the probability of completing the project in time is 50 percent
- The probability of completing the project in specified time is calculated using the following rules:
 - $Z = (T_r - T_{cp}) / SD$ where T_r = Duration in which the project is required to be completed, T_{cp} = Duration of the critical path.
 - Obtain the value of Z from normal tables and call it as NT (Z)
 - Probability of completing a project within required duration = $0.5 \pm NT (Z)$

CPM Versus PERT:

Particulars	CPM	PERT
Event/activity	CPM is activity oriented. Results of various calculations are considered in terms of activities	PERT is event-oriented
Uncertainty	It is a deterministic model. It does not consider uncertainties involved in project completion	It is a probabilistic model. It uses three estimates of time keeping time uncertainty in view
Emphasis	It places dual emphasis on time and cost and evaluates the trade-off between project cost and project time	It is primarily concerned with time
Nature of projects	It is used for projects of repetitive nature, where one has prior experience of handling similar projects	It is generally used for new projects where time required for various activities are not pre-determined

Chapter 15: Simulation**Introduction:**

- Simulation is a quantitative procedure, which describes a process by developing a model of that process and then conducting a series of organized trial and error experiments to predict the behaviour of the process over time.
- Simulation can serve as a pre-service test to try out new policies and decision rules for operating a system before running the risk of experimenting on the real system

Steps in case of simulation:

- **Step 1:** Determine the objective which may be either maximisation of return or minimisation of cost/time etc.
- **Step 2:** Identify the variables that have significant influence on the objective
- **Step 3:** Determine the cumulative probability distribution of each variable under step 2. Obtain random numbers for each variable
- **Step 4:** Obtain a set of random numbers from the tables
- **Step 5:** Identify the variable with which the chosen random number falls in step 3. Repeat step 5 for all random numbers.

Chapter 16: Learning Curve Theory**Learning curve:**

"Learning curve is a geometrical progression, which reveals that there is steadily decreasing cost for accomplishment of a given repetitive operation, as the identical operation is increasingly repeated. The amount of decrease will be less and less with successive unit produced. The slope of the decision curve is expressed as a percentage. The other names given to learning curve are experience curve, improvement curve and progress curve".

Learning curve equation:

Mathematicians have been able to express relationships in equations. The basic equation is

$$y = ax^b$$

Where:

- y = Average time per unit for x units
- a = Time required for first unit
- x = Cumulative number of units produced
- b = Learning co-efficient

Learning curve ratio:

In the initial stage of a new product or a new process, the learning effect pattern is so regular that the rate of decline established at the outset can be used to predict labour cost well in advance. The effect of experience on cost is summarized in the learning ratio or improvement ratio.

$$\text{Learning ratio} = \frac{\text{Average labour cost of first } 2N \text{ units}}{\text{Average labour cost of first } N \text{ units}}$$

Summary of Adjustments

Qn	Summary
Topic 1: Total Quality Management	
1	❖ Customer support (External Failure), Equipment testing (appraisal), warranty repair (external failure), manufacturing rework (internal failure), Supplier review (prevention) and downtime (internal failure)
2	❖ Internal failure, Internal failure, External failure, External failure, Internal failure, External failure, Prevention cost, Appraisal cost
3	❖ Loss due to faulty bats = Relevant cost of manufacture faulty bats + Contribution lost due to lower market share ❖ Implementation of inspection process before delivery will not remove faulty bats. However it can save delivery cost of faulty bats and also can earn contribution from higher market share
4	❖ AC (4 & 8), PC (3,5 & 10), IFC (2,6,9) & EFC (1 & 7)
5	❖ Quality costs are prevention cost, appraisal cost, external failure and internal failure costs ❖ Units delivered to customers = Sales + Replacements ❖ Units produced = Units delivered + Faulty production ❖ RM Purchases = (Units produced * Input/Output) + RM scrapping
6	❖ Reliability, Performance, aesthetics and durability
7	❖ Internal failure cost, Appraisal cost, Prevention/appraisal cost, Prevention/appraisal cost, Prevention/appraisal cost, External failure cost, Internal failure cost, External failure cost
8	❖ Invalid, Valid, Invalid, Invalid, Invalid
Topic 3: Activity Based Costing	
1	❖ Non-value, value, value, Value and Value
2	❖ Simple problem on ABC with no special adjustment ❖ Calculate OAR for traditional method and based on that calculate cost under traditional method ❖ Calculate cost driver rate under ABC system and use the same to apportion overheads
3	❖ No special adjustment
4	❖ Calculate the cost of various activities ❖ Receiving materials (no of consignments received), set-up of machines (no of set-ups) and quality inspection (no of inspections) ❖ Design cost should be apportioned for every quarter for calculation of cost
5	❖ No special adjustment
6	❖ Calculate cost driver rate and apportion OH ❖ Prepare profitability statement based on the revised OH ❖ Prepare revised profitability statement based on change in sales mix. Change in sales mix should also lead to increase in cost driver quantity and hence the overheads will increase
7	❖ Fixed cost of the company will reduce due to reduction in engineering hours and number of production runs. Production runs will come down due to increase in production units per run ❖ BEP = Revised fixed cost/contribution per unit. ❖ BEP in terms of production runs = BEP in units / Production run size
8	❖ Fixed costs under ABC remains same for situation one as there is no reduction in

Qn	Summary
	cost ❖ Fixed cost would reduce for part II due to lower set up cost and engineering cost and hence the same would reduce BEP
9	❖ Not required, Required, Required and Not required
10	❖ Non-value added time will be waiting time, inspection time and move time ❖ Valued added time will be processing time ❖ Cycle efficiency = Value added time/total time ❖ Manufacturing cycle time = Total time / units per batch
11	❖ Manufacturing cost = No of machine hours, no of labour hours ❖ HR = No of employees, No of training hours ❖ Marketing = No. of customer orders, No of sales contract ❖ Accounting cost = No. of billings, no of cash receipts
12	❖ Key activities and drivers are purchase of medicines (no. of purchase orders), Scheduling of patients (no. of patients), Perform tests (no. of tests) and preparation of test reports (no. of reports)
13	❖ Calculate total overheads of the company with the help of OAR. Total overheads = Number of machine hours * Rs.60 per hour ❖ Split the overheads into various costs and then calculate cost driver rate with the help of the same
14	❖ Prepare profit statement for both products based on the changed cost driver quantity and cost structure ❖ Scenario II - BEP with semi-variable cost. Semi-variable cost change every 30 units. Set-up cost and step fixed cost are to be treated as fixed for the purpose of BEP calculation. Consider the semi-variable cost as VC/unit and get tentative BEP. Then get the final BEP
Topic 4: Target Costing	
1	❖ Target cost = Target SP - Target profit - Target royalty ❖ Compute the actual cost and then compare the same with target cost ❖ Other materials = $(0.6 \text{ Kg} * 16)/96\%$
2	❖ The company wants to increase the profit to Rs.50,000 and hence the targeted contribution will increase to Rs.3,87,000 (Fixed cost goes up due to advertisement) ❖ We can calculate contribution per unit with the given sales volume and the same can help us in getting the targeted variable cost ❖ We need to eliminate material cost from this and the balance will be labour and variable OH per unit. We can use this and get the target labour time per unit
3	❖ Calculate cost driver rate for production line cost (no. of machine hours), transportation cost (60% based on number of deliveries and 40% based on distance travelled) ❖ Total cost of manufacture = DM + DL + ABC related OH ❖ Target cost = Target selling price - 25% margin ❖ Compare actual cost with target cost to get the cost gap
4	❖ Valid and valid
Topic 5: Kaizen Costing	
1	❖ Kaizen costing focuses on small and continuous improvement. Hence the company should change from standard cost control system to cost reduction system, reduce the periodicity of setting standards and also involve the executives in setting of budgets
2	❖ Invalid, Valid, Invalid and Invalid

Qn	Summary
Topic 6: Life Cycle Costing	
1	❖ Life-cycle costing is preferred when high percentage of total life-cycle costs are incurred before production begins and high fraction of costs are locked ❖ Some of the examples are Tata Motors Limited, Dabur India Limited and Ranbaxy Laboratories
2	❖ Calculate total cost for life-time for the two scenarios. Compare it with sales and calculate profit
3	❖ Calculate profits for the two price levels ❖ PVR for the original price is 40% and based on that variable cost is to be computed. Variable manufacturing cost = Total variable cost - Variable selling cost ❖ Variable manufacturing cost would remain same even with a lower price and hence the profitability will be impacted
4	❖ Valid, Valid, Invalid, Valid, Valid, Valid
5	❖ Calculate total life-cycle costs = Initial costs + Annual costs * PVAF ❖ Select the plan which has low life-cycle cost
6	❖ Simple problem on life-cycle costing with no special adjustment
7	❖ Calculate life cycle cost per unit and compare with target cost
Topic 7: Value Chain Analysis	
1	❖ Primary, Support, Primary and Support
2	❖ Primary, Primary, Support, Primary, Support, Primary, Support & Primary
3	❖ Invalid, Invalid and Invalid
Topic 8: Cost control and cost reduction	
1	❖ CC, CC, CR, CR, CC, CC, CR, CR
2	❖ The company wants BEP at 400 units and this can be used to calculate the target contribution per unit ❖ Target VC per unit = Revised SP - Target Contribution
Topic 9: Just in Time	
1	❖ Calculate total inventory cost for various options ❖ Inventory carrying cost is to be calculated on average inventory. Average inventory is to be taken as half of quantity ordered
2	❖ Carrying cost is to be computed on average inventory ❖ Work force has to be paid for minimum of 4000 hours and hence any utilization lower than 4000 hours during JIT will not lead to any savings ❖ Work beyond 4000 hours will involve overtime payment and the relevant expense will be the full amount paid (in a normal scenario only OT premium will be relevant as that would be the incremental amount - compare with question no.14)
3	❖ Back-flush costing require no entry for issue of raw material/apportionment of overheads ❖ Entry would be passed once the goods are finished ❖ Cost of goods sold entry is for 3,57,000 whereas for produced is 3,75,000. In an ideal JIT scenario the units produced should be equal to units sold
4	❖ Inventory carrying cost is to be computed on average inventory. Average inventory = (Opening inventory of quarter + Closing inventory of quarter) / 2 ❖ Incremental production cost = Overtime cost + Increased production cost due to differential cost in each period
5	❖ Valid, Invalid, Invalid and Invalid

Qn	Summary
Topic 11: Theory of Constraints	
1	❖ Three measures of TOC are throughput contribution (7), operating cost (2, 4 & 5) and investment (1, 3, 6 & 8)
2	❖ TA ratio = Demand for factor/supply of factor ❖ Bottle-neck is to be considered based on highest TA ratio and then do the allocation based on bottle-neck
3	❖ TA ratio = Demand for factor/supply of factor ❖ Bottle-neck is to be considered based on highest TA ratio and then do the allocation based on bottle-neck
4	❖ TA ratio = Demand for factor/supply of factor ❖ Bottle-neck is to be considered based on highest TA ratio and then do the allocation based on bottle-neck
5	❖ TA ratio for product = Contribution per minute / operating cost per minute
Topic 12: Cost classification	
1	❖ Product cost, Committed cost, Differential/Incremental cost & Shut down cost
2	❖ Sunk cost (irrelevant), Opportunity cost (Relevant), Out of pocket cost (Relevant), Differential (Relevant) and Notional (Relevant)
3	❖ Committed cost, Differential cost, Sunk cost, Opportunity cost, Period cost and Direct cost
4	❖ Salary will be considered as selling cost as the responsibility of Mr. Philips is co-ordination of shipments for distribution
5	❖ VC/unit remains same for both options, fixed cost that is not committed and is different between two options, additional future cost which is different between options, cost already have been incurred and cannot be recovered
6	❖ Relevant cost, Sunk cost and Opportunity cost
7	❖ Rs.50 lakh is sunk and irrelevant and Rs.4 lakh is opportunity cost and relevant ❖ Rs.50 lakh is sunk and irrelevant and Rs.25,000 is committed cost and irrelevant ❖ Rs.50,000 per month is incremental/ out of pocket cost and relevant ❖ Rs.15,000 per month is committed cost and irrelevant
8	❖ Three way classification of costs are required. Controllable refer to those costs which can be reduced whereas uncontrollable refer to those costs which cannot be reduced ❖ Direct cost refers to cost directly related to the department whereas indirect costs refer to apportioned costs ❖ Sunk costs refer to past cost and out of pocket costs refer to future costs
9	❖ Committed, Discretionary, Committed, Discretionary, Committed, Committed, Discretionary, Discretionary and Discretionary
Topic 13: Relevant costing	
1	❖ Material A (Replacement cost), Material B (Resale value) and Material C (Replacement cost) ❖ Skilled labour - Lost contribution + Wages payable (Answer given in suggested answer is incorrect), Unskilled labour - Nil ❖ Variable OH - Relevant, Fixed OH - Irrelevant
2	❖ Flight crew salary is irrelevant (unavoidable) and flight assistant salary is relevant ❖ Baggage charges is irrelevant, 1/3 rd of liability insurance is relevant and the balance is irrelevant, Depreciation is irrelevant, hanger parking fee is irrelevant
3	❖ Material A - Non-moving item - Realizable value ❖ Material B - Out of stock - Replacement cost

Qn	Summary
	❖ Department X – Relevant ❖ Department Y – Spare capacity exist – Irrelevant ❖ Patterns and specifications = Cost to be incurred – Realizable value
4	❖ Material cost – This is a relevant benefit as the company would save disposal charges in case the project is taken up ❖ Other items – No special adjustment
5	❖ R1 will have a relevant benefit of Rs.1,250 as use of them will save disposal cost ❖ G1 will have relevant cost for non-idle portion whereas G2 will be entirely irrelevant
6	❖ Sunk cost (Irrelevant) ❖ Sunk cost (Irrelevant) & Replacement cost (Relevant) ❖ Period cost (Relevant) & Committed cost (Irrelevant) ❖ Sunk cost (Irrelevant) & Opportunity cost (Relevant)
Topic 14: Basics of Marginal Costing	
1	❖ Cost-benefit analysis is to be done for the system. Benefits are reduction in damages and contribution from incremental revenues ❖ Savings in damaged cartons is to be valued at variable costs ❖ Part 3 the benefits should be equated to cost and we should get the desired contribution and then reverse work on the required sales
2	❖ $F1 + F2 = 1,50,000$ ❖ $C2 = 0.8C1$ ❖ $F1 = 1800C1$ ❖ Use the formula of indifference point and establish an equation for $F1 + F2$ and get the answer to the various things asked in the question
3	❖ We can assume number of units sold in 2007 to be 100 units and then calculate the cost per unit and selling price ❖ Estimation of 2008 to be done 150 units and we need to consider change in cost structure as per the information in the question ❖ Overheads can be split as variable and fixed using the formula – $VC/unit = \text{Change in total OH} / \text{Change in units}$ ❖ We should remove the effect of inflation and consider only the real increase in OH while calculating VC/unit
4	❖ Scenario wherein there is a differential fixed and variable cost and the cost of the earlier level changes when we move from one level to another level ❖ Possible options are: 600 units, 750 units, 900 units, 1000 units and 1250 units as these undergo either a change in variable/fixed cost ❖ Each class interval can have a BEP if the contribution is able to recover the fixed cost
5	❖ The current profitability statement does not present the true picture as all expenses have been apportioned on basis of machine hours ❖ Revised profitability statement is to be prepared and machine related OH are to be distributed on basis of Machine hours, Batch related OH on number of hours, product specific is to be allocated to specific product and general fixed OH are to be not charged to individual product ❖ BEP is to be computed assuming a scenario of semi-variable cost and BEP. Treat batch related OH as variable OH and calculate tentative BEP. Take one class interval in which tentative BEP falls and one below the same to get the final BEP
6	❖ Sales = Minimum of production and demand ❖ Opportunity cost for every product = Maximum contribution of the other

Qn	Summary
	products
7	❖ Sales units is the limiting factor and hence the ranking is to be done on the basis of contribution per unit ❖ Compute the weighted contribution per set considering the present mix and then calculate the breakeven sets ❖ Incremental units: Company should prefer Product E as the same gives Rs.25 per unit and thereafter it can either do E or Z as both give Rs.10 per unit. Identify the number of units at which contribution equals fixed cost and the same would be the breakeven level ❖ Best mix for incremental 4,000 units would be 2,000 units of E and 2,000 units of Z as the same gives better contribution per unit
Topic 15: Marginal costing versus absorption costing	
1	❖ The current profitability statement has been prepared under marginal costing which would show better profits with higher production. This is due to over-absorption of OH ❖ Marginal costing will show higher profits when sales increase and hence we should re-draft the given profit and loss account under marginal costing
Topic 16: Indifference point and shut-down point	
1	❖ Indifference point = Change in fixed cost / Change in variable cost per unit ❖ Indifference point is to be done for (M1 & M2), (M1 & M3) and (M2 & M3)
2	❖ Shut-down point = (Cost during operation - Cost during shutdown - additional cost to resume operations) / Contribution per unit
3	❖ Indifference point = Change in fixed cost / Change in variable cost/unit
4	❖ Problem focuses on calculation of shut-down point ❖ Direct labour is an irrelevant cost as the same is paid to permanent labour force which cannot be terminated ❖ Cost during operation = (2 lacs units * 7) ❖ Cost during shutdown = (1.25 lacs + 1.5 lacs - off-loading income) ❖ Shutdown point = (cost during operation - cost during shutdown)/ CPU
5	❖ Shut down point = [Fixed cost during operation - fixed cost during shutdown - additional fixed cost to resume operations] / Contribution per unit ❖ Decision on shut-down point can be made by comparing the expected sales volume with shut-down point
Topic 17: Limiting factor	
1	❖ Sales value (PVR), RM (Cont/kg of RM), Labour (Cont/labour hour) and heavy demand (PVR)
2	❖ Compute contribution net of fixed cost per unit for all four products. Prepare the statement of ranking based on contribution per unit and do the allocation ❖ We need to take 10,000 units at a time while doing allocation and ensure that contribution from incremental units take care of specific fixed cost. In case the contribution is not sufficient then we should not manufacture those units. For example Q production will have to be restricted to 30,000 as those extra 10,000 units will not give contribution which is sufficient to cover incremental fixed cost ❖ Transfer price = (Variable cost + Lost contribution) / 20,000 ❖ Transfer can happen to B if the TP is less than Rs.45 per unit
3	❖ There are multiple limiting factors and hence we need to ranking based on contribution per unit, contribution per hour and contribution per kg of raw material. ❖ We will first produce Product Z as the same is preferred either as rank 1 or 2 on

Qn	Summary
	three parameters. The balance allocation will be done based on simultaneous equations
4	❖ Prepare a statement of ranking on the basis of contribution per machine hour. While evaluating the allocation we need to allocation for every 1,00,000 units and then compare the contribution with incremental fixed cost ❖ The company will not be meeting the full demand of P as the company will not be earning the incremental contribution to recover the incremental fixed cost ❖ Part two: Assume that we meet the full demand of P and then do the allocation. The overall profits will come down and the fall in profits will be regarded as opportunity cost
5	❖ Simple problem on limiting factor ❖ Imported Raw material is the limiting factor in this question and we have to calculate ranking on the basis of contribution per unit of imported material ❖ We will have to first meet the contracted supply and then the balance RM can be allocated
6	❖ Limiting factor with product specific fixed cost ❖ We have to first ascertain the ranking on the basis of machine hours. However we have to consider product specific fixed costs while doing allocation and we should select a product mix which can provide maximum profit ❖ Ranking can ensure maximum contribution. However it may not ensure maximum profit due to product specific fixed cost
Topic 18: Make or Buy Decision	
1	❖ Compare variable manufacturing cost with cost of purchase and decide on products to be manufactured/subcontracted ❖ Compute the savings per hour in manufacture and then do a statement of ranking ❖ Prepare statement of allocation while considering twin factors. One is incremental fixed cost due to increase in production (units basis) and also on the basis of labour hours ❖ Minimum units to break-even: Identify the units which are getting manufactured and find the product having maximum contribution per unit. See whether it can recover the fixed cost or else move to the next product and identify the number of units at which break-even can happen ❖ Unlimited assembly hours will not change the profits as the profitability is constrained currently due to step up fixed cost
2	❖ Compare manufacturing cost with cost of purchase and decide on make versus buy ❖ Prepare statement of ranking based on saving per hour and then decide on the production mix ❖ The decision will continue to remain the same as long as the saving per hour of product A is lower than saving per hour of Product C
3	❖ Two limiting factors are possible in this question as M-1 and M-2 availability is restricted. We need to calculate the amount of M-1 and M-2 required for contracted units, non-contracted units and for material Z ❖ Identify the limited factor and then prepare statement of ranking. Material Z's contribution will be calculated by comparing current purchase price of Rs.200 per unit with variable cost of manufacture ❖ Identify the product whose production will have to compromised to produce product Z. Relevant cost of manufacture = Cost of manufacture + Opportunity cost

Qn	Summary
	❖ Prepare the optimum production plan with the available resources ❖ Decision can be sustained in part (i) as long as the cost of purchase is lower than relevant manufacturing cost
4	❖ Part one: VMC will be 20% of material and 10% of other cost. This is to be compared with the cost of purchase and decision is to be taken. Decision would be to manufacture for first 1,50,000 cans. The company should then compare for incremental 25,000 and 75,000 cans and decide on make versus buy. The company will continue to make first 1,50,000 cans and the balance can either be make/buy ❖ Part two : Indifference point = $\text{Change in fixed cost} / \text{Change in VC/unit}$ ❖ Part three: Prepare a normal profitability statement
5	❖ Compare variable manufacturing cost with cost of purchase and decide on products to be manufactured/purchased ❖ Compute the number of hours required to produce the products and see whether production capacity is limiting factor ❖ Do a statement of ranking based on savings per hour and then do the allocation ❖ Prepare the profitability statement based on the allocation
6	❖ We need to compare the variable manufacturing cost with cost of purchase to decide on make versus buy decision ❖ Cost of make has to be adjusted with opportunity cost of loss of production of Product K. Product K can give a contribution of Rs.15,000 per unit. The proportionate contribution per hour is Rs.300 and hence the opportunity cost is Rs.12,000 per unit (300×40 hours) ❖ Relevant cost of make is Rs.29,000 and relevant cost of purchase is Rs.25,000 and hence we should go ahead with purchase
7	❖ Compare cost of purchase with manufacturing cost and decide on units to be purchased/manufactured ❖ Prepare statement of ranking and do a statement of allocation considering the current available hours ❖ Compare second shift working versus purchase for units which could not be manufactured due to non-availability of machine hours
Topic 19: Differential selling prices and product mix	
1	❖ We will have to first calculate the contribution at different sales levels for Product A and Product B ❖ We will then ascertain the various possible product mix within the available labour hours and select the mix which provides maximum contribution
2	❖ We cannot have follow combination approach as there are 25 possible combinations and hence we will have to follow incremental approach ❖ We will have to calculate incremental contribution per incremental unit and then do the ranking based on the same ❖ Product allocation will be done on the basis of the rank
Topic 20: Special orders	
1	❖ Profitability statement is required to be prepared for all three alternatives ❖ Alternative 1: Continuation with domestic order will lead to contribution of 20 percent of sales and profit can be calculated accordingly ❖ Alternative 2: Domestic contribution will proportionately reduce and the new product will give additional contribution ❖ Alternative 3: we need to consider incremental fixed cost and the cost of capital for this alternative. ❖ We should select the alternative which gives maximum profit

Qn	Summary
2	❖ The company needs a profit of 10% on selling price. Compute the current cost and compare with target cost. Difference in cost can be the inspection cost ❖ The selling price can be changed as current cost / 90%. This would give profit of 10% on sales as the company won't be incurring inspection cost. Compare the revised price with Rs.1,600 and then calculate the percentage of discount
3	❖ Similar to question no.4
4	❖ Sales at 100 percent capacity is Rs.72 lacs and factory cost at full capacity is Rs.48 lacs. Prime cost will be Rs.36 lacs ❖ We need to prepare profitability statement at the current capacity. Calculate the relevant cost for the new order and then calculate sales revenues based on maintenance of same profit margin
Topic 21: Evaluation of multiple alternatives	
1	❖ We need to prepare profitability statement for 4 proposals ❖ Piece rate under personnel director proposal = Existing rate + 1% for every 2 % increase ❖ Chairman proposal – Reverse work and get units
2	❖ Cost of change in Average Length of Stay (ALOS) = Rs.25,00,000 ❖ Readmission income = Rs.13,50,000 ❖ Savings in variable cost = Rs.37,50,000. We can go ahead with plan as savings are more than cost
3	❖ $EOQ = \sqrt{2 * \text{Annual Demand} * \text{Ordering cost/order}} / \text{Carrying cost}$ ❖ Total ordering cost = Number of orders * Ordering cost/order ❖ Total carrying cost = Average inventory * Carrying cost per unit/annum
4	❖ The current profit of the company is Rs.50,000 and based on that fixed OH is arrived at balancing figure ❖ We need to calculate the return on capital employed and see whether the company achieves the desired ROCE
5	❖ Profitability statement for the existing distribution model and the new distribution model of dealers is to be analyzed ❖ Staff salary expense will come down by 50%, Commission will be an extra expense, saving in opportunity cost on inventory and savings in interest cost due to dealer deposit are to be considered while preparing the profitability statement
6	❖ The average individual output will increase by 60% and the same will lead to 20 percent increase in wage rate per unit ❖ Incremental contribution = New contribution – Old contribution
7	❖ WIP is to be valued based on 100 percent of material cost and 50 percent of conversion cost ❖ Net benefit of new product = Profit of new product – Inventory carrying cost – loss in contribution of existing product
8	❖ Renewal of lease will lead to reduction of profits by Rs.24 lacs per annum ❖ Transfer to Factory B & Factory C: Prepare marginal costing statement wherein the contribution is shown. The same would move up due to transfer of sales and also increase in variable costs. Fixed costs would change by the amount of increase in fixed overheads and also the apportionment of head office expenses to the other division
9	❖ We need to prepare a profitability statement for the situation when strike happens and strike does not happen ❖ If the strike does not happen then only the variable labour cost increases and based on the profitability statement is prepared

Qn	Summary
	❖ If the strike happens then there will be loss of sales of few products, it will incur overtime premium on few units, incremental fixed cost and also there will be a 10% increase in labour costs
Topic 22: Further processing decisions	
1	❖ For a joint product the relevant cost is variable post separation cost and for a normal product then the relevant cost is overall variable cost ❖ Production of G is recommended in case it is a joint product and the same would not be preferred if it is not a joint product
2	❖ Prepare a product input-output chart ❖ Compute incremental revenues and compare with incremental cost. A product can be processed further if incremental revenues are more than incremental cost and vice versa
Topic 23: Dropping a product line	
1	❖ Division C earns contribution of Rs.2,41,500 and also there is a saving in variable cost of Division A and B. Division A and B has economies of scale benefits and hence its cost is only at 90 percent of the normal cost. Normal cost hence should be Rs.23,00,000 and hence there is a cost saving of Rs.2,30,000 ❖ The company will save fixed cost of Rs.4,14,000 but would incur cost of around Rs.4,71,500 against it and hence should not close the division
Topic 24: Pricing decisions	
1	❖ H and T are joint products. Calculate the existing profit as per the current sal mix ❖ The company receives additional order for T and the same will also lead to incremental order for H. We need to calculate the minimum price to ensure that profits are maintained
2	❖ Retaining same profit per unit: The current profit per unit is Rs.240 per unit. In case the company wants to retain the same profit per unit then the cost of purchase option should match with cost of manufacture. Hence it can pay a maximum of Rs.204 per unit. The cost of manufacture is Rs.210 per part and hence considering the transportation cost it should be Rs.204 per unit ❖ If the company prefers any additional revenue then it would be fine taking the extra volume at zero incremental profit. It can currently sell 25,000 units and the same can give the company a profit of Rs.60,00,000. The target profit for 50,000 units will be Rs.60,00,000 and based on that the purchase price for lower part is to be calculated
3	❖ Assume sales price as X and get sales in terms of X. Capital employed = 8,00,000 + 50% of net sales ❖ Profit = 25 percent of capital employed. Profit = Sales - Total cost. Compute X based on the above equation
4	❖ The company makes profit of Rs.25 per unit and hence the total cost per unit should be Rs.117. The current cost adds upto Rs.115 and the balance Rs.2 per unit can be assumed as fixed/variable ❖ We need to calculate the cost for 6,000 units and compute the sales value to get a profit of Rs.1,67,300. Reverse work and get the selling price
5	❖ Cost of dismantled kit = Cost + Insurance + Freight. Customs duty is to be considered while calculating the cost ❖ Technology fee = 8 crores/ 8 lac computers ❖ Assume royalty as X and sale price to be Y. Based on the two equations finally get the selling price
6	❖ The company needs 12 percent post tax ROCE and hence it would need 20

Qn	Summary
	percent pre-tax ROCE ❖ Sales is assumed as X and based on that Capital employed is to be calculated. Profit will be taken as 20% of ROCE ❖ Sales = Cost + Profit. Calculate selling price per unit after arriving at overall sales value
7	❖ Price = $a - bQ$. a refers to the price at which no sales is made. In this case it will be price of Rs.35 per unit. b refers to the rate of change which is measured as 500 units change for every 0.5 rupees ❖ $MR = a - 2bQ$. Equate MR to MC and then find the optimum level. ❖ Price = $35 - (0.5/500)Q$; $MR = 35 - 2(0.5/500)Q$; When MR is equated to MC then we get optimum level as 9,000 units and the price would be Rs.26 per unit
8	❖ Contribution = 25% of investment. Investment = 40% of plant and machinery and working capital of Rs.2,72,800. Total investment is Rs.18,72,800 and hence desired contribution is Rs.4,68,200 and the cont per unit is Rs.19.51. Desired price = Variable cost + Contribution per unit ❖ Product is newly introduced = Minimum Price = Variable cost ❖ Product is well established = Minimum Price = Total cost
9	❖ Profit = 20% of investment. Get the sales by adding cost and profit and then calculate selling price ❖ Assume list price as X. Profit is 6% of list price and then reverse work and get the list price
10	❖ Sealed bid pricing, Skimming/Penetration Pricing, any cash realizable value, Competitive/Going rate pricing
11	❖ Penetration, Market Price or Just below Market Price, Skimming, any cash realizable value
12	❖ Skimming, Skimming, Penetration, Skimming, Skimming, Penetration, External selling price – saving in costs, variable cost + reasonable markup, any cash realizable value
13	❖ Invalid, Valid, Valid, Valid, Valid
14	❖ Calculate contribution per unit and then total contribution. Select the level which gives maximum contribution
15	❖ Reduce price, Improve quality, improve customer satisfaction, enter new markets
16	❖ Skimming Pricing, Penetration Pricing, Skimming Pricing, Penetration Pricing
17	❖ Me-too product & Market Price ❖ Revolutionary product & Premium Price ❖ Evolutionary product & Demand based pricing
Topic 25: Pareto Analysis	
1	❖ Arrange the defects in the descending order of value. Compute cumulative defects as percentage of total defects and this would help us in finding the most important reasons for defects
2	❖ Arrange the products in the descending order of sales and calculate cumulative sales as percentage of total sales. Identify the products which contribute to 80 percent of sales ❖ Arrange the products in the descending order of contribution and calculate cumulative contribution as percentage of total contribution. Identify the products which contribute to 80 percent of contribution
Topic 26: Flexible budget	
1	❖ Overhead A will proportionately change with units change and hence has to be

Qn	Summary
	measured for 5,000 units as Rs.12/hr * 2 hours * 5,000 units ❖ Overhead B is a semi-variable OH. We need to split into variable and fixed and then compute the semi-variable OH ❖ Overhead C is a fixed and will remain same for flexible budget
2	❖ Actual sales has to be adjusted for sales price variance to get the percentage of capacity utilization. The capacity utilization will be 80.74% ❖ Variable cost can be considered as 80.74% of the full capacity cost. Fixed cost will remain same. Semi-variable cost has to be split for fixed and variable and then the cost is to be calculated
3	❖ Invalid, Invalid, Invalid, Valid & Valid
4	❖ Flexible budget is to be revised for 3,200 units ❖ DM, DL and VOH will change based on change in volume. FOH will remain same and then total cost can be calculated ❖ Variances have to be computed using the normal standard costing formulae
5	❖ Material units would be comparing budgeted quantity with budgeted output ❖ Material price would be computing by comparing the percentage increase in price and then applying the same percentage again on revised price ❖ Labour rate will increase by 20 paise but the number of labour hours will be computed as standard hours divided by 90 percent. The rate increase has to be applied on the actual labour rate. (Institute material they have multiplied with 110 percent. The same is incorrect and it should be divided by 90 percent)
Topic 27: Functional budgets	
1	❖ Production = Sales + Closing stock - Opening stock ❖ Prepare RM consumption based on purchases. Based on RM consumption compute the amount of RM purchases to be made ❖ Principal budget factor is one which constrains the sale of units. If the company does not have adequate labour hours then the same become principal budget factor. If the company has adequate labour then sales will continue to be the principal budget factor
2	❖ Cash budget is to be prepared which will show various receipts and payments ❖ Receipts = Cash sales, Collections from customers ❖ Payments = Purchases, office expenses, Interest, Advance Tax, Rent
3	❖ Compute production with sales, closing stock and opening stock of FG ❖ Use this and compute consumption. Based on consumption we need to purchase of RM ❖ Find the number of labour hours required. Anything upto 40 hours a week will be normal time and beyond that it will be overtime. We need to consider higher rate for hours beyond normal time
4	❖ Calculate the VC per unit and total variable cost for the period. Total variable cost = Sales - FOH - profit ❖ Compute units to be produced as = Sales + Closing stock - Opening stock ❖ Compute units to be consumed based on production and post that calculate the units to be consumed
5	❖ Production of M & N = Sales + Closing Stock - Opening Stock ❖ Compute the desired consumption of raw material using the formula: production * Input / Output ❖ $EOQ = \sqrt{2 * \text{Annual Demand} * \text{Ordering cost} / (\text{Carrying cost})}$
6	❖ Annual production = Sales + Closing stock of FG - Opening stock. This has to be split into quarter wise based on 80% of current quarter sales and 20% of next

Qn	Summary
	quarter sales ❖ $\text{RM Consumption} = \text{Annual Production} * (\text{Input/Output})$ ❖ $\text{RM Purchases} = \text{Closing stock of RM} + \text{Consumption} - \text{Opening stock of RM}$
7	❖ Prepare a cost sheet to get the missing information ❖ $\text{DM} + \text{DL} + \text{VOH} + \text{Opening WIP} - \text{Closing WIP} = \text{Variable cost of goods manufactured}$ ❖ $\text{Variable cost of goods manufactured} + \text{Opening FG} - \text{Closing FG} = \text{Variable cost of goods sold}$
8	❖ Similar to question no.4
9	❖ $\text{Production} = \text{Closing stock of FG} + \text{Sales} - \text{Opening stock of FG}$ ❖ Compute annual consumption of RM based on Production ❖ $\text{RM Purchases} = \text{Closing stock} + \text{Consumption} - \text{Opening stock}$. We need to consider processing loss while calculating this
Topic 28: Zero based budgeting	
1	❖ Lack of coordinated goals, Influence of uncontrollable factors, short-run perspectives are the current problems in the system
2	❖ Traditional, Traditional, Zero base and Zero base
3	❖ $\text{Budget for street maintenance} = \text{No of KM} * (\text{Last year cost} * (1 + \text{inflation rate} * (1 + \text{weather related increase})))$ ❖ Zero based budgeting is a process wherein the budgets are prepared without taking any base information
Topic 29: Cost and sales variances	
1	❖ Simple problem for material variances with no special adjustments ❖ $\text{SQ} = \text{AO} * \text{Input /Output}$
2	❖ Calculate SQ of B using Material Usage Variance ❖ Mix of two products will be 1:1. Assume AQ of A as X and get RSQ as total of AQ split in the ratio of 1:1 ❖ Use the material mix variance and then get the missing figures
3	❖ Simple problem for labour variances
4	❖ Use hours approach for calculation of missing figures ❖ There is no days information and hence the four columns would be $\text{SR} * \text{SH}$, AFOH , BFOH and $\text{SR} * \text{AH}$ ❖ Use the variances information and then compute missing information
5	❖ Favorable Fixed OH Volume Variance, Adverse Material Usage, Adverse material usage and favorable material price, adverse sales price, adverse material price, adverse labour efficiency, adverse market share variance
6	❖ Labour rate variance will be the difference between $\text{SR} * \text{AH} - \text{AR} * \text{AH}$ ❖ Labour efficiency variance is the difference between $\text{SR} * \text{SH} - \text{SR} * \text{AH}$ ❖ Sales volume Variance is the difference between $\text{BM} * \text{AQ} - \text{BM} * \text{BQ}$ ❖ Sales Price variance is the difference between $\text{AM} * \text{AQ} - \text{BM} * \text{AQ}$
7	❖ Material variances: Compute actual material cost by considering the opening stock purchase at standard price and current purchase at the purchase price ❖ Other variances are to be computed in the normal manner with no special adjustment
8	❖ $\text{Number of units produced} = \text{OH absorbed} / \text{SR per unit}$ ❖ OH absorbed can be calculated by comparing it with overhead incurred and overhead incurred can be calculated with the help of FOH expenditure variance
9	❖ Simple problem on all variances - no special adjustment

Qn	Summary
10	❖ Simple problem on all variances – no special adjustment
11	❖ Critical success factors are quality, price, delivery options, attractive packing ❖ Purchase price variance and labour efficiency variance is favorable and the same may indicate that the company is using inferior quality raw material. Hence the company has been going against its critical success factor of quality
Topic 30: Variances with equivalent units	
1	❖ Equivalent units are to be calculated based on process costing ❖ Material equivalent units should be taken as base for calculating SQ. Labour equivalent units should be used as base for SH calculation. Units sold should be taken for calculating sales variances
Topic 31: FOH ratios	
1	❖ Efficiency ratio = Standard hours/actual hours ❖ Activity ratio = Standard Hours/ Budgeted hours ❖ Capacity ratio = Actual hours/ Budgeted hours ❖ Activity ratio = Efficiency ratio * Capacity ratio
2	❖ Efficiency ratio = Standard hours/actual hours ❖ Activity ratio = Standard Hours/ Budgeted hours ❖ Capacity ratio = Actual hours/ Budgeted hours ❖ Activity ratio = Efficiency ratio * Capacity ratio
Topic 32: Reconciliation of cost and profits	
1	❖ Good problem on understanding all reconciliation approaches ❖ No special adjustment in computation of variances ❖ Budget to Actual – Absorption – All variances are considered ❖ Budget to Actual – Marginal – FOH volume variance is ignored ❖ Standard to Actual – Absorption – Sales margin volume variance is ignored ❖ Standard to Actual – Marginal – FOH volume and sales margin volume variance is ignored ❖ Budgeted profit – Absorption – Budgeted units * Budgeted profit/unit ❖ Budgeted profit – Marginal – (Budgeted units * Budgeted cont/unit) – BFOH ❖ Standard profit – Absorption – Actual units * Budgeted profit/unit ❖ Standard profit – Marginal – (Actual units * Budgeted cont/unit) – BFOH
2	❖ Assume no of units as 100 and also it is assumed that one unit require 1 KG of RM and 1 labour hour ❖ Data of 2015 are standards and 2016 are actuals ❖ Compute all variances and use marginal costing approach for reconciliation
Topic 33: Partial plan versus single plan	
1	❖ Partial plan recognizes variances only post consumption of material whereas single plan will recognize the same at the time of receipt of material ❖ All variances in partial plan originate from WIP account whereas the same for single plan is from respective control account ❖ RM is valued at actual cost in partial plan and the same is valued at standard cost in single plan
2	❖ Refer theory part on journal entries
Topic 34: Planning and operating variances	
1	❖ Planning variance refers to the difference between original budget and revised budget whereas operating variance refers to the difference between revised budget and actual
2	❖ Traditional approach computes variances in the normal manner

Qn	Summary
	❖ Planning variance is the difference between original budget and revised budget whereas operating variance is the difference between revised budget and actual
Topic 35: Growth, Productivity and Price recovery variances	
1	❖ Growth component is the Sales volume variance and the difference between budgeted cost and standard cost ❖ Price recovery component is material price variance, labour rate variance, FOH expenditure variance, VOH expenditure variance and sales price variance ❖ Productivity component is material usage variance, labour efficiency variance, FOH volume and VOH efficiency variance
2	❖ Growth component can be split into market size and market share factor. Market share factor is attributable to product differentiation component ❖ Price recovery will get mapped to product differentiation component ❖ Productivity will get mapped to productivity component
Topic 36: Market size and share variances	
1	❖ Reconciliation will have sales variances and cost variances ❖ Sales variances will be split as sales price and sales volume variance. Sales volume variance can be split as market size and market share variance ❖ Cost variance will have variable cost variance and fixed cost variance. Variable cost variance will be the difference between standard variable cost and actual variable cost whereas fixed cost variance will be the difference between budgeted fixed cost and actual fixed cost
2	❖ Sales mix variance is the difference between RBQ and AQ whereas sales quantity variance is the difference between BQ and RBQ ❖ Market size variance is the difference between original budget and new budget whereas market share is the difference between new budget and revised budget
Topic 37: Reverse working problems	
1	❖ Actual cost for each cost component is available and with the help of variances we can compute standard cost ❖ We can then go ahead compute SP, SQ, SR, SH and Standard variable OH rate
2	❖ Reverse work problem with no special adjustment
3	❖ Commission at 5% percentage is earned and the same can be used to compute actual sales ❖ Actual sales is to be adjusted with sales volume variance and sales price variance to get budgeted sales ❖ Budgeted margin = Budgeted sales - Budgeted cost. This amount is to be adjusted with sales price variance and sales margin mix variance to get the actual margin
Topic 38: Activity based costing and ABC Analysis	
1	❖ Expenditure Variance = Difference between budgeted expenditure and actual expenditure ❖ Efficiency variance = The company should have done 21 deliveries for 2100 units and hence the difference between standard cost of 21 and 19 deliveries
Topic 39: Costing of service sector	
1	❖ The current revenues has to be split into three segments. The gross margins for three segments are available and the same can be used for calculating the current profit ❖ The company needs 20 percent increase in profit and the same would be the additional targeted profit. Profit from existing operations are not impacted due to the two suggestions

Qn	Summary
	❖ Profit per two night holiday = 70% of accommodation + 20% of restaurant + 30% of bar ❖ No of room nights to be sold = Incremental profit / Profit per two night holiday ❖ Second suggestion: The group will be making extra profit due to increase in charges in restaurant and bar division. Increase in prices will directly lead to higher profit as there are no costs associated with it. This will be compared with targeted increase in profit and the balancing figure would be requirement from accommodation. The required increase in accommodation charges is to be compared with original accommodation revenue to identify the percentage increase in accommodation revenues
2	❖ Simple problem on concept of relevance costs ❖ Capture the relevant costs of three proposals and select the proposal having the lowest cost
3	❖ Operating cost statement can be prepared for a single bus ❖ Petrol, lubricants & sundries etc will be calculated based on kilometres travelled ❖ KM per bus = (Passenger KM per bus/40) ❖ Get the total cost and add desired margin. The rate per passenger KM can be arrived by dividing the revenues with no of passenger KM ❖ Part two: The margins of the company will decline as some of the expenses will increase due to inflation. Depreciation and route permit charges will not have impact of inflation
4	❖ Original scenario: The company will have 240 passengers and they will give contribution of Rs.4,200 per passenger (fare – commission – food cost). The fixed cost against this is annual lease cost, ground services and flight crew services cost, fuel cost. BEP can be computed by dividing the fixed cost with contribution per passenger ❖ Part 2: The company will have to first find out the number of passengers travelling in different routes. 50 passengers will travel from D to B as per haltgo offer. ❖ The no of passengers for A to B can be 215 (240 -25 lost). However the number will be restricted to 210 as 50 seats will have to be given to Haltgo passengers from D to B ❖ The no of passenger from A to D will be 50 as compared to demand of 60. Consider incremental contribution and fixed cost and decide on the selection of the alternative
5	❖ Variable cost per room day is available. The occupancy levels for off-season and normal season can help in getting the number of room days. The same can be used for getting total variable cost ❖ Total cost = Variable cost + fixed cost. Sales is computed with the help of the given profit margin ❖ We can therefore calculate the tariff per day by dividing overall sales by the number of room days ❖ BEP = Total fixed cost / Contribution per room day. Subtract the number of rooms of off-season to get the required occupancy of normal season ❖ Contribution per room day is to be calculated and the same can be multiplied with overall room days to get contribution. We can compute profit with the help of this contribution ❖ Target contribution = Current profit + Fixed cost. Contribution per room day is 150 and overall contribution divided by contribution per day would give us the

Qn	Summary
	number of room days and hence the desired increase in occupancy
6	❖ Direct wages per week for various activities are given and the same needs to be recorded ❖ Direct expenses per week needs to be computed for house keeping and restaurant activity ❖ The direct expenses of general departments needs to be apportioned between house-keeping and restaurant on the basis of direct wages ❖ Indirect expenses should be split between house-keeping and restaurant on the basis of floor area. The amount should be calculated as per week ❖ There will be 60% occupancy and hence 294 room nights per week. This will give the cost per room night for house-keeping and restaurant. We need to add food charges in restaurant. Add profit margins and then get the final charges
7	❖ Patient days, Room nights/room days, Passenger KM/Tonne KM, No of meals/staff
8	❖ Similar to question no.1
9	❖ Calculate the number of patients attended by multiplying the no of patient per physicians * No of physicians * Number of days * Number of weeks ❖ Split the number of patients into the various patient mix. Also identify the mix of patient appointments ❖ Compute the revenues as per the given revenue structure and calculate profit ❖ Compute contribution per patient and then find out the break-even number of patients. Then convert the same into occupancy percentages.
Topic 40: Transfer Pricing	
1	❖ G, G, R, G
2	❖ Identify the current product mix of the company based on the transfer price of Rs.290 per unit ❖ Transfer price will have an impact on overall company profits if the company operates at a level different from the optimum level due to wrong transfer price. Find the optimum level from company point of view and see whether the overall profits are impacted ❖ Transfer price will have a range. Minimum transfer price = (VC + OC); Maximum transfer price = NMR at OL / Incremental units
3	❖ We are required to find strategy of division A in this question. The benefit for Division A will be the reduced purchase price and the loss for Division A will be the loss in contribution ❖ We need to compare both and select an alternative which has the highest net benefit ❖ Rate of change in discount: Discount changes from Rs.1900 to Rs.1600 for two alternatives. Rate of change = Change in discount/Market price
4	❖ Transfer price = VC + Opportunity cost ❖ Opportunity cost = (Contribution without internal transfer) - (Contribution with internal transfer)
5	❖ Department Y and Z need material X as their input ❖ We need to first identify the strategy of Division Z and decide whether to expand or not. Similarly strategy of Division Y is to be identified ❖ Strategy of Division X would depend on the strategy of Division Y and Division Z
6	❖ Transfers have to happen at opportunity cost. Transfer price = [(VC * Units not having external demand) + (SP * Units having external demand)] / Total units transferred

Qn	Summary
	❖ Impact on profit = (Purchase price - Transfer price) * Units transferred
7	❖ Price = $a - bQ$. a refers to the price at which no sales is made. b refers to the rate of change ❖ $MR = a - 2bQ$. Equate MR to MC and then find the optimum level.
8	❖ Indian subsidiary will have cost savings due to purchase from the Indian supplier. This is because of lower purchase price and we need to calculate the post tax savings for Indian subsidiary ❖ Chinese subsidiary will lose sale of 30,000 units and will incur excise duty on 1,20,000 units. We need to calculate post-tax savings additional cost and compare the savings with additional cost
9	<u>Transfer price from Division A point of view</u> ❖ Option 1 - Loss is sale of product PC and hence that contribution has to be recovered from internal transfer ❖ Option 2 - Proportionate loss of product PC and AC and hence the contribution of that has to be recovered from internal transfer ❖ Maximum Price which B will offer = External purchase price - Modification cost ❖ <u>Part 4 & 5:</u> Division A should transfer units to Division B as the minimum transfer price is lower than maximum transfer price
10	❖ Part one: Prepare a revised profitability statement with changes in selling price. The component cost is to be taken as Rs.35 per unit ❖ Part two: Division Y has production capacity of 85,000 units and hence has to lose external demand if it has to fully meet internal demand. Prepare two profitability statement and decide on the best option
11	❖ Part 1 - TP based on full cost would be double of total cost (VC + FC) - Second option for TP would be based on current market price of 9,000 Yen ❖ Part 2 - Simple profitability statement
12	❖ Division B wants to purchase 40,000 units and hence outside sale can be only 60,000 units. ❖ Revenues of 1,00,000 units = Total cost + Interest cost + Target Profit ❖ Revenues from internal transfers = Total revenues - external revenues. Based on this we need to compute the transfer price ❖ Part two: First 30,000 units does not have any external demand and hence the transfer price would be equal to variable cost. Balance 10,000 units have external demand and for this the transfer price would be variable cost + Opportunity cost
<u>Topic 41: Direct Product Profitability / Consumer Profitability Analysis</u>	
1	❖ Principles of Activity Based Costing is to be used for preparing profitability statement using DPP method ❖ Cost driver quantity is to be taken as cubic metres and the cost per cubic metre is to be calculated for various products. ❖ OH cost has been given per month and hence ❖ Overhead costs is to be divided by the number of units to get the OH cost per unit. Compare gross margin and OH cost/unit to get the profit
2	❖ We have to calculate the profitability statement for both customers in the normal way. Discount of 5% will be applicable for both customers whereas discount of 8% on original price is applicable for customer B as he takes the delivery ❖ Profitability of customer B is significantly lower due to the above discount and hence the company should review its discount policy
3	❖ Customer wise profitability statement has to be calculated based on the principles of ABC

Qn	Summary
4	❖ Customer wise profitability statement is required ❖ Profit = Sales - Order processing cost - Variable cost - Discount - Regular delivery cost - Expedited delivery cost ❖ General administration cost is to be deducted from the overall profit of the channel (small pharma and large pharma)
5	❖ Customer profitability statement is prepared based on the principles of ABC
Topic 42: Balanced Scorecard	
1	❖ Innovation/learning perspective, Financial perspective & customer perspective
2	❖ Innovation and learning, Internal business, Customer, Innovation and learning, Internal business, Financial, Financial, Customer
3	❖ Customer, Learning and Growth, Internal Business, Learning and Growth
4	❖ Customer perspective - Increase the customer loyalty - Percentage of customers using loyalty cards ❖ Internal business - Customer to pay in reasonable time - Time spent by customers in queue to pay for products ❖ Learning and Growth - Qualified staff able to meet the needs of customers - No of staff training days
5	❖ Financial perspective - Operating ratio has increased for the year instead of the target of reducing it ❖ Financial perspective - Average revenue per user has increased but the target has not been met ❖ Customer perspective - The company wanted to reduce the number of customer complaints. However the complaints have increased ❖ Internal business perspective - Increasing the customer relationship centres is part of this perspective. Company has met this target ❖ Learning and growth perspective - Employee coverage under training is covered in this - the company has not been able to meet this target
6	❖ Internal business perspective, customer perspective, customer perspective, Internal business, Learning and growth, Financial, Learning and Growth, Customer, Financial, Customer
Topic 43: Simplex Method	
1	❖ There are three products in the question and hence the objective function will have three variables. However 30 units of X3 is to be exactly produced and hence the same can be converted into fixed profit of Rs.150 ❖ The available resources has to be reduced by the utilization for X3 and then the same should be solved by simplex method
2	❖ A feasible solution is one which does not have artificial variable in the solution. Hence the given solution is a feasible one ❖ The given solution is also an optimal one as the various variables of NER is less than or equal to zero. However there exist an alternative solution as one of the non-program variables (X2) has NER of 0. Perform one more step of iteration and get the shadow prices ❖ Shadow prices refers to the NER of the various slack variables ❖ NER of product X3 will tell us how much should be the price increase for it to form part of final solution ❖ Only one product has entered in the given table and hence the same would be the second table. We will have to reverse work and get the original table and then get to the desired answer

Qn	Summary
3	❖ Test of optimality can be done by getting the NER and the solution will be optimal if all NER is less than or equal to zero ❖ Alternative optimal solution exist if one of the non-program variable has NER of zero ❖ Feasible solution is one which has no artificial variable in the solution ❖ Degeneracy is the situation where one of the variables has quantity of zero ❖ Objective function is the initial equation. Profit has to be computed by substituting the quantity in the objective function ❖ Machines not being fully utilized will form part of the final solution. S3 is not being fully utilized in this case ❖ Payment for one hour of machine would be equal to the shadow price as seen in NER ❖ Machine having highest shadow price should be given priority for expansion ❖ Loss in profit = Loss in hours * Shadow Price ❖ Price increase for Z = NER of Z ❖ Profitability of new product = Base profit - Shadow costs
4	❖ Co-efficient of S1, S2 and A2 = 0,0 & -M in equation 1 ❖ Co-efficient of S1, S2 and A2 = 0,-1 & 1 in equation 3 ❖ Slack variable = S1; Surplus variable = S2 ❖ S1 and A2 form part of initial solution ❖ Part 4: Co-efficient of S1, S2 and A2 = 0,0 & M in equation 1 ❖ Co-efficient of S1, S2 and A2 = 0,-1 & 1 in equation 3
5	❖ Co-efficient in objective function = +M. M indicates infinity and hence you will have infinite cost in case the same part of final solution ❖ S1 and S2 will not form part of initial solution as they have negative 1 co-efficient
6	❖ Similar to question no.3
7	❖ Application theory question – refer theory module for answer
8	❖ Two products are there and three constraint equations can be formed ❖ We can solve this problem using graphical method
Topic 44: Graphical Method	
1	❖ Three constraints and one objective function is to be developed ❖ We need to assume one of the variable as 0 and get the two co-ordinates for every constraint ❖ Prepare graph and find the common area. The other corners will form part of the feasible solution and select the level which gives maximum profit
2	❖ Objective is to maximize reach ❖ Variables: No of radio programmes and No of TV Programmes ❖ Constraints: Maximum budget, maximum radio and minimum TV
3	❖ Objective function: Maximize return ❖ Constraints: Minimum return, maximum risk, maximum limit on investment of portfolio X and Y, maximum limit on overall investment
4	❖ We need to assume one of the variable as 0 and get the two co-ordinates for every constraint ❖ Prepare graph and find the common area. The other corners will form part of the feasible solution and select the level which gives maximum profit
5	❖ Primal can be converted into dual by doing transpose of the matrix ❖ The minimization function will become maximization function in dual ❖ $\geq$ constraint will become $\leq$ constraint
Topic 45: LPP Formulation	

Qn	Summary
1	❖ Objective is to maximize the number of principal buyers. The same would be 20,000 for A, 9,000 for B and 3,200 for C ❖ Constraints: Total advertisement cost, maximum limit on A, Minimum limit of B and C
2	❖ Objective function will have 3 products and its profits ❖ Constraint no.1 will be on operation 1 time and constraint no.2 will be on operation 2 time ❖ The company can sell maximum of product R and the same will also be one constraint ❖ Relationship between product Q and R to be shown as one constraint
3	❖ Objective function: Maximize return ❖ Constraints: Minimum return, maximum risk, maximum limit on investment of stock and mutual fund
4	❖ Objective is to maximize return. We can assume the various variables as amount invested in each of the asset class ❖ Various constraints are investment in Govt Bonds, total investment, investment in shares, investment in money market, investment in shares to be not more than investment in mutual fund, investment in mutual fund
5	❖ Contribution for three products are to be calculated by subtracting the raw material cost. RM cost is computed as given percentage of three products multiplied with respective cost per kg. The composition of inert ingredients will be 80 percent for all three products ❖ RM availability has to be developed as three constraints ❖ Production constraint of product 1 has to be developed as one constraint
6	❖ Objective is to maximize interest income ❖ Constraint: Loan limit, 30% limit for farm and commercial loans, 50% limit for home loans, 5% limit for bad debts
Topic 46: Transportation	
1	❖ Unbalanced maximization transportation problem with no special adjustment
2	❖ Initial basic feasible solution is given. We need to check for optimality directly ❖ Carrier of route C wants to II wants to take the entire quantity. This will have reallocation of other costs and hence the overall costs can go up. The increase in cost has to be absorbed as a discount by the carrier of route C to II
3	❖ Initial basic feasible solution is to be found and later on the same is to be tested for optimality ❖ An alternative solution can exist in case Delta (ij) table has zero for any of the non-allocated cells
4	❖ Convert the given matrix into an opportunity loss matrix. Opportunity loss matrix is identified by subtracting all elements of profit matrix from the highest element of the matrix ❖ Get the initial solution through VAM
5	❖ Initial solution through 3 methods to be found with no special adjustment
6	❖ A dummy row is to be introduced to make it a balanced transportation problem. There will be 9 columns and if the allocations are less than 8 then we will have degeneracy
7	❖ Not mandatory as R2C2 can form part of the solution
8	❖ Feasible is one where the supply and demand of various locations are met ❖ Degeneracy is a scenario where the number of allocations is less than $m+n-1$

Qn	Summary
	❖ An optimum solution is one where all elements of Delta (ij) table are greater than or equal to zero
9	❖ Initial solution through 3 methods to be found with no special adjustment
10	❖ A dummy row is to be introduced to make it a balanced transportation problem. There will be 9 columns and if the allocations are less than 8 then we will have degeneracy
11	❖ Similar to question no.2
12	❖ Given problem can be treated as an assignment problem and be solved using rules of assignment
13	❖ Initial solution has been given and an alternative solution exist as one of Delta (ij) element is zero. We need to draw a loop from zero and find the alternative solution
14	❖ Initial solution has to be computed as per least cost method and North west corner rule ❖ Degeneracy can come if the number of allocations are less than $m+n-1$. Number of allocations can be lesser if a row and column both gets cancelled with one allocation. The same can happen if D2 and D3 is mapped with F3
15	❖ Balanced minimization problem - no special adjustment
Topic 47: Assignment	
1	❖ Unbalanced minimization problem with no special adjustment
2	❖ Two zeroes in initial matrix need not be same as one of the zero could have been created out of column operations ❖ Two allocations are already done and the balance allocation can be either combination of first row with 4 th column or 1 st column. Other allocation can be combination of fourth row with 1 st column or 4 th column
3	❖ We need to draw minimum number of lines to cover zeroes and the same would have been possible in less than 4 lines. Hence we will not get a solution ❖ Part two : We need to draw the matrix and do a reverse working to get the solution
4	❖ Unbalanced minimization problem with no special adjustment ❖ Rejected method has to be compared with other methods to find out the required savings in time
5	❖ We need to follow trial and error method to get the final allocation
6	❖ A is possible, B is not possible, C and D are not possible
7	❖ Two zeroes in initial matrix need not be same as one of the zero could have been created out of column operations ❖ Two allocations are already done and the balance allocation can be either combination of first row with 4 th column or 1 st column. Other allocation can be combination of fourth row with 1 st column or 4 th column
8	❖ Balanced minimization problem with no special adjustment
9	❖ We can get a solution if R3C3 is zero ❖ Second solution: If other elements are zero then we have to do column operations to get extra zero and then get a solution
10	❖ Balanced minimization problem with no special adjustment
11	❖ We need to follow trial and error method to get the final allocation
12	❖ Balanced maximization problem with no special adjustment
13	❖ Create a layover time for stay at Kolkata and a table for layover at Bangkok ❖ Compare both matrix and get minimum of every cell and then do normal row and

Qn	Summary
	- column operations ❖ Check for optimality
14	❖ If we draw the number of lines then it will be only two and hence we have to find the least open element ❖ The LOE will be added at the intersection of first row and first column and hence it will not form part of the final solution
15	❖ False, False, False, True
Topic 48: CPM & PERT	
1	❖ Draw the network diagram and calculate E and L values for every node ❖ The path with the longest duration will be critical path. The activities on critical path will have same E and L ❖ Total float = LFT - EFT; Free float = Total Float - Slack of head event
2	❖ Invalid, Valid, Invalid, Invalid, Invalid and Valid
3	❖ Draw network diagram and find the various paths ❖ Prepare cost slope table and find the maximum possible reduction in time for every activity ❖ Prepare crashing table till one of the paths is fully crashed out ❖ Find the duration which has the lowest cost and the same will be the optimum duration
4	❖ Draw the network diagram and find the various time estimates such as EST, EFT, LFT and LST ❖ Activities having LFT of less than 15 days should have been completed by day 15 and all activities have LST of less than 15 days should have been started by day 15. If these is not followed then overall project duration will increase ❖ We need to update the revised network diagram as per the changes in the various activities
5	❖ Draw network diagram and calculate E and L for various nodes ❖ Activities having same E and L will form part of critical path. Critical path will have the longest duration ❖ Project cost = Normal cost of various activities + Critical path duration * 115/day
6	❖ Expected time for an activity = (Pessimistic time + Optimistic time + 4* Most likely time)/6 ❖ Variance of an activity = [(Pessimistic time - Optimistic time)/6]^2 ❖ Variance of critical path = Sum of variances of various activities forming part of critical path ❖ Critical path duration will get revised as the duration of one of the activities forming part of critical path undergoes a change
7	❖ Draw network diagram and find the various paths ❖ Prepare cost slope table and find the maximum possible reduction in time for every activity ❖ Prepare crashing table till one of the paths is fully crashed out ❖ Find the duration which has the lowest cost and the same will be the optimum duration ❖ Find the duration with minimum time and the associated cost
8	❖ Expected time for an activity = (Pessimistic time + Optimistic time + 4* Most likely time)/6 ❖ Variance of an activity = [(Pessimistic time - Optimistic time)/6]^2 ❖ Variance of critical path = Sum of variances of various activities forming part of critical path

Qn	Summary
	❖ Probability can be calculated with the help of Z value. $Z = (\text{Target time} - \text{Normal time}) / \text{SD of critical path}$
9	❖ Draw network diagram and find the various paths ❖ Prepare cost slope table and find the maximum possible reduction in time for every activity ❖ Prepare crashing table till one of the paths is fully crashed out ❖ Find the duration which has the lowest cost and the same will be the optimum duration ❖ Find the duration with minimum time and the associated cost
10	❖ Draw network diagram and find the various paths ❖ Prepare cost slope table and find the maximum possible reduction in time for every activity ❖ Prepare crashing table till one of the paths is fully crashed out ❖ Find the duration which has the lowest cost and the same will be the optimum duration ❖ Find the duration with minimum time and the associated cost
11	❖ P and Q are parallel activities. These activities can be corrected by drawing a dummy activity
12	❖ Draw the network diagram and list down the various path ❖ Identify the various time estimates by doing a reverse working on EST, TF and duration
13	❖ Invalid, Valid, Invalid, Invalid, Invalid and Valid
14	❖ Normal network diagram with no special adjustments
15	❖ Draw the network diagram and find the various time estimates such as EST, EFT, LFT and LST ❖ Activities having LFT of less than 15 days should have been completed by day 15 and all activities have LST of less than 15 days should have been started by day 15. If these is not followed then overall project duration will increase ❖ We need to update the revised network diagram as per the changes in the various activities
16	❖ Draw network diagram and find the various paths ❖ Prepare cost slope table and find the maximum possible reduction in time for every activity ❖ Prepare crashing table till one of the paths is fully crashed out ❖ Find the duration which has the lowest cost and the same will be the optimum duration
17	❖ Duration of activity = Difference between EST and EFT ❖ $LST = LST + \text{Duration}$ ❖ $TF = LFT - EST$ ❖ Activities with TF of 0 form part of critical path ❖ Draw a network diagram and then do the crashing of the low cost activities
18	❖ Similar to question no.8
Topic 49: Simulation	
1	❖ Fit single digit random number for every year cash flow ❖ Run the model and get the cash flow of each year. Calculate NPV of the identified cash flow structure ❖ Find the average NPV for the five experiments
2	❖ Closing cash balance = Opening cash balance + Sales - Wages - RM cost

Qn	Summary
	❖ Find sales, Wages and RM cost with the random number table
3	❖ Fit random number table for demand ❖ Find the stock position of each day with these columns, Opening balance, RN for demand, Demand Quantity, Units received, Closing balance, Units under order, Need for fresh order ❖ Select the option at which the total of ordering and carrying cost is lowest
4	❖ Draw a network diagram and find the normal duration of the project. The path with the longest duration is the critical path. Duration of the critical path is the project duration ❖ Crashing steps: Identify the various paths, prepare cost slope table, do step-by-step crashing to reduce duration, find the cost associated with the crashing for 5 days ❖ Part three: Look at the network diagram and find the various activities which can be relaxed. We can relax only non-critical activities as the same will not increase the duration but will save cost for the company
5	❖ Random number tables have already been prepared for patient arrival time and consultation time ❖ The patient has to arrive every 20 mins and their time of arrival can change depending on whether they come early/late ❖ Patient waiting time is the difference between patient in time and patient service start time ❖ Dietician waiting time is the difference between service end time of one patient and the service start time of next patient ❖ The dietician should look at increasing the gap between two appointments for them to reduce the waiting time of patients
6	❖ Identify the demand for every day using the RN table ❖ Profit for 10 days = (Units sold * SP) - (Units produced * Production cost) - (Unmet demand * Penalty) - (Unsold cake * Penalty)
7	❖ Fit random number table for demand of fresh cake and one day old cake ❖ Order on day 1 would depend on the stock position of day 0 and also the demand of previous day. The order placed on day 1 would be received on day 2 and will be utilized for meeting the demand of day 2 ❖ Profit = Sale value of fresh cakes - sale value of old cake - Purchase cost
8	❖ Prepare a random number table for arrival and service ❖ Run the simulation exercise and find out the number of laptops under service by end of every day
9	❖ Fit in a random number table for demand ❖ Find the demand for every units ❖ To a unit reconciliation with these columns: Opening stock, Purchase, Sales, units scrapped, Closing stock ❖ Profit = Value of sales - Value of purchases + Value of closing stock - Value of opening stock
10	❖ Fit random number table for time to deal with clients and time between call arrivals ❖ Start with minute 0 and find the call in time of first caller. Service start time for first caller will be the call in-time itself ❖ Service start time for second caller will depend on service end time of first caller. If the waiting time is more 10 minutes then a gift voucher is to be given ❖ Weekly cost = (Cost during simulation period / Simulation period in mins) * 4500

Qn	Summary
	mins
11	❖ Random number table is to be fit for type of service (manual and automated) and arrival rate ❖ The probabilities are given in the question and we need
12	❖ Draw a network diagram and identify the various possible paths ❖ Prepare random number table for each activity and find the time taken for each activity ❖ Critical path will be the one which takes the longest time for each of the trial
13	❖ Fit random number table for demand, CPU, advertising cost and investment ❖ Calculate profit for each trial. Profit = Demand * CPU - Advertising cost ❖ ROI = Profit / Investment
14	❖ Prepare random number table for receipt and payment. Find the closing cash balance as opening balance + Receipt - Payment ❖ If the closing cash balance is negative then the same indicates that the bank will fall short in payment ❖ Probability of shortfall with OD of 45 crores = No of months having shortfall of more than 45 crores / 12
15	❖ Fit random number table for demand and supply ❖ Profit = Value of sales - Value of purchases - (unmet demand * 8)
16	❖ Calculate the probability for demand and then fix the random number for the same ❖ Run the simulation exercise and then estimate the demand ❖ Loss due to non-fulfillment of demand = Demand lost * Profit per unit
Topic 50: Learning curve	
1	❖ Part one: The company plans to produce 4 units and hence the labour cost can be identifying using multiplication technique. Average labour time for 4 units = Average labour time of 2 units * 90%; Average labour time of 2 units = Time for 1st unit * 90%. ❖ Part two: Learning curve benefit is not applicable if different people work on the order and hence the price identified in part one cannot be justified
2	❖ The overall variable cost for unit 1 is 4,400. 50% of these costs are having learning benefit and the balance 50% do not have this benefit ❖ The average variable cost for 4 units is Rs.4,120. This will be split as 2,200 for part where learning benefit is not there and Rs.1,920 where learning benefit is available ❖ Average labour cost for 4 units = Average cost for 1 unit * LR * LR. Solving this equation we will get learning ratio ❖ Part two: We need to calculate the average cost at various levels and then find out the contribution which can be earned. The price level giving maximum contribution will be selected ❖ Learning co-efficient of learning ratio = Log of learning ratio / Log of 2
3	❖ Learning curve ratio will help us in getting the average time. Average time of 2 units = Time of unit 1 * Learning curve ratio ❖ Time for 2nd unit = Total time for 2 units - Time for 1st unit
4	❖ Average time for 25 batches = Average time for 1 batch * (25)^{Learning co-efficient} ❖ Time for 25th batch = Total time for 25 batches - Total time for 24 batches ❖ Average selling price for 500 units: Labour cost (total time for 25 batches + time of 25th batch * 25) + Other cost + Fixed cost + Desired Profit - Sales value of first 4,500 units

Qn	Summary
5	❖ Not valid, Valid, Valid and Not valid
6	❖ The company has two options for meeting the P Limited order. It can use its own workforce for P Limited order or use the services of P Limited's workforce ❖ The above options has different cost structure as the learning curve benefit is applicable for full 8 units (option 1) or first 4 units and then balance 4 units (option 2) ❖ Prepare profitability statement and decide the better option
7	❖ Not applicable, Not applicable, Not applicable and Not applicable
8	❖ Average time for 63 units and 64 units can be computed with the available values given in the question ❖ Time for 64 th unit = Total time for 64 units - total time for 63 units ❖ Calculate cost for 256 units and compute the overall profit ❖ Part two: Calculate target labour cost = Total sales - Profit - Material cost - Other variable costs - Specific fixed cost. ❖ Get the target labour cost per unit and then use the below formula ❖ Average labour time for 256 units = Time for unit 1 * (LCR) ⁸
9	❖ Sensitivity analysis is done to find the level of change in variable which can lead to reversal of decision ❖ In this case the company is currently making profits. We need to find out the level at which zero profit will be made ❖ Target labour cost = Sales - All other costs. From this we will have to find the desired learning curve ratio ❖ Sensitivity = (Change/Base) * 100
10	❖ The budget was prepared based on wrong learning curve and hence the same needs to be adjusted ❖ The budgeted figures can be used for calculating SR and actual figures can be used for calculating actual rate ❖ Standard time is to be re-computed based on the revised learning curve understanding. Variances are then to be computed in the normal manner
11	❖ Expected total labour hours = (AT for 250 units * 250 units) + (Time for 250 th unit * 750 units) ❖ Time for 250 th unit = Total time for 250 units - total time for 249 units ❖ Target labour cost = Sales - All other costs - profit. Target labour cost per unit = Total labour cost/No of units
12	❖ Material variances: SP is to be taken from the original budget whereas SQ is to be calculated using learning curve analysis. SQ = Total time for 320 batches - Total time for 319 batches ❖ Labour and VOH Variances: SR is to be taken from the original budget whereas SH is to be calculated using learning curve analysis. ST = Total time for 320 batches - Total time for 319 batches
13	❖ We need to calculate average time for 40 units and 60 units ❖ Total time for 40 units and 60 units can be calculated. Incremental time for 20 units = Total time for 60 units - Total time for 40 units
14	❖ Standard time for 250 units = Average time for 250 units * 250 + Time for 250 th unit * 250 units ❖ Compare ST and AT and then calculate efficiency variance ❖ Standard time will be taken as 40000 hours in case the concept of learning curve is not used and accordingly the variance will be calculated
15	❖ Learning curve ratio is to be used and the production is getting doubled. Total

Qn	Summary
	time for 8,000 units = Time for first 2,000 units * 90% * 90% ❖ OT hours = Total time required – Normal time available ❖ The company works for 25 days in a month (calendar days of 30) and the same amounts of 5,000 hours. It need to spend additional 1,480 hours in next month and the same approximates to around 30 percent of the normal hours. Hence this can be taken as 9 days for calculation of penalty

Topic 1: Total Quality Management**1. Cost Classification – November 2015 RTP**

Hindustan Bikes Ltd. (HBL) formerly known as HELCO is an Indian multinational company. Its headquarter is located in Bengaluru, India. It has been founded in the year 1990 as a manufacturer of locomotives. The company is presently listed locally as well as in international stock market. HBL's parent company is Hindustan Group. The management of HBL recognizes the need to establish a culture at the company so that - "Do the right things, right the first time, every time". Management has provide you following actual information for the most recent month of the current year:

Cost Data

Customer Support Centre Cost	35 per hour
Equipment Testing Cost	18 per hour
Warranty Repair Cost	1,560 per bike
Manufacturing Rework Cost	228 per bike

Volume and Activity Data

Bikes Requiring Manufacturing Rework	3,200 bikes
Bikes Requiring Warranty Repair	2,600 bikes
Production Line Equipment Testing Time	1,600 hours
Customer Support Centre Time	2,000 hours

HBL carried out a quality review of its existing suppliers to enhance quality levels during the month at a cost of Rs. 1,25,000. Due to the quality issues in the month, the bike production line experienced unproductive 'down time' which cost Rs. 7,70,000. Prepare a statement showing 'Total Quality Cost'.

2. Cost classification:

Classify the following items under appropriate categories of quality costs:

- i. Rework
- ii. Scrap
- iii. Warranty Repairs
- iv. Revenue loss
- v. Repair to manufacturing equipments
- vi. Discount on defective sale
- vii. Establishment of quality circles
- viii. Packaging inspection

3. Impact of TQM – November 2014 RTP

7 Star Sports Co. (7SSC) is engaged in the manufacture of cricket bats. Following table shows the budgeted figures for the coming year:

Particulars	Per unit
Selling Price	4,800
Less: Component (1 set)	1,200
Assembling costs	2,000
Delivery cost	800
Contribution	800

Components like willow, rubber grip and handle bar in a set, are bought in and an assembling process carried out to transform them into a single bat. Market is intensely competitive where 7SSC currently holds 30% market share. Annual demand of these bats is 1,00,000 units.

On reviewing previous performance it is revealed that 3% of the bats supplied to customers were returned for free replacement because of faults. Defective components, which are initially bought in to assembling process, are held responsible for this. These returned bats cannot be repaired and have no scrap value. Supply of faulty bats to customers could be eliminated by implementing an inspection process immediately before the goods are delivered. This would improve customer perception thus resulting in an increase of 5% in current market share (making in all a total share of 35%).

Required

- ❖ Calculate the quality non-conformance cost for the coming year, based on the budgeted figures and sales returns rate.
- ❖ Calculate the impact on profitability due to implementation of inspection process for the bats.

4. Quality Costs Classification – November 2015

Classify 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):

- (i) *Unplanned replacement to customers*
- (ii) *Correction of a bank statement*
- (iii) *Design review*
- (iv) *Equipment accuracy check*
- (v) *Staff training*
- (vi) *Reprocessing of a loan operation*
- (vii) *Product liability warranty*
- (viii) *Product acceptance*
- (ix) *Wastage of material*
- (x) *Planned maintenance of equipment*

5. Implementation of TQM – May 2016

A company produces and sells a single product. The cost data per unit for the year 2017 is predicted as below:

₹ per unit	
Direct material	35
Direct labour	25
Variable overheads	15
Selling price	90

The company has forecast that demand for the product during the year 2017 will be 28,000 units. However to satisfy this level of demand, production quantity will be increased?

There are no opening stock and closing stock of the product.

The stock level of material remains unchanged throughout the period.

The following additional information regarding costs and revenue are given:

- 12.5% of the items delivered to customers will be rejected due to specification failure and will require free replacement. The cost of delivering the replacement item is ₹ 5 per unit.
- 20% of the items produced will be discovered faulty at the inspection stage before they are delivered to customers.
- 10% of the direct material will be scrapped due to damage while in storage.

Due to above, total quality costs for the year is expected to be ₹ 10,75,556.

The company is now considering the following proposal:

1. To introduce training programmes for the workers which, the management of the company believes, will reduce the level of faulty production to 10%. This training programme will cost ₹ 4,50,000 per annum.
2. To avail the services of quality control consultant at an annual charges of ₹ 50,000 which would reduce the percentage of faulty items delivered to customers to 9.5%.

Required

- (i) Prepare a statement of expected quality costs the company would incur if it accepts the proposal. Costs are to be calculated using the four recognised quality costs heads.
- (ii) Would you recommend the proposal? Give financial and non-financial reasons.

6. Quality Characteristics – May 2015

Quality products can be determined by using a few of the dimensions of quality. Identify the following under the appropriate dimension:

- (i) *Consistency of performance over time.*
- (ii) *Primary product characteristics.*
- (iii) *Exterior finish of a product*
- (iv) *Useful life of a product.*

7. Quality cost classification – November 2017

Classify the following items under appropriate categories of quality costs viz. Prevention cost, Appraisal cost, Internal failure cost and External failure cost.

- (i) *Re-inspection of product reworked.*
 - (ii) *Testing of material of special nature from outside laboratory.*
 - (iii) *Employee time spent on reviewing and assessing the quality of output regarding material supplied.*
 - (iv) *Customer survey for assessing the feedback on quality of product sold.*
 - (v) *Calibration of testing equipment*
 - (vi) *Warranty claim processing*
 - (vii) *Repurchase of components to create replacements*
 - (viii) *Loss of customer due to supply of low quality product.*
- (4 × 4 = 16 Marks)**

8. TQM – May 2014

A Ltd. is going to introduce Total Quality Management (TQM) in its company. State whether and why the following are valid or not for the successful implementation of TQM.

- (i) *Some departments serve both the external and internal customers. These departments have been advised to focus on satisfying the needs of the external customers.*
- (ii) *Hold a training program at the beginning of a production cycle to ensure the implementation of TQM.*
- (iii) *Implement Management by Objectives for faster achievement of TQM.*
- (iv) *Appoint the Head of each department as the person responsible to develop improvement strategies and performance measures.*
- (v) *Eliminate wastage of time by avoiding documentation and procedures.*

Topic 3: Activity Based Costing**1. Classification of activities – May 2012**

State whether each of the following independent activities is value-added or non-value added:

- ❖ Polishing of furniture used by a systems engineer in a software firm
- ❖ Maintenance by a software company of receivables management software for a banking company
- ❖ Painting of pencils manufactured by a pencil factory
- ❖ Cleaning of customers' computer key boards by a computer repair centre
- ❖ Providing brake adjustments in cars received for service by a car service station

2. Basic sum in ABC Costing – Allocation of activity costs to products

You have been appointed as a management consultant by XYZ Ltd – a key manufacturer of machining tools. You need to analyse how application of activity-based costing (ABC) to costing of the company's product lines would improve product costing and help it price its product offerings in a more efficient manner. Details of the four products and relevant information are given below for one period:

Product	P	Q	R	S
Output in units	150	120	60	90
Costs per unit	Rs.	Rs.	Rs.	Rs.
Direct material	50	60	40	80
Direct labour	32	24	18	20
Machine hours (per unit)	5	4	3	2

The four products are similar and are usually produced in production runs of 15 units and sold in batches of 10 units. The production overhead is currently absorbed by using a machine hour rate, and the total of the production overhead has been analysed as follows:

	Rs.
Machine department costs (rent, Business, rates, depreciation and Supervision)	18,960
Set-up costs	5,600
Stores receiving	4,000
Inspection/quality control	1,620
Material handling and dispatch	7,980

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

Cost	Cost Driver
Set-up costs	Number of production runs
Stores receiving	Requisitions raised
Inspection/quality control	Number of production runs
Materials handling and dispatch	Orders executed

The number of requisitions raised on the stores was 20 for each product and the number of orders executed was 42, each order being for a batch of 10 of a product.

Requirements

- ❖ Calculate the total costs for each product if all overhead costs are absorbed on a machine-hour basis.
- ❖ Calculate the total cost of each product, using activity-based costing.

- ❖ Compare the two costs under the two scenarios and identify the implications this could have on pricing and profit.

3. ABC Costing – Allocation of costs to activities and then to products – November 2013

MK 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 no. of orders executed is 192, each order being for a batch of 12 units of a product.

Calculate the total overhead cost per unit of each product using activity based costing after finding activity wise overheads allocated to each product. (8 Marks)

4. Developing ABC System – November 2014

Chicago Manufacturing Co. (CMC) manufactures several product of varying levels of designs and models. It uses a single overhead recovery rate based on direct labour hours. The Overheads incurred by the CMC in the half of the year are as under:

	Rs.
Machine Operation Expenses	10,12,500
Machine Maintenance Expenses	1,87,500

Salaries of technical staff	6,37,500
Wages and salaries of stores staff	2,62,500

During this period, CMC introduced activity based costing system and the following significant activities were identified:

- ❖ Receiving materials and components
- ❖ Set up of machines for production runs
- ❖ Quality inspection

It is determined that:

- ❖ The machine operation and machine maintenance expenses should be apportioned between stores and production activity in 20:80 ratio
- ❖ The technical staff salaries should be apportioned between machine maintenance, set-up and quality inspection in 30:40:30 ratio

The Consumption of activities during the period under review are use under:

- ❖ Direct labour hours worked 40,000
- ❖ Direct wage rate Rs. 6 per hour
- ❖ Production set-up 2,040
- ❖ Material and component consignments from received from suppliers 1,960
- ❖ Number of quality inspections carried out 1,280

The data relation to two product manufactured by the CMC during period are as under:

	Product P	Product Q
Direct Material costs (Rs.)	6,000	4,000
Direct labour hours	960	100
Direct material consignments received	48	52
Number of quality inspections done	30	10
Number of production runs	36	24
Quantity products (units)	15,000	5,000

A potential customer has approached CMC for the supply of 24,000 units of components K to be delivered in lots of 3,000 units per quarter. The job will involve an initial design cost of Rs. 60,000 and the manufacture will involve the following per quarter:

Direct material costs	Rs. 12,000
Direct labour hours	300
Production runs	6
Inspections	24
Number of consignments of	20
Direct materials to be received	
CMC desires a mark up to 25% on cost.	

Required:

- ❖ Calculate the cost of product P and Q based on the existing system of single overhead recovery rate.
- ❖ Determine the cost of product P and Q using activity based costing system
- ❖ Compute the sales value per quarter of component K using activity based costing system.

5. ABC Costing for a retail store – May 2014

PQR Ltd. specializes in the distribution of pharmaceutical products. It buys from pharmaceutical companies and resells to each of the three different markets:

- (i) General Supermarket Chains
- (ii) Drug Store Chains
- (iii) Chemist Shops

The company plans to use activity based costing for analyzing the profitability of its distribution channels. The following data for the quarter ending March 2014 is given:

	General Supermarket Chains	Drug Store Chains	Chemist Shop
Average sales per delivery	₹ 96,500	₹ 32,450	₹ 6,225
Average cost of goods sold per delivery	₹ 94,650	₹ 31,800	₹ 5,950
Number of deliveries	960	2,470	8,570
Total number of orders	1,000	2,650	9,500
Average number of cartons shipped per delivery	250	75	12
Average number of hours of shelf stocking per delivery	2	0.5	0.1

The following information is available in respect of operating costs (other than cost of goods sold) for the quarter ending March 2014:

Activity Area	Cost Driver	Total Cost (₹)
Customer purchase order processing	Purchase order by customers	5,91,750
Customer store delivery	Number of deliveries	9,60,000
Cartons dispatched to customer stores	Number of Cartons dispatched to customer stores	7,92,135
Shelf stocking at customer store	Hours of shelf stocking	80,240

Compute the operating income of each distribution channel for the quarter ending March 2014 using activity based costing. (8 Marks)

6. Decision on revision in product mix – November 2012

DEO Limited sells two versions: Deluxe and premium of its only product GoGo Juicer. The GoGo Juicer uses patented technology to extract the last drop of juice from most fruits. The 'Premium' version can handle larger fruit and has more options relative to the 'Deluxe' Version. The following table provides the financial results of the most recent year of operations:

Particulars	Deluxe 90,000 units	Premium 10,000 unit	Total 1,00,000 units
Revenue (Rs.)	63,00,000	9,00,000	72,00,000
Material Cost (Rs.)	10,80,000	2,50,000	13,30,000
Direct labour cost (Rs.)	14,40,000	1,60,000	16,00,000
Contribution margin (Rs.)	37,80,000	4,90,000	42,70,000
Allocated fixed manufacturing overhead (Rs.)	34,20,000	3,80,000	38,00,000
Allocated fixed selling and administrative overheads (Rs.)	2,51,563	35,937	2,87,500
Profit margin (Rs.)	1,08,437	35,937	1,82,500
Profit Margin per unit (Rs.)	1.2048	7.4063	

Labour cost is Rs. 16 per hour and each product requires one hour of labour. The company currently allocates all fixed manufacturing overheads, using labour hours as the allocation basis. It allocates fixed selling and administrative overheads, using revenue as the allocation base.

Although the profit margin per unit of 'Deluxe juicer is rather low, DEO limited believes that it is important to keep this model in the product mix. However, DEO can tailor its promotion and sales strategies to improve the sales mix to 16:4 ratio from the current 9:1 ratio of 'Deluxe' to 'Premium' juicer, with total volume staying at 1,00,000 units.

Deo Limited finds that Rs. 1.1 million of the Rs. 3.8 million of fixed manufacturing overheads pertains to batch related activities such as scheduling production runs. Similarly, Rs. 115,000 is the amount of administrative overheads out of the Rs. 2,87,500 of selling and administrative overheads.

It is found the 'Premium' juicer is produced in smaller batches (250 unit per batch) than that of 'Deluxe' juicer (500 unit per batch). Similarly, it takes 10 sales visits to sell 1,000 units of the 'Deluxe' juicer, while it takes 25 visits to sell 1,000 units of 'Premium' juicer.

Required:

- ❖ Prepare a profitability statement based on the proposed sales mix, using the most appropriate basis of allocating overheads. (In absence of an appropriate basis, do not allocate overhead to products)
- ❖ Advise the company on whether it should go ahead with the proposed change in sales mix.

7. Break-even point under ABC - November 2015

X Ltd. makes a single product with the following details:

Description	Current Situation	Proposed Change
Selling Price (₹/unit)	10	
Direct Costs (₹/unit)	5	
Present number of setups per production period, (before each production run, setup is done)	42	

Cost per set up (₹)	450	Decrease by ₹90
Production units per run	960	1,008
Engineering hours for production period	500	422
Cost per engineering hour (₹)	10	

The company has begun Activity Based Costing of fixed costs and has presently identified two cost drivers, viz. production runs and engineering hours. Of the total fixed costs presently at ₹96,000, after the above, ₹72,100 remains to be analyzed. There are changes as proposed above for the next production period for the same volume of output.

- How many units and in how many production runs should X Ltd. produce in the changed scenario in order to break-even?
- Should X Ltd. continue to break up the remaining fixed costs into activity based costs? Why? (8 Marks)

8. ABC and Break-even point – May 2016 RTP, Nov 2017 RTP

A manufacturing company produces Ball Pens that are printed with the logos of various companies. Each Pen is priced at ₹5. Costs are as follows:

Cost Driver	Unit Variable Cost (₹)	Level of Cost Driver
Units Sold	2.5	—
Setups	225	40
Engineering hours	10	250

Other Data:

Total Fixed Costs (conventional) ₹ 48,000

Total Fixed Costs (ABC) ₹ 36,500

Required:

- Compute the break-even point in units using activity-based analysis.
- Suppose that company could reduce the setup cost by ₹75 per setup and could reduce the number of engineering hours needed to 215. How many units must be sold to break even in this cost?

9. Applicability of ABC System – May 2012

State with a brief reason whether you would recommend an activity based system of costing in each of the following independent situations:

- ❖ Company K produces one product. The overhead costs mainly consist of depreciation.
- ❖ Company L produces 5 different products using different production facilities.
- ❖ A consultancy firm consisting of lawyers, accountants and computer engineers provides management consultancy services to clients.
- ❖ Company S 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 the target costs.

10. Value added versus Non-value added Time – November 2016 RTP

Queenstown Furniture (QF) manufactures high-quality wooden doors within the forests of Queenstown since 1952. Management is having emphasize on creativity, engineering, innovation and experience to provide customers with the door they desire, whether it is a standard design or a one-of-a-kind custom door. The following information pertains to operations during April:

Processing time	9.0 hrs.*	Waiting time	6.0 hrs.*
Inspection time	1.5 hr.*	Move time	7.5 hrs.*
Units per batch	60 units		

(*) average time per batch

Required

Compute the following operational measures:

- Average non-value-added time per batch
- Average value added time per batch
- Manufacturing cycle efficiency
- Manufacturing cycle time

11. Activity Cost Drivers – May 2016

Indicate 2 activity drivers in respect of each of the following activity cost pools:

- Manufacturing cost
- Human resources cost
- Marketing and sales costs
- Accounting costs

12. Cost drivers for hospital – November 2016 RTP

'SM' hospital is a primary medical care facility and trauma center that serves National Capital Territory. The hospital offers all the medical/ surgical services of typical small hospital.

Required

- Using your (limited, moderate, or in-depth) knowledge of a hospital's operations, identify 4 key activities that are important.
- For each of the activities, suggest an appropriate cost driver.

13. ABC versus traditional costing – November 2017

A Company produces three products P, Q and R for which the standard cost per unit and quantities produced are as under:

Products	P	Q	R
Units produced and sold	36,000	48,000	96,000
Direct material cost per unit (₹)	60	48	45
Direct labour cost per unit (₹)	30	24	18
Machine hours per unit (hours)	0.50	0.40	0.30

Total production overheads are absorbed on machine hour basis. The rate is ₹ 60 per machine hour.

The Company has analysed its operations and determined that five activities act as cost drivers for overheads. Data relating to five activities are given below:

Activity Area	Cost Driver	Cost of each activity as % of total production overhead cost
Store receiving	Number of requisitions	25%
Machine set up	Number of set ups	20%
Machine running	Machine hours worked	25%
Packing	Packing time in hours	16%
Storage	Area in square metres	14%

The investigation into the production overhead activities for the period revealed the following:

Activity	P	Q	R
Number of requisitions	1,200	1,500	3,900
Number of machine set ups	60	120	320
Packing hours	3,000	4,800	10,200
Storage (Sq metres)	10,800	12,000	19,200

Required:

- Calculate total production overheads.
- Prepare product cost statement showing per unit cost under traditional absorption costing method.
- Calculate the cost driver rates.
- Prepare product cost statement showing per unit cost under activity based costing method.
- What is the difference in costs due to adoption of traditional absorption costing method and activity based costing method?

(10 Marks)

14. ABC and Break-even point – May 2017

A company can make any or both of products A and B in a production period not exceeding a total of 10,000 units due to non-availability of the required material and labour. Until now, the company had been taking decisions on the product mix, based on the following marginal cost analysis.

	A (₹/u)	B (₹/u)	
Selling Price	100	120	
Variable Cost	60	70	
Contribution	40	50	
Total fixed costs			3,00,000

Since the decisions based on the above approach did not yield the required results, the fixed costs were analysed as follows for 10,000 units of only A or 10,000 units of only B.

Item of Cost	Details for A	A (Amt.)	B (Amt.)	Details for B
Set up cost	10 production runs	40,000	75,000	10 production runs
Distribution cost	₹ 120/ box	60,000	25,000	₹ 200 per box
Step fixed cost	₹ 4,000 per 2,000 units	20,000	50,000	₹ 5,000 per 1,000 units
Total		1,20,000	1,50,000	

₹ 30,000 can be taken as the unanalysed fixed cost, and unavoidable whether A or B or both are produced.

The following cost reduction measures were taken by the Product Managers of A and B:

	A	B
Increase in number of units per run to	2,000 units	1,250 units
Increase in the number of units per box distributed to	30 units	125 units

Further, the Management ensured availability of raw material and labour to support a production of 15,000 units of either A or B or both together. There was no change to the step costs or contribution. However, the total unanalysed fixed cost increased to ₹ 32,000.

- Based on the principles of Activity Based Costing, prepare a statement showing the contribution and item wise analysed overheads for each product, arrive at the profitability of A and B and then the final profits if 15,000 units of only A or 15,000 units of only B are manufactured.
- Find the minimum break-even point in units if only product A is manufactured after the cost reduction. (12 Marks)

Topic 4: Target Costing**1. Target costs and cost reduction:**

A toy company 'T' expects to successfully launch Toy Z based on a film character. T must pay 15% royalty on the selling price to the film company. 'T' targets a selling price of ₹100 per toy and profit of 25% selling price.

The following are the cost data forecast:

	₹/toy
Component A	8.50
Component B	7.00
Labour: 0.4 hr. @ ₹60 per hr	24.00
Product specific overheads	13.50

In addition, each toy requires 0.6 kg of other materials, which are supplied at a cost of ₹16 per kg with a normal 4% substandard quality which is not usable in the manufacture.

You are required to determine if the above cost structure is within the target cost. If not, what should be the extent of cost reduction? (4 Marks)

2. Target labour time for achieving desired profit – May 2016

Sterling 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 (2 hrs × Re. 0.50)	1
Contribution per unit	15
Budgeted Contribution	1,50,000
Budgeted Fixed costs	1,40,000
Budgeted Profit	10,000

The Board of Directors is dissatisfied with this budget, and asks a working party to come up with an alternate budget with higher target profit figures.

The working party reports back with the following suggestions that will lead to a budgeted profit of ₹25,000. The company should spend ₹28,500 on advertising, & put 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 work force 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. Prepare a revised budget giving effect to the above suggestions.

3. Target Costing – November 2016

Speedo Limited is a specialist car manufacturer that produces various models of cars. The organization is due to celebrate its 100th anniversary next year. To mark the occasion, Speedo Limited intends to produce a sports car; the Model Royal. As this will be a special edition, production will be limited to 1,000 numbers of Model Royal Cars.

Speedo Limited is considering using a target costing approach and has conducted market research to determine the features that consumers require in a sports car. Based on this market research and knowledge of competitor's products, company has decided to price the Model Royal at ₹ 9.75 Lacs. Company requires an operating profit margin of 25% of the selling price of the car. Details for the forthcoming year are as follows:

Forecast of direct costs for a Model Royal Car-

Labour	₹ 2,50,000
Material	₹ 4,75,000

Forecast of annual overhead costs-

	₹ in Lacs	Cost Driver
Production Line Cost	2,310	See Note 1
Transportation Costs	900	See Note 2

Note 1

The production line that would be used for Model Royal has a capacity of 60,000 machine hours per year. The production line time required for Model Royal is 6 machine hours per car. This production line will also be used to make other cars and will be working at full capacity.

Note 2

Some models of cars are delivered to showrooms using car transporters. 60% of the transportation costs are related to the number of deliveries made. 40% of the transportation costs are related to the distance travelled.

The car transporters have forecast to make a total of 640 deliveries in the year and carry 10 cars each time. The car transporter will always carry its maximum capacity of 10 cars.

The total annual distance travelled by car transporters is expected to be 2,25,000 kms. 50,000 kms of this is for the delivery of Model Royals car only. All 1,000 Model Royal cars that will be produced will be delivered in the year using the car transporters.

Required

- Calculate the forecast total cost of producing and delivering a Model Royal car using Activity Based Costing principles to assign the overhead costs.*
- Calculate the cost gap that currently exists between the forecast total cost and the target total cost of a Model Royal car.*

4. Applicability of Target Costing – November 2015

State whether and why the following statements are valid or not valid:

- (i) Target costing is not applicable to a monopoly market.*
- (ii) Target costing ignores non-value added activities.*

Topic 5: Kaizen Costing**1. Target Costing versus Kaizen Costing:**

M. India Ltd. (MIL) is an automobile manufacturer in India and a subsidiary of Japanese automobile and motorcycle manufacturer Leon. It manufactures and sells a complete range of cars from the entry level to the hatchback to sedans and has a present market share of 22% of the Indian passenger car markets. MIL uses a system of standard costing to set its budgets. Budgets are set semi-annually by the Finance department after the approval of the Board of Directors at MIL. The Finance department prepares variance reports each month for review in the Board of Directors meeting, where actual performance is compared with the budgeted figures. Mr. Suzuki, group CEO of the Leon is of the opinion that Kaizen costing method should be implemented as a system of planning and control in the MIL.

Required

Recommend key changes vital to MIL's planning and control system to support the adoption of 'Kaizen Costing Concepts'.

2. Kaizen Costing – May 2015 RTP, November 2017 RTP

ABC Ltd. is planning to introduce Kaizen Costing approach in its manufacturing plant. State whether and why the following are Valid or Not in respect of Kaizen Costing.

- (i) VP (Finance) is of the view that company has to make a huge initial investment to bring a large scale modification in production process.*
- (ii) Head (Personnel) has made a point that introduction of Kaizen Costing does not eliminate the training requirement of employees.*
- (iii) General Manager (Manufacturing) firmly believes that only shop floor employees and workers' involvement is prerequisite of Kaizen Costing approach.*
- (iv) Manager (Operations) has concerns about creation of confusion among employees and workers regarding their roles and degradation in quality of production.*

Topic 6: Life Cycle Costing**1. Suitability of Life Cycle Costing:**

Meena is a news reporter and feature writer for an economic daily. Her assignment is to develop a feature article on 'Product Life-cycle Costing', including interviews with the Chief Financial Officers (CFO) and operating managers. Meena has been given a liberal budget for travel so as to research into company's history, operations, and market analysis for the firm she selects for the article. Meena has asked you to recommend industries and firms that would be good candidates for the article. What would you advice? Explain your recommendations.

2. Computation of life-cycle cost – November 2015 RTP

P & G International Ltd. (PGIL) has developed a new product "K" which is about to be launched into the market and anticipates to sell 80,000 of these units at a sales price of Rs.300 over the product's life cycle of four years. Data pertaining to product "K" are as follows:

Costs of Design and Development of Molds, Dies, and Other Tools	Rs.8,25,000
Manufacturing costs	Rs.125 per unit
Selling costs	Rs.12,500 per year + Rs.100 per unit
Administration costs	Rs.50,000 per year
Warranty expenses	5 replacement parts per 25 units at Rs.10 per part; 1 visit per 500 units (Cost Rs.500 per visit)

- ❖ Compute the product K's Life cycle cost
- ❖ Suppose PGIL can increase sales volume by 25% through 10% reduction in selling price. Should PGIL choose the lower price?

3. Decision on price reduction – May 2015 RTP, Nov 2017 RTP

Y-Connections, China based firm, has just developed ultra-thintablet S-5 with few features like the ability to open two apps at the same time. This tablet cost Rs. 5,00,000 to develop; it has undergone extensive research and is ready for production. Currently, the firm is deciding on plant capacity, which could cost either Rs. 35,00,000 or Rs. 52,00,000. The additional outlay would allow the plant to increase capacity from 500 units to 750 units. The relevant data for the life cycle of the tablet at different capacity level are as under:

Expected sales	500 units	750 units
Sale Price	Rs.79,600 per unit	Rs.69,600 per unit
Variable selling costs	10% of selling price	10% of selling price
Salvage value – Plant	Rs.6,25,000	Rs.9,00,000
Profit volume Ratio	40%	

Advise Y-Connections, regarding the 'Optimal Plant Capacity' to install. The tablet's life cycle is two years.

4. Product Life Cycle – November 2016 RTP

Examine the **Validity** of following statements:

- (i) In the introduction stage, usual marketing strategy is to strengthen the supply chain relationships to make the product easily accessible by target customers.
- (ii) In the introduction stage, competitors will purchase the product to carry out reverse engineering and understand how the product works, so that they can develop their own similar, but different product.
- (iii) In the introduction phase, the firm will seek to avoid this competition by maintaining its selling price at the end of the introduction stage.
- (iv) In the growth stage, if the product cannot be differentiated in other ways, the firm may need further reductions in selling price to maintain growth.
- (v) In the maturity stage, firms are tempted to engage in costly promotional price wars to wean away market share from competitors.
- (vi) In the decline stage, failing sales may induce firms to slash marketing expenditure. Brand loyalty will be exploited to create profits.

5. Selection of machine – November 2016 RTP

In WM Ltd. the 'OB' equipment is about to be replaced either by 'CF' system or by an 'OF' system. Finance costs 12% a year and the other estimated costs are as follows:

	CF (₹)	OF (₹)
Initial Cost	28,000	40,000
Annual Operating Costs	24,000 p.a.	18,000 p.a.

Required

If the company expected the new system (either CF or OF) to last at least for 12 years, which system should be chosen?

6. Calculation of life cycle cost – November 2017

MK international Ltd. has developed a new product 'RIO' 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 Product 'RIO' are as under:

Research and 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	₹ 6,60,000 per year
Warranty expenses	4 replacement parts per 50 units at ₹ 30 per part.

Calculate:

- The life cycle cost of the product 'RIO'.
- The revised life cycle cost if the MK international Ltd. increases sales by 12% through 5% reduction in sale price along with increase in fixed manufacturing cost by ₹1,20,000 per year.
- Should the company go for reduction in sale price? (6 Marks)

7. Decision on product manufacture – November 2015

A company is planning a new product. Market research information suggests that 40,000 units of the product can be sold at a maximum of ₹25 per unit. The company seeks a minimum mark-up of 25% on product cost. It is estimated that the lifetime costs of the product will be as follows:

- Research and development, design costs ₹ 1,50,000
- Manufacturing costs ₹ 16 per unit
- End of life costs ₹ 70,000
- Promotion and capacity cost ₹ 20,000

Should the product be manufactured?

(4 Marks)

Topic 7: Value Chain Analysis**1. Classification of primary and support activities – May 2015**

Classify the following business activities into primary and support activities under value chain analysis.

- (i) Material Handling and Warehousing.*
- (ii) Purchasing of raw materials, supplies and other consumables.*
- (iii) Order processing and distribution*
- (iv) Selection, placement and promotion of employees.*

2. Classification of primary and support activities – November 2013

In Value Chain analysis, business activities are classified into primary activities and support activities. Classify the following under the more appropriate activity.

- (i) Order processing and distribution*
- (ii) Installation, repair and parts replacement*
- (iii) Purchase of raw material and other consumable stores*
- (iv) Transforming inputs into final products*
- (v) Selection, promotion, appraisal and employee relations*
- (vi) Material handling and warehousing*
- (vii) General management, planning, finance, accounting*
- (viii) Communication, pricing and channel management*

3. Value Chain Analysis – Nov 2017 RTP, May 2015 RTP

Examine the Validity of following statements along with the reasons:

- (i) The concepts, tools and techniques of value chain analysis apply only to all those organizations which produce and sell a product.*
- (ii) Procurement activities are included in the Primary activities as classified by Porter under value chain analysis concept.*
- (iii) As per Porter's five forces model, bargaining power of buyers does influence the profitability of an industry or market.*
- (iv) Value chain analysis in the strategic framework consists of single cost driver concept.*

Topic 8: Cost Control and Cost Reduction**1. Cost control versus cost reduction – May 2012**

Classify the following items under the most appropriate category

Category – Cost control (CC) & Cost Reduction (CR)

- ❖ Costs exceeding budgets or standards are investigated
- ❖ Preventive function
- ❖ Corrective function
- ❖ Measures to standardize for increasing productivity
- ❖ Provision of proper storage facilities for materials
- ❖ Continuous comparison of actuals with standards set
- ❖ Challenges the standards set
- ❖ Value analysis

2. Calculation of cost reduction (May 2017)

XY Ltd. manufactures two types of mobile phones, X and Y. Due to severe competition, it has to reduce the prices for the next production period. The following information is provided:

	X	Y
<i>Current Period:</i>		
<i>Selling price (₹ / unit)</i>	10,000	12,000
<i>P/V ratio</i>	25%	30%
<i>Product-specific fixed cost (₹)</i>	10,00,000	15,00,000
<i>Next Period:</i>		
<i>Selling price (₹ /unit)</i>	8,000	9,000

For the next period the company wants the present P/V ratio to be maintained and achieve a break-even for both the products at 400 units.

What is the cost reduction programme envisaged?

(5 Marks)

Topic 9: Just in Time**1. Decision on Just-in-time inventory policy – May 2014 RTP**

United Video International Company (UVIC) sells package of blank video tapes to its customer. It purchases video tapes from Indian Tape Company (ITC) @ Rs. 140 a package. ITC pays all freight to UVIC. No incoming inspection is necessary because ITC has a superb reputation for delivery of quality merchandise. Annual demand of UVIC is 13,000 packages. UVIC requires 15% annual return on investment. The purchase order lead time is two weeks. The purchase order is passed through Internet and it costs Rs. 2 per order. The relevant insurance, material handling etc Rs. 3.10 per package per year. UVIC has to decide whether or not to shift to JIT purchasing. ITC 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 Rs. 0.02 per package. UVIC incurs no stock out under its current purchasing policy. It is estimated UVIC incurs stock out cost on 50 video tape packages under a JIT purchasing policy. In the event of a stock out, UVIC has to rush order tape packages which costs Rs. 4 per package. Comment whether UVIC should implement JIT purchasing system.

Hindustan Tape Company (HTC) also supplies video tapes. It agrees to supply @ Rs. 136 per package under JIT delivery system. If video tape purchased from HTC, relevant carrying cost would be Rs. 3 per package against Rs. 3.10 in case of purchasing from ITC. However HTC doesn't enjoy so sterling a reputation for quality. UVIC anticipates following negative aspects of purchasing tapes from HTC.

- ❖ To incur additional inspection cost of 5 paisa per package.
- ❖ Average stock out of 360 tapes packages per year would occur, largely resulting from late deliveries. HTC cannot rush order at short notice. UVIC anticipates lost contribution margin per package of Rs. 8 from stock out.
- ❖ Customer would likely return 2% of all packages due to poor quality of the tape and to handle this return an additional cost of Rs. 25 per package.

Required

Comment whether UVIC places order to HTC.

2. Decision on JIT versus Regular manufacturing – November 2014 RTP

KP Ltd. (KPL) manufactures and sells one product called "KEIA". Managing Director is not happy with its current purchasing and production system. There has been considerable discussion at the corporate level as to use of 'Just in Time' system for "KEIA". As per the opinion of managing director of KPL Ltd. – "Just-in-time system is a pull system, which responds to demand, in contrast to a push system, in which stocks act as buffers between the different elements of the system such as purchasing, production and sales. By using Just in Time system, it is possible to reduce carrying cost as well as other overheads".

KPL is dependent on contractual labour which has efficiency of 95%, for its production. The labour has to be paid for minimum of 4,000 hours per month to which they produce 3,800 standard hours. For availing services of labour above 4,000 hours in a month, KPL has to pay overtime rate which is 45% premium to the normal hourly rate of Rs.110 per hour. For avoiding this overtime payment, KPL in its current production and purchase plan utilizes full available normal working hours so that the higher inventory levels in the month of lower demand would be able to meet sales of month with higher demand level. KPL has determined that the cost of holding

inventory is Rs.70 per month for each standard hour of output that is held in inventory. KPL has forecast the demand for its products for the first six months of year 2014 as follows:

Month	Demand (Standard Hours)
Jan'14	3,150
Feb'14	3,760
Mar'14	4,060
Apr'14	3,350
May'14	3,650
Jun'14	4,830

Following other information is given:

- ❖ All other production costs are either fixed or are not driven by labour hours worked.
- ❖ Production and sales occur evenly during each month and at present there is no stock at the end of Dec'13.
- ❖ The labour are to be paid for their minimum contracted hours in each month irrespective of any purchase and production system.

As a chief accountant you are requested to comment on managing director's view.

3. Back-flush costing – November 2016 RTP

Napier Company uses a backflush costing system with three trigger points:

- (a) Purchase of Direct Materials
- (b) Completion of Good Finished Units of Product
- (c) Sales of Finished Goods

You are provided with the following information for July 2016.

Direct Materials Purchased	₹2,64,000	Conversion Costs Allocated	₹1,20,000
Direct Materials Used	₹2,55,000	Costs Transferred to Finished Goods	₹3,75,000
Conversion Costs Incurred	₹1,26,600	Cost of Goods Sold	₹3,57,000

Required

- (i) Prepared journal entries for July (without disposing of under allocated/ over allocated conversion costs).
- (ii) Under an ideal JIT production system, how would the amounts in your journal entries change from the journal entries in requirement (i)?

4. Just in Time versus Normal Production – November 2015

Innovation Ltd. has entered into a contract to supply a component to a company which manufactures electronic equipments.

Expected demand for the component will be 70,000 units totally for all the periods. Expected sales and production cost will be

Period	1	2	3	4
Sales (units)	9,500	17,000	18,500	25,000
Variable cost per unit	30	30	32.50	35

Total fixed overheads are expected to be ₹14 lakhs for all the periods.

The production manager has to decide about the production plan.

The choices are:

Plan 1: *Produce at a constant rate of 17,500 units per period. Inventory holding costs will be ₹ 6.50 per unit of average inventory per period.*

Plan 2: *Use a just-in-Time (JIT) system*

Maximum capacity per period normally.....18,000 units

It can produce further up to 10,000 units per period in overtime.

Each unit produced in overtime would incur additional cost equal to 30% of the expected variable cost per unit of that period.

Assume zero opening inventory.

Required

- (i) *Calculate the incremental production cost and the savings in inventory holding cost by JIT production system.*
- (ii) *Advise the company on the choice of a plan.*

5. Just-in-time implementation – November 2013

The following independent situations are given in JIT systems of production. You are required to state if each recommendation is valid or invalid and give a brief reason.

Sl. No.	Situation	Recommendation by the Cost Accountant
(i)	A company produces LCD TVs. Presently total inventory turnover is measured annually.	Compute inventory turnover every month. Break it down into raw material, WIP, expensive inventory and finished goods.
(ii)	Textile company.	Accept employees' claim for piece rate incentive for exceeding a certain production volume.
(iii)	Sports goods manufacturing company.	Closely monitor direct labour variances including idle time variances to convince employees to work faster.
(iv)	Multiproduct production	Monitor the average set up time per machine in a period which is given by <u>Aggregate set up time of all machines</u> Total number of machines.

(4 Marks)

Topic 11: Theory of Constraints**1. Three measures of theory of constraints – May 2014**

Classify the following items under the three measures used in the theory of constraints:

- (i) *Research and Development Cost*
- (ii) *Rent/Utilities*
- (iii) *Raw materials used for production*
- (iv) *Depreciation*
- (v) *Labour Cost*
- (vi) *Stock of raw materials*
- (vii) *Sales*
- (viii) *Cost of equipments and buildings.*

2. Theory of Constraints:

Vikram Ltd. produces 4 products using 3 different machines. Machine capacity is limited to 3,000 hours for each machine. The following information is available for February, 2009:

Products	A	B	C	D
Contribution (Sales-direct material)	1,500	1,200	1,000	600
Machine Hours Required/ Unit :				
Machine 1	10	6	2	1
Machine 2	10	9	3	1.5
Machine 3	10	3	1	0.5
Estimated Demand (units)	200	200	200	200

From the above information you are required to identify the bottleneck activity and allocate the machine time.

3. Theory of constraints – May 2015

Phi Ltd. produces 4 products P, Q, R and S by using three different machines X, Y and Z. Each machine capacity is limited to 6,000 hours per month. The details given below are for July, 2013:

Particulars	P	Q	R	S
<i>Selling Price p.u. (₹)</i>	<i>10,000</i>	<i>8,000</i>	<i>6,000</i>	<i>4,000</i>
<i>Variable Cost p.u. (₹)</i>	<i>7,000</i>	<i>5,600</i>	<i>4,000</i>	<i>2,800</i>
<i>Machine Hours Required p.u.</i>				
<i>Machine X</i>	<i>20</i>	<i>12</i>	<i>4</i>	<i>2</i>
<i>Machine Y</i>	<i>20</i>	<i>18</i>	<i>6</i>	<i>3</i>
<i>Machine Z</i>	<i>20</i>	<i>6</i>	<i>2</i>	<i>1</i>

Expected Demand (units)	200	200	200	200

Required:

- Find out the bottleneck activity.
- Allocate the machine hours on the basis of the bottleneck.
- Ascertain the profit expected in the month if the monthly fixed cost amounts to ₹ 9,50,000.
- Calculate the unused spare hours of each machine.

4. Calculation of TA Ratio – November 2016

BTS Ltd. produces three products A, B and C. The following information is available for a period:

	A	B	C
Contribution (per unit)	₹ 30	₹ 25	₹ 15
[Sales – Direct materials]			

Machine hours required per unit of production:

	Hours			Throughput Accounting Ratio
	A	B	C	
Machine 1	10	2	4	133.33%
Machine 2	15	3	6	200.00%
Machine 3	5	1	2	66.67%

Estimated sales demand for A, B and C are 500 units each and machine capacity is limited to 6,000 hours for each machine.

You are required to analyse the above information and apply theory of constraints process to remove the constraints.

How many units of each product will be made?

5. TA ratio for product:

H. Ltd. manufactures three products. The material cost, selling price and bottleneck resource details per unit are as follows:

Particulars	Product X	Product Y	Product Z
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 ₹ 2,21,600. The bottleneck resources time available is 75,120 minutes per period.

Required:

- Company adopted throughput accounting and products are ranked according to 'product return per minute'. Select the highest rank product.
- Calculate throughput accounting ratio and comment on it.

Topic 12: Cost Classification**1. Relevant cost Analysis – November 2013**

State the type of cost in the following cases:

- a) Cost associated with the acquisition and conversion of material into finished product.
- b) Cost arising from a prior decision which cannot be changed in the short run.
- c) Increase in cost resulting from selection of one alternative instead of another.
- d) Rent paid for a factory building which is temporarily closed.

2. Relevant Cost Analysis – November 2016

- a) Costs are historical costs which have already been incurred and cannot change by any decision made in future
- b) It is measure of benefits foregone by rejecting the second best alternative of resources in favor of the best
- c) It is portioning of cost which involve payments to outsiders (i.e.) it gives rise to cash expenditure as opposed to such costs as depreciation
- d) Total cost is changed due to change in level of activity, technology or production process
- e) Cost used in evaluation of a product to reflect the use of resources but that have no observable cost

3. Relevant Cost Analysis – November 2014 RTP

- a) An advertising program has been set and management has signed the non-negotiable contract for a year with an agency. Under the terms of contract, agency will create 5 advertisements within the contract duration for the company and company will pay Rs.12,00,000 for each advertisement.
- b) A manager has to decide to run a fully automated operation that produces 100,000 widgets per year at a cost of Rs.1,200,000, or of using direct labour to manually produce the same number of widgets for Rs.1,400,000.
- c) A Company had paid Rs.5,00,000 a Marketing Research company to find expected demand of the newly developed product of the company.
- d) A company has invested Rs.25 lacs in a project. Company could have earned Rs.2 lacs by investing the amount in Government securities.
- e) An Oil Refining Co. has paid a salary of Rs.20, 00,000 to the chairman for a particular year. The Company has sold 25 MT of Oil in that particular year.
- f) Accountant of a cloth factory paid Rs.25, 000 for water that has been used for washing clothes before they go for final drying process.

4. Cost classification:

Marine Diesel Ltd. (MDL) manufactures and sells Diesel Engine. Company appoints Mr. Philips to coordinate shipments of the Diesel Engine from the factory to distribution warehouses located in various parts of the India so that goods will be available as orders are received from customers. MDL is unsure how to classify his annual salary of ₹6,00,000 in its cost records. The company's cost analyst says that Mr. Philips's salary should be classified as manufacturing cost; the finance controllers says that it should be classified as selling cost; and the managing director says that it does not matter which way Mr. Philips's salary cost is classified.

Required

Which view point is correct and why?

5. Relevant/Irrelevant costs – November 2015

Proposal A is being evaluated against Proposal B. Fill up column IV of the following table:

<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>Sl. No.</i>	<i>Type of Cost</i>	<i>Classification</i>	<i>Condition under which the classification happens</i>
<i>(i)</i>	<i>Variable cost per unit</i>	<i>Irrelevant</i>	-
<i>(ii)</i>	<i>Unavoidable fixed costs</i>	<i>Relevant</i>	-
<i>(iii)</i>	<i>Out of pocket costs in future</i>	<i>Relevant</i>	-
<i>(iv)</i>	<i>Sunk cost</i>	<i>Irrelevant</i>	-

6. Cost classification – May 2017

Classify the following costs into one or more the following categories: Relevant cost, Opportunity cost, Sunk cost, Notional cost and Historical cost.

A company wishes to manufacture 'Smart' watches that can be interactive with mobile phones, computers and CCTV systems. It is planning to do research on the compatibility. It has done market survey and is satisfied about the demand being sufficient for making the product profitable. Some facilities can be made available by discontinuing its existing line of telephone instruments division.

- (i) R & D costs indicated above*
- (ii) Cost of Market Survey*
- (iii) The profit of the Telephone Instruments Division*

7. Cost classification – November 2017

Identify the type of cost in each of the following independent situations. Also state whether it is relevant or irrelevant.

- (i) A company has invested ₹ 50 lakh in a project. Company could have earned ₹ 4 lakh by investing the amount in Government securities.
- (ii) Company has purchased a new machine for ₹ 50 lakh and entered into three year maintenance contract at ₹ 25,000 per year.
- (iii) A special drilling machine has to be hired on monthly charges of ₹ 50,000 for two months for the Construction project.
- (iv) There are 15 skilled workers in the production department of X Ltd. currently underutilized. It is the policy of the company to continue to pay skilled workers at ₹ 15,000 month in full. Acceptance of the new project will reduce the idle time of skilled workers.

8. Cost classification – November 2016 RTP

ANZB Financial Services Limited is an Indian banking and financial services company headquartered in Chennai, Tamil Nadu. Apart from lending to individuals, the company grants loans to micro, small and medium business enterprises. Listed below are several costs incurred in the loan division of ANZB Financial Services Limited.

- (i) Remuneration of the loan division manager.
- (ii) Cost of Printer Paper, File Folders, View Binders, Ink, Toner & Ribbons used in the loan division.
- (iii) Cost of the division's MacBook Pro purchased by the loan division manager last year.
- (iv) Cost of advertising in business newspaper by the bank, which is allocated to the loan division.

Cost Classification

Controllable by the loan division manager	Direct cost of the loan division	Sunk Cost
Uncontrollable by the loan division manager	Indirect Cost of the loan division	Out of Pocket Cost

Required

For each Cost, indicate which of the above mentioned Cost Classification best describe the cost.

9. Discretionary versus committed fixed costs – May 2014 RTP

Pick out from each of the following items, costs that can be classified under 'committed fixed costs' or 'discretionary fixed costs'.

- a) Annual increase of salary and wages of administrative staff by 5% as per agreement
- b) New advertisement for existing products is recommended by the Marketing Department for achieving sales quantities that were budgeted for at the beginning

- of the year.
- c) Rents paid for the factory premises for the past 6 months and the rents payable for the next six months. Production is going on in the factory.
 - d) Research costs on a product that has reached 'maturity' phase in its life cycle and the research costs which may be needed on introducing a cheaper substitute into the market for facing competition.
 - e) Legal consultancy fees payable for patent rights on a new product Patenting rights have been applied for.
 - f) Depreciation on assets
 - g) Advertising
 - h) Research
 - i) Employees training

Topic 13: Relevant Costing**1. Relevant cost – May 2012**

A company has decided to launch a new product X which is, expected to have demand of 10,000 units during the year at ₹160 per unit. The following information is furnished by the company:

- (i) *Material - The manufacture of one unit of X requires one unit of each of materials A, B and C.*

Raw Material	Current stock (units)	Cost per unit (₹)		
		Original cost	Current Purchase Price	Resale Value
A- Regularly being used	10,000	16	20	14
B- Old stock (Not in use)	6,000	28	24	8
C- New stock	---	---	48	---

- (ii) *Direct labour*

Skilled labour is paid at ₹80 per hour. It takes 0.25 hours/unit. Skilled labour has to be drawn from another production line which has a contribution of ₹ 240 per unit, with each unit requiring 2 hours of skilled labour.

Unskilled labour - 2 hours/unit @ ₹ 56 per hour. There is abundant Unskilled labour in the factory, but according to an agreement with the labour union, no unskilled worker can be retrenched.

- (iii) *Variable overhead - ₹ 10 per unit.*

- (iv) *Fixed Costs –no increase.*

Using relevant cost approach, you are required to find out the average variable cost per unit of X.
(5 Marks)

2. Relevant/irrelevant costs – November 2016 RTP

Aves Airlines Ltd. operates its services under the brand 'Yellow Bird'. The 'Yellow Bird' route network spans prominent business metropolis as well as key leisure destinations across the Indian subcontinent. 'Yellow Bird', a low-fare carrier launched with the objective of commoditizing air travel, offers airline seats at marginal premium to train fares across India.

Profits of the 'Yellow Bird' have been decreasing for several years. In an effort to improve the company's performance, consideration is being given to dropping several flights that appear to be unprofitable.

Income statement for one such flight from 'New Delhi' to 'Kullu' (Y-09) is given below (per flight):

	₹	₹
Ticket Revenue (175 seats x 80% Occupancy x ₹7,000 ticket price)		9,80,000
Less: Variable Expenses (₹1,400 per person)		1,96,000
Contribution Margin		7,84,000
Less: Flight Expenses:		
Salaries, Flight Crew	2,05,000	
Salaries, Flight Assistants	45,500	
Baggage Loading and Flight Preparation	72,000	
Overnight Costs for Flight Crew and Assistants at destination	18,000	
Fuel for Aircraft	2,55,000	
Depreciation on Aircraft	51,000*	
Liability Insurance	1,53,000	
Flight Promotion	35,000	
Hanger Parking Fee for Aircraft at destination	15,000	8,49,500
Net Gain / (Loss)		(65,500)

* Based on obsolescence

The following additional information is available about flight Y-09.

- Members of the flight crew are paid fixed annual salaries, whereas the flight assistants are paid by the flight.
- The baggage loading and flight preparation expense is an allocation of ground crew's salaries and depreciation of ground equipment.
- One third of the liability insurance is a special charge assessed against flight Y-09 because in the opinion of insurance company, the destination of the flight is in a "high-risk" area.
- The hanger parking fee is a standard fee charged for aircraft at all airports.
- If flight Y-09 is dropped, 'Golden Bird' Airlines has no authorization at present to replace it with another flight.

Required

Prepare an analysis showing what impact dropping flight Y-09 would have on the airline's profit.

3. **Relevant costing – November 2013**

A company has to decide whether to accept a special order or not for a certain product M in respect of which the following information is given:

<i>Material A required</i>	<i>5,000 kg</i>	<i>Available in stock. It was purchased 5 years ago at ₹ 35 per kg. If not used for M, it can be sold as scrap @ ₹ 15 per kg.</i>
<i>Material B required</i>	<i>8,000 kg</i>	<i>This has to be purchased at ₹ 25 per kg from the market.</i>
<i>Other hardware items</i>	<i>₹ 10,000</i>	<i>To be incurred</i>
<i>Dept X - Labour oriented</i>	<i>5 men for 1 month @ ₹ 7,000 per month per man</i>	<i>Labour to be freshly hired. No spare capacity available.</i>
<i>Dept Y - Machine oriented</i>	<i>3,000 machine hours @ ₹ 5 per machine hour</i>	<i>Existing spare capacity may be used.</i>
<i>Pattern and Specification</i>	<i>₹ 15,000</i>	<i>To be incurred for M, but after the order, it can be sold for ₹ 2,000</i>

Considering relevant costs, find out the minimum value above which the company may accept the order.
(5 Marks)

4. **Decision on continuance of project**

A research project which to date has cost the company Rs.2, 50,000 is under review. It is anticipated that should the project be allowed to proceed would be completed approximately in one year when the project would be sold to government agency for Rs.3,00,000. Shown below are the additional expenses which the company estimates will be necessary to complete the work.

Material – Rs.90, 000

This material, which has just been received, is extremely toxic and if not used on the project would be disposed by special means at a cost of Rs.25, 000

Labour – Rs.60, 000

The men are highly skilled and very difficult to recruit. They were transferred to the project from a production department, and at a recent board meeting, the works manager claimed that if the men were returned to him he would earn the company each year Rs.2, and 00,000 extra sales. The accountant calculated that the prime cost (excluding direct labour cost of Rs.60, 000) would be Rs.1, 00,000 and the overhead absorbed (all fixed) would amount to Rs.20, 000.

Research staff – Rs.60, 000

A decision has already been taken that this will be the last major piece of research undertaken and consequently when the work ceases the staff involved will be made redundant. Redundancy pay has been estimated at Rs.35, 000.

Share of General building services – Rs.50, 000

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

Assuming that the above estimates are correct, should the MD allow the project to continue?

5. Relevant costing – November 2015 RTP

XL Polymers, located in Sahibabad Industrial Area, manufactures high quality industrial products. AT Industries has asked XL Polymers for a special job that must be completed within one week.

Raw material R_1 (highly toxic) will be needed to complete the AT Industries' special job. XL Polymers purchased the R_1 two weeks ago for ₹7,500 for a job 'A' that recently was completed. The R_1 currently in stock is the excess from that job and XL Polymers had been planning to dispose of it. XL Polymers estimates that it would cost them ₹1,250 to dispose of the R_1 . Current replacement cost of R_1 is ₹6,000.

Special job will require 250 hours of labour G_1 and 100 hours of labour G_2 . XL Polymers pays their G_1 and G_2 employees ₹630 and ₹336 respectively for 42 hours of work per week. XL Polymers anticipates having excess capacity of 150 [G_1] and 200 [G_2] labour hours in the coming week. XL Polymers can also hire additional G_1 and G_2 labour on an hourly basis; these part-time employees are paid an hourly wage based on the wages paid to current employees.

Suppose that material and labour comprise XL Polymers's only costs for completing the special job.

Required:

Calculate the 'Minimum Price' that XL Polymers should bid on this job?

6. Relevant costing – May 2014

Buildico, a company that builds houses presents the following facts relating to a certain housing contract that it wishes to undertake:

The CEO's and Marketing Director's food and hotel expenses of ₹ 3,750 were incurred for a meeting with a prospective client.

1,200 kgs of raw material Z will be required for the house. Inventory of Z available is 550 kg. It was purchased at ₹ 580 per kg. It is used by Buildico in other projects. Its current market price is ₹ 650 per kg. Its resale value is ₹ 350 per kg.

The house will require 90 hours of engineer's time. The engineers are paid a fixed monthly salary of ₹ 47,500 per engineer who can work 150 hours a month. Spare time is not available now and an engineer has to be hired for this house for one month. He cannot be used in any other project once he does this contract.

Buildico will use a special earthquake proof foundation material. This was developed by Buildico at a cost of ₹ 30,000 for some other project that had to be abandoned. If it does not use it in this project, it can use it in some other project and charge the client ₹ 50,000 for it.

A list of items is given below. You are required to name the type of cost and state whether it is relevant or not in calculating the cost of the given housing project:

S. No.	Item	Type of Cost	Relevant (R)/ Irrelevant (IR)
1	Food and hotel expenses ₹ 3,750		
2. (i)	Material Z : 550 kg × ₹ 580/kg		
(ii)	Material Z : 550 kg × ₹ 650 per kg		
3. (i)	Engineer's salary ₹ 47,500		
(ii)	Engineer's free time cost $\frac{60}{150} \times ₹ 47,500$		
4. (i)	Design cost ₹ 30,000		
(ii)	Design cost ₹ 50,000		

(8 Marks)

Topic 14: Basics of Marginal Costing**1. Revenues required to justify additional investment – May 2016 RTP**

ABC Road Carriers is a transporting company that transports goods from one place to another. It measures quality of service in terms of:

- ❖ Time required to transport goods
- ❖ On-time delivery
- ❖ Number of lost or damaged cartons.

To improve its business prospects and performance the company is seriously considering installing a scheduling and tracking system, which involves an annual outlay of Rs. 1, 25,000. The company furnishes the following information about its present and anticipated future performance:

	Current	Expected
On-time delivery	85%	95%
Variable costs per carton lost or damaged	Rs.55	Rs.55
Fixed costs per carton lost or damaged	Rs.45	Rs.45
Number of cartons lost or damaged	2,500	1,200

The company expects that each half per cent point increase in on-time performance will result in revenue increase of Rs. 9,000 per annum. Contribution margin of 45% is required.

- ❖ Should ABC Road Carriers acquire and install the new system?
- ❖ Also calculate additional amount of revenue required if benefits from new system are equal to cost & Contribution margin is 47.5%.

2. BEP of multiple products – May 2012

XY Ltd. makes two products X and Y, whose respective fixed costs are F1 and F2. You are given that the unit contribution of Y is one-fifth less than the unit contribution of X, that the total of F1 and F2 is Rs. 1,50,000, that the BEP of X is 1,800 units (for BEP of X F2 is not considered) and that 3,000 units is the indifference point between X and Y.(i.e. X and Y make equal profits at 3,000 unit volume, considering their respective fixed costs). There is no inventory buildup as whatever is produced is sold.

- ❖ Find out the values F1 and F2 and units contributions of X and Y.

3. Calculation of Break-even point

A Limited makes and sells a single product. The company's trading results for the year are

Particulars	Year 2007 (in '000s)
Sales	3,000
Direct Materials	900
Direct Labour	600
Overheads	900
Profits	600

For the year 2008, the following are expected:

- ❖ Reduction in the selling price by 10%
- ❖ Increase in the quantity sold by 50%
- ❖ Inflation of direct material cost by 8%
- ❖ Price inflation in variable overhead by 6%
- ❖ Reduction of fixed overhead expenses by 25%

It is also known that

- ❖ In 2006, overhead expenditure totaled to Rs.8,00,000
- ❖ Total overhead cost inflation for 2007 has been 5% more than 2006
- ❖ Production and sales volumes have been 25% higher in 2007 than in 2006

The high-low method is being used by the company to estimate the overhead expenditure. You are required to:

- ❖ Prepare a statement showing the estimated trading results for 2008
- ❖ Calculate the break-even point for 2007 and 2008
- ❖ Comment on the BEP and profits for the years 2007 & 2008
- ❖ Calculate the sales to be made in 2008 to maintain the same net profit ratio
- ❖ Calculate the percentage increase in sale price to maintain same net profit ratio
- ❖ Rework the earlier two parts if the company want to maintain same profit

4. BEP – Advanced – Differential fixed and change in variable costs with moving from one range to next range – November 2015 RTP

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 up to 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) Calculate for each of the possible sales levels at which your friend could expect to benefit by going into the venture on his own.
- (ii) Calculate the 'Break – Even Point' of the venture for each of the selling price.
- (iii) Advise your friend as to the viability of the venture.

5. **BEP in batches – May 2016 RTP**

Electro Life Ltd. is a leading Home Appliances manufacturer. The company uses just-in-time manufacturing process, thereby having no inventory. Manufacturing is done in batch size of 100 units which cannot be altered without significant cost implications. Although the products are manufactured in batches of 100 units, they are sold as single units at the market price. Due to fierce competition in the market, the company is forced to follow market price of each product. The following table provides the financial results of its four unique products:

	<i>Alpha</i>	<i>Beta</i>	<i>Gamma</i>	<i>Theta</i>	
<i>Sales (units)</i>	2,00,000	2,60,000	1,60,000	3,00,000	Total
	(₹)	(₹)	(₹)	(₹)	(₹)
<i>Revenue</i>	26,00,000	45,20,000	42,40,000	32,00,000	145,60,000
<i>Less: Material Cost</i>	6,00,000	18,20,000	18,80,000	10,00,000	53,00,000
<i>Less: Labour Cost</i>	8,00,000	20,80,000	12,80,000	12,00,000	53,60,000
<i>Less: Overheads</i>	8,00,000	7,80,000	3,20,000	12,00,000	31,00,000
<i>Profit / (Loss)</i>	4,00,000	(1,60,000)	7,60,000	(2,00,000)	8,00,000

Since, company is concerned about loss in manufacturing and selling of two products so, it has approached you to clear picture on its products and costs. You have conducted a detailed investigation whose findings are below:

The overhead absorption rate of ₹ 2 per machine hour has been used to allocate overheads into the above product costs. Further analysis of the overhead cost shows that some of it is caused by the number of machine hours used, some is caused by the number of batches produced and some are product specific fixed overheads that would be avoided if the product were discontinued. Other general fixed overhead costs would be avoided only by the closure of the factory. Numeric details are summarized below:

	₹	₹
<i>Machine hour related.....</i>		6,20,000
<i>Batch related</i>		4,60,000
<i>Product specific fixed overhead:</i>		
<i>Alpha.....</i>	10,00,000	
<i>Beta.....</i>	1,00,000	
<i>Gamma.....</i>	2,00,000	
<i>Theta.....</i>	1,00,000	14,00,000
<i>General fixed overheads.....</i>		6,20,000
		31,00,000

The other information is as follows:-

	Alpha	Beta	Gamma	Theta	Total
Machine Hours	4,00,000	3,90,000	1,60,000	6,00,000	15,50,000
Labour Hours	1,00,000	2,60,000	1,60,000	1,50,000	6,70,000

Required

- Prepare a profitability statement that is more useful for decision making than the profit statement prepared by Electro Life Ltd.
- Calculate the break-even volume in batches and also in approximate units for Product 'Alpha'.

6. Opportunity cost calculation – November 2013

A company can produce any of its 4 products, A, B, C and D. Only one product can be produced in a production period and this has to be determined at the beginning of the production run. The production capacity is 1,000 hours. Whatever is produced has to be sold and there is no inventory build-up to be considered beyond the production period. The following information is given:

	A	B	C	D
Selling Price (₹/unit)	40	50	60	70
Variable Cost (₹/unit)	30	20	20	30
No. of units that can be sold	1,000	600	900	600
No. of production hours required per unit of product.	1 hour	1 hour and 15 minutes	1 hour and 15 minutes	2 hours

What are the opportunity costs of A, B, C and D?

(5 Marks)

7. BEP and step up fixed cost – May 2012:

Ezee Ltd makes two products, E and Z. All units produced are sold. There is no inventory build up. Production facilities may be used interchangeably for both the products. Sales units are the limiting factor. The following information is given:

	Price Level			Proposed increase
	E	Z	Total	Total
Contribution ₹/units	25	20		
Fixed Cost ₹			46,000	47,500
Sales units (nos)	3,000	2,000	5,000	4,000

For increase in quantities above 4,000 units for each product, there will be an increase in variable selling costs, (for the increased portion only), thereby reducing the contribution per unit to the following figures:

Units	Contribution per unit (₹)	
	E	Z
4001-5000	20	15
5001-6000	15	10
Above 6000	No Sales possible	

- For the present level, find the break-even point with the present product
- What is the minimum number of incremental units to be sold to recover the additional fixed cost off ₹ 47,500 to be incurred? (Present product mix need not be maintained):
- If you are allowed to choose the best product mix for the incremental level, (while taking the present mix given in the first table above for the present level), what would be the individual product quantities and the corresponding total contributions, the total average contribution per unit and the total profits for the complete production? (8 Marks)

Topic 15: Marginal costing versus absorption costing**1. Marginal versus absorption costing**

Mr. Rajesh is quite displeased and frustrated as despite his and his staff's best efforts, although the sales are increasing, the profits are declining over the last three years. He supplies you with the following information:

(In '000s)

Particulars	2011-12	2012-13	2013-14
Sales	1,000	1,100	1,200
Cost of production			
Variable	260	240	160
Fixed (applied)	390	360	240
Opening inventory (added)	50	200	250
Closing inventory (deducted)	200	250	50
	500	550	600
Adjustment for overheads applied	(30)		120
Actual cost of goods sold	470	550	720
Gross profit	530	550	480
Less: Selling expenses (semi-variable)	490	530	570
Net profit	40	20	(90)

Actual productions for the last three years were 65,000, 60,000 and 40,000 units respectively. 5,000 units were in stock at the beginning of 2011 - 12. Fixed manufacturing overheads are applied to production based on planned activity of 60,000 units every year. Actual overheads were Rs.10, 80,000 for past three - year period and were evenly incurred.

Topic 16: Indifference Point and Shut-down Point**1. Indifference point – May 2013**

The following are the cost data for three different alternative ways of processing work

Particulars	Manual	Semi-automatic	Fully-automatic
Monthly fixed costs			
Occupancy	15,000	15,000	15,000
Maintenance contract	-	5,000	10,000
Equipment lease	-	25,000	1,00,000
Variable costs			
Supplies	40	80	20
Labour	200	60	20

- ❖ Calculate the cost indifference points and interpret your results
- ❖ If the present case load is 600 cases and it is expected to go up to 850 cases in near future, which method is most appropriate on cost considerations?

2. Shutdown point

A paint manufacturing company manufacture 2, 00,000 per annum medium sized tins of spray lac paints when working at normal capacity. It incurs the following costs of manufacturing per unit:

Direct Material	7.80
Direct Labour	2.10
Variable overheads	2.50
Fixed overheads	4.00
Products costs per unit	16.40

The selling price is Rs.21 per unit and variable and administrative expenses are 60 paise per ton. During the next quarter only 10,000 units can be produced and sold. Management plans to shut down the plant estimating that the fixed manufacturing cost can be reduced to Rs.74, 000 for the quarter. When the plant is operating, the fixed overheads are incurred at a uniform rate throughout the year. Additional costs of plant shutdown for the quarter are estimated at Rs.14, 000.

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

3. Indifference Point – November 2015

The following are cost data for three alternative ways of processing work cases in an office system:

	A Manual (₹)	B Semi- Automatic (₹)	C Fully Automatic (₹)
<i>Total fixed cost per month</i>	3,000	9,000	25,000
<i>Variable cost per case</i>	48	28	8

Calculate cost indifference points, Interpret your result. State for what volumes of cases will you prefer each of A, B and C. (5 Marks)

4. Shutdown point – May 2017 RTP

If AICI Limited operates its plant at normal capacity it produces 2,00,000 units from the plant 'C'. The unit cost of manufacturing at normal capacity is as under:

	₹
Direct material.....	65
Direct labour.....	30
Variable overhead.....	33
Fixed overhead.....	7
	135

Direct labour cost represents the compensation to highly-skilled workers, who are permanent employees of the company. The company cannot afford to lose them. One labour hour is required to complete one unit of the product.

The company sells its product for ₹ 200 per unit with variable selling expenses of ₹ 16 per unit. The company estimates that due to economic down turn, it will not be able to operate the plant at the normal capacity, at least during the next year. It is evaluating the feasibility of shutting down the plant temporarily for one year.

If it shuts down the plant, the fixed manufacturing overhead will be reduced to ₹ 1,25,000. The overhead costs are incurred at a uniform rate throughout the year. It is also estimated that the additional cost of shutting down will be ₹ 50,000 and the cost of re-opening will be ₹ 1,00,000.

Required

Calculate the minimum level of production at which it will be economically beneficial to continue to operate the plant next year if 50% of the labour hours can be utilized in another activity, which is expected to contribute at the rate of ₹ 40 per labour hour. The additional activity will relate to a job which will be off-loaded by a sister company only if the company decides to shut down the plant.

5. Shutdown point – November 2016

G Ltd., produces and sells 95,000 units of 'X' in a year at its 80% production capacity. The selling price of product is ₹ 8 per unit. The variable cost is 75% of sales price per unit. The fixed cost is ₹ 3,50,000. The company is continuously incurring losses and management plans to shut-down the plant. The fixed cost is expected to be reduced to ₹ 1,30,000. Additional costs of plant shut-down are expected at ₹ 15,000.

Should the plant be shut-down? Find the shut-down point in units and also in percentage of capacity level of production.

(5 Marks)

Topic 17: Limiting Factor**1. Analysis of limiting factor – May 2016 RTP**

List out the basis for deciding the priority of selecting the best product in the different circumstances as stated below:

- ❖ When maximum sales (in value) is limiting factor
- ❖ When raw-material is limiting factor
- ❖ When labour hour is limiting factor
- ❖ When there is heavy demand for the product

2. Limiting factor & specific fixed costs – November 2015

Four products P, Q, R and S are produced by profit center Division A. Each product is sold in the external market also. Data for the period are as follows:

Particulars	P	Q	R	S
Market price	70	69	56	46
Variable cost	66	59	36	37
Labour hours per unit	3	2	2	3
Specific fixed costs per 10,000 units of product	2,500	12,600	15,000	18,000

Product S can be transferred to Division B but the maximum quantity that might be required for transfer is 20,000 units of S. The specific fixed costs given above are avoidable if a product is not made. They are incurred for every 10,000 units.

The maximum sales (units) in the external market are:

- ❖ Product P = 30,000 units
- ❖ Product Q = 31,000 units
- ❖ Product R = 28,000 units
- ❖ Product S = 18,000 units

Division B can purchase the same product at a slightly cheaper price of Rs. 45 per unit instead of receiving transfers of product S from Division A without any extra transport/inspection costs. B can also take partial supplies from A. The total labour hours available in Division A is 1,92,000 hours.

- ❖ What is A's optimal product mix and the corresponding contribution net of specific fixed costs?
- ❖ How many units should A transfer to B and at what price?
- ❖ Is it in the company's interest to transfer 20,000 units of S to B?

3. Multiple limiting factors – November 2014

A company is producing three products X, Y & Z. Relevant information is given below:

Product	X	Y	Z
Raw material per unit (kg)	20	12	30
Machine hours per unit (hours)	3	5	4
Selling price per unit (Rs.)	500	400	800
Maximum limit of production Unit	1,500	1,500	750

Only 9,200 hours are available for production at a cost of Rs.20 per hour and maximum 50,000 kgs. Of material @ Rs. 20 per kg., can be obtained. (Only product mix quantities are to be shown, calculation of total profit at that product mix not required to be shown)

On the basis of the above information determine the product-mix to give the highest profit if at least two products are produced.

4. Limiting factor – May 2015

Apex Limited manufactures two products, P and Q, using the same production facility. The following information is available for a production period:

Particulars	Product P	Product Q
Demand (units)	2,20,000	1,75,000
Contribution (Rs./ unit)	10	12
Machine hours required per 100 units	15	25

P and Q can be produced only in batches of 100 units, and whatever is produced has to be sold or discarded. Inventory build-up is not possible from one production period to another. The total fixed costs for each level of production and directly attributable to P and Q are given below:

Level of output	Fixed cost of Product P	Fixed cost of Product Q
Upto 1,00,000 units	6,00,000	5,50,000
1,00,001 to 2,00,000 units	13,50,000	12,20,000
2,00,001 to 3,00,000 units (maximum possible level)	18,70,000	15,50,000

75,000 machine hours are available in the production period.

Required

- ❖ Calculate the quantities of P and Q in the best product mix to achieve the maximum Profit and compute the maximum profit.
- ❖ What will be the opportunity cost of meeting P's demand fully?

5. Limiting factor – November 2017

AB company produces three products X, Y and Z by using Indigenous and Imported raw materials. The relevant information available from the records of the Company is as under:

	Product X	Product Y	Product Z
<i>Selling price in ₹ per unit</i>	425	380	500
<i>Direct materials in ₹ per unit</i>	180	160	190
<i>Direct Labour ₹ 40 per hour</i>	100	80	120
<i>Variable Overheads @ ₹ 12 per labour hour</i>	30	24	36
<i>Maximum Sales Potential (in units)</i>	1,500	2,500	2,500

The Company also has an agreement to supply 1,000 units of Product X to a vendor which has to be executed. Out of direct materials, 60% is imported raw material and it is purchased at ₹ 24 per kg.

Prepare a statement showing Contribution of these three products assuming availability of imported raw materials is restricted to 24,000 kgs per year. (5 Marks)

6. Limiting factor

Jaya-Surya Ltd. (JSL) manufactures and sells two products 'Jaya' and 'Surya'. Both Jaya and Surya use a regular machine while Surya uses another high-precision machine as well. The following information is available for the next quarter.

	Jaya	Surya
Selling Price per unit (Rs.)	1,500	2,000
Variable Manufacturing Cost per unit (Rs.)	900	1,600

Variable Marketing Cost per unit (Rs.)	250	150
Budgeted Allocation of Fixed Overhead Costs (Rs.)	18,00,000	85,00,000
Regular Machine Hours per unit	2.0	1.0

Further information is available as follows:

- ❖ JSL faces a capacity constraint of 60,000 hours on the regular machine for the next quarter and there is no constraint on the high precision machine for the next quarter.
- ❖ Out of Rs.85, 00,000 budgeted allocation of fixed overhead costs to product Surya, Rs. 60, 00,000 is payable for hiring the high precision machine. This cost is charged entirely to product Surya. The hiring agreement can be cancelled at any time without penalties.
- ❖ All other overhead costs are fixed and cannot be changed.
- ❖ A minimum quantity of 12,500 units per quarter of Jaya must be produced to fulfill a commitment to a customer.
- ❖ Any quantity of any product can be sold at the given prices.

Required:

- ❖ Calculate the product mix of Jaya and Surya which would maximize the relevant operating profit of JSL in the next quarter.
- ❖ JSL can double the quarterly capacity of regular machine at a cost of Rs. 28, 00,000. Calculate the new product mix and the amount by which the relevant operating profit will increase.

Topic 18: Make or Buy Decisions**1. Subcontracting decision and limiting factor – May 2014**

AXE Ltd. manufactures four products A, B, C and D. The following details are available for a production period:

	A	B	C	D
Selling Price	100	109	121	124
Material cost	40	42	46	40
Labour cost				
Assembly department @ Rs.10 per hour	15	20	15	20
Machine department @ Rs.12 per hour	18	24	36	30
Variable overheads @ Rs.4 per assembly hour	6	8	6	8
Maximum external demand (units)	40,000	55,000	36,000	30,000

Total fixed cost is dependent on the output level and is tabulated below at different levels of output:

Production units (any combination of one or more of any A, B, C or D)	Total fixed cost
Zero to 1,00,000 units	8,43,000
1,00,001 to 1,50,000 units	12,50,000
1,50,001 to 2,00,000 units	16,00,000

Production facilities can be interchangeably used among the products. Labour availability in the assembly department is limited to 2, 20,000 hours for the production period. A local firm has offered to make any quantity of any of the products on a sub-contract basis at the following rates:

Particulars	A	B	C	D
Sub-contract Price (Rs./unit)	85	95	101	100

Required

- ❖ Advise the management on how many units of each product are to be manufactured or subcontracted to fulfill maximum market demand. What would be the corresponding profits?
- ❖ What is the minimum number of units to be produced to achieve break-even point?
- ❖ What would you advise as the best strategy to maximize profits if assembly labour is not a limiting factor and if there is no compulsion to fulfill market demand?
- ❖ Rework part (i & iii) of the question if the fixed cost for second level is 8, 65,500?

(Only relevant figures need to be discussed. A detailed profitability statement is not required).

2. Make or Buy decision – May 2017

A company manufactures three components, A, B and C. these components pass through machines P and Q. The machine hour capacity of Q is limited to 7,800 hours a month. The company is interested in fulfilling the market demand to retain its market share. The following information is given:

	A	B	C
Demand (units/ month)	1,200	1,200	1,500
Variable cost (₹/ unit)	187	215	111
Fixed cost (₹/ unit) (at normal capacity utilization)	115	115	55
Hours per unit			
P	2	2	1½
Q	3	3	1

Component B has to be made by the company. There is a supplier available for components A and C at ₹ 280 and ₹ 161 per unit respectively.

- Which component(s) and in what quantities should be purchased to minimize costs?
- From a financial perspective, what do you need to ensure in order to justify your answer in (i) above?
(5 Marks)

3. Make or buy decision and limiting factor – May 2014 RTP

Aditya Ltd. manufactures four products A-1, B-2, C-3 and D-4 in Gurgaon and one product F-1 in Faridabad. Aditya Ltd. operates under Just-in-time (JIT) principle and does not hold any inventory of either finished goods or raw materials. Company has entered into an agreement with M Ltd. to supply 10,000 units per month of each product produced from Gurgaon unit at a contracted price. Aditya Ltd is bound to supply these contracted units to M Ltd. without any fail. Following are the details related with non-contracted units of Gurgaon unit.

Particulars	A-1	B-2	C-3	D-4
Selling Price per unit	360.00	285.00	290.00	210.00
Direct Labour @ Rs. 45 per hour	112.50	67.50	135.00	67.50
Direct Material M-1 @ Rs. 50 per kg.	50.00	100.00	-	75.00
Direct Material M-2 @ Rs. 30 per liter.	90.00	45.00	60.00	-
Variable Overhead (varies with labour Hrs)	12.50	7.50	15.00	7.50
Variable Overhead (varies with machine Hrs)	9.00	12.00	9.00	15.00
Total Variable Cost	274.00	232.00	219.00	165.00
Machine Hours per unit	3 hours	4 hours	3 hours	5 hours
Maximum Demand per month (units)	90,000	95,000	80,000	75,000

The products manufactured in Gurgaon unit use direct material M-1 and M-2 but product F-1 produced in Faridabad unit is made by a distinct raw material Z. Material Z is purchased from the outside market at Rs. 200.00 per unit. One unit of F-1 requires one unit of material Z. Material Z can also be manufactured at Gurgaon unit but for these 2 hours of direct labour, 3 hours of machine time and 2.5 liters of material M-2 will be required. The Purchase manager has reported to the production manager that material M-1 and M-2 are in short supply in the market and only 6,50,000 Kg. of M-1 and 6,00,000 liter of M-2 can be purchased in a month.

- ❖ Calculate whether Aditya Ltd should manufacture material Z in Gurgaon unit or

continue to purchase it from the market and manufacture it in Faridabad unit.

- ❖ Calculate the optimum monthly usage of Gurgaon unit's available resources and make decision accordingly.
- ❖ Calculate the purchase price of material Z at which your decision in (i) can be sustained.

4. Make or Buy decision and indifference point – November 2013 RTP

Jupiter Ltd, a 'Fast-Moving Consumer Goods (FMCG)' company intends to diversify the product line to achieve full utilisation of its plant capacity. As a result of considerable research made, the company has been able to develop a new product called 'EXE'.

'EXE' is packed in *cans* of 100 ml capacity and is sold to the wholesalers in cartons of 24 *cans* at ₹120 per carton. Since the company uses its spare capacity for the manufacture of 'EXE', no additional fixed expenses will be incurred. However accountant has allocated a share of ₹1,12,500 per month as fixed expenses to be absorbed by 'EXE' as a fair share of the company's present fixed costs to the new product for costing purposes.

The company estimates the production and sale of 'EXE' at 1,50,000 *cans* per month and on this basis the following cost estimates (per carton) have been developed:

	₹
Direct Materials	54
Direct Wages	36
All Overheads	<u>27</u>
Total Costs	117

After a detailed market survey the economy is confident that the production and sales of 'EXE' can be increased to 1,75,000 *cans* per month and ultimately to 2,25,000 *cans* per month.

The company at present has a capacity for the manufacture of 1,50,000 empty *cans* and the cost of the empty *cans* if purchased from outside will result in a saving of 20% in material and 10% in other costs of 'EXE'. The price at which the outside firm is willing to supply the empty *cans* is ₹ 0.675 per empty *can*. If the company desires to manufacture empty *cans* in excess of 1,50,000 *cans*, a machine involving an additional fixed overhead of ₹ 7,500 per month will have to be installed.

Required:–

- (a) State by showing your workings whether the company should make or buy the empty *cans* at each of the three volumes of production of 'EXE' namely, 1,50,000, 1,75,000 and 2,25,000 *cans*.
- (b) At what volume of sales will it be economical for the company to install the additional equipment for the manufacture of empty *cans*?
- (c) Evaluate the profitability on the sale of 'EXE' at each of the aforesaid three levels of output based on your decision and showing the cost of empty *cans* as a separate element of cost.

5. Make or Buy decision and limiting factor – November 2016

A company manufactures four products. The annual demand for products, selling prices and variable production costs are as follows:

Product	P	Q	R	S
Demand (Units)	1,20,000	1,86,000	1,71,000	99,000
Selling price/unit	23.88	28.68	55.08	47.88
Direct Material/Unit	10.08	13.20	30.48	24.96
Direct Labour/unit	4.08	4.08	6.72	6.36
Variable overheads/unit	1.44	1.44	2.40	2.16

Other data:

- (i) The variable overheads are absorbed on a machine hour basis at a rate of ₹ 1.20 per machine hour.
- (ii) Fixed overheads total ₹ 46,84,000 per annum.
- (iii) Production capacity available 8,15,000 machine hours per annum.
- (iv) Products P, Q and R can be bought-in at ₹ 21.36 per unit, ₹ 24 per unit and ₹ 48 per unit respectively.

You are required to calculate the best product mix for the year and the resulting optimal profit.
(8 Marks)

6. Make or Buy decision – May 2015

PQ Limited manufactures and sells a range of products. For one of its products, it makes 2,000 units of a component which has the following budgeted manufacturing cost:

	<u>Cost per unit</u>
	(₹)
<i>Direct materials</i>	<i>8,000</i>
<i>Direct Labour (specially skilled)</i>	
<i>(40 hours @ ₹ 150 per hour)</i>	<i>6,000</i>
<i>Variable overhead (40 hours ₹ 75 per labour)</i>	<i>3,000</i>
<i>Allocated Fixed overhead</i>	<u><i>10,000</i></u>
<i>Total production cost</i>	<u><i>27,000</i></u>

Softech Limited has offered to supply the component at a guaranteed price of ₹ 25,000 per unit.

If the component is not manufactured by PQ Limited, all the direct labour thus released can be employed in increasing the production by 1,600 units of an existing product K, which uses 50 of this type of direct labour hours per unit. K is sold for ₹ 45,000 per unit and has a marginal cost of production of ₹ 30,000 per unit and has sufficient market demand. The direct labour force cannot be retrenched or recruited for the next two production periods. From a financial perspective, using incremental cost analysis, would you advise PQ Ltd. to make or buy the component for the forthcoming production period?

(5 Marks)

7. Make or Buy decision and limiting factor – May 2012

A machine manufacturing company needs four components A, B, C and D.

The components may be procured from outside. The cost, market price for the components and other information are given below.

<i>Number of units required</i>	<i>3,000</i>	<i>3,500</i>	<i>2,000</i>	<i>3,000</i>
	<i>Figs. ₹ per unit</i>			
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
<i>Direct Material</i>	<i>120</i>	<i>140</i>	<i>150</i>	<i>120</i>
<i>Direct Wages</i>	<i>60</i>	<i>80</i>	<i>120</i>	<i>80</i>
<i>Direct expenses at ₹40 per machine hour</i>	<i>80</i>	<i>60</i>	<i>80</i>	<i>80</i>
<i>Fixed Cost</i>	<i>40</i>	<i>40</i>	<i>30</i>	<i>50</i>
<i>Total Cost</i>	<i>300</i>	<i>320</i>	<i>380</i>	<i>330</i>
<i>Market Price</i>	<i>300</i>	<i>320</i>	<i>400</i>	<i>270</i>

There are constraints on the machine time in manufacturing all the components. Total machine hours available is only 12,000 hours.

It is possible to use the machine time in a second shift which will attract 20 % extra wages and other fixed overheads at ₹6,000 for every 1,000 hours or part thereof.

With relevant supporting figures, advise the best course of action to maximize the profits.

(Note: Students need not work out the complete profitability statement). (8 Marks)

Topic 19: Differential selling prices and product mix**1. Differential selling prices and non-incremental approach**

Sellaway Ltd. manufactures and markets 2 products A and B, the demand in the market of which fluctuates with the prices quoted. As a result of the deliberations of its recent Sales Conference the following data were agreed upon as a working basis:

Product	A			B		
Selling price per unit (Rs.)	32	30	28	22	20	18
Expected demand per month (Nos.)	900	1,000	1,500	1,600	2,000	3,000

8 labour hours are required to produce product A and 4 labour hours to produce product B and the maximum capacity of the factory is restricted to 20,000 labour hours per month.

The cost structure per unit of production is as under:

Product	A	B
	Rs.	Rs.
Direct material	4	3
Direct labour	6	5
Variable overheads	10	6
	20	14

Fixed overheads are Rs. 32,400 per quarter.

You are required to compute the possible combinations and arrive at a proper price mix for maximum profitability.

2. Different selling price and Incremental approach:

Universe limited manufactures two products X and Y. It is facing severe competition in the market. The monthly sales potential in units at different selling prices as anticipated by the manager are as under:

Product X		Product Y	
SP	Sales potential	SP	Sales Potential
110	5000	78	30000
108	7500	77	32000
107	8000	75	35000
103	8400	72	40000
96	9000	69	45000

The total costs as disclosed by the budgets of the company are as follows:

Particulars	Product X		Product Y	
Output and sales per month (units)	5000	9000	30000	45000
Total costs per month (in lacs)	5	6.6	18	25.5
Labour hours needed per month	20000	36000	60000	90000

Find out the selling price and units to be sold to earn maximum profit where

- Labour hours are available without any restriction and
- Only 96,000 hours are available

Topic 20: Special Orders**1. Special order – November 2017**

UV Limited manufactures a product ZED. It currently operates at 70% capacity. It has received an export order which will utilize 50% of the capacity of the factory. The order has to be either taken in full or rejected totally. The order has to be executed at a price of ₹ 86 per unit and company has to incur additional cost of packing and forwarding of ₹ 2.50 per unit on the goods exported. Commission @ 3% will be payable to overseas agent.

Other information available is as under:

Sale value 63,000 units @ ₹ 95 per unit	₹ 59,85,000
Direct materials @ ₹ 42.10 per unit	₹ 26,52,300
Variable manufacturing overheads	₹ 4,41,000
Variable selling & distribution overheads (including 2% commission on domestic sales)	₹ 4,34,700
Fixed overheads	₹ 6,75,000
P/V ratio	20%

Following three alternatives are available to the management:

- Continue with the current domestic sale and reject the export order.
- Accept the export order by reducing the domestic sale.
- Increase the capacity by 10% by installing a new machine costing ₹ 2,50,000. Fixed overheads will increase by ₹ 96,000. Opportunity cost of investment is 15%.

Overtime is to be paid at one and a half time the normal rate to meet the balance of the required capacity.

Required:

- Prepare Statement of profitability for each of the above three alternatives.
- Which is the best alternative in terms of profitability? **(8 Marks)**

2. Decision on maximum discount/inspection cost – May 2014

PQR Ltd., a manufacturer of tool kits has just completed XY's domestic order of 100 kits at a price of Rs. 1,650 per kit. The details of cost for XY's order are:

Particulars	Amount
Direct Material	90,000
Direct Labour	32,000
Tools and Consumables	16,400
Variable overheads	9,600
Fixed overheads (allocated)	15,000
Total	1,63,000

The company wishes to evaluate a special export order from Expo Ltd. of similar 300 kits at Rs. 1,600 per kit. For the export order, special packing has to be done at Rs. 20 per kit. An additional fixed inspection cost specific to this export order has to be incurred. The allocation of fixed overheads will be revised to increase by Rs. 25,000. Tools and

Consumables above include special purpose tools costing Rs. 10,000 incurred for XY's order and these can be reused for the export order and the remaining portion is variable. PQR Ltd. wishes to accept the export order at 10% profit on the selling price.

Required

- ❖ What should be the maximum amount that can be incurred as inspection cost for making such an acceptance possible?
- ❖ If Expo Ltd. offers to take the products without inspection, what is the maximum discount (as a percentage of the existing export price) that PQR Ltd. can offer to retain its 10% profit on the revised selling price? (Round off calculations to two decimal places).

3. Price to be quoted for export order – November 2017

JC Company produces electronic product and factory is working in Special Economic Zone (SEZ). The expected capacity utilization is 60% and turnover for the year 2016-17 is ₹ 660 lakh. If the company works at 100% capacity, the sales cost relationship will be as follows:

Factory cost	:	65 per cent of sales value
Prime cost	:	75 per cent of factory cost
Selling and administrative cost	:	20% of sales value and being 80% variable

The factory overheads will vary according to operating capacity in the following manner:

Operating capacity	60%	80%	100%	120%
Factory overheads (₹ in lakhs)	155.25	164.00	178.75	214.50

The Government of India gives 10% subsidy on the export order amount and it is expected that currency fluctuation trends will be positive by 8% in next financial year.

The Company receives an offer from abroad for a value of ₹ 150 lakhs. The prime cost of this order is estimated at ₹ 96 lakhs and selling and administrative expenses applicable to this order is ₹ 7,20,000. The order will occupy 40% of the capacity of the plant. To complete the export order, quality maintenance cost of ₹ 1,20,000 will also be incurred.

The Marketing Director estimates that the company's own sales will increase to 80% of the capacity by the time of materialization of new order. The factory overheads will increase by ₹ 50.50 lakhs (for increase from 80% to 120% capacity).

The maximum demand in local market can be extended up to 120% with export order. The export order cannot be accepted partly.

Required:

- (i) Prepared a profitability statement at the capacity level of 60% 80% and 100%.
- (ii) Should the company accept the export order? (8 Marks)

4. Price to be quoted for export order – May 2012

A company is operating at 60 % of its capacity with a turnover of Rs. 43.20 lacs. If the company works at 100 % capacity, the sales-cost relation is: Factory cost is two thirds of sales value. Prime cost is 75% of factory cost. Administration and selling expenses (75% variable) are 20% of the sales value. Factory overhead will vary according to operating capacity as given below:

Operating capacity (%)	60	80	100	120
Factory overheads (Rs. lacs)	9.90	10.80	12	15

The company has planned to operate at 80 % of its capacity. Moreover, it has received an export order and its execution will involve 40 % of the capacity. The prime cost of the order is estimated at Rs. 6.0 lacs and the shipping involved will be around Rs. 1.0 lac. Administration and selling expenses will be avoided on the export order. Taking the same percentage of profits as on the domestic sales, determine the minimum price to be quoted for the export order.

Topic 21: Evaluation of multiple alternatives**1. Decision making – Evaluation of multiple alternatives – May 2013**

Better and Best Ltd. Manufacture only one product. Production is regular throughout the year and the capacity of the factory is 1,50,000 units per annum. The summarized Profit and Loss Account for the year ended 31st December is being reviewed by the Board of Directors.

Particulars	Amount
Sales @ Rs.10 per unit	10,00,000
Cost of sales	
Direct Materials	2,50,000
Direct labour	1,50,000
Variable production overheads	30,000
Fixed production overheads	2,30,000
Fixed administration overheads	1,00,000
Variable selling and distribution overheads	50,000
Fixed selling and distribution overheads	1,50,000

- ❖ The Production Director proposed to reduce selling price to Rs.9 in order to utilize full capacity.
- ❖ The Sales Director proposed to increase selling price by 20 percent. By spending Rs. 2, 25,000 on advertisement, sales will be increased to 1, 20,000 units per annum.
- ❖ The Personnel Director pleaded for a change in the method of wage payment. For the present piece rate of Rs.1.50 per unit, a bonus scheme (for each 2% increase in production over the target, there would be an increase of 1% in the basic wage of each employee) will be implemented. A target of 2,000 units per week for the company will be set for 50 week year. Selling price increase by 10%. With an additional advertisement cost of Rs. 1, 60,000, 20% increase in present sales will be achieved.
- ❖ The Chairman felt that the packaging of the product required improvement. He wanted to know the sales required to earn a target profit of 10% on turnover with the introduction of an improved packing at an additional cost of 20 paise per unit (no change in selling price).

Required

Evaluate individually the proposals of each of the board member and give your recommendation.

2. Decision making – November 2017 RTP

Recently, Ministry of Health and Family Welfare along with Drug Control Department have come hard on health care centres for charging exorbitant fees from their patients. Indraprastha Health Care Ltd. (IHCL), a leading integrated healthcare delivery provider company is feeling pinch of measures taken by authorities and facing margin pressures due to this. IHCL is operating in a competitive environment so; it's difficult to increase patient numbers also. Management Consultant of the company has come out with some plan for cost control and reduction.

IHCL provides treatment under package system where fees is charged irrespective of days a patient stays in the hospital. Consultant has estimated 2.50 patient days per patient. He wants to reduce it to 2 days. By doing this, consultant has targeted the general variable cost of ₹ 500 per patient day. Annually 15,000 patients visit to the hospital for treatment.

Medical Superintendent has some concerns with that of Consultant's plan. According to him, reducing the patient stay would be detrimental to the full recovery of patient. They would come again for admission thereby increasing current readmission rate from 3% to 5%; it means readmitting 300 additional patients per year. Company has to spend ₹ 25,00,000 more to accommodate this increase in readmission. But Consultant has found blessing in disguise in this. He said every readmission is treated as new admission so it would result in additional cash flow of ₹ 4,500 per patient in the form of admission fees.

Required

Calculate the impact of Management Consultant's plan on profit of the company. Also comment on result and other factors that should be kept in mind before taking any decision.

3. Inventory analysis

A company manufactures a special product which requires a component 'Alpha'. The following particulars are collected for the year 2013:

- ❖ Annual demand of Alpha : 8000 units
- ❖ Cost of placing an order : Rs.200 per order
- ❖ Cost per unit of Alpha : Rs.400
- ❖ Carrying cost % p.a. : 20%

The company has been offered a quantity discount of 4% on the purchase of 'Alpha' provided the order size is 4,000 components at a time.

Required:

- ❖ Compute the economic order quantity
- ❖ Advise whether the quantity discount can be accepted
- ❖ Find out the level of discount at which the company would be indifferent between purchase of 4,000 and EOQ units.

4. Evaluation of new proposal – May 2017 RTP

The profit for the year of Garena 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 joined the company recently estimates for next year a profit of about 23% on capital employed, provided the volume of sales is 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%.

Required

Find out by computing in detail the cost and profit for next year, whether the proposal of Sales Manager can be adopted.

5. Own salesman versus retail outlets – May 2016

XYLtd. is manufacturing a consumer product and doing marketing through 200 depots all over the country. The company is considering closing down the depots and resorting to dealership arrangements. The total turnover of the company is Rs. 160 crores per annum.

The following information is given for each depot. (amount in lacs)

❖ Annual turnover.....	80.00
❖ Average inventory.....	16.00
❖ Administrative expenses per annum.....	1.60
❖ Staff salary per annum.....	2.88

The inventory carrying cost is 16% p.a. which is also the interest rate prevailing in the market for working capital finance. The other fixed cost per annum is Rs. 16 crores. Marketing through dealers would involve engaging dealers for each area. The dealers will assure minimum sales for each area. This would result in increasing the capacity utilization from 80% to 100%. At present the company's P/V ratio is 20%. Marketing through dealers would involve payment of commission of 8% on sales. Half of the existing depot staff will have to be absorbed in the company. The dealer will deposit Rs. 3.20 crores with company on which interest at 12%p.a. will be paid. You are required to work out the impact on profitability of the company by accepting the proposal.

6. Evaluation of new proposal – May 2016

A manufacturing unit of ABC Co. Ltd. has presented the following details:

Average units produced and sold per month... 2,40,000

No. of workers..... 80

Sales value..... ₹ 60 Lacs

Contribution..... ₹ 24 Lacs

Wage rate..... ₹ 5 per unit

The production manager proposes to introduce a new automated machine due to which following changes will take place:

- 1. No. of units produced and sold are expected to increase by 20%.*
- 2. No. of workers will be reduced to 60.*
- 3. With a view to provide incentive for increased production, production manager intends to offer 1 % increase in wage rate for every 3% increase in average individual output achieved.*
- 4. Decrease in selling price by 2%.*

Required:

Calculate amount of extra contribution after introduction of new automated machine and give your recommendations. (8 Marks)

7. Impact on introduction of new product – May 2012

PQR Ltd is considering introducing a new product at a price of Rs. 105 per unit. 'PQR Ltd.'s controller has compiled the following incremental cost information based on an estimate of 1, 20,000 units of sales annually for the new product:

❖ Direct material cost	= Rs.36,00,000
❖ Direct Labour cost	= Rs.24,00,000
❖ Flexible manufacturing support	= Rs.12,00,000
❖ Sales commission	= 10% of sales
❖ Capacity- related cost	= Rs.20,00,000

The average inventory levels for the new product are estimated as follows:

- ❖ Raw materials = 2 months production
- ❖ Work-in-progress (100% complete for Materials and 50% complete for labour and Flexible manufacturing support) = 1 month production
- ❖ Finished goods = 2 months production

Annual inventory carrying costs not included in the flexible manufacturing support listed earlier are estimated to be 12% of inventory value. In addition, the sales manager expects the introduction of new product to result in a reduction in sales of existing product from 3,00,000 to 2,40,000 units. The contribution margin for the existing product is Rs. 20 per unit. Prepare a statement showing the budgeted impact on PQR's profits on the introduction of the new product. Should the new product be introduced?

8. **Decision making – November 2014**

A manufacturing company has three factories namely 'Factory A', 'Factory B' and 'Factory C'. All three factories produce the same product which are sold at ₹ 750 per unit. The factory-wise estimates of operation results for 2014 are as follows:

	Factory A	Factory B	Factory C	Total
Sales	600	2,400	1,200	4,200
Costs:				
Raw materials	150	700	290	1,140
Direct labour	150	560	280	990
Factory overheads-variable	40	220	110	370
Factory overheads-fixed	80	240	120	440
Selling overheads-variable	46	140	80	266
Selling overheads-fixed	30	100	60	190
Administrative overheads	40	180	80	300
Head office expenses	24	100	60	184
Profit	40	160	120	320

When the above estimates were under finalization, the company's legal department advised that the lease of Factory 'A' was due to expire on 31st December, 2013 and that it could be renewed by enhancing the lease rent by ₹ 24 lakhs per annum. Since this enhancement will have impact on the profitability of the company, the management is constrained to examine following proposals:

- Renew the lease and bear the impact.
- Close down factory 'A', sell off plant, machinery and stock and liquidate all liabilities including the staff and workers', pay retrenchment compensation from sale proceeds which are sufficient for the purpose.

In order however to maintain the customer relations, the total planned output of the factory 'A' will be transferred to EITHER factory 'B' OR factory 'C'. Plant capacity is available at both the factories to takeover the manufacture. The additional cost involved in the manufacture of the extra output so transferred in factory 'B' and 'C' are estimated as under:

		Factory B	Factory C
(a)	Additional fixed overheads due to increase in capacity utilization (per annum)	₹100 lakhs	₹80 lakhs
(b)	Additional freight, selling and other overheads to produce and distribute the output to the present customers of factory 'A'	₹50 per unit	₹70 per unit

You are required to prepare comparative statements of profitability in the aforesaid alternative courses of action and give your recommendations. (9 Marks)

9. Relevant cost of strike – May 2017 RTP, May 2015 RTP

MFG Ltd. is producing a component called 'KDK'. Estimated costs are:

	Fixed cost per year (thousands)	Variable cost per unit
Production	32,000	3,600
Distribution	2,000	200

Direct labour costs are 40% of the variable production costs. In the production department machining and assembling of 'KDK', 90 men work 8 hours per day for 300 days in a year. Each worker can machine and assemble 1 'KDK' per uninterrupted 180 minutes time frame. In each 8 hours working day, 20 minutes are allowed for coffee-break, 30 minutes on an average for training and 22 minutes for supervisory instructions. Besides 10% of each day is booked as idle time to cover checking in and checking out changing operations, getting materials and other miscellaneous matters.

MFG Ltd. has been facing industrial relations problem as the workers of company have a very strong union. Company is faced with the possibility of a strike by direct production workers engaged on the assembly of 'KDK'. The trade union is demanding an increase of 15%, back-dated from the beginning of financial year, but the company expects that if a strike does take place, it will last 25 Days after which the union will settle for an increase of 10% similarly back-dated. The only product of the company is being sold at Rs.6, 000.

If the strike takes place, Sales of 1,300 'KDK' would be lost. The balance that would ordinarily have been produced during the strike period could, however be sold, but these 'KDK' would have to be made up in overtime working which would be at an efficiency rate of 90% of normal. This would entail additional fixed cost of Rs.1, 00,000 and wage payments at time and one-half.

Required

Give necessary advice to the management to allow the strike to go ahead or to accept the Union's demand.

Topic 22: Further Processing Decisions**1. Decision on further processing – May 2017 RTP**

A process industry unit manufactures three joint products: A, B and C. C has no realizable value unless it undergoes further processing after the point of separation. The cost details of C are as follows:

- ❖ Upto point of separation
 - Marginal cost.....30
 - Fixed Cost.....20
- ❖ After point of separation
 - Marginal cost.....15
 - Fixed cost.....5

C can be sold at Rs.37 per unit and no more.

- ❖ Would you recommend production of C?
- ❖ Would your recommendation be different if A, B and C are not joint products?

2. Decision on further processing – May 2014

A company processes different products from a certain raw material. The raw material is processed in process I (where normal loss is 10% of input) to give products A and B in the ratio 3: 2. B is sold directly. A is processed further in process II (where normal loss is 12.5% of output) to give products C and D in the ratio 5:3. At this point C and D have sale values Rs. 55 and Rs. 40 per kg respectively. C can be processed further in process III with processing cost Rs. 3, 95,600 and normal wastage 5% of input and then be sold at Rs. 66 per kg. D can be processed further in process IV with processing cost Rs. 3, 82,500 and normal wastage 12.5% of output and then be sold at Rs. 55 per kg. The normal wastage of each process has no realizable value. During the production period, 2,00,000 kgs of raw material is to be introduced into Process I.

Using incremental cost-revenue approach, advice whether sale at split off or further processing is better for each of the products C and D.

Topic 23: Dropping a product line**1. Division discontinuation – May 2015**

Rabi Ltd. is considering the discontinuance of Division C. The following information is given:

<i>Particulars</i>	<i>Divisions A & B</i>	<i>Division C</i>	<i>Total</i>
<i>Sales (Maximum achievable)</i>	<i>41,40,000</i>	<i>5,17,500</i>	<i>46,57,500</i>
<i>Less: Variable cost</i>	<i>20,70,000</i>	<i>2,76,000</i>	<i>23,46,000</i>
<i>Contribution</i>	<i>20,70,000</i>	<i>2,41,500</i>	<i>23,11,500</i>
<i>Less: Specific avoidable fixed cost</i>	<i>14,49,000</i>	<i>4,14,000</i>	<i>18,63,000</i>
<i>Divisional Income</i>	<i>6,21,000</i>	<i>(1,72,500)</i>	<i>4,48,500</i>

The rates of variable costs are 90% of the normal rates due to the current volume of operation. There is adequate market demand.

For any lower volume of operation, the rates would go back to the normal rates.

Facilities released by discontinuing Division C cannot be used for any other purpose.

Evaluate the decision to discontinue Division C using relevant cost approach. (4 Marks)

Topic 24: Pricing Decisions**1. Acceptance of additional order – May 2013**

HTM Ltd., by using 12,00,000 units of a material M produces jointly 2,00,000 units of H and 4,00,000 units of T. The costs and sales details are as under:

	₹
Direct Material M @ ₹5 per unit	60,00,000
Other variable costs	42,00,000
Total fixed costs	18,00,000
Selling price of H per unit	25
Selling price of T per unit	20

The company receives an additional order for 40,000 units of T at the rate of ₹ 15 per unit. If this order has been accepted, the existing price of T will not be affected.

However, the present price of H should be reduced evenly on the entire sale of H to market the additional units to be produced.

Find the minimum average unit price to be charged on H to sustain the increased sales.

2. Price fixation – May 2017

ABC Ltd. produces a gadget made up of special steel plates. The company gets an order for supply of 50,000 gadgets at a price of ₹680 per unit.

The gadgets are made of two halves (upper part and lower part) and then welded together.

The cost structure is:

Materials 15 kg. per half @ ₹10 per kg; Labour ₹60 per half.

Welding charges and fitting charges would be ₹20 per gadget.

The special steel plates are in short supply and ABC Ltd. has stock of only 750 Tons. A supplier has only the lower part and has offered to supply 50,000 numbers. Transportation and handling will cost ₹6 per half. (consider 1 ton = 1,000 kg)

ABC Ltd. could either execute its order to the extent of material available, or could fulfil the entire order by buying the lower part from the supplier. Evaluate both the options and find out the maximum price that ABC would be willing to pay the supplier per lower part if.

- it wants to retain the same level of profit per unit as in own manufacture.
- if any additional revenue is preferred.

Present your calculations to the nearest rupee.

(6 Marks)

3. Price fixation – May 2015

A company produces a single product 'Impex'.

For an annual sales of 40,000 units of Impex, fixed overhead is ₹ 5,50,000. The variable cost per unit is ₹ 60. Capital employed in fixed assets is ₹ 8,00,000 and in current assets is 50% of net sales (i.e. sales less discount). The company sells goods at 20% discount on the maximum retail price (M.R.P.), which is ₹ X per unit. The company wants to earn a return of 25% before tax on capital employed in fixed and current assets.

Determine the value of X.

(5 Marks)

4. Minimum price fixation – November 2014

A shoe manufacturer has a net profit of ₹ 25 per pair on a selling price of ₹143. He is producing 6,000 pairs per annum which is 60% of the potential capacity. The cost per pair is as under:

	₹
Direct Materials	35.00
Direct Wages	12.50
Works Overheads (50% fixed)	62.50
Administrative Overheads (75% fixed)	6.00

During the current year the manufacturer also estimates demand of 6,000 pairs but anticipates that the fixed charges to go up by 10% while the rate of direct labour and direct materials will increase by 8% and 6% respectively. But he has no option of increasing the selling price. Under this situation he obtains an offer to utilise further 20% of capacity. What minimum price will you recommend to ensure an overall profit of ₹ 1,67,300?

(5 Marks)

5. Fixation of selling price – May 2013 RTP

Computer Tec a manufacturing firm has entered into an agreement of strategic alliance with Comp Inc. of United States of America for the manufacture of Super Computers in India. Broadly, the terms of agreement are:

- ❖ Comp Inc. will provide Computer Tec with kits in a dismantled condition. These will be used in the manufacture of the Super Computer in India. On a value basis, the supply, in terms of the FOB price will be 50% thereof.
- ❖ Computer Tec will procure the balance of materials in India.
- ❖ Comp Inc will provide to Computer Tec with designs and drawings in regard to the materials and supplies to be procured in India. For this, Computer Tec will pay Comp Inc. a technology fee of Rs. 8 crores.
- ❖ Comp Inc. will also be entitled total royalty at 10% of the selling price of the computers fixed for sales in India as reduced by the cost of standard items procured in India and also the cost of imported kits from Comp Inc.
- ❖ Computer Tec will furnish to Comp Inc. detailed quarterly returns.

Other information available:

- ❖ FOB price agreed \$2,040. Exchange rate to be adopted \$1 = Rs. 55.00
- ❖ Insurance and freight – Rs. 2,000 per imported kit;
- ❖ Customs duty leviable is 200% of the CIF prices; but as a concession, the actual

- rate leviable has been fixed at 40% of CIF.
- ❖ The technology agreement expires with the production of 8,00,000 computers;
 - ❖ The quoted price on kits includes a 25% margin of profits on cost to Comp Inc.
 - ❖ The estimated cost of materials and supplies to be obtained in India will be 150% of the cost of supplies made by Comp Inc. 50% of the value in rupees of the locally procured goods represent cost of the standard items.
 - ❖ Cost of assembly and other overheads in India will be Rs. 8,000 per Super Computer.

Calculate the selling price, of a personal computer in India bearing in mind that Computer Tec Ltd has targeted a profit of 20% to itself on the selling price.

6. ROCE pricing - May 2017 RTP

Determine the selling price per unit to earn a return of 12% net on capital employed (net of tax @ 40%).

The cost of production and sales of 80,000 units per annum are:

- ❖ Material = Rs.4,80,000
- ❖ Labour = Rs.1,60,000
- ❖ Variable overhead = Rs.3,20,000
- ❖ Fixed overhead = Rs.5,00,000

The fixed portion of capital employed is Rs.12 lacs and the varying portion is 50% of sales turnover.

7. Optimum price fixation - May 2017 RTP

APV Ltd. has developed a new product which is about to be launched into the market. The variable cost of selling the product is ₹ 17 per unit. The marketing department has estimated that at a sale price of ₹ 25, annual demand would be 10,000 units. However, if the sale price is set above ₹ 25, sales demand would fall by 500 units for each ₹ 0.50 increase above ₹ 25. Similarly, if the price is below ₹ 25, demand would increase by 500 units for each ₹ 0.50 stepped reduction in price below ₹ 25.

Required

Determine the price which would maximise APV Ltd.'s profit in the next year.

8. Fixation of Price – May 2016

A company manufactures a product Y in addition to other products by using the same machines in department A and department B.

The usage details are:

Per Unit of Product Y	Department A		Department B	
	Usage	Rate	Usage	Rate
Direct Material	8 kg	₹ 4	4 kg	₹ 6
Direct Labour	2 hours	₹ 14	3 hours	₹ 12

Basis of overhead recovery are given below:

	Deptt. A per rupee of direct material ₹	Deptt. B per direct labour hour ₹
Variable overheads	0.80	2.00
Fixed overheads	2.20	3.00

Other Details are:

Value of Plant & Machinery in department A is ₹ 22 Lacs and in department B is ₹ 18 Lacs.

The Working Capital requirement of Product Y based on a target volume of output of 2,000 units per month is estimated at ₹ 2,72,800 per annum which is 40% of the potential capacity.

Required:

- Calculate the selling price of Product Y to ensure contribution equivalent to 25% of investment made.
- If Product Y is a new product about to be launched in the market, on what basis should the price be fixed and what would be the minimum price?
- If Product Y is a well established product, what should be the basis for price fixing and what would be the minimum price? (8 Marks)

9. Fixation of price – November 2014

An organization manufactures a product, particulars of which are detailed below:

Particulars	Amount
Annual Production (units)	20,000
Material cost	50,000
Other variable cost	60,000
Fixed cost	40,000
Apportioned investment	1,50,000

Determine the unit selling price under two strategies mentioned below. Tax rate is 40%.

- ❖ 20% return on investment
- ❖ 6% profit on list sales, when trade discount is 40%

10. State the pricing policy which is most suitable in each of the following independent situations:

- a. The company makes original equipments and also does defense contract work. There are other companies which also undertake such projects
- b. The product made by the company is new to the market. It is expected to enjoy a long-term demand. Competition is expected very soon, since the product will be desirable to most customers.
- c. Stock of processed ready-to-eat product, whose shelf life will soon be over in the next 2 months. The product is going to be discontinued.
- d. A company sells a homogenous product in a highly competitive market.

11. Pricing policy – May 2017 RTP, November 2013

State the appropriate pricing policy in each of the following independent situations:

- ❖ 'A' is a new product for the company and the market and meant for large scale production and long term survival in the market. Demand is expected to be elastic.
- ❖ 'B' is a new product for the company, but not for the market. B's success is crucial for the company's survival in the long term.
- ❖ 'C' is a new product to the company and the market. It has an inelastic market. There needs to be an assured profit to cover high initial costs and the usual sources of capital have uncertainties blocking them.
- ❖ 'D' is a perishable item, with more than 80% of its shelf life over.

12. Pricing policy – November 2015

State the most appropriate pricing policy to be adopted in the following independent situations:

- ❖ Modern patented drug entering the market.
- ❖ The latest version of a mobile phone is being launched by an established, financially strong company.
- ❖ An established company has recently entered the stationery market segment and launched good quality paper for printing at home and office.
- ❖ A car manufacturer is launching an innovative, technologically advanced car in the highly priced segment.
- ❖ A new product is to be launched. It has had high promotional expenditure and its demand in the market is not known
- ❖ A new product is to be launched. It is to be mass manufactured
- ❖ A product which has an external market demand is to be transferred to another division of the same company. For the external market, variable selling costs of Rs.10 per unit and fixed selling costs amounting to Rs.10 lakhs per annum are incurred. These costs are not applicable to divisional transfer. The divisional transfer can take up only 20% of the output produced
- ❖ A special one-time order for the use of idle capacity is offered. This order will not impact the existing sales of the company. The product has competition in the market
- ❖ There is stock of a discontinued product. It has severe competition and the product is perishable

13. Pricing analysis – May 2017 RTP

State whether the following statements are VALID or INVALID.

- ❖ When price reductions are introduced to increase sales revenue, the revenue line will be a straight line.

- ❖ In fixing selling prices, volume consideration should be taken into account so that fuller utilisation of plant capacity is achieved.
- ❖ There is no price policy in perfect competition.
- ❖ The rate of return to be earned by factory should cover the risk involved in business.
- ❖ Survival and progress of a firm depend on its ability to maintain and replace, whenever necessary, its fixed assets.

14. Cost Plus Pricing – November 2015

The budgeted cost data of a product manufactured by Ayudhya Ltd. is furnished as below:

Budgeted units to be produced.....	2,00,000
Variable cost (₹).....	32 per unit
Fixed cost (₹).....	16 lacs

It is proposed to adopt cost plus pricing approach with a mark-up of 25% on full budgeted cost basis.

However, research by the marketing department indicates that demand of the product in the market is price sensitive. The likely market responses are as follows:

<i>Selling price (₹ per unit)</i>	44	48	50	56	60
<i>Annual Demand (units)</i>	1,68,000	1,52,000	1,40,000	1,28,000	1,08,000

Required

Analyse the above situation and determine the best course of action.

15. Pricing Decisions and Product Life Cycle – Nov 2017 RTP

Rapid Heal Tech Ltd. (RHTL) is a leading IT security solutions and ISO 9001 certified company. The solutions are well integrated systems that simplify IT security management across the length and depth of devices and on multiple platforms. RHTL has recently developed an Antivirus Software and company expects to have life cycle of less than one year. It was decided that it would be appropriate to adopt a market skimming pricing policy for the launch of the product. This Software is currently in the Introduction stage of its life cycle and is generating significant unit profits.

Required

- (i) *Explain, with reasons, the changes, if any, to the unit selling price that could occur when the Software moves from the Introduction stage to Growth stage of its life cycle.*
- (ii) *Also suggest necessary strategies at this stage.*

16. Pricing strategy – November 2017

State the Market Entry Strategies of pricing applicable in the following situations:

- (1) *Inelastic demand*
- (2) *Mass Production*
- (3) *Assured profit*
- (4) *Elastic demand*

17. Pricing strategy – May 2017

The following independent situations relate to new product pricing. Classify the products into the appropriate category: Revolutionary Product (RP), or Evolutionary Product (EP) or a Me-Too Product (MP) and state the corresponding pricing to be followed:

<i>Sl. No.</i>	<i>Situation</i>	<i>RP/EP/MP</i>	<i>Pricing</i>
<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
(i)	<i>Adjustable work table like a stool, has been successfully capturing the market. Company X makes a small variant of this product and is trying to enter the market.</i>		
(ii)	<i>R & D has just been completed on an innovative computer processor in the shape of a pen, with accompanying pen-like devices to act as keyboard</i>		
	<i>projector and monitor projector. This is expected to get the laptops out of business due to extreme ease of portability of just 3 pen-like light weight devices.</i>		
(iii)	<i>A successful mobile manufacturing company has built into its latest mobile phone, an additional sliding screen and improved its processor capabilities so that the phone is almost a laptop.</i>		

You may present only columns I, III & IV. You are required to explain the pricing in one sentence.

(5 Marks)

Topic 25: Pareto Analysis**1. Pareto analysis – May 2017**

the following information is given about the type of defects during a production period and the frequencies of their occurrence in a spectacle manufacturing company:

Defect	No. of items
<i>End Frame not equidistant from the centre</i>	10
<i>Non-uniform grinding of lenses</i>	60
<i>Power mismatches</i>	20
<i>Scratches on the surface</i>	110
<i>Spots / Stains on lenses</i>	5
<i>Rough edges of lenses</i>	70
<i>Frame colours-shade differences</i>	25

Construct a frequency table so that a Pareto Chart can be constructed for the defect type. Which areas should the company focus on?

2. Pareto Analysis – May 2016 RTP, Nov 2014 RTP

Generation 2050 Technologies Ltd. develops cutting-edge innovations that are powering the next revolution in mobility and has nine tablet smart phone models currently in the market whose previous year financial data is given below:

Model	Sales (₹'000)	Profit-Volume (PV) Ratio
<i>Tab - A001</i>	5,100	3.53%
<i>Tab - B002</i>	3,000	23.00%
<i>Tab - C003</i>	2,100	14.29%
<i>Tab - D004</i>	1,800	14.17%
<i>Tab - E005</i>	1,050	41.43%
<i>Tab - F006</i>	750	26.00%
<i>Tab - G007</i>	450	26.67%
<i>Tab - H008</i>	225	6.67%
<i>Tab - I009</i>	75	60.00%

Required

- Using the financial data, carry out a Pareto analysis (80/20 rule) of Sales and Contribution.*
- Discuss your findings with appropriate recommendations.*

Topic 26: Flexible Budget**1. Flexible Budget – November 2013, November 2015 RTP**

The PLN Co. presents the following static budgets for 4,000 units and 6,000 units activity levels for October 2013:

	Activity Level	
	4,000 units	6,000 units
Overhead A ₹12/hr. x 2 hr. / unit	96,000	1,44,000
Overhead B	1,40,000	1,90,000

Overhead C was omitted to be listed out. It is a fixed plant overhead, estimated at ₹12.5/hr. at 4,000 units activity level. This has to also feature in the flexible budget. The actual production was 5,000 units and 9,600 hours were needed for production.

Required

Present the flexible budget amount of each overhead to enable appropriate comparison with the actual figures.

2. Flexible Budget – May 2016 RTP

Satjuj Motors Ltd. had prepared fixed and flexible budget for the financial year 2013-14 as under:

	Fixed Budget for full capacity	Flexible Budget for 75% level
	(₹)	(₹)
Sales	13,50,000	10,12,500
Direct Material	4,25,000	3,18,750
Direct Labour	1,85,000	1,38,750
Variable Overheads	2,15,000	1,61,250
Semi-Variable Overheads	3,65,000	3,23,750
Profit	1,60,000	70,000

After the closing of the financial year 2013-14, total actual sales stood at ₹ 11,07,000 and there was a favourable sales price variance of ₹ 17,000 (F).

Required

Prepare a flexible budget for the actual level of sales.

3. Budgeting – May 2017 RTP

Which of the following statements are VALID in respect of flexible budgeting.

- (i) A flexible budget is one which changes from year to year.
- (ii) It is a budget which departmental heads can change at will.
- (iii) It is a system of budgeting which will recast the budgets because of a change in fixed expenses.
- (iv) It is a system of budgeting under which budgets are recast quickly for changes in the volume of activity.
- (v) It involves careful differentiation between fixed and variable expenses.

4. Flexible budget – May 2015

Tricon Co. has prepared the following statement for the month of April 2015.

<i>Particulars</i>	<i>Budget Details</i>	<i>Static Budget</i>	<i>Actual</i>
<i>Units produced & Sold</i>		4,000	3,200
		₹	₹
<i>Direct Materials</i>	<i>3 kg p.u. @ ₹ 15 per kg.</i>	1,80,000	1,55,000
<i>Direct Labour</i>	<i>1 hr. p.u. @ ₹ 36 per hour</i>	1,44,000	1,12,800
<i>Variable Overhead</i>	<i>1 hr. p.u. @ ₹ 22 per hour</i>	88,000	73,600
<i>Fixed Overhead</i>		90,000	84,000
<i>Total Cost</i>		5,02,000	4,25,400
<i>Sales</i>		6,00,000	4,48,000
<i>Profit</i>		98,000	22,600

During the month 10,000 kg. of materials and 3,100 direct labour hours were utilized.

- (i) *Prepare a flexible budget for the month.*
- (ii) *Determine the material usage variance and the direct labour rate variance for the actual Vs the flexible budget.* (8 Marks)

5. Flexible budget – November 2014

The following are the details regarding budgeted and actual production costs for the year 2013 of an industrial concern. You are required to prepare a Production Cost Budget for the year 2014.

	Budget		Actual	
Output (units)	39,900		40,600	
	Units	₹	Units	₹
Materials consumed	42,000	42,000	43,000	53,750
Wages at 1 hour per unit at ₹1 per unit Budget	---	39,900	---	44,660
Variable Overhead at ₹1 per unit Budget	---	19,950	---	20,600
Fixed Overheads	---	30,000	---	35,000
		1,31,850		1,54,010

During the budget period:

- (1) Production is expected to reach 50,000 units,
- (2) Material price are expected to increase further by the same percentage as they had increased over the budget period.
- (3) Labour rates are expected to increase by ₹ 0.20 per hour above the actual rates shown above; efficiency is expected to decline by 10%; upto 31st December, 2013, there has been no decline in efficiency.
- (4) Variable overhead of previous year to be maintained.
- (5) Fixed overheads are expected to rise by 10% per annum.
- (6) Wastage of materials to be maintained at 2013 budget level. (6 Marks)

Topic 27: Functional Budgets**1. Principle budget factor – November 2015**

JCL Corporation manufactures and sells two products RB and RD. Three types of materials, A, B and C are required for producing these products. Projected information for 2015-16 is given below:

Product	Projected Sales for 2015-16 (units)	Inventory (in units)		Direct Labour Requirement (Hours/Unit)
		On 1-4-2015	On 31-3-2016	
RB	75,000	25,000	31,250	4
RD	50,000	10,000	11,250	6

Raw material stock and usage are as follows:

Direct Material	Required per unit		Inventory on 1-4-2015	Inventory on 31-3-2016
	RB	RD		
A	5.00 kg	5.00 kg	40,000 kg	45,000 kg
B	2.50 kg	3.00 kg	36,250 kg	40,000 kg
C	0	1.00 kg	7,500 kg	8,750 kg

You are required to prepare the following for 2015-16:

- Production budget (in units)
- Direct material purchase budget in quantities for A, B and C.
- After (i) and (ii), you are told that only 6,00,000 labour hours will be available for production. If there is no requirement to hold the stated level of finished goods closing inventory, what would be the principal budget factor? Substantiate your view with appropriate figures. (8 Marks)

2. Cash Budget – November 2016

From the information given below, prepare a cash budget of the company for the first half of 2016, assuming that cost would remain unchanged.

- Sales are both on credit and for cash, the latter being one-third of the former.
- Realisation from debtors are 25% in the month of sale, 60% in the following month and the balance in the month after that.
- Company's policy of selling price is 25% over cost.
- Budgeted sales of each month are purchased and paid for in the preceding month.
- Rent payable is ₹ 2,000 per month.

(vi) Sales forecast for the different months are:

2015– October ₹ 1,60,000; November ₹ 1,80,000; December ₹ 2,00,000

2016– January ₹ 2,20,000; February ₹ 1,40,000; March ₹ 1,60,000; April ₹ 1,50,000; May ₹ 2,00,000; June ₹ 1,80,000 and July ₹ 1,20,000

(vii) The company has outstanding debentures of ₹ 2 Lakhs on 1st January carrying interest at 15% per annum payable on the last date of each quarter on calendar year basis. 20% debentures are due for redemption on 30 June 2016.

(viii) The company has to pay advance tax of ₹ 54,000 in March.

(ix) Anticipated office costs for the six months are :

January ₹ 25,000; February ₹ 20,000; March ₹ 40,000; April ₹ 35,000; May ₹ 30,000 and June ₹ 45,000.

(x) Opening cash balance is ₹ 10,000 on January 1, 2016. (8 Marks)

3. Manpower Budget -November 2013 RTP

SIAM Ltd. manufactures two products using one type of material and one grade of labour. Shown below is an extract from the company's working papers for the next period's budget.

Particulars	Product A	Product B
Budgeted Sales (Units)	1,800	2,400
Budgeted Material Consumption per Product (Kg.)	5	3
[Budgeted Material Cost ₹12 per Kg.]		
Standard Hours Allowed per product	5	4
[Budgeted Wage Rate ₹8 per hour]		

Overtime premium is 50% and is payable, if a worker works for more than 40 hours a week. There are 45 direct workers.

The target productivity ratio (or efficiency ratio) for the productive hours worked by the direct workers in actually manufacturing the products is 80%; in addition the non-productive downtime is budgeted at 20% of the productive hours worked.

There are twelve 5-day weeks in the budget period and it is anticipated that sales and production will occur evenly throughout the whole period.

It is anticipated that stock at the beginning of the period will be:

Product A 510 units; Product B 1,200 units; Raw material 2,150 Kg.

The target closing stock, expressed in terms of anticipated activity during budget period are - Product A 15 days sales; Product B 20 days sales; Raw material 10 days consumption.

Required:

- the material purchases budget, and
- the wages budget for the direct workers, showing the quantities and values, for the next period.

4. Functional Budgets – May 2014

DEF Ltd manufactures and sells a single product and has estimated sales revenue of ₹ 397.80 lacs during the year based on 20% profit on selling price. Each unit of product requires 6 kg of material A and 3 kg of material B and processing time of 4 hours in machine shop and 2 hours in assembly shop. Factory overheads are absorbed at a blanket rate of 20% of direct labour. Variable selling & distribution overheads are ₹ 6 per unit sold and fixed selling & distribution overheads are estimated to be ₹ 7,20,000.

The other relevant details are as under:

<i>Purchase Price.....</i>	<i>Material A</i>	<i>₹ 16 per kg</i>	
	<i>Materials B</i>	<i>₹ 10 per kg</i>	
<i>Labour Rate.....</i>	<i>Machine Shop</i>	<i>₹ 14 per hour</i>	
	<i>Assembly Shop</i>	<i>₹ 7 per hour</i>	
	<i>Finished Stock</i>	<i>Material A</i>	<i>Material B</i>
<i>Opening Stock.....</i>	<i>25,000 units</i>	<i>75,000 kg</i>	<i>40,000 kg</i>
<i>Closing Stock.....</i>	<i>30,000 units</i>	<i>80,000 kg</i>	<i>55,000 kg</i>

Required

- Calculate number of units of product proposed to be sold and selling price per unit,
- Production Budget in units and
- Material Purchase Budget in units.

5. Functional Budgets and EOQ – May 2016

A Company is engaged in manufacturing two products 'KX' and 'KY'. Product 'KX' uses one unit of component 'KP' and two units of component 'KQ'. Product 'KY' uses two units of component 'KP', one unit of component 'KQ' and two units of component 'KR'. Component 'KR' which is assembled in the factory uses one unit of component 'KQ'.

Component 'KP' and 'KQ' are purchased from the market. The company has prepared the following forecast of sales and inventory for the next year:

Particulars	Product 'KX'	Product 'KY'
Sales (in units)	40,000	75,000
At the end of the year	5,000	10,000
At the beginning of the year	15,000	25,000

The production of both the products and the assembling of the component 'KR' will be spread out uniformly throughout the year. The company at present orders its inventory of 'KP' and 'KQ' in quantities equivalent to 3 months production. The company has compiled the following data related to two components:

Particulars	'KP'	'KQ'
Price per unit (₹)	40	16
Order placing cost per order (₹)	3,000	3,000
Carrying cost per annum	10%	10%

Required

- Prepare a Budget of production and requirements of components during next year.
- Suggest the optimal order quantity of components 'KP' and 'KQ'.

6. Functional Budgets – November 2013 RTP

A single product company estimated its sales for the next year quarter wise as under:

Quarter	Sales Units
I	60,000
II	75,000
III	82,500
IV	90,000

The opening stock of finished goods is 20,000 units and the company expects to maintain the closing stock of finished goods at 32,500 units at the end of the year. The production pattern in each quarter is based on 80% of the sales of the current quarter and 20% of the sales of the next quarter.

The opening stock of raw materials in the beginning of the year is 20,000 Kg. and the closing stock at the end of the year is required to be maintained at 10,000 Kg. Each unit of finished output required 2 Kg. of raw materials.

The company proposes to purchase the entire annual requirement of raw materials in the first three quarters in the proportion and at the prices given below:

Quarter	Purchase of raw materials % total annual requirement in quantity	Price per Kg. (₹)
I	30%	2
II	50%	3
III	20%	4

The value of the opening stock of raw materials in the beginning of the year is ₹ 40,000.

You are required to present the following for the next year, quarter wise:

- Production budget in units.
- Raw material consumption budget in quantity.
- Raw material purchase budget in quantity and value.

7. Comprehensive income statement – May 2017 RTP

Following information are extracted from monthly budgets of JIT Ltd.

	November	December
Beginning WIP Inventory	36,000	???
Beginning Finished Goods Inventory	44,000	???
Variable Cost of Goods Sold	1,23,000	???
Direct Material Usage	50,000	56,000
Direct Labour	53,100	69,000

Variable Overhead	25,000	29,000
Variable Cost of Goods Manufactured	1,07,500	1,15,900
Ending WIP Inventory	???	???
Ending Finished Goods Inventory	???	45,000

Required

Find out missing figures.

8. Functional budgets – November 2017

A company manufactures two products X and Y. The current pattern of sales of Product X and Product Y is in the ratio of 5:3. The budgeted data for the quarter ending 30-09-2017 is as under:

Particulars	Product X	Product Y
Direct material cost per unit	₹ 161	₹ 176
Direct labour cost per unit	₹ 75	₹ 90
Variable overheads per unit	₹ 30	₹ 50
Commission on sales	4% of selling price	5% of selling price
PIV ratio	20%	16%
Stock as on 1-7-2017	1,400 units	1,050 units

The annual fixed overheads amounts to ₹ 25,36,000 and it is assumed to be occurred evenly throughout the year. The Company desires profit of ₹ 4,50,000 per quarter.

Closing stock is to be maintained at 20% of the budgeted sales.

Required:

- Calculate sales quantity to be sold during quarter ending 30-09-2017.
- Prepare production budget in units for the quarter ending 30-09-2017. **(8 Marks)**

9. Functional budgets – May 2017

A Tea company manufactures two brands of tea namely Super and Normal by blending of four grades of tea leaves as raw material in the following proportion:

Raw Material	Product Super	Product Normal
Grade A	70%	-
Grade B	30%	-
Grade C	-	40%
Grade D	-	60%

During the month of May 2017. It is expected that 200 tons of brand Super and 80 tons of brand Normal will be sold. Actual and budgeted inventories for the month of May 2017 are as follows:

	Actual inventories on 1 st May, quantity in Tons	Budgeted inventories on 31 st May, quantity in Tons
Grade A	40	50
Grade B	25	56
Grade C	150	250.90
Grade D	60	40.50
Product Super	40	20
Product Normal	20	15

Purchased tea leaves are seasoned and then held in stock or issued for production. During seasoning, they lost 15% of their initial weight. Calculate the following:

- (i) The Production Budget for the month of May 2017 (in quantity)
- (ii) the Raw Material Purchase Budget for May 2017 (in quantity) (8 Marks)

Topic 28: Zero Based Budgeting**1. Budgeting and Behavioral issues:**

"It's frustrating working with Denial. He's very dominant and expects everything to be done his way. We have done more and better work to get up to budget, and the minute we make it he tightens the budget on us. We can't work any faster and still maintain quality. We always seem to be interrupting the big jobs for all those small rush orders. The accountants seem to know everything that's happening in my department, sometimes even before I do. I thought all that budget and accounting stuff was supposed to help, but it just gets me into trouble. I'm trying to put out quality work; they're trying to save money. This is a dead end job. I don't see much of a future here." said Mr. Singh, manager of the machine shop of Global Mfg. Ltd. a UK based Company.

Mr. Singh had just attended the monthly performance evaluation meeting for plant department heads. These meetings had been held on the third Friday of each month since Mr. Denial, MBA from Manchester University, had joined the Indian operations a year earlier. Mr. Singh had just been given the worst evaluation he had ever received in his long career with Global

Mfg. Ltd. He was the most respected of the experienced machinists in the company. Old Plant Manager had often stated that the company's success was due to the high quality of the work of machinists like Mr. Singh. He had been with Global Mfg. Ltd. for many years and was promoted to supervisor of the machine shop when the company expanded and moved to its present location. As supervisor, Mr. Singh stressed the importance of craftsmanship and told his workers that he wanted no careless work coming from his department.

When Mr. Denial became the plant manager, he directed that monthly performance comparisons be made between actual and budgeted costs for each department. The departmental budgets were intended to encourage the supervisors to reduce inefficiencies and to seek cost reduction opportunities. The company controller was instructed to have his staff 'tighten' the budget slightly whenever a department attained its budget in a given month; this was done to reinforce the plant supervisor's desire to reduce costs. Mr. Denial often stressed the importance of continued progress toward attaining the budget; he also made it known that he kept a file of these performance reports for future reference.

Required

Identify the problems which appear to exist in budgetary control system and explain how budgetary control system could be revised to improve the effectiveness.

2. Traditional versus zero based budgeting:

In each of the following independent situations, state with a brief reason whether 'Zero Based Budgeting' (ZBB) or 'Traditional Budgeting' (TB) would be more appropriate for year II.

- (i) A company producing a certain product has done extensive ZBB exercise in year I. The activity level is expected to marginally increase in year II.*
- (ii) The sale manager of a company selling three products has intuitive feeling that in year II, sales will increase for one product and decrease for the other two. His expectation can not be substantiated with figures.*
- (iii) The top management would like to delegate responsibility to the functional managers for their results during year II.*
- (iv) Resources are heavily constrained and allocation for budget requirements is very strict.*

3. Zero-based budgeting – November 2016 RTP

Country N's regional administration is organized in 10 states, with 9 of them subdivided into 210 municipalities. The municipal sector is a provider of vital services to the country N's public. The municipalities have wide powers over the local economy, with the state exercising strict supervision. They have the right to tax and to use their resources to support education, libraries, social security, and public works such as streetcar lines, gas and electricity works, roads, and town planning, but they are usually aided in these activities by state funds. The municipalities submit a budget each year to respective state which forms the basis of the fund received.

The following information is available as part of the 2016 budget preparation about a municipality NZ.

Street Maintenance

Like all structures, streets deteriorate over time. Deterioration is primarily due to accumulated damage from vehicles, however environmental effects often contribute. In 2016 it is anticipated that 5 km of the street will need maintenance but a contingency of extra 10% has been decided.

In 2015 the average cost of a street maintenance was ₹14 million per km maintained, but this excluded any cost effects of extreme weather conditions. The following probability estimates have been made in respect of 2016

Weather Type Predicted	Probability	Increase in Maintenance Cost
Good	0.65	0
Poor	0.05	+5%
Lousy	0.30	+30%

Inflation on street revamping costs is anticipated to be 2% between 2015 & 2016.

New Streets

New streets are budgeted on a zero basis and will have to enter for funds along with other capital projects such as hospitals and libraries.

Required

- Calculate the budgets for street maintenances for 2016.
- Explain the process involved for zero based budgeting.

Topic 29: Cost and Sales Variances**1. Material variances – Multiple materials – May 2015**

The standard cost of a certain chemical mixture is as under:

40% of Material A @ ₹ 30 per kg

60% of Material B @ ₹ 40 per kg

A standard loss of 10% of input is expected in production. The following actual cost data is given for the period.

350 kg Material – A at a cost of ₹ 25

400 kg Material - B at a cost of ₹ 45

Actual weight produced is 630 kg.

You are required to calculate the following variances raw material wise and indicate whether they are favourable (F) or adverse (A):

(i) Cost variance

(ii) Price variance

(iii) Mix variance

(iv) Yield variance

(8 Marks)

2. Material Variances – Missing information – November 2014, May 2015 RTP, Nov 2017 RTP

A company produces a product X, using raw materials A and B. The standard mix of A and B is 1:1 and the standard loss is 10% of input. You are required to compute the missing information indicated by '?' based on the data given below:

Particulars	A	B	Total
Standard Price of raw material (Rs./Kg)	24	30	
Actual input (Kg.)	?	70	
Actual output (kg.)			?
Actual price (Rs. /kg.)	30	?	
Standard input quantity (kg.)	?	?	
Yield variance (sub-usage)	?	?	270A
Mix variance	?	?	?
Usage variance	?	?	?
Price Variance	?	?	?
Cost Variance	0	?	1300A

3. Multiple labour – missing information – November 2013

The following information relates to labour of x Ltd.

Type of Labour	Skilled	Semi-Skilled	Unskilled	Total

No. of workers in standard gang	4	3	2	9
Standard rate per hour (Rs)	6	3	1	-
Actual rate per hour (Rs.)	7	2	2	-

In a 40 hours week, the gang produced 270 standard hours. The actual number of semi-skilled workers is two times the actual number of unskilled workers. The rate variance of semi-skilled workers is Rs.160 (F). Find the following:

- (i) The number of workers in each category
- (ii) Total gang variance
- (iii) Total Sub-efficiency variance
- (iv) Total labour rate variance
- (v) Total labour cost variance

4. Overheads - Missing information - May 2013

The following are the information regarding overheads of a company :

- ❖ Overheads cost variance = Rs. 2,800 (A)
- ❖ Overheads volume variance = Rs. 2,000 (A)
- ❖ Budgeted overheads = Rs. 12,000
- ❖ Actual overhead recovery rate = Rs. 8 per hour
- ❖ Budgeted hours for the period = 2,400 hours

Compute the following -

- ❖ Overheads expenditure variance.
- ❖ Actual incurred overheads.
- ❖ Actual hours for actual production.
- ❖ Overheads capacity variance.
- ❖ Overheads efficiency variance.
- ❖ Standard hours for actual production.

5. Impact assessment on variances - November 2016 RTP

State possible impact on Variances in each of the following independent situations:

- ❖ More units were produced than was budgeted.
- ❖ Careless handling of materials by production personnel
- ❖ The purchase of inferior quality material
- ❖ New competition entered the market.
- ❖ New suppliers were used.
- ❖ New production staff was recruited.
- ❖ Market share has fallen from 20% to 18%

6. Multiple variances computation – November 2015

Alpha Ltd. uses standard costing system for manufacturing its single product 'APS'.

Standard cost card is as follows:

	₹ per unit (₹)
Selling Price.....	120
Direct Material (1 kg per unit).....	20
Direct Labour (6 hrs @ ₹ 8 per hour).....	48
Variable Overheads.....	24
Contribution.....	28

Actual and budgeted activity levels in units for the month of September are:

	Budget	Actual
Sales.....	50,000	51,200
Production.....	50,000	52,000

Actual sales revenue and variable costs for the month of September are given as under:

Sales.....	61,33,760
Direct Material.....	10,65,600
Direct Labour (3,00,000 hrs).....	24,42,000
Variable Overheads.....	12,28,000

Calculate:

- (i) Direct Labour Rate Variance
- (ii) Direct Labour Efficiency Variance
- (iii) Sales Volume Variance
- (iv) Sales Price Variance
- (v) Comment on your findings in (i) and (ii) above.

(8 Marks)

7. Multiple variances – November 2012

Sunglow Limited manufactures and sells a single product. From the records of the company the following information is available for November 2012:

The standard cost comprises the following:

Direct material	Unit	₹
X	8	320
Y	24	1,680
Z	16	<u>400</u>
		2,400
Direct wages (₹ 40 per hour)		1,600
Variable overhead (25% of direct wages)		400
Fixed overhead (based on budgeted production of 10,000 units of the final product per month)		600
		<u>5,000</u>

The budgeted selling price is ₹ 700 each and the budgeted sales for the month were 14,000 units.

The following were the transactions for the month:

Direct material:	Units	Purchased Price per unit	Issued unit
X	44,000	42	82,400
Y	1,40,000	71	2,46,400
Z	60,000	24	1,64,000
Direct Wages:	₹ 90,00,000 (3,98,000 hours)		
Overheads:			
Variable	₹ 2,00,000		
Fixed	₹ 3,00,000		
Production:	11,000 units		
Sales:	9,000 units at ₹ 700 each and 3,500 units at ₹ 750 each		

Required:

Calculate (i) Material price variance; (ii) Material mix variance; (iii) Labour rate variance (iv) Labour efficiency variance (v) Variable overhead efficiency variance; and (vi) Fixed overhead efficiency variance. (9 Marks)

8. FOH variances – November 2014 RTP

KYC Ltd. uses a standard absorption costing system. The following details have been extracted from its budget for year 2013-14.

Fixed Overhead Cost ₹ 7,20,000

Production 36,000 units

In 2013-14 the Fixed Overhead Cost was over-absorbed by ₹3,200 and the Fixed Overhead Expenditure Variance was ₹20,000(F). What was the actual number of units produced in 2013-14?

9. Calculation of multiple variances – May 2017

The following data pertains to a company which uses standard marginal costing for manufacture and sale of a single product during the year.

Particulars	Budget	Actual
Sales (in units)	60,000	66,000
Sales (₹)	1,80,00,000	2,14,50,000
Direct Materials (₹)	28,80,000	36,30,000
Direct Labour (₹)	43,20,000	52,80,000
Variable Overheads (₹)	72,00,000	81,84,000
Total Variable Costs	1,44,00,000	1,70,94,000

Additional information is as follows:

	Standard	Actual
Direct material price per kg	₹12	₹11
Direct labour rate per hour	₹9	₹10

Calculate the following variance for the year and indicate the type of variance favourable (F), unfavourable (U) or adverse (A).

- Direct material usage variance
- Direct material price variance
- Direct labour efficiency variance
- Direct labour rate variance
- Variable overhead cost variance
- Sales margin volume variance

(8 Marks)

10. Cost and sales variances – November 2017

S. Ltd. produces and sells a single product. The product is manufactured by mixing two raw materials Q and R. The standard cost data of the product is as follows:

Raw material input:	Q 3 kg @ ₹ 18.00 per kg	₹ 54.00
	R 7kg. @ ₹ 6.00 per kg	₹ 42.00
Raw material cost per kg of input		₹ 96.00
Yield		96%
Raw material cost per kg of output		₹ 100
Fixed production overheads per kg of output		₹ 8.00
Total standard cost per kg of output		₹ 108.00

The budgeted and actual data are as follows:

Budgeted data		Actual data	
Sales	72,000 kg	Sales	71,000 kg
Production	70,000 kg	Production	69,000 kg
Opening inventory	2,000 kg (valued at standard cost)	Cost per kg of Q	₹ 18.10
		Cost per kg of R	₹ 5.80
Selling price per kg	₹ 200	Selling price per kg	₹ 203.00
Fixed production overheads	₹ 5,60,000	Fixed production overheads incurred	₹ 5,08,000
		Input of Q	2,21,000 kg
		Input of R	4,79,000 kg

The fixed production overhead absorption rate is based on the budgeted production.

Calculate Sales price variance, Sales volume variance, Material price variance, Material mix variance, Material yield variance, Fixed overhead expenditure variance and Fixed overhead volume variance. **(8 Marks)**

11. Critical Success Factors – November 2015 RTP

Natural Spices manufactures and distributes high-quality spices to gourmet food shops and top quality restaurants. Gourmet and high-end restaurants pride themselves on using the freshest, highest-quality ingredients.

Natural Spices has set up five state of the art plants for meeting the ever growing demand. The firm procures raw material directly from the centers of produce to maintain uniform taste and quality. The raw material is first cleaned, dried and tested with the help of special machines. It is then carefully grounded into the finished product passing through various stages and packaged at the firm's ultraclean factory before being dispatched to customers.

The following variances pertain to last week of operations, arose as a consequence of management's decision to lower prices to increase volume.

<i>Sales Volume Variance</i>	<i>18,000 (F)</i>
<i>Sales Price Variance</i>	<i>14,000 (A)</i>
<i>Purchase Price Variance</i>	<i>10,000 (F)</i>
<i>Labour Efficiency Variance</i>	<i>11,200 (F)</i>
<i>Fixed Cost Expenditure Variance</i>	<i>4,400 (F)</i>

Required

- (i) Identify the 'Critical Success Factors' for Natural Spices.*
- (ii) Evaluate the management's decision with the 'Overall Corporate Strategy' and 'Critical Success Factors'.*

Topic 30: Variances with Equivalent Units**1. Reconciliation with WIP inventory**

The standard cost sheet of a company based on a normal output of 36,000 units for a quarter is as follows:

Direct Material	4 kgs @ Rs.2	Rs.8
Direct wages	6 Hours @ Rs.4	Rs.24
Overheads	50% of direct wages	Rs.12
Total costs		Rs.44
Profit		Rs.6
Selling Price		Rs.50

The budgeted fixed overheads amount to Rs.1,44,000 per quarter and it is included in the overhead cost given above. On the basis of the budgeted activity of 36,000 units the company estimated profit of Rs.2,16,000 . The cost records revealed that the company produced and sold 25,000 units and had closing wip of 5000 units on which material is fully issued and labour and overheads are 50% complete.

Direct materials consumed 96000 kgs @ Rs.2.25 per kg

Direct wages paid, 1,60,000 hours at Rs.4.10 per hour. Out of which 6,000 hours being idle time were not recorded on production. Overheads Rs.3,32,000 out of which Rs.1,50,000 were fixed. Sales 25,000 units at an average price of Rs.51.50 per unit.

- ❖ Prepare the reconciliation statement reconciling the budgeted profit and actual profit under marginal as well as absorption costing approach.
- ❖ Also value the closing WIP.
- ❖ Identify one or more departments in the company who might be held responsible for each variance.

Topic 31: FOH Ratios**1. FOH ratios computation – May 2017 RTP**

Calculate from the following figures:

- (i) Efficiency ratio,
- (ii) Activity, Ratio and
- (iii) Capacity Ratio:

Budgeted Production..... 528 units

Standard Hours per unit.....10

Actual Production.....450 units

Actual Working Hours..... 6,000

2. Budget ratios – November 2016

A company manufactures two products X and Y. Product X requires 5 hours to produce while Y requires 10 hours. In a month of 25 effective working days of 8 hours a day, 1,000 units of X and 600 units of Y were produced. The company employs 50 workers in the production department to produce X and Y. The budgeted hours are 1,02,000 for the year.

Calculate Capacity Ratio, Activity Ratio and Efficiency Ratio. Also establish their inter-relationship.
(4 Marks)

Topic 32: Reconciliation of cost and profits**1. Reconciliation – Multiple approaches**

Fo -Tan Ltd. operating on a standard costing system, for a given four week period budgeted for sales of 10,000 units at Rs. 50 per unit, actual sales were 9,000 units at Rs. 51.25 per unit. Costs relating to that period were as follows:

	Standard	Actual
Materials.....	2,50,000	2,57,400
Wages.....	75,000	70,875
Fixed Overhead.....	20,000	18,810
Variable Overhead.....	10,000	9,250
Semi-Variable Overhead.....	2,700	2,430
Hours.....	50,000	40,500

- ❖ The standard material content of each unit is estimated at 25 Kg. at Rs. 1 per Kg. actual figures was 26 Kg. at Rs. 1.10 per Kg.
 - ❖ The standard wages per unit are 5 hours at Rs. 1.50 per hour, actual wages were 4.5 hours at Rs. 1.75.
 - ❖ Semi-variable overhead consists of five-ninths fixed expenses and four-ninths variable.
 - ❖ There were no opening stocks and the whole production for the period was sold.
 - ❖ The four week period was a normal period.
- a) Compute the variance in sales, materials, labour and overhead due to all possible causes, and
 - b) With the help of such a computation draw-
 - a. a statement reconciling the actual profit for the period with the standard profit.
 - b. A statement reconciling the actual profit for the period with the budgeted profit.

2. Variances and Reconciliation – May 2017 RTP

HKT Ltd. has provided the following summarized results for two years:

	Year ended (₹ In lacs)	
	31-03-2015	31-3-2016
Sales	3,000	3,277.50
Material	2,000	2,357.50
Variable overheads	500	525.00
Fixed overheads	300	367.50
Profit	200	27.50

During the year ended 31-3-2016 sale price has increased by 15% whereas material and overhead prices have increased by 15% and 5% respectively.

Required

- Analyse the variances of revenue and each element of cost over the year in order to bring out the reasons for the change in profit.
- Present a profit reconciliation statement starting from profits in 2014-15 showing the factors responsible for the change in profits in 2015-16.

Note – Consider 'Contribution Variances' for solving this question.

Topic 33: Partial Plan Versus Single Plan**1. Reconciliation with partial & single plan**

X Limited produces and sells single product. Standard cost card per unit of the product is as follows:

Direct material: A 10 Kg @ Rs.5	Rs.50
B 5 Kg @ Rs.6	Rs.30
Direct wages 5 hours @ Rs.5	Rs.25
Variable production overheads 5 hours @ Rs.12	Rs.60
Fixed production overheads	Rs.25
Total standard cost	Rs.190
Standard gross profit	Rs.35
Standard selling price	Rs.225

The fixed production overheads has been absorbed on the expected annual output of 25,200 units produced evenly throughout the year. During the month of December 2009, the following were for the actual production of 2,000 units:

Sales 2,000 units @ Rs.225	4,50,000
Direct material: A 18,900 kg	99,225
B 10,750 kg	61,275
Direct wages 10,500 hours (actually worked 10,300 hours)	50,400
Variable production overheads	1,15,000
Fixed production overheads	56,600
Total	3,82,500
Gross profit	67,500

The material price variance is extracted at the time of receipt of materials. Material purchases were A: 20,000 kg @ Rs.5.25 and B 11,500 Kg @ Rs.5.70.

- Calculate all variances
- Prepare an operating statement showing standard gross profit, variances and actual gross profit
- Explain the reason for the difference in actual gross profit in the question and calculated in (b) above

2. Journal entries:

Under the single plan, record the journal entries giving appropriate narration, with indication of amounts of debits or credits alongside the entries, for the following transactions using the respective control A/c.

- ❖ Material price variance (on purchase of materials)
- ❖ Material usage variance (on consumption)
- ❖ Labour rate variance.

Topic 34: Planning and Operating Variances**1. Planning and operating variances**

ABC Limited makes and sells a single product. Demand for the product exceeds the capacity. The holding of the stocks of the finished product is avoided if possible because of the physical nature of the product is such that it deteriorates quickly and stocks may become unsaleable. A standard marginal cost system is in operation. Feedback reporting takes planning and operational variances into consideration. The cost accountant has given the following operating statement for period 9

Particulars	Amount	Amount
Original budgeted contribution		36,000
Revision variances		
Material usage	9600A	
Material price	3600F	
Wage rate	1600F	4400A
Revised budgeted contribution		31,600
Sales volume variance		
Casual factor		
Extra capacity	4740F	
Productivity drop	987.5A	
Idle time	592.5A	
Stock increase	2370A	790F
Revised standard contribution for sales achieved		32390
Other variances		
Material usage	900F	
Material price	3120A	
Labour efficiency	1075A	
Labour idle time	645A	
Wage rate	2760A	6700A
Actual contribution		25,690

Other data are as follows:

- The original standard contribution per product unit as determined at period 1 was

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

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

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

- Stock of finished goods are valued at the current efficient standard cost

Required

- Prepare detailed figures showing how the material and labour variances in the operating statement have been calculated
- Prepare detailed figures showing how the sales volume variance has been calculated for each casual factor shown in the operating statement

2. Planning and operating variances – November 2013 RTP

Managing Director of Petro-KL Ltd (PTKLL) thinks that Standard Costing has little to offer in the reporting of material variances due to frequently change in price of materials.

PTKLL 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 PTKLL 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 'P' PTKLL could use either 2.50 Kg of 'PG' or 2.50 kg of 'PD'. PTKLL planned to use 'PG' as it appeared it would be cheaper of the two and plans were based on a cost of 'PG' of ₹ 1.50 per Kg. Due to market movements the actual prices changed and if PTKLL had purchased efficiently the cost would have been:

'PG' ₹ 2.25 per Kg;

'PD' ₹ 2.00 per Kg

Production of 'P' was 1,000 units and usage of 'PG' amounted to 2,700 Kg at a total cost of ₹ 6,480/-

Required

Analyze the material variance for 'P' by:

- Traditional Variance Analysis; and*
- An approach which distinguishes between Planning and Operational Variances.*

Topic 35: Growth Productivity and Price Recovery Variances**1. Growth productivity – price recovery variances – May 2015 RTP**

Aditya Decors Ltd. (ADL) is a leading manufacturer of luxury sanitary products and has divided its whole business into different product segments. At the Last year the management of ADL has decided to make some changes in its one of product-line 'AADee', the improved version was made available for sale from 1st of April 2014.

At the end of the financial year 2014-15, the finance and accounts department has extracted some relevant data for the product line 'AADee' to analyse the decision taken last year. The data related with AADee for the financial year 2013-14 and 2014-15 are as follows:

	2013-14	2014-15
No. of Units Sold	4,00,000	4,30,000
Selling Price <i>per unit</i>	₹4,175	₹ 4,325
Direct Materials Consumed	24,00,000 kg.	25,10,000 kg.
Cost <i>per kg.</i> of Direct Materials	₹470	₹485
Direct LabourUsed	32,00,000 hrs.	34,80,000 hrs.
Rate <i>per labour hour</i>	₹30	₹ 31
Fixed Costs	₹1,60,00,000	₹ 1,76,00,000

ADL has the capacity to produce 5,00,000 units of AADee a year.

Required:

- (i) ANALYSE the changes in the operating income from financial year 2013-14 to 2014-15 with respect to the following components:
 - (a) Growth, (b) Price- Recovery and (c) Productivity Components
- (ii) RECONCILIATION of Operating Profit from 2013-14 to 2014-15.

2. Reconciliation with product differentiation and productivity factors

X Limited is a manufacturer of cardboard boxes. An analysis of the operating income between 2014 and 2015 revealed the following:

	Income statement for 2014	Revenue and cost impact of growth component	Revenue and cost impact of price recovery component	Cost impact of productivity component	Income statement for 2015
Revenues	40,00,000	2,00,000 F	4,20,000 F	-	46,20,000
Cost	29,20,000	60,000 A	2,56,000 A	58,000 F	31,78,000
Operating income	10,80,000	1,40,000 F	1,64,000 F	58,000 F	14,42,000

X Limited sold 4, 00,000 boxes and 4, 20,000 boxes in 2014 and 2015 respectively. During 2015, market for cardboard boxes grew 3 percent in terms of number of units and all other changes are due to company's differentiation strategy and productivity. Compute how much of change in operating income from 2014 to 2015 is due to industry market size factor, productivity and product differentiation and also reconcile the profits of both years due to these factors.

Topic 36: Market Size and Share Variances**1. Reconciliation with market size and share variance – May 2016 RTP**

Sapporo Manufacturing Co. (SMC) is a leading consumer goods company. The budgeted and actual data of SMC for the year 2014-15 are as follows:-

Particulars	Budget	Actual	Variance
Sales / Production (units)	2,00,000	1,65,000	(35,000)
Sales (₹)	21,00,000	16,92,900	(4,07,100)
Less: Variable Costs (₹)	12,66,000	10,74,150	1,91,850
Less: Fixed Costs (₹)	3,15,000	3,30,000	(15,000)
Profit	5,19,000	2,88,750	(2,30,250)

The budgeted data shown in the table is based on the assumption that total market size would be 4,00,000 units but it turned out to be 3,75,000 units.

Required

Prepare a statement showing reconciliation of budget profit to actual profit through marginal costing approach for the year 2014-15 in as much detail as possible.

2. Market size and share variances – November 2016

Zed company manufactures two types of flooring rolls. Budgeted and actual data for 2015 are-

	Static Budget			Actual Result		
	Industrial	Domestic	Total	Industrial	Domestic	Total
Unit Sales in Rolls ('000)	200	600	800	252	588	840
Contribution Margin (₹ in Lacs)	100.00	240.00	340.00	119.70	246.96	366.66

In late 2014, a marketing research estimated industrial volume for industrial and domestic flooring at 80 Lacs Rolls. Actual industry volume for 2015 was 70 Lacs Rolls.

Required

- Sales Mix Variance and Sales Quantity Variance by type of flooring rolls and in total.
- Market Share Variance and Market Size Variance.

Topic 37: Reverse Working Problems**1. Reverse working – May 2016**

A company operates a standard cost system to control the variable works cost of its only product. The following are the details of actual production, costs and variances for November, 2015.

Production and cost (actual)

Production..... 10,000 units
 Direct Materials (1,05,000 kg.)..... ₹ 5,20,000
 Direct Labour (19,500 hrs.)..... ₹ 3,08,000
 Variable Overheads..... ₹ 4,10,000

Cost variances

Direct materials – Price..... ₹ 5,000 (F)
 Direct materials – Usages..... ₹ 25,000 (A)
 Direct labour – Rate..... ₹ 15,500 (A)
 Direct labour – Efficiency..... ₹ 7,500 (F)
 Variable overheads..... ₹ 10,000 (A)

The Cost Accountant finds that the original standard cost data for the product is missing from the cost department files. The variance analysis for December, 2015 is held up for want of this data.

You are required to calculate:

- (i) Standard price per kg. of direct material.
- (ii) Standard quantity for each unit of output.
- (iii) Standard rate of direct labour hour.
- (iv) Standard time for actual production.
- (v) Standard variable overhead rate.

(8 Marks)

2. Reverse working – May 2014 RTP

S. Ltd. operates a system of standard costing in respect of one of its products which is manufactured within a single cost center, the following information is available: Standard price of material is Rs. 2 per liter. The standard wage rate is Rs. 6 per hour and 5 hours are allowed to produce one unit. Fixed production overhead is absorbed at the rate of 100% of direct wages cost.

During the month just ended the following occurred -

Actual Price (paid for material purchased)..... 1.95 per liter
 Total Direct Wages Cost..... 1,56,000
 Fixed Production Overhead..... 1,58,000

Variance	Favorable	Adverse
Material Price Variance	8,000	
Material usage variance		5,000
Direct labour rate		5,760

Labour efficiency	2,760	
Fixed OH expenditure		8,000

Calculate the following:

- ❖ Budgeted output in units
- ❖ Number of liters purchased
- ❖ Number of liters used above standard allowed
- ❖ Actual units produced
- ❖ Actual hours worked
- ❖ Average actual wage rate per hour

3. Selling expenses variances – November 2015 RTP

Worldwide LTD. is engaged in marketing of wide range of consumer goods. M, N, O and P are the zonal sales officers for your zones. The company fixes annual sales target for them individually.

You are furnished with the following:

- ❖ The standard costs of sales target in respect of M, N, O and P are Rs. 5,00,000, Rs. 3,75,000, Rs. 4,00,000 and Rs. 4,25,000 respectively.
- ❖ M, N, O and P respectively earned Rs. 29,900, Rs. 23,500, Rs. 24,500 and Rs. 25,800 as commission at 5% on actual sales effected by them during the previous year.
- ❖ The relevant variances as computed by a qualified cost accountant are as follows :

Particulars	M	N	O	P
Sales Price Variance	4,000F	6,000A	5,000A	2,000A
Sales margin variance	6,000A	26,000F	15,000F	8,000F
Sales margin mix variance	14,000A	8,000F	17,000F	3,000A

- a) Compute the amount of sales target fixed and the actual amount of margin earned in case of each of the zonal sales officer.
- b) Evaluate the overall performance of these zonal sales officers taking three relevant base factors and then recommend whose performance is the best.

Topic 38: Activity Based Costing and Variance Analysis**1. Variance computation in ABC - November 2016 RTP**

ABC Limited is a multiple product manufacturer. ABC produces the unit and all overheads are associated with the delivery of units to its customers.

Particulars	Budget	Actual
Overheads	4,000	3,900
Output (units)	2,000	2,100
Customer deliveries	20	19

Calculate efficiency and expenditure variance by adopting ABC approach

Topic 39: Costing of Service Sector**1. Hotel costing – November 2016**

The budget of a hotel for the year 2016 shows following room occupancy:

Quarter	January – March	April – June	July – September	October – December
Average occupancy %	45	60	90	55

Revenue for the year is estimated to be ₹ 60,00,000 and arises from three profit centres namely Accommodation * 45%, restaurant 35% and Bar 20%.

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

The three profit centres have following percentage of margin:

	Accommodation (%)		Restaurant (%)		Bar (%)	
Revenue		100		100		100
Wages	20		30		15	
Cost of sale	-		35		50	
Direct cost	10	30	15	80	5	70
Gross Margin		70		20		30

Fixed cost for the year is estimated to be ₹ 9,15,000.

As a means of improving the budgeted profitability by 20%, following two suggestions have been made:

- (1) To offer special two night holidays at a reduced price of ₹250/- per night. It is expected that those accepting the offer would spend an amount equal to 40% of the accommodation charges in the restaurant and 40% of the accommodation charges in the bar.
- (2) To increase prices Management is confident that there will be no drop in volume of sales if restaurant prices are increased by 7.50% and bar prices by 10%. Accommodation prices would also need to be increased.

You are required to:

- (i) Calculate the budgeted profit.
- (ii) How many two night holidays would need to be sold each week in three quarters, totalling 39 weeks, when occupancy is less, to achieve the desired profitability as per suggestion (1)?
- (iii) By what percentage the prices of accommodation would need to be increased as per suggestion (2) to achieve the desired profitability? (10 Marks)

2. Transportation costing – analysis of alternatives – May 2016

Fuji Ltd. is considering three alternative proposals for conveyance facilities for its sales personnel who have to do considerable travelling, approximately 20,000 kilometres every year. The proposals are as follows:

- (i) Purchase and maintain its own fleet of cars. The average cost of a car is ₹ 1,00,000.*
- (ii) Allow the Executive to use his own car and reimburse expenses at the rate of ₹ 1.60 per kilometre and also bear insurance costs.*
- (iii) Hire cars from an agency at ₹ 20,000 per year per car. The company will have to bear costs of petrol, taxes and tyres.*

The following further details are available:

<i>Petrol.....</i>	<i>₹ 0.60 per km</i>
<i>Repairs and maintenance.....</i>	<i>₹ 0.20 per km</i>
<i>Tyres.....</i>	<i>₹ 0.12 per km</i>
<i>Insurance.....</i>	<i>₹ 1,200 per car per annum</i>
<i>Taxes.....</i>	<i>₹ 800 per car per annum</i>
<i>Life of the car.....</i>	<i>5 years with annual mileage of 20,000 kms</i>
<i>Resale value.....</i>	<i>₹ 20,000 at the end of the fifth year</i>

Required

Work out the relevant costs of three proposals and rank them.

3. Transportation Costing – May 2016 RTP, May 2015 RTP

Expert Roadways Services Pvt. Ltd. is planning to run a fleet of 15 buses in Birpur City on a fixed route. Company has estimated a total of 2,51,85,000 passenger kilometers per annum. It is estimated buses to have 100% load factor. Buses are purchased at a price of ₹ 44,00,000 per unit whose scrap value at the end of 5 years life is ₹ 5,50,000. Seating capacity of a bus excluding a Driver's seat is 42. Each bus can give a mileage of 5 kmpl. Average cost of fuel is ₹ 66 per liter. Cost of Lubricants & Sundries per 1,000 km would be ₹ 3,300. Company will pay ₹ 27,500 per month to Driver and two attendants for each bus.

Other annual charges per bus: Insurance ₹ 55,000, Garage Charges ₹ 33,000, Repairs & Maintenance ₹ 55,000. Route Permit Charges upto 20,000 km is ₹ 5,500 and ₹ 2,200 for every additional 5,000 km or part thereof.

Required

- (i) Calculate a suggested fare per passenger/km taking into account markup on cost @20% to cover general overheads and sufficient profit.*
- (ii) The Transport Sector of Birpur is highly regulated. The Government has fixed the fare @ ₹ 1.35 for next 2 years. Comment on the two year's profitability taking into consideration the inflation rate of 8%.*

Note: Route permit charges is not subject to Inflation.

4. Air Transportation Costing – November 2013

Flyway Ltd. has hired an aircraft to specially operate between cities A and B. All the seats are economy class.

The following information is available:

<i>Seating capacity of the aircraft.....</i>	<i>260 passengers</i>
<i>Average number of passengers per flight.....</i>	<i>240 passengers</i>
<i>Average one-way fare from A to B.....</i>	<i>₹ 5,000 per passenger</i>
<i>Fuel costs per flight from A to B.....</i>	<i>₹ 90,000</i>
<i>Food cost (A to B sector).....</i>	<i>₹ 300 per passenger</i>
<i>(no charge to passenger)</i>	
<i>Commission to travel agents.....</i>	<i>10% of the fare</i>
<i>(All tickets are through agents)</i>	
<i>Annual lease costs allocated to each flight.....</i>	<i>₹ 2,00,000</i>
<i>Ground services, baggage handling/checking in</i>	
<i>service costs per flight A to B.....</i>	<i>₹ 40,000</i>
<i>Flight crew salaries per flight A to B.....</i>	<i>₹ 48,000</i>

There is an offer from another airlines operator, Haltgo 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 Haltgo at ₹ 2,700 per ticket, whether or not Haltgo 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 Flyway Ltd. at no further charge to Haltgo or the passengers.

A maximum of 60 tickets can be sold by Flyway's travel agents for the A to D sector at a fare of ₹ 3,000 per passenger.

Since the stop-over wastes more time, 25 of Flyway'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 Flyway Ltd.

Flyway 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 Flyway ₹ 200. This will be in addition to the original food at ₹ 300 served in the A to D sector.

You may 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

Without considering Haltgo's offer,

- (i) What is the profit earned by Flyway Ltd. per flight from A to B?
- (ii) What is the Break-even number of passengers for each flight from A to B?

Considering the effects of Haltgo's offer,

- (iii) Evaluate whether Flyway should accept the offer.

(A detailed profitability statement is not essential. Only figures relevant for the cost-revenue analysis are required.)

5. Hotel Costing – May 2014 RTP

A Hotel having 50 single rooms is having 80% occupancy in normal season (8 months) and 50% in off- season (4 months) in a year (take 30 days month).

Annual Fixed Expenses	(₹ Lakh)
Salary of the Staff (excluding Room Attendant).....	7.50
Repair & Maintenance.....	2.60
Depreciation on Building & Furniture.....	2.40
Other Fixed Expenses like Dusting, Sweeping etc.....	3.25
Total	15.75

Variable Expenses (per Guest per Day)

<i>Linen, Laundry & Security Support.....</i>	<i>₹ 30.00</i>
<i>Electricity & Other Facilities.....</i>	<i>₹ 20.00</i>
<i>Misc Expenses like Attendant etc.....</i>	<i>₹ 25.00</i>

Management wishes to make a Margin of 25% of Total Cost.

Required

- Calculate the Tariff Rate per Room.*
- Calculate the Break Even Occupancy in Normal Season assuming 50% Occupancy is Off-Season.*
- Management is proposing 10% cut in Tariff to improve Occupancy at 100% and 70% in Normal Season and Off-Season respectively. Give your views on it.*
- What is the minimum rise in Occupancy % to take care of risk of fall in Profit due to Tariff-Cut?*

6. Hotel Costing - November 2012

XY Hotel has 40 bed rooms with a maximum occupancy of 490 sleeper nights per week. Average occupancy is 60% throughout the year. Meals provided to guests have been costed and the average food cost per person per day is as follows:

	<i>(₹)</i>
<i>Breakfast.....</i>	<i>72.00</i>
<i>Lunch.....</i>	<i>220.00</i>
<i>Dinner.....</i>	<i>268.00</i>
	<i>560.00</i>

Direct wages and staff meals per week are as under:

	<i>(₹)</i>
<i>Housekeeping.....</i>	<i>39,040.00</i>
<i>Restaurant and Kitchen.....</i>	<i>68,600.00</i>
<i>General.....</i>	<i>35,200.00</i>

Direct expenses per annum are ₹ 9,15,200 for house-keeping and ₹ 10,40,000 for restaurant. Indirect expenses amount to ₹ 68,22,400, which should be apportioned on the basis of floor area. The floor areas are as follows:

	<i>Sq. Mt.</i>
<i>Bed Rooms.....</i>	<i>3,600</i>
<i>Restaurant.....</i>	<i>1,200</i>
<i>Service Area.....</i>	<i>600</i>

A net profit of 10% must be made on the restaurant taking and also on accommodation takings.

Required

Calculate what inclusive term per person should be charged per day and also show the split between meals and accommodation charges.

7. Cost units – May 2012

Suggest suitable cost units for the following services:

- (i) Hospital
- (ii) Hotel
- (iii) Transport
- (iv) Staff canteen

(4 Marks)

8. Hotel costing – November 2017

MH hotel has a capacity of 50 rooms, each of which can accommodate one or two guests. Guests staying in hotel are provided with free facilities like sports centre, kids zone, swimming pool etc. The details in the budget for the year ending 31-3-2018 are narrated below:

- (i) *Standard room rent of ₹ 3,500 per night during high season i.e. May, June, July, December and January and for the remaining months (low season) standard room rent of 1,800 per night will be charged.*
- (ii) *Average room occupancy per night during high season is 80% and during low season is 50%.*
- (iii) *The hotel is registered with number of internet based hotel providers. It is expected that subject to capacity available, an average of 15 rooms per night can be sold through them. These bookings will be in addition to the occupancy level stated in point (ii). The internet service provider will pay 60% of the standard booking rate.*
- (iv) *Variable cost per room night will be ₹ 1,075 per room night.*
- (v) *Fixed cost will be ₹ 12,00,000 per month. However, when occupancy is 100%, fixed cost will increase by ₹ 9,000 per night.*

Prepare budgeted profitability statement for the year ending 31-03-2018 showing the details of revenue, costs and profits.

(8 Marks)

9. Health Centre – May 2013 RTP

Modern health centre provides health and other related services to the citizens who are covered under insurance plan. The health centre receives a payment from the insurance company each time any patient attends the centre for consultation as under:

Consultations involving	Payment from Insurance company ₹
No treatment	30
Minor treatment	125
Major treatment	250

In addition, the adult patients will have to make a co-payment which is equivalent to the amount of payment for the respective category of treatment made by the insurance company. However, children and senior citizens are not required to make any such co-payment.

The health centre will remain open for 6 days in a week for 52 weeks in a year. Each physician treated 20 patients per day although the maximum number of patients that could have been treated by a physician on any working day is 24 patients.

The health centre received a fixed income of ₹ 20,000 per month for promotion of health products from the manufacture.

The annual expenditure of the health centre is estimated as under:

Materials and consumable (100% variable)	₹ 11,16,000
Staff salaries per annum per employee (fixed):	
Physician	₹ 2,25,000
Assistants	₹ 75,000
Administrative staff	₹ 45,000
Establishment and other operating costs (fixed)	₹ 5,00,000

The non-financial information is as under:

(i)	Staff:	
	Number of physicians employed	8
	Assistants	8
	Administrative staff	2
(ii)	Patient Mix:	
	Adults	50%
	Children	40%
	Senior Citizens	10%
(iii)	Mix of patient appointments (%)	
	Consultation requiring no treatment	60%
	Minor treatment	30%
	Major treatment	10%

Required:

- (i) Calculate the Net income of the city health centre for the next year;
- (ii) Determine the percentage of maximum capacity required to be utilized next year in order to break even.

Topic 40: Transfer Pricing**1. Application Theory Question – May 2015**

G is the transferring division and R, the receiving division in a company. R has a demand for 20% of G's production capacity which has to be first met as per the company's policy. Assuming no inventory build-up state whether G or R enjoys more advantage in each of the following independent situations?

S.No.	G transfers to R at transfer price equal to	G's production level	External demand	Division having more advantage	Reason
1	Full cost: No Markup	60%	40%		
2	Market Price	80%	60%		
3	Marginal cost	100%	80%		
4	Market Price	100%	90%		

2. Transfer pricing & differential selling prices- November 2012

PEX is a manufacturing company of which Division PQR manufactures a single standardized product. Some of the output is sold externally whilst the remainder is transferred to Division RPQ where it is a sub-assembly in the manufacture of that division's product. PQR has the capacity (annual) to produce 30,000 units of the product. The unit costs of Division PQR's products is as under:

Particulars	Amount
Direct Material	40
Direct Labour	20
Direct Expenses	20
Variable manufacturing overheads	20
Fixed manufacturing overheads	40
Selling and variable expenses – Variable	10
	150

Annually 20,000 units of the product are sold externally at the standard price of Rs. 300 per unit. In addition to the external sales, 10,000 units are transferred annually to Division RPQ at an internal transfer price of Rs. 290 per unit. This transfer price is obtained by deducting variable selling and packing expenses from the external price since those expenses are not incurred for internal transfers.

Division RPQ incorporates the transferred-in goods into a more advanced product. The unit costs of this product are as follows:.

Particulars	Amount
Transferred-in-item (from Division PQR)	290
Direct material and components	230
Direct Labour	30
Variable overheads	120
Fixed overheads	120
Selling and variable expenses – Variable	10
	800

Division RPQ's manager disagrees with the basis used to set the transfer price. He argues that the transfers should be made at variable cost plus an agreed (minimal) mark up because his division is taking output that Division PQR would be unable to sell at the price of Rs. 300. Partly because of this disagreement, a study of the relationship between selling price and demand has recently been carried out for each division by the company's

sales director. The study has brought out the following demand schedule:

Division PQR			
Selling Price	200	300	400
Demand (units)	30,000	20,000	10,000
Division RPQ			
Selling Price	800	900	1000
Demand (units)	14,400	10,000	5,600

The manager of the Division RPQ claims that this study supports his case. He suggests that a transfer price of Rs. 120 would give Division PQR a reasonable contribution to its fixed overheads while allowing Division RPQ to earn a reasonable profit. He also believes that it would lead to an increase of output and an improvement in the overall level of company profits.

Required

- ❖ Calculate the effect of the transfer price of Rs. 290 per unit on company's operating profit. Calculate the optimal product mix.
- ❖ Advise the company on whether the transfer price should be revised to Rs. 120 per unit.

3. Transfer pricing and multiple scenarios – May 2012

AB Ltd. makes component 'C' and billing machines. Division A makes component 'C' that is used in the final assembly of the machine in Division B.

(One unit of Component 'C' is used per machine). Component C has an outside market also. A and B operate as profit centres and each can take its own decisions. The following data is given in the existing scenario for Divisions A and B, under which Division A has enough special and external demand to use its capacity and hence is offering B rates of 800 ₹/Unit for quantity up to 750 units and 900 Rs/unit for more than 750 units, so that its outside contribution is not affected by transfers to B. A

and B can sell any quantity up to the maximum indicated under 'units sold', without affecting their future demands.

	Division A		Division B	
	External Market (normal sales)	Special sales	External Market (normal sales)	
Selling Price (₹/u)	1,000	800	4,000	
Variable manufacturing cost (₹/u)	600	600	1,500*	(* excluding component C)
Variable selling cost (₹/u)	100**	--	200**	(** Not incurred on inter division transfers)
Total variable cost (₹/unit)	700	600	1,700*	(* excluding component C)
Contribution (₹/unit)	300	200		
Units Sold	1,250	750	900	
Production capacity	2,000 units		900 units	

For the next period, A requires for its own use in its selling outlets, 50 units of billing machines produced by B. B's manager proposes as follows:

Option I - B will supply 50 machines to A on its variable manufacturing cost basis provided A supplies to B, 500 units of Component C at A's variable manufacturing cost basis.

Option II - Both A and B resort to total variable cost per unit basis applicable to normal external sale, though neither A nor B incurs any selling cost on inter division transfers. A will be given 50 machines for its use. A will have to supply B all the 900 units that B requires.

Option III - Both A and B use the external market selling price (i.e. 1,000 and 4,000 ₹/Unit for 900 units of Component 'C' and 50 machines respectively).

From a financial perspective, advise Division A's manager what he should choose. Support your advice with relevant figures.

What is the change in the rate of discount per unit given by B to A (based on unit transfer price to market price ratio) from option I to option II ?

4. Transfer pricing on opportunity cost basis – November 2015 RTP

Division Z is a profit center which produces four products A, B, C and D. Each product is sold in the external market also. Data for the period is:

	A	B	C	D
Market price per unit (Rs.)	150	146	140	130

Variable cost of pdn. Per unit	130	100	90	85
Labour hours required per unit	3	4	2	3

Product D can be transferred to division Y, but the maximum quantity that may be required for transfer is 2,500 units of D.

The maximum sales in the external market are:

A	2800 units
B	2500 units
C	2300 Units
D	1600 Units

Division Y can purchase the same product at a price of Rs. 125 per unit from outside instead of receiving transfer of product D from Division Z. What should be the transfer price for each unit for 2,500 units of D, if the total labour hours available in division Z are 20,000 hours?

5. Transfer pricing and decision on capacity expansion – November 2013

B Ltd. makes three products X, Y and Z in Divisions X, Y and Z respectively. The following information is given:

Particulars	X	Y	Z
Direct Material (Rs. / Unit) (excluding material X for Divisions Y and Z)	8	22	40
Direct Labour (Rs. / Unit)	4	6	8
Variable Overhead (Rs. / Unit)	2	2	2
Selling price to outside customers (Rs. / Unit)	25	65	90
Existing capacity (no. of units)	6,000	3,000	3,000
Maximum external Market demand (no of units)	5,000	5,500	5,000
Additional fixed cost that would be incurred to install additional capacity (Rs.)	45,000	9,000	23,100
Maximum additional units that can be produced by additional capacity	6,000	2,000	2,250

Y and Z need material X as their input. Material X is available in the market at Rs. 23 per unit. Defectives can be returned to suppliers at their cost. Division X supplies the material free from defects and hence is able to sell at Rs. 25 per unit. Each unit of Y and Z require one unit of X as input with slight modification.

If Y purchases from outside at Rs. 23 per unit, it has to incur Rs. 3 per unit as modification and inspection cost. If Y purchases from Division X, it has to incur, in addition to the transfer price, Rs. 2 per unit to modify it.

If Z gets the material from Division X, it can use it after incurring a modification cost, of Rs. 1 per unit. If Z buys material X from outside, it has to either inspect and modify it at its own shop floor at Rs. 5 per unit or use idle labour from Division X at Rs. 3 per unit. Division X will lend its idle labour as per Z's requirement even if Z purchases the material from outside.

The transfer prices are at the discretion of the Divisional Managers and will remain confidential. Assume no restriction on quantities of inter-division transfers or purchases.

Required

Discuss with relevant figures the best strategy for each division and for the company as a whole.

6. Transfer pricing based on opportunity cost – November 2014

X Division and Y Division are two divisions in the XY group of companies. X Division manufactures one type of component which it sells to external customers and also to Y Division.

Details of X Division are as follows:

Market price per component.....	Rs.300
Variable cost per component.....	Rs.157
Fixed costs.....	Rs.20,62,000 per period
Demand from Y Division.....	20,000 components per period
Capacity.....	35,000 components per period

Y Division assembles one type of product which it sells to external customer. Each unit of that product requires two of the components that are manufactured by X Division.

Details of Y Division are as follows:

Selling price per unit.....	Rs.1,200
Variable cost per unit:	
❖ Two components from X.....	2 @ transfer price
❖ Other variable costs per unit.....	Rs.375
Fixed costs.....	Rs.13,50,000 per period
Demand.....	10,000 units per period
Capacity.....	10,000 units per period

Group Transfer Pricing Policy

- ❖ Transfers must be at opportunity cost.
- ❖ Y must buy the components from X.
- ❖ X must satisfy demand from Y before making external sales.

Required

- ❖ Calculate the profit for each division if the external demand per period for the components that are made by X Division is:
 - i. 15,000 Components
 - ii. 19,000 components
 - iii. 35,000 components
- ❖ Calculate the financial impact on the Group if Y Division ignored the transfer pricing policy and purchased all of the 20,000 components that it needs from an external supplier for Rs.255 each. Your answer must consider the impact at each of the three levels of demand (15,000, 19,000 and 35,000 components) from external customers for the component manufactured by X Division.

7. Pricing decision – May 2014 RTP

Eastern Company Ltd. has two Divisions namely Casnub Bogie Division (CBD) and Wagon Division (WD). CBD manufactures Casnub Bogies and WD manufactures BOBN type of Wagons. To manufacture a Wagon WD needs four Casnub Bogies. CBD is the only manufacturer of the Casnub Bogies and supplies both WD and outside customers. Details of CBD and WD for the coming financial year 2014-15 are as follows:

	CBD	WD
Fixed costs (Rs.)	9,20,20,000	16,45,36,000
Variable cost per unit (Rs.)	2,20,000	4,80,000 *
Capacity per month (units)	320	12

* excluding transfer costs

Market research has indicated that the demands in the market for Eastern Company Ltd.'s products at different quotations are as follows-

For Casnub Bogies: Quotation price of Rs.3,20,000 no tender will be awarded, but demand will increase by 30 Casnub Bogies with every Rs.10,000 reduction in the unit quotation price below Rs.3,20,000.

For Wagons: Quotation price of Rs.17,10,000 no tender will be awarded, but the demand for Wagons will be increased by two Wagons with every Rs.50,000 reduction in the unit quotation price below Rs.17,10,000.

Required

- ❖ Calculate the unit quotation price of the Wagon that will maximise Eastern Company Ltd.'s profit for the financial year 2014-15.
- ❖ Calculate the unit quotation price of the Wagon that is likely to emerge if the divisional managers of CBD and WD both set quotation prices calculated to maximise divisional profit from sales to outside customers and the transfer price is set at market selling (quotation) price.

[Note: If $P = a - bQ$ then $MR = a - 2bQ$]

8. Multinational transfer pricing – May 2015 RTP

Standard Corporation Inc. (SCI) is a US based multinational company engaged in manufacturing and marketing of Printers and Scanners. It has subsidiaries spreading across the world which either manufactures or sales Printers and Scanners using the brand name of SCI.

The Indian subsidiary of the SCI buys an important component for the Printers and Scanners from the Chinese subsidiary of the same MNC group. The Indian subsidiary buys 1,50,000 units of components per annum from the Chinese subsidiary at CNY (¥) 30 per unit and pays a total custom duty of 29.5% of value of the components purchased.

A Japanese MNC which manufactures the same component which is used in the Printer and Scanners of SCI, has a manufacturing unit in India and is ready to supply the same component to the Indian subsidiary of SCI at ₹ 320 per unit.

The SCI is examining the proposal of the Japanese manufacturer and asked its Chinese subsidiary to presents its views on this issue. The Chinese subsidiary of the SCI has informed that it will be able to sell 1,20,000 units of the components to the local Chinese manufactures at the same price i.e. ₹ 30 per unit but it will incur an excise duty @ 10% on sales value. Variable cost per unit of manufacturing the component is ₹ 20 per unit. The Fixed Costs of the subsidiaries will remain unchanged.

The Corporation tax rates and currency exchange rates are as follows:

Corporation Tax rates		Currency Exchange Rates
China	25%	1 US Dollar (\$) = ₹61.50
India	34%	1 US Dollar (\$) = ₹ 6.25
USA	40%	1 CNY (¥) = ₹ 9.80

Required:

- PREPARE a financial appraisal for the impact of the proposal by the Japanese manufacturer to supply components for Printers and Scanners to Indian subsidiary of SCI. [Present your solution in Indian Currency and its equivalent.]
- IDENTIFY other issues that would be considered by the SCI in relation to this proposal.

9. Transfer pricing and different scenarios – May 2017

Supreme Limited has two Divisional Profit Centres A and B. A produces two components 'AC' and 'PC' and has a maximum capacity of 1,20,000 hours per annum, which can be used for AC or PC.

The following information is given:

Details	Division A		Division B
	AC	PC	RAC
Direct Material ₹/ unit	25	10	100
Imported Component (equivalent of AC) ₹/ unit	-	-	450
Direct Labour and Variable overhead ₹/unit			
@ ₹ 50 / hour	200	50	-
@ ₹ 35 / hour	-	-	350
Fixed cost ₹/ annum	30,00,000		6,00,000
External demand (no of units)	18,000	Unlimited	6,000
External selling price (₹/ unit)	450	90	1,050

Division B presently imports a component which is similar to AC at ₹ 450. If it uses AC from Division A, it has to make some modification which will involve two direct labour hours, thereby increasing the cost by ₹ 70/- per modified unit.

What is the minimum transfer price per unit that A will agree to, if the requirement of B is

- (i) 12,000 units
- (ii) 15,000 units?
- (iii) What is the maximum price that B will offer A per unit of AC transferred if its labour hours are restricted to 6,00,000 hours?

Is it in the company's interest that A transfers units to B after meeting its external demand for AC.

- (iv) If B's labour hours are restricted to 6,00,000 hours?
- (v) If B's labour hours have no limitation?

(Present your answers from a financial perspective and with only relevant figures. A detailed profitability statement is not required). (8 Marks)

10. TP conflict – May 2016

Division X and Y are two divisions of XY Ltd., which operates as profit centres. Division X makes and sells product X. The budgeted Income statement of Division X, based on a sales volume of 30,000 units, is given below:

Budgeted Income Statement of Division X

Particulars	₹ In '000
Sales Revenue	6,000
Component purchase costs	1,050
Other variable costs	1,680
Fixed costs	480
Variable marketing costs	270
Fixed marketing overheads	855
Operating profit	1,665

The manager of Division X suggests that sales can be increased by 9,600 units, if the selling price is reduced by ₹ 20 per unit from the present price of ₹ 200 per unit and that for this additional volume, no additional fixed costs will be incurred.

Division Y makes a component Y which is sold outside at a price of ₹ 50 per unit.

Division X presently uses a component which is purchased from outside at ₹ 35 per unit. This component is similar to component made by Division Y. Division Y can make this component for Division X with a minor modification in specification which would cause reduction in direct material cost for the Division Y by ₹ 1.5 per unit and would require extra labour hour of 1 per unit at the rate of ₹ 1.5 per hour.

Further the Division Y will not incur variable selling marketing cost on units transferred to the Division X. Division X's manager has offered to buy the component from Division Y at ₹ 25.00 per unit. Division Y has the capacity to produce 85,000 units.

The current budgeted information of Division Y are as follows:

Number of units sold outside 60,000 units @ ₹ 50 per unit, variable cost including material and labour ₹ 15 per unit, variable marketing cost ₹ 3 per unit, operating profit ₹ 12,00,000 and fixed overheads ₹ 7,20,000.

Advise

- (i) Should the Division X reduce the selling price by ₹ 20 per unit even if it is not able to procure the component from Division Y at ₹ 25 per unit?
- (ii) Should the Division Y be willing to supply 39,600 units to Division X at ₹ 25 per unit?

Support each of your conclusions with appropriate calculations.

(8 Marks)

11. International transfer pricing – November 2017

ABC miners operates two divisions, one in Japan and other in United Kingdom (U.K.). Mining Division is operated in Japan which is rich in raw emerald.

The other division is United Kingdom Processing Division. It processes the raw emerald into polished stone fit for human wearing.

The cost details of these divisions are as follows:

Division	Japan Mining Division	United Kingdom Processing Division
	Per carat of raw emerald	Per carat of polished emerald
Variable Cost	2,500 Yen	150 Pound
Fixed Cost	5,000 Yen	350 Pound

Several polishing companies in Japan buy raw emerald from other local Mining Companies at 9,000 Yen per carat. Current Foreign Exchange Rate is 50 yen = 1 Pound. Income Tax rates are 20% and 30% in Japan and the United Kingdom respectively.

It takes 2 carats of Raw Yellow emerald to yield 1 carat of Polished Stone. Polished emerald sell for 3,000 Pounds per carat.

Required:

- Compute the transfer price for 1 carat of raw emerald transferred from Mining Division to the Processing Division under two methods - (a) 200% of Full Costs and (b) Market Price.
- 1,000 carats of raw emerald are mined by the Japan Mining Division and then processed and sold by the U.K. Processing Division. Compute the after tax operating income for each division under both the Transfer Pricing Methods stated above in (i).

(8 Marks)

12. Dual Quotes – May 2016 RTP, Nov 2017 RTP

Maryanne Ltd. has two divisions Division A and Division B. Division A produces product Z, which it sells to external market and also to Division B. Divisions in the Maryanne Ltd. are treated as profit centres and divisions are given autonomy to set transfer prices and to choose their supplier. Performance of each division measured on the basis of target profit given for each period.

Division A can produce 1,00,000 units of product Z at full capacity. Demand for product Z in the external market is for 70,000 units only at selling price of ₹ 2,500 per unit. To produce product Z Division A incurs ₹ 1,600 as variable cost per unit and total fixed overhead of ₹ 4,00,00,000. Division A has employed ₹ 12,00,00,000 as working capital, working capital is financed by cash credit facility provided by its lender bank @ 11.50% p.a. Division A has been given a profit target of ₹ 2,50,00,000 for the year.

Division B has found two other suppliers R Ltd and S Ltd. who are agreed to supply product Z.

Division B has requested a quotation for 40,000 units of product Z from Division A.

Required

- Calculate the transfer price per unit of product Z that Division A should quote in order to meet target profit for the year.
- Calculate the two prices Division A would have to quote to Division B, if it became Maryanne Ltd. policy to quote transfer prices based on opportunity costs.

Topic 41: Direct Product Profitability / Customer Profitability Analysis**1. Direct Product Profitability – May 2014 RTP**

Jigyasa India Ltd. (JIL) has 30 retail stores of uniform sizes 'Fruity & Sweety Retails' across the country. Mainly three products namely 'Butter Jelly', 'Fruits & Nuts' and 'Icy Cool' are sold through these retail stores. JIL maintains stocks for all retail stores in a centralised warehouse. Goods are released from the warehouse to the retail stores as per requisition raised by the stores. Goods are transported to the stores through two types of vans i.e. normal and refrigerated. These vans are to be hired by the JIL.

Costs per month of JIL are as follows:

	(₹)
Warehouse Costs:	
Labour & Staff Costs	27,000
Refrigeration Costs	1,52,000
Material Handling Costs	28,000
Total	2,07,000
Head Office Cost:	
Salary & Wages to Head Office Staff	50,000
Office Administration Costs	1,27,000
Total	1,77,000
Retail Stores Costs:	
Labour Related Costs	33,000
Refrigeration Costs	1,09,000
Other Costs	47,000
Total	1,89,000

Average transportation cost of JIL per trip to any retail stores are as follows:

Normal Van	₹3,200
Refrigerated Van	₹4,900

The Chief Financial Manager asked his Finance managers to calculate profitability based on three products sold through Fruity & Sweety retail stores rather than traditional method of calculating profitability.

The following information regarding retail stores are gathered:

	Butter Jelly	Fruits & Nuts	Icy Cool
No. of Cartons per cubic metre (m ³)	42	28	40
No. of Items per cartons (units)	300	144	72
Sales per month (units)	18,000	4,608	1,152
Time in Warehouse (in months)	1	1.5	0.5
Time in Retail Stores (in months)	1	2	1
Selling Price per unit (₹)	84	42	26
Purchase Price per unit (₹)	76	34	22

Butter Jelly and Icy-Cool are required to be kept under refrigerated conditions.

Additional information:

Total Volume of All Goods Sold per month	40,000 m ³
Total Volume of Refrigerated Goods Sold per month	25,000 m ³
Carrying Volume of each van	64 m ³

Required:

Calculate the Profit per unit using Direct Product Profitability (DPP) method.

2. Customer wise profitability – November 2015

A and B are two customers of XYZ Electronics Ltd., a manufacturer of audio players. Selling price per unit is ₹5,400. Its cost of production per unit is ₹4,420.

Additional costs are:

Order Processing Cost..... ₹2,000 per order

Delivery Costs..... ₹3,500 per delivery

Details of customers A and B for the period are given below:

	Customer A	Customer B
Audio Players purchased(nos.)	350	500
No. of orders	5 (each of 70 units)	10 (each of 50 units)
No. of deliveries	5	0

The company's policy is to give a discount of 5% on the selling price on orders for 50 units or more, and to further give 8% discount on the undiscounted selling price if a customer uses his own transport to collect the order. Assume that production levels are not altered by these orders.

Required

- Analyse the profitability by comparing profit per unit for each customer.
- Comment on the discount policy on delivery.

3. Customer wise profitability – November 2013 RTP

Edward Ltd. manufactures weighing machines of standard size and sells its products to two industrial customers namely MT Ltd. and KG Ltd. and to a dealer MG Bros. having shops in different cities. The maximum retail price per unit of weighing machine is ₹ 11,000 and per unit average cost of production is ₹ 5,500 (40% is general fixed overhead cost).

The Finance Officer has been asked to undertake a customer profitability analysis and calculate and compare the profit margin per customer (before deducting general fixed overhead) to know about the real customer profitability.

Following are the additional overhead information:

Delivery Costs	₹ 200 per Kilometer
Emergency Delivery Cost (in addition to Delivery Cost)	₹ 21,000 per Delivery
Order Processing Cost	₹ 6,000 per Order
Specific Discount and Sales Commission	As per Negotiation
Product Advertisement Cost	Actual Cost

The following data are available for each customer:

Particulars	MT Ltd.	KG Ltd.	MG Bros.
Sales (in units)	2,000	1,000	800
Total Delivery Kilometer Travelled	1,000	800	900
No. of Emergency Delivery	2	1	0
No. of Orders Processed	4	2	8
Specific Discount (Percentage of Sales Revenue)	25%	20%	15%
Sales Commission (Percentage of Sales Revenue)	15%	10%	5%
Advertisement Costs (₹)	8,75,000	6,15,000	4,30,000

Required

Analyze the profitability for each customer, which customer is the most profitable.

4. Customer wise profitability – November 2015 RTP

Oxford Medical Care Co. (OMCC) is a pharmaceutical firm, operating its entire business through its four customers Ox_1 , Ox_2 , Ox_3 , and Ox_4 . Ox_1 and Ox_2 are small pharmaceutical stores while Ox_3 and Ox_4 are large discount stores with attached pharmacies. OMCC uses discount pricing strategy and prices its products at variable cost plus 25%.

Item	Small Pharmaceuticals		Large Pharmaceuticals		Activity Rate
	Ox_1	Ox_2	Ox_3	Ox_4	
Number of Orders	4	9	6	3	₹750
Order Size	₹40,000	₹20,000	₹4,25,000	₹4,00,000	n/a
Average Discount	4.50%	9.50%	17.50%	11.50%	n/a
Regular Deliveries	4	9	6	3	₹375
Expedited Deliveries	2	0	2	0	₹1,250
General Administration Cost	₹20,250		₹48,375		

Required

- Prepare a 'Customer Profitability Statement' that shows the profit from each customer and each customer channel.
- Recommend some points to improve OMCC's profit.

5. Product-wise profitability statement – May 2017

PH Ltd. makes and supplies pizzas to three college A, B and C across the city. It is exploring the viability of discontinuing C and supplying to a nearer college 'D'. However, there is an extra quantity of 800 units which it can supply to A if it discontinues C. The details are given below:

	A	B	C	D
No. of Pizzas (existing)	1,500	2,500	4,800	-
Proposed	*			4,000
Contribution ₹/unit excluding delivery costs	72	67	65	60
(km/delivery) distance	20	30	40	25
No. of deliveries (normal)	100	125	400	200
No. of rush deliveries (₹ 200 / rush delivery)	-	40	20	30
Normal Delivery Cost (₹ /km) (not applicable to rush deliveries)	20	20	20	20

- * If it has to supply 800 extra units to A, it has to reduce the price on the original supply also. Moreover, these 800 units will involve 65 normal deliveries and 20 rush deliveries.
- (i) Prepare a customerwise profitability statement based on the existing quantities given in the table for A, B and C and the proposed 4,000 numbers for D.
- (ii) By how much can PH reduce the price per unit supplied to college A in order to justify the additional supply? (8 Marks)

Topic 42: Balanced Scorecard**1. Balance score-card measures – May 2017 RTP**

Classify the following measures under appropriate categories in a Balanced Scorecard for a banking company which excels in its home loan products:

- (i) A new product related to life insurance is being considered for a tie up with the successful housing loan disbursements.
e.g. every housing loan applicant to be advised to take a life policy or compelled to take a fire insurance policy.
- (ii) How different sectors of housing loans with different interest rates have been sanctioned, their volumes of growth in the past 4 quarters.
- (iii) How many days are taken to service a loan, how many loans have taken longer, what additional loans are to be released soon, etc.

2. Balanced score-card measures – May 2016

Classify the following under appropriate categories in Balanced Score Card:

- (i) Research and development
- (ii) New product introduction
- (iii) Price
- (iv) Cost leadership
- (v) Sales penetration
- (vi) Profitability
- (vii) Sales
- (viii) Quality

(4 Marks)

3. Balances score-card measures – May 2015

In the context of a balanced scorecard, identify the perspectives of the following independent situations:

Sl. No.	Organisation	Target Parameter	Perspective
(i)	Courier Company	100% on-time delivery of priority dispatches.	
(ii)	Tuition Centre	Set up class-on-internet facility for better reach of more number of students and absentees.	
(iii)	Computer Manufacturing Company	Set up service centres in all major cities for after sales support.	
(iv)	Government Taxation Department	Ensure Computer training to all officers above a certain rank to improve their capabilities.	

4. Balanced Scorecard for Super Market – November 2014

ABC Ltd. has supermarkets located in most towns and cities. Over the last few years, profits have fallen. ABC Ltd. has recognized that customer care has been paid insufficient attention. ABC Ltd. has now realized the importance of the customer experience at its supermarkets.

ABC Ltd. has introduced a loyalty card scheme that rewards customers with discount vouchers based on their spend and buying patterns at supermarkets in an attempt to earn the loyalty of its customers.

The management of ABC Ltd. is considering the introduction of a Balanced Scorecard approach to manage the performance of its stores.

Required

Recommend an objective and a suitable performance measure for each of three non-financial perspectives of a Balanced Scorecard that ABC Ltd. could use to support its new strategy of improving the customer experience. You should state three perspectives, an objective and a performance measure for each one of the three perspectives.

5. Balanced Scorecard – Telecom Company – Nov 2017 RTP, May 2015 RTP

Standard Telecom Ltd. is a leading cellular service provider having a global presence. It aims to be the most innovative and trusted telecom company in the world. To achieve this aim, it is constantly working on its overall functioning. It is trying to adopt best managements practices in the world. Following are some information related to the company's performance for a particular period:

<i>Particulars</i>	<i>Current Year</i>	<i>Base Year</i>	<i>Target</i>
<i>Operating Ratio</i>	<i>60%</i>	<i>54%</i>	<i>Reduce it to 50%</i>
<i>Average Revenue per user</i>	<i>₹ 225</i>	<i>₹ 210</i>	<i>Increase it to ₹250</i>
<i>Unresolved Consumer Complaints</i>	<i>27,500</i>	<i>25,000</i>	<i>Reduce it by 20%</i>
<i>Customer Relationship Centres</i>	<i>280</i>	<i>200</i>	<i>Take the total to 250</i>
<i>Employee Coverage under Training Programme</i>	<i>10%</i>	<i>8%</i>	<i>At least 15%</i>

Required

Evaluate the performance of the company using Balance Scorecard approach.

6. Balanced Scorecard – Miscellaneous – May 2014 RTP

Identify Balance Scorecard Perspectives from the following potential measures observed in different business sectors (Healthcare/ Airlines/ Banking).

- (i) Weekly Patient Complaints*
- (ii) Patient Satisfaction Survey*
- (iii) Flight Cancellation Rate*
- (iv) On-time Performance of an Airline*
- (v) Number of Grants Awarded to a Healthcare unit*
- (vi) Outstanding Loan Balances / Deposit Balances of a Banking Company*
- (vii) Employee Turnover Rate of a Healthcare unit*
- (viii) Patient Referral Rate*
- (ix) Non-interest Income of a Banking Company*
- (x) Lost of Bag Reports per 5,000 Passengers*

Topic 43: Simplex Method**1. Simplex method – May 2014**

A factory produces 3 products X_1 , X_2 and X_3 . Each of these products is processed in two departments, machining and Assembly. The processing time in hours for each product in each department and the total available time in hours in the departments and contribution per unit are given below:

Product	Processing time (in hours)		Contribution ₹ /unit
	Machining Department	Assembly Department	
X_1	4	3	8
X_2	4	2	6
X_3	6	4	5
Available time (hours)	384	288	

Exactly 30 units of X_3 must be produced.

- (i) Determine the optimal product mix using simplex method and find the optimal profit.
 (ii) Comment on the solution, objective function and the constraints. (6 Marks)

2. Simplex method – Interpretation – November 2013

Given below is an iteration in a simplex table for a maximization objective linear programming product mix problem for products X_1 , X_2 and X_3 .

$C_j \rightarrow$			6	4	10	0	0	0
	Basic Variable	Quantity	X_1	X_2	X_3	S_1	S_2	S_3
0	S_1	400	0	$4/3$	0	1	$-1/3$	0
6	X_1	400	1	$2/3$	2	0	$1/3$	0

0	S_3	400	0	$5/3$	0	0	$-2/3$	1
Z_j		2,400	6	4	12	0	2	0
$C_j - Z_j$			0	0	-2	0	-2	0

Answer the following questions:

- Is the above solution feasible?
- Perform one more iteration with X_2 entering the solution to get a solution with the same value for the objective function.
- Indicate the shadow prices.
- If customer is prepared to pay higher price for product X_3 then by how much should the price be increased so that the company's profit remains unchanged?
- From the given table, derive any one original constraint inequality with the coefficients of variables in their simplest whole number forms. (8 Marks)

3. Simplex method – Interpretation – November 2015 RTP

Given below is an iteration in a simplex table for a maximization objective linear programming product mix problem for products x, y and z. Each of these products is processed in three machines KA-07, KB-27 & KC-49 and each machine has limited available hours.

$C_j \rightarrow$			30	40	20	0	0	0
C_B	Basic Variable (B)	Value of Basic Variables b ($=X_B$)	x	y	z	s_1	s_2	s_3
30	x	250	1	0	$-26/16$	$10/16$	$-12/16$	0
40	y	625	0	1	$31/16$	$-7/16$	$10/16$	0
0	s_3	125	0	0	$11/16$	$-3/16$	$1/8$	1

s_1 , s_2 and s_3 are slack variables for machine KA-07, KB-27 and KC-49 respectively. Answer the following questions, giving reasons in brief:

- Does the table above give an 'Optimal Solution'?
- Are there more than one 'Optimal Solution' / 'Alternate Optimal Solution'?
- Is this solution 'Feasible'?
- Is this solution 'Degenerate'?

- (v) Write down the 'Objective Function' of the problem.
- (vi) Write the 'Optimal Product Mix' and 'Profit' shown by the above solution.
- (vii) Which of these machines is being used to the full capacity when producing according to this solution?
- (viii) How much would you be prepared to pay for another hour of capacity each on machine KA-07, machine KB-27, and machine KC-49?
- (ix) If the company wishes to expand the production capacity, which of the three resources should be given priority?
- (x) What happens if 16 machine hours are lost due to some mechanical problem in machine KB-27?
- (xi) A customer would like to have one unit of product z and is willing to pay higher price for z in order to get it. How much should the price be increased so that the company's profit remains unchanged?
- (xii) A new product is proposed to be introduced which would require processing time of 4 hours on machine KA-07, 2 hours on machine KB-27 and 4 hours on machine KC-49. It would yield a profit of ₹12 per unit. Do you think it is advisable to introduce this product?

4. Simplex method – Interpretation – May 2015

The following information is given relating to the simplex method of a linear program with the usual notations.

Objective function:

$$Z = x_1 + 5x_2 \rightarrow (1)$$

Subject to:

$$6x_1 + 8x_2 \leq 12 \rightarrow (2)$$

$$5x_1 + 15x_2 \geq 10 \rightarrow (3)$$

$$x_1, x_2 \geq 10 \rightarrow (4)$$

Let s_1 be the variable introduced to restate (2) as an equality and let s_2 and A_2 be variables to restate (3) as an equality.

If the objective is to maximize Z,

- (i) *What will be the coefficients of s_1 , s_2 and A_2 in equation (1) and (3) restated as equality?*
- (ii) *Identify the slack and surplus variables.*
- (iii) *Which variables will form part of the initial solution? Why?*
- (iv) *If the objective is to minimize Z what will be your answer to (i) above? (8 Marks)*

5. Simplex method – Interpretation – May 2017

The following is the data for a minimisation problem of a linear program in the simplex method.

Minimise $Z = 3x_1 + 4x_2$, subject to

$$2x_1 + 3x_2 \geq 150$$

$$4x_1 + 3x_2 \geq 120$$

$$x_1, x_2 \geq 0$$

Assume usual notations for additional variables s_1, s_2 for conversion to equality.

- What would be the coefficient of the artificial variables in the objective function? Why?
- Will s_1 and s_2 be part of the initial solution? Why?

6. Simplex method – interpretation – November 2017

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

C_j	Product Mix	x_1	x_2	s_1	s_2	Quantity
5	x_2	1	1	1	0	10
0	s_2	1	0	-1	1	3
C_j		4	5	0	0	
Z_j		5	5	5	0	50
$C_j - Z_j$		-1	0	-5	0	

Answer the following questions giving reasons in brief:

- If s_1 is slack in machine A (in hours/week) and s_2 is slack in machine B (in hours/week), which of these machines is being used to the fullest capacity?
- A customer would like have to one unit of product, x_1 and is willing to pay more than the normal price in order to get it. How much should the price be increased in order to maintain same level of profit?
- Machine A (associated with slack s_1 in hours/week) has to be shut down for repairs for 2 hours next week. What will be the effect on profits?
- How much would you be prepared to pay for another hour (per week) of machine A and machine B? **(4 Marks)**

7. Simplex – interpretation – November 2017

Explain the following terms in relation to Simplex method of Linear Programming problem:

- Multiple optimal solution
- Infeasible solution
- Degeneracy
- Unbounded solution

8. Maximization – Simplex Method – May 2013

A company manufactures two products A and B, involving three departments - Machining, Fabrication and Assembly. The process time, profit/unit and total capacity of each department is given in the following table:

	<i>Machining (hours)</i>	<i>Fabrication (hours)</i>	<i>Assembly (hours)</i>	<i>Profit (₹)</i>
<i>A</i>	<i>1</i>	<i>5</i>	<i>3</i>	<i>80</i>
<i>B</i>	<i>2</i>	<i>4</i>	<i>1</i>	<i>100</i>
<i>Capacity</i>	<i>720</i>	<i>1,800</i>	<i>900</i>	

Set up Linear Programming problem to maximize profits. What will be the product-mix at maximum profit level? What will be the profit?

Topic 44: Graphical Method**1. Graphical method – Maximisation – May 2016**

A manufacturer produces two types of products i.e. X and Y. Each of these products requires three types of processing. The processing time for each unit and the profit per unit are given in the following table:

	Product X (hours/unit)	Product Y (hours/unit)	Available capacity per day (hours)
Process I	12	12	840
Process II	3	6	300
Process III	8	4	480
Profit per unit (₹)	5	7	

Applying Graphical method, how many units of each product should the company manufacture per day in order to maximize profit? (8 Marks)

2. Graphical method – Maximization – November 2014

A market advertising firm desires to reach two type of audiences customer of annual income of more than ₹50,000 (target audience A) and customers with annual income of less than ₹50,000 (target audience B).

The total advertising budget is ₹2,000 crores. One programme of TV advertising costs ₹500 crores and one programme on Radio advertising costs ₹ 200 crores. Contract conditions ordinarily require that there should be atleast 3 programmes for TV and the number of programmes on radio must not exceed 5. Survey indicates that a single TV programme reaches 7,50,000 customers in target audience A and 1,50,000 in target audience B. One Radio programme reaches 40,000 customers in target audience A and 2,60,000 customers in target audience B.

Formulate this as a linear programming problem and determine the media mix to maximize the total reach using graphic method. (8 Marks)

3. Graphical method – maximisation – May 2014 RTP

Let us assume that you have inherited ₹1,00,000 from your father that can be invested in a combination of only two stock portfolios, with the maximum investment allowed in either portfolio set at ₹75,000. The first portfolio has an average rate of return of 10%, whereas the second has 20%. In terms of risk factors associated with these portfolios, the first has a risk rating of 4 (on a scale from 0 to 10), and the second has 9. Since you wish to maximize your return, you will not accept an average rate of return below 12% or a risk factor above 6. Hence, you then face the important question. How much should you invest in each portfolio?

Formulate this as a Linear Programming Problem and solve it by Graphic Method.

4. Graphical method – Maximisation – May 2012

The following linear program is presented to you:

Objective: Maximize $Z = 30x + 45Y$

Subject to: (i) $2x + 3y \leq 1,440$

(ii) $9x + 12y \geq 2,160$

(iii) $3x + 4y \geq 1,080$

(iv) $x, y \geq 0$

You are required to draw the graph taking quantities of x and y in the respective axes in steps of 60 units (scale 1 cm. = 60 units), determine the optimality and offer your comments on the solution and the constraints. (8 Marks)

5. Dual problem – November 2013 RTP

Find the dual problem for the following:

Minimize

$$Z = 2x_1 - 3x_2 + 4x_3$$

Subject to the constraints

$$3x_1 + 2x_2 + 4x_3 \geq 9$$

$$2x_1 + 3x_2 + 2x_3 \geq 5$$

$$7x_1 - 2x_2 - 4x_3 \leq 10$$

$$6x_1 - 3x_2 + 4x_3 \geq 4$$

$$2x_1 + 5x_2 - 3x_3 = 3$$

$$x_1, x_2, x_3 \geq 0$$

Topic 45: LPP Formulation**1. LPP Formulation – Advertisement – May 2017 RTP**

The owner of Fancy Goods Shop is interested to determine, how many advertisements to release in the selected three magazines A, B and C. His main purpose is to advertise in such a way that total exposure to principal buyers of his goods is maximized. Percentages of readers for each magazine are known. Exposure in any particular magazine is the number of advertisements released multiplied by the number of principal buyers. The following data are available:

Particulars	Magazines		
	A	B	C
Readers	50,000	30,000	20,000
Principal buyers	40%	30%	16%
Cost per advertisement	₹12,000	₹9,000	₹7,500

The budgeted amount is at the most ₹ 1.5 lakh for the advertisements. The owner has already decided that magazine A should have no more than 8 advertisements and that B and C each gets at least 4 advertisements.

Required

Formulate a Linear Programming model for this problem.

2. LPP Formulation – Product planning – November 2016 RTP

In a chemical industry two products P and Q are made involving two operations. The production of Q also results in a by-product R. The product P can be sold at a profit of ₹ 3 per unit and Q at a profit of ₹ 8 per unit. The by-product R has a profit of ₹ 2 per unit. Forecast show that upto 5 units of R can be sold. The company gets 3 units of R for each unit of Q produced. The manufacturing times are 3 hrs per unit for P on each of the operation one and two and 4 hrs and 5 hrs per unit for Q on operation one and two respectively. Because the product R results from producing Q, no time is used in producing R. The available times are 18 hrs and 21 hrs of operation one and two respectively. The company desires to know that how much P and Q should be produced keeping R in mind to make the highest profit.

Required

Formulate LP model for this problem.

3. LPP Formulation – Investment Planning – November 2015

Mr. X has ₹ 10 lacs which he wants to invest in the share market in anticipation of having good returns. He wants to invest only in two stock and one mutual fund with an investment allowed in each stock or mutual fund not being more than ₹ 7 lacs.

	Expected rate of Return	Risk rating (on a scale of 0 to 10)
Stock L	15%	5
Stock M	18%	8
Mutual Fund	13%	4

He does not want to accept an average rate of return below 12% or a risk factor above 6.

How much money he should invest in each alternative so as to obtain the highest annual total return?

Formulate the above as a linear program and present the inequalities with coefficients in their simplest integer forms. (8 Marks)

4. LPP Formulation – Investment Planning – November 2012

An investor is interested in investing ₹ 15,00,000 in a portfolio of investments. The investment choices and expected rates of return on each one of them are :

Investment	Projected Rate of Return
Mutual Fund 'XY'	15%
Mutual Fund 'HN'	9%
Money Market Fund	8%
Government Bonds	8.75%
Shares 'P'	17%
Share 'Q'	18%

The investor wants at least 40% of his investment in Government Bonds. Because of the higher perceived risk of the two shares, he has specified that the combined investment in these two shares not to exceed ₹ 2,60,000. The investor has also specified that at least 25% of the investment should be in the money market fund and that the amount of money invested in shares should not exceed the amount invested in Mutual Funds. His final investment condition is that the amount invested in mutual fund 'XY' should be no more than the amount invested in mutual fund 'HN'. The problem is to decide the amount of money to invest in each alternative so as to obtain the highest annual total return.

Required:

Formulate the above as a linear programming problem. (5 Marks)

5. LPP formulation – production planning – May 2016 RTP

The manufacturing company has 100 kg of A, 180 kg of B and 120 kg of C ingredients available per month. Company can use these materials to make three basic products namely 5-10-5, 5-5-10 and 20-5-10, where the numbers in each case represent the percentage of weight of A, B and C respectively in each of products. The cost of these raw materials are as follows:

Ingredient	Cost per Kg. (₹)
A	64
B	16
C	40
Inert Ingredients	16

Selling price of these products are ₹ 32.60, ₹ 34.80, and ₹ 36.00 per Kg, respectively. There is capacity restriction of the company product 5-10-5, so that company cannot produce more than 30 Kg per month.

Required

Formulate this problem as an LP model to determine the productions (in Kg.) of each product which will maximise its monthly profit.

Note: Formulate Only

6. LPP Formulation – May 2013 RTP

Global Bank is in the process of formulating a loan policy that involves a maximum of ₹ 25 lakhs. The following table provides Interest Rate and Bad-Debt Ratio about available types of loans.

Type of loan	Interest Rate	Bad-Debt Ratio
Personal	0.135	0.09
Credit Card	0.145	0.12
Home	0.115	0.02
Farm	0.120	0.04
Commercial	0.105	0.01

Bank allocates at least 30% of the funds to farm and commercial loans. To assist the housing industry in the region, home loans must equal at least 50% of the personal, credit card and home loans. The bank also has a stated policy of not allowing the overall ratio of bad debts on all loans to exceed 5%. Formulate this as a Linear Programming Problem

Topic 46: Transportation

Question No.1 - May 2016 RTP

Coupers Partners a leading CA firm has three managers. Each manager can work up to 176 hours during the next month, during which time three assignments must be completed. Tax Accounting (TA) Assignment will take 143 hours, Tax Performance Advisory (TPA) will take 154 hours, and Global Compliance & Reporting (GCR) will take 176 hours. The amount per hour that can be billed for assigning each manager to each assignment is given below:

Manager	Assignment		
	TA (₹)	TPA (₹)	GCR (₹)
C ₁	1,800	2,250	2,850
C ₂	2,100	1,950	1,800
C ₃	2,400	2,100	2,250

Required

Formulate this as a transportation problem and find the optimal solution. Also find out the maximum total billings during the next month.

Note: A manager may be involved in more than one assignment.

Question No.2 - November 2016

The following table shows all the necessary information on the available supply from each warehouse, the requirement of each market and the unit transportation cost in rupees from each warehouse to each market.

Warehouses	Markets				Supply in Units
	I	II	III	IV	
A	5	2	4	3	22
B	4	8	1	6	15
C	4	6	7	5	8
Requirement in Units	7	12	17	9	45/45

The shipping clerk has worked out the following schedule from experience:

12 units from A to II, 1 unit from A to III,

9 units from A to IV, 15 units from B to III,

7 units from C to I and 1 unit from C to III.

- Check if the clerk has made the 'Optimum Schedule'.
- Find the 'Optimum Schedule' and 'Minimum Total Shipping Cost'.
- Carrier of route C to II offers to transport entire supply of warehouse C at a reduced price. By how much must the rate be reduced by the Carrier before the clerk should consider giving him business?

(8 Marks)

Question No.3 - May 2016

The cost per unit of transporting goods from the factories X, Y and Z to destination A, B, C and D and the quantities demanded and supplied are given:

Factories	Destinations				Supply
	A	B	C	D	
X	25	50	20	25	100
Y	30	40	35	10	250
Z	20	10	25	35	200
Demand	250	100	150	50	550

Answer the following question with reasons taking u_3 as zero while calculating u_i & v_j :

- (i) Is this solution is optimum?
 (ii) If yes, can there be any alternate optimum solution? (5 Marks)

Question No.4 - November 2015

The unit profit matrix based on four factories and three sales depots of a company and unbalanced quantities of demand and supply are tabulated below. The main object of the company is to maximize profit. Assume that there is no profit in case of surplus production.

Factories	Sales Depots			Supply (Nos.)
	S1	S2	S3	
F1	6	6	1	10
F2	-2	-2	-4	150
F3	3	2	2	50
F4	8	5	3	100
Demand (Nos.)	80	120	150	

Formulate the above as a usual transportation minimization problem and find the initial solution by using Vogel's Approximation Method (VAM). (5 Marks)

Question No.5 - May 2015

Four student A, B, C and D were asked to work out the initial solution of the following matrix showing unit transportation costs from plants to sales outlets, with a minimization objective and unbalanced quantities of supply and demand. A introduced a dummy row D on top (above S₁ position), while others introduced the dummy row D at the bottom (below S₃ position). A and B were asked to do the North West Corner Rule, while C did Least Cost Method and D did Vogel's method.

<i>Plants</i> <i>Sales outlets</i>	P_1	P_2	P_3	<i>Demand</i>
S_1	9	27	18	80
S_2	12	12	18	120
S_3	24	10	15	140
<i>Supply</i>	120	150	90	

Using the usual notation of cell reference (e.g. $S_2 P_3$ refers to the cell at the intersection of the S_2 row and P_3 column), what would be the 3rd allocation step in the initial allocation by each student?

You are advised to use the following format for your answers.

<i>Student</i>	<i>Allocation Details at Step III</i>		
	<i>Cell Reference</i>	<i>Quantity Allocated units)</i>	<i>Unit Cost at that cell</i>
<i>A</i>			
<i>B</i>			
<i>C</i>			
<i>D</i>			

(Candidates are not expected to show a fair version of the transportation matrix showing the calculations.) (8 Marks)

Question No.6 – November 2014

In a transport problem for cost minimization, there are 4 rows indicating quantities demanded and these totals up to 1800 units. There are 4 columns giving quantities supplied and these totals up to 2,100 units. What is the condition for a solution to be degenerate?

Question No.7 – May 2014

In a 3×4 transportation problem for minimizing costs, will the R_2C_1 cell (at the intersection of the 2nd row and 1st column) always figure in the initial solution by the North West Corner Rule? Why? (4 x 4 = 16 Marks)

Question No.8 – May 2013

XYZ Company has three plants and four warehouses. The supply and demand in units and the corresponding transportation costs are given. The table below shows the details taken from the solution procedure of the transportation problem :

		WAREHOUSES									
		I		II		III		IV		Supply	
Plants	A		5		10	10	4		5	10	
	B	20	6		8		7	5	2	25	
	C	5	4	10	2	5	5		7	20	
Demand		25		10		15		5			

Answer the following questions. Give brief reasons:

- Is this solution feasible?
- Is this solution degenerate?
- Is this solution optimum? (8 Marks)

Question No.9 - May 2012

The following table gives the unit transportation costs and the quantities demanded/supplied at different locations for a minimization problem:

Demand \ Supply	C ₁	C ₂	C ₃	C ₄	Total Units
R ₁	100	120	200	110	20000
R ₂	160	80	140	120	38000
R ₃	180	140	60	100	16000
Total Units	10000	18000	22000	24000	

You are required to find out which cell gets the 3rd allocation in the initial basic feasible solution under each of the following methods and to give the cell reference, cost per unit of that cell and the quantity allocated to that cell :

- North West Corner Rule
- Vogel's Approximation Method
- Least Cost Method

(Candidates may use the standard notation of C_i R_j for cell reference. (e.g. C₂ R₃ means the cell at the intersection of Column 2 and Row 3)

(Note: The full solution is not required to be worked out). (5 Marks)

Question No.10 - May 2012

In a transportation problem for cost minimization, there are 4 rows indicating quantities demanded and this totals up to 1,200 units. There are 4 columns giving quantities supplied. This totals up to 1,400 units. What is the condition for a solution to be degenerate?

Question No.11 – November 2015 RTP

The following table shows all the necessary information on the available supply from each warehouse, the requirement of each market and the unit transportation cost in rupees from each warehouse to each market.

Warehouses	Markets				Supply
	I	II	III	IV	
A	5	2	4	3	22
B	4	8	1	6	15
C	4	6	7	5	8
Requirement	7	12	17	9	45/45

The shipping clerk has worked out the following schedule from experience:

12 units from A to II, 1 unit from A to III, 9 units from A to IV, 15 units from B to III, 7 units from C to I and 1 unit from C to III.

- Check if the clerk has made the 'Optimal Schedule'.
- Find the 'Optimal Schedule' and 'Minimum Total Shipping Cost'.
- Carrier of route C to II offers to transport entire supply of warehouse C at a reduced price. By how much must the rate be reduced by the Carrier before the clerk should consider giving him business?
- If the supply from warehouse B reduces to 11 units and simultaneously the requirement of market III reduces to 13 units, find the 'Optimal Transportation Schedule'.
- Further, if supply from warehouse A also reduces to 19 units and simultaneously the requirement of III reduces further to 10 units, will the optimal solution of part (iv) change?

Question No.12 – November 2014 RTP

A project consists of four (4) major jobs, for which four (4) contractors have submitted tenders. The tender amounts, in thousands of rupees, are given in the each cell. The initial solution of the problem obtained by using Vogel's Approximation Method is given in the Table below:

Contractors	Job P	Job Q	Job R	Job S
A	112.50	100.00	127.50	167.50
B	142.50	105.00	157.50	137.50
C	122.50	130.00	120.00	160.00
D	102.50	112.50	150.00	137.50

Find the assignment, which minimizes the total cost of the project. Each contractor has to be awarded one job only.

Question No.13 – May 2014 RTP

The following matrix is a minimization problem for transportation cost. The unit transportation costs are given at the right hand corners of the cells and the Δ_i values are encircled.

	D ₁	D ₂	D ₃	Supply
F ₁	3	4	4	500
F ₂	8 9	300 6	8 7	300
F ₃	0 4	8 6	200 5	200
Demand	300	400	300	1,000

Find the optimum solution (s) and the minimum cost.

Question No.14 – May 2017

The following matrix is a transportation cost matrix giving unit costs from Factories F_1 , F_2 and F_3 to Destinations D_1 , D_2 and D_3 :

Factory Destination	F_1	F_2	F_3	Demand
D_1	3	6	7	60
D_2	8	5	7	30
D_3	4	9	11	30
Supply	35	55	30	

$u_1=0$

- Find the initial solution by the Least Cost Method.
- Is the solution non-degenerate? Can you expect a degenerate solution in such a situation? Why?
- Compute the Δ_{ij} matrix by taking $u_1 = 0$ as shown.
- If you considered $u_1=5$ and did the $u_i + v_j$ matrix, would the Δ_{ij} matrix be different from the one you have computed in (iii) above? Why? (You are expected to show the revised computation.)
- Find the initial solution by the North West Corner Rule. (10 Marks)

Question No.15 – November 2017

XYZ chemical company has three plants located in a state. The daily chemical production at each plant is as follows:

Plant-I: 12 million litres

Plant-II: 2 million litres

Plant-III: 20 million litres

Each day, company must fulfil the needs of its four distribution centres.

Minimum requirements at each centre are as follows:

Distribution centre 1: 14 million litres

Distribution centre 2: 10 million litres

Distribution centre 3: 6 million litres

Distribution centre 4: 4 million litres

Cost in hundreds of rupees of shipping one million litres from each plant to each distribution centre is given in the following table:

		Distribution Centre			
		D1	D2	D3	D4
Plant	P1	2	3	11	7
	P2	1	0	6	1
	P3	5	8	15	9

Required:

- Find initial basic feasible solution for given transportation problem by using Vogel's approximation method if the object is to minimize the total cost.
- Is this the degenerate solution?

(6 Marks)

Topic 47: Assignment

Question No.1 – May 2017 RTP

A factory is going to modify of a plant layout to install four new machines X_1 , X_2 , X_3 and X_4 . There are 5 vacant places P, Q, R, S and T available. Because of limited space machine X_2 cannot be placed at R and X_3 cannot be placed at P. The cost of locating machine to place in Rupees is shown below:

(₹)

	P	Q	R	S	T
X_1	9	11	15	10	11
X_2	12	9	--	10	9
X_3	--	11	14	11	7
X_4	14	8	12	7	8

Required

Determine the optimal assignment schedule in such a manner that the total costs are kept at a minimum.

Question No.2 – May 2016

Answer the following independent situation relating to an assignment problem with a minimization objective:

- Just after row and column minimization operations, we find that a particular row has two zeros. Does this implies that the 2 corresponding numbers in original matrix before any operation were equal? Why?
- Under the usual notation, where A_{32} means the element at the intersection of the 3rd row and 2nd column, we have, in a 4×4 assignment problem, A_{24} and A_{32} figuring in the optimal solution. What can you conclude about the remaining assignment? Why?

(4 Marks)

Question No.3 – November 2015

R_3C_2 denotes the element at the intersection of the third row and 2nd column. Under this notation, R_1C_1 , R_2C_1 , R_3C_1 , R_3C_2 , R_3C_3 , R_4C_3 , R_4C_4 , were the only zero elements in a 4×4 minimization assignment problem after the row minimum and column minimum operations.

- In the next step to draw lines to cover zeroes, a student drew 4 horizontal lines covering rows R_1 , R_2 , R_3 , and R_4 . Will he arrive at the optimal assignment at the next step? Why? Explain the concept.
- Independent of (i), if you are given the additional information that R_2C_2 element is lesser than the Row 1 and Row 2 non-zero values, how will you arrive at the optimal solution?

(8 Marks)

Question No.4 - May 2015

Methods I, II, III and IV are available for one-to-one assignment to factories A, B and C. The time taken (in hours) for implementing these methods in the factories is tabulated below with the objective of minimization.

↓ Methods	(Time Taken - hours)		
	A	B	C
I	35	25	28
II	23	32	25
III	25	42	21
IV	35	35	28

- (i) Show the optimal assignment by circling the cells using the assignment algorithm (description of algorithm is not required). Which method will not be implemented?
- (ii) What is the minimum savings (in hours) required over the current given duration, for preferring the implementation of the method identified in (i) above? When it so justifies, which method will it replace? Why? (5 Marks)

Question No.5 - November 2014

A salesman has to visit five cities. He wishes to start from a particular city, visit each city once and then return to his starting point. Cost (in ₹ '000) of travelling from one city to another is given below. You are required to find out the least cost route.

From \ To	P	Q	R	S	T
P	-	6	12	4	6
Q	6	-	10	4	6
R	12	10	-	12	8
S	4	4	12	-	12
T	6	6	8	12	-

(5 Marks)

Question No.6 - May 2014

Can there be (i) more than one dummy row or column or (ii) one dummy row and a dummy column in a given problem of (a) assignment (b) transportation? Why? (In other words, state whether and why each of situations A, B, C and D is possible or not):

	Assignment	Transportation
More than one dummy row or column	A	B
One dummy row and one dummy column	C	D

(4 Marks)

Question No.7 – November 2013

Answer the following independent situations relating to an assignment problem with a minimization objective:

- (i) Just after row and column minimum operations, we find that a particular row has 2 zeroes. Does this imply that the 2 corresponding numbers in the original matrix before any operation were equal? Why?
- (ii) Under the usual notation, where a_{32} means the element at the intersection of the 3rd row and 2nd column, we have, in a 4×4 assignment problem, a_{24} and a_{32} figuring in the optimal solution. What can you conclude about the remaining assignments? Why? (5 Marks)

Question No.8 – November 2012

A production supervisor is considering how he should assign five jobs that are to be performed to five operators. He wants to assign the jobs to the operators in such a manner that the aggregate costs to perform the job is the least. He has the following information about the wages paid to the operators for performing these jobs.

Operators	Jobs				
	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:

Assign the jobs to the operators so that the aggregate cost is the least. (8 Marks)

Question No.9 – May 2012

The following matrix was obtained after performing row minimum operations on rows R_1 and R_2 in an assignment problem for minimization. Entries "xx" represent some positive numbers. (It is not meant that all "xx" numbers are equal). State two circumstances under which an optimal solution is obtained just after the row minimum and column minimum operations.

(Candidates may use cell references as $C_i R_j$ for uniformity. e.g. $C_1 R_1$ represents the cell at the intersection of Column1 (C_1) and Row 1 (R_1) etc.

	C_1	C_2	C_3
R_1	0	xx	xx
R_2	xx	0	xx
R_3	xx	xx	xx

(4 Marks)

Question No.10 – May 2014 RTP

A BPO company is taking bids for 4 routes in the city to ply pick-up and drop cabs. Four companies have made bids as detailed below-

Bids for Routes (₹)

Company / Routes	R_1	R_2	R_3	R_4
C_1	4,000	5,000	–	–
C_2	–	4,000	–	4,000
C_3	3,000	–	2,000	–
C_4	–	–	4,000	5,000

Each bidder can be assigned only one route. Determine the minimum cost that the BPO should incur.

Question No.11 – November 2015 RTP

A salesman has to visit five cities. He wishes to start from a particular city, visit each city once and then return to his starting point. Cost (in ₹ '000) of travelling from one city to another is given below:

	P	Q	R	S	T
P	-	5	14	20	2
Q	17	-	8	23	5
R	23	20	-	11	20
S	35	11	17	-	14
T	2	8	5	23	-

Required:

Find out the 'Least Cost Route'.

Question No.12 – November 2013 RTP

Imagine yourself to be the Executive Director of a 5-Star Hotel which has four banquet halls that can be used for all functions including weddings. The halls were all about the same size and the facilities in each hall differed. During a heavy marriage season, 4 parties approached you to reserve a hall for the marriage to be celebrated on the same day. These marriage parties were told that the first choice among these 4 halls would cost ₹ 25,000 for the day. They were also required to indicate the second, third and fourth preferences and the price that they would be willing to pay. Marriage party A & D indicated that they won't be interested in Halls 3 & 4. Other particulars are given in the following table:

Revenue/Hall

Marriage Party	Hall 1	Hall 2	Hall 3	Hall 4
A	₹25,000	₹22,500	X	X
B	₹20,000	₹25,000	₹20,000	₹12,500
C	₹17,500	₹25,000	₹15,000	₹20,000
D	₹25,000	₹20,000	X	X

Where X indicates that the party does not want that hall. Decide on an allocation that will maximize the revenue to your hotel.

Question No.13 – May 2013 RTP

'Air-Pacific' airways operating 7 days a week has given the following time-table. Crews must have a minimum layover of 5 hours between flights. Obtain the pairing flights and minimizes layover time away from home. For any given pairings the crew will be based at the city that results in the smaller layover:

Kolkata – Bangkok			Bangkok - Kolkata		
Flight Number	Depart.	Arrive	Flight Number	Depart.	Arrive
KX1	05:15 AM	07:15 AM	BX1	07:15 AM	09:15 AM
KX2	07:15 AM	09:15 AM	BX2	08:15 AM	10:15 AM
KX3	01:15 PM	03:15 PM	BX3	01:15 PM	03:15 PM
KX4	07:15 PM	09:15 PM	BX4	06:15 PM	08:15 PM

Question No.14 – May 2017

The following 3×3 matrix arises after the Row minimum and Column minimum operation of a minimization assignment problem:

Columns Rows	C_1	C_2	C_3
R_1	0	0	0
R_2	0	a	b
R_3	0	c	d

Given that $a \neq b \neq c \neq d \neq 0$, (i.e. a, b, c, d are non zero and unequal), will $R_1 C_1$ (cell at the intersection of Row 1 and Column 1) appear in the final solution under the assignment algorithm? Why? Interpret this part of the algorithm. (5 Marks)

Question No.15 – November 2017

State with reason whether the following statements are true or false in relation to assignment problem:

- There cannot be multiple optimal solutions in an assignment problem.
- In 4×6 minimisation problem, we can solve it by introducing one dummy row in given matrix.
- In a problem relating to sales maximization, we have to convert the given matrix into minimization by subtracting lowest element among all the elements of given matrix from all the elements of that matrix.
- When there is a restriction of assignment in a particular cell, then we put M to avoid assignment in that cell.

Question No.1 - May 2017 RTP

The following table gives the activities in a construction project and the time duration of each activity:

Activity	Predecessors	Normal Time (Days)
A	---	16
B	---	20
C	A	8
D	A	10
E	B,C	6
F	D,E	12

Required

- Draw the activity network of the project.
- Find critical path.
- Find the total float and free-float for each activity.

Question No.2 - May 2016 RTP, Nov 2017 RTP

State the Validity of following statements along with the reasons:

- Two activities have common predecessor and successor activities. So, they can have common initial and final nodes.
- In respect of any activity whether real or dummy, the terminal node should bear a number higher than the initial node number.
- The difference between the latest event time and the earliest event time is termed as free float.
- For every critical activity in a network, the earliest start and the earliest finish time as well as the latest finish time and the latest start time are the same.
- The optimal duration of a project is the minimum time in which it can be completed.
- Resource leveling aims at smoothening of the resource usage rate without changing the project duration.

Question No.3 - November 2016

The following table shows for each activity needed to complete the road construction project, the normal time, the shortest time in which the activity can be completed and cost per day for reducing the time of each activity. The contract includes a penalty clause of ₹ 80 per day over 19 days. The overhead cost is ₹ 150 per day. The cost of completing the eight activities in normal time is ₹ 6,000.

The following table shows for each activity needed to complete the road construction project, the normal time, the shortest time in which the activity can be completed and cost per day for reducing the time of each activity. The contract includes a penalty clause of ₹ 80 per day over 19 days. The overhead cost is ₹ 150 per day. The cost of completing the eight activities in normal time is ₹ 6,000.

Activity	Normal time in days	Shortest time in days	Cost of reduction per day (₹)
1-2	7	5	90
1-3	9	5	100
1-4	7	4	40
2-4	4	4	—
2-5	6	4	50
3-6	13	9	210
4-6	8	5	60
5-6	6	6	—

Required

- Draw the network diagram for the project and identify the critical path and show normal duration and minimum duration of different paths.
- Calculate the total cost associated to normal duration of the project.
- Crash the relevant activities systematically and determine the lowest cost and the associated time. (8 Marks)

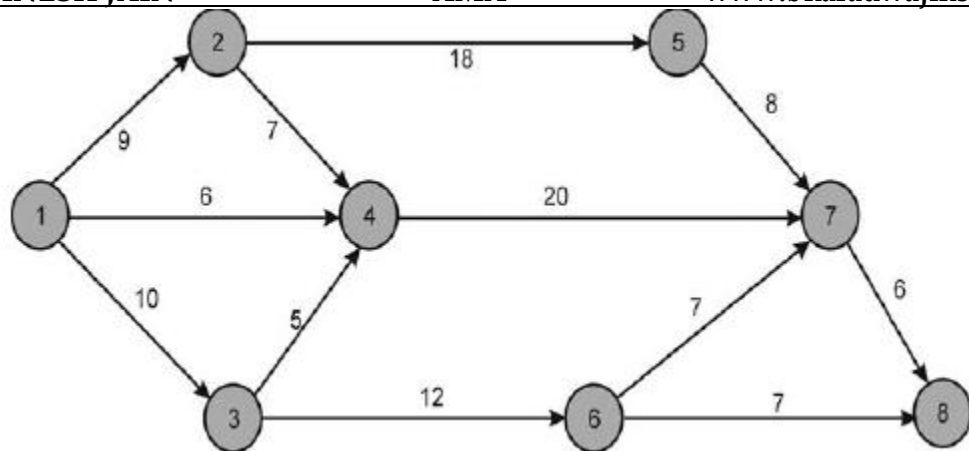
Question No.4 - May 2016

After 15 days of working the following progress is noted for the network of an erection job:

- Activity 1-2, 1-3, and 1-4 completed as per original schedule.
- Activity 2-4 is in progress and will be completed in 3 more days.
- Activity 3-6 is in progress and will need 18 days more for completion.
- Activity 6-7 appears to present some problem and its new estimated time of completion is 12 days.
- Activity 6-8 can be completed in 5 days instead of originally planned for 7 days.

You are required to:

- Updated the above diagram after 15 days of the start of work based on the assumption given above.
- Write down the critical path with total project duration (8 Marks)

**Question No.5 – May 2015**

A project comprised of 10 activities whose normal time and cost are given as follows:

Activity	Normal Time (Days)	Normal Cost (₹)
1 - 2	3	800
2 - 3	3	100
2 - 4	7	900
2 - 5	9	1,400
3 - 5	5	600
4 - 5	0	0
5 - 6	6	590
6 - 7	4	720
6 - 8	13	1,490
7 - 8	10	1,780

Indirect cost ₹ 115 per day.

- Draw the network.
- List all the paths along with their corresponding durations and find the critical path.
- When and at what cost will the project be completed? (8 Marks)

Question No.6 – November 2014

The activities involved in a project are detailed below:

Duration (Weeks)

Job	Optimistic	Most likely	Pessimistic
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 after estimating the earliest and latest event times for all nodes, expected project length, variance of critical path, standard deviation of critical path and
- (iii) What will be the effect on current critical path if the most likely time of activity 3-5 gets revised to 14 instead of 11 weeks given above? (6 Marks)

Question No.7 - May 2014

The following table relates to a network:

Activity	Normal Time (Days)	Crash Time (Days)	Normal Cost (₹)	Crash (₹)
1-2	5	4	30,000	40,000
2-3	6	4	48,000	70,000
2-4	8	7	1,25,000	1,50,000
2-5	9	6	75,000	1,20,000
3-4	5	4	82,000	1,00,000
4-5	7	5	50,000	84,000

The overhead cost per day is ₹ 5,000 and the contract includes a penalty clause of ₹ 15,000 per day if the project is not completed in 20 days.

- (i) Draw the network and calculate the normal duration and its cost.
- (ii) Find out:
- (1) the lowest cost and the associated time.
 - (2) the lowest time and the associated cost.

Question No.8 - November 2013

A project consists of seven activities whose time estimates (optimistic - t_o , pessimistic - t_p and most likely - t_m) in days are given below:

Activity	t_o	t_p	t_m
1-2	1	5	3
1-3	1	7	4
1-4	2	10	6
2-5	2	8	2
3-5	3	15	6
4-6	2	8	5
5-6	2	14	5

Required:

- Draw the network and find out the expected time and variance for each activity. What is the expected duration for completion of the project?
- If the target time is 22 days, what is the probability of not meeting the target?
- Within how many days can the project be expected to be completed with 99 percent chance?

Given $Z_{2.33} = 0.9901$ and $Z_{1.67} = 0.9525$

(8 Marks)

Question No.9 – May 2013

The Noida Nirman Authority intends to install a road traffic regulating signal in a heavy traffic prone area. The total installation work has been broken down into six activities. The normal duration, crash duration and crashing cost of the activities are expected as given in the following table :

Activity	Normal Duration (Days)	Crash Duration (Days)	Crashing Cost per day (₹)
1-2	9	6	30,000
1-3	8	5	40,000
1-4	15	10	45,000
2-4	5	3	15,000
3-4	10	6	20,000
4-5	2	1	60,000

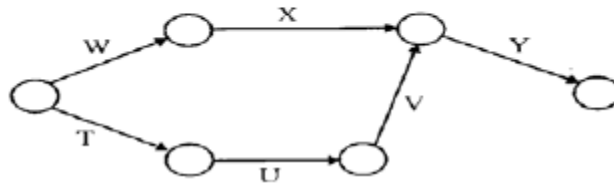
You are required to :

- draw the network and find the normal and minimum duration of the work.
- compute the additional cost involved if the authority wants to complete the work in the shortest duration.

(7 Marks)

Question No.10 – May 2012

The following network and table are presented to you:

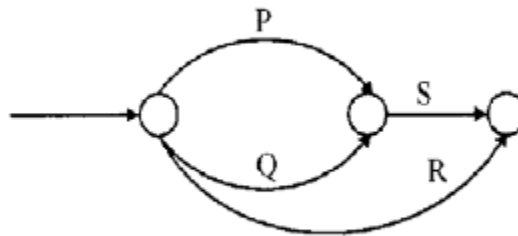


Activity	Normal Duration (Days)	Normal Cost (₹)	Crash Duration (Days)	Crash Cost (₹)
T	8	2,250	6	2,750
U	16	1,875	11	2,750
V	14	2,250	9	3,000
W	12	3,000	9	3,750
X	15	1,000	14	2,500
Y	10	2,500	8	2,860

Perform step by step crashing and reduce the project duration by 11 days while minimizing the crashing cost. What would be the cost of the crashing exercise? (8 Marks)

Question No.11 - May 2012

The following is a part of a network.



What are activities P and Q called? How would you rectify the situation? (4 Marks)

Question NO.12 - November 2014 RTP

The number of days of total float (TF), earliest start times (EST) and duration in days are given for some of the following activities.

Activity	TF	EST	Duration
1-2	0	0	???
1-3	2	???	???
1-4	5	???	???
2-4	0	4	???
2-5	1	???	5
3-6	2	12	???
4-6	0	12	???
5-7	1	???	???
6-7	???	23	???
6-8	2	???	???
7-8	0	23	???
8-9	???	30	6

- Find??? Figures.
- Draw the network.
- List the paths with their corresponding durations and state when the project can be completed.

Question No.13 – November 2014 RTP

State the validity of following statements along with the reasons:

- Two activities have common predecessor and successor activities. So, they can have common initial and final nodes.
- In respect of any activity whether real or dummy, the terminal node should bear a number higher than the initial node number.
- The difference between the latest event time and the earliest event time is termed as free float.
- For every critical activity in a network, the earliest start and the earliest finish time as well as the latest finish time and the latest start time are the same.
- The optimal duration of a project is the minimum time in which it can be completed.
- Resource leveling aims at smoothening of the resource usage rate without changing the project duration.

Question No.14 – May 2014 RTP

A project has the following time schedule:

Activity	Duration (in Weeks)	Activity	Duration (in Weeks)
1 – 2	4	5 – 7	8
1 – 3	1	6 – 8	1
2 – 4	1	7 – 8	2
3 – 4	1	8 – 9	1
3 – 5	6	8 – 10	8
4 – 9	5	9 – 10	7
5 – 6	4		

- (i) Draw the arrow diagram.
- (ii) Identify critical path and find the total project duration.
- (iii) Determine total, free and independent floats.

Question No.15 – May 2014 RTP

A company had planned its operations as follows:

Activity	Duration (Days)	Activity	Duration (Days)
1 – 2	7	4 – 7	19
2 – 4	8	3 – 6	24
1 – 3	8	5 – 7	9
3 – 4	6	6 – 8	7
1 – 4	6	7 – 8	8
2 – 5	16		

- (i) Draw the network and find the critical paths.
- (ii) After 15 days of working, the following progress is noted:
 - (a) Activities 1 – 2, 1 – 3 and 1 – 4 completed as per original schedule.
 - (b) Activity 2 – 4 is in progress and will be completed in 4 more days.
 - (c) Activity 3 – 6 is in progress and will need 17 more days to complete.
 - (d) The staff at activity 3 – 6 are specialised. They are directed to complete 3 – 6 and undertake an activity 6 – 7, which will require 7 days. This rearrangement arose due to a modification in a specialisation.
 - (e) Activity 6 – 8 will be completed in 4 days instead of the originally planned 7 days.
 - (f) There is no change in the other activities.

Update the network diagram after 15 days of start of work based on the assumption given above. Indicate the revised critical paths along with their duration.

Question No.16 – May 2013 RTP

The following is a table showing details of a project.

Activity	Immediate Predecessor	Normal Time in weeks	Normal Cost ('000)	Crash Time in weeks	Crashing Cost ('000)
A	—	20	40	14	60
B	—	16	30	12	40
C	B	10	16	8	28
D	B	12	22	8	30
E	B	16	18	10	30
F	E	10	10	8	16
G	A, D, C	24	6	16	8

Indirect cost is ₹ 800 per day. Required:

- Draw the network and identify the critical path.
- What is the normal project duration?
- What is the associated cost?
- Find out crash cost slope of activities.

Question No.17 – May 2017

The following information on activities, the Earliest Start Time (EST), Latest Start Time (LST), Earliest Finish Time (EFT) in days is given for a certain project:

Activity	EST	LST	EFT	Crashing Cost ₹/ day
A	0	0	5	1,000
B	0	6	6	2,000
C	5	8	9	3,000
D	5	7	8	4,000
E	5	5	6	5,000
F	6	6	10	6,000
G	10	10	24	7,000
H	9	12	21	8,000
I	24	24	26	9,000

Given that: G is immediately preceded by F and D.

B's successor is H and H's successor is I. It is not possible to have a zero duration activity.

Given that: G is immediately preceded by F and D.

B's successor is H and H's successor is I. It is not possible to have a zero duration activity.

- (i) What is the project completion time?
- (ii) Find the LFT (Latest Finish Times) of activities C, D, H and B.
- (iii) Reduce the project duration by three days, by performing step by step crashing to minimize crashing cost assuming that no activity can be crashed by more than one day.
- (iv) After the crashing exercise, if activity H's duration is increased by one day, by how many days can you increase the duration of each of the activities B and C without delaying the project beyond its crashed duration? Explain the underlying concept.

(You are not expected to present the network diagram).

(You may opt the following format for your answer).

Sl. No.			
(i)	Duration	=	
(ii)	LFT:		
	C :		
	D :		
	H :		
	B :		
(iii)	Step	Crash Activity	Days
	I		
	II		
	III		
(iv)	Activity	Increase duration by (days)	
	B		
	C		
Concept			

(10 Marks)

Question No.18 – November 2017

i) A small project consisting of eight activities has the following characteristics:

Activity	Time (Weeks)		
	Optimistic	Pessimistic	Most likely
1-2	4	12	8
1-3	3	5	4
1-4	4	8	6
2-5	4	6	5
3-5	3	3	3
4-6	7	11	9
5-6	6	12	9
5-7	5	9	7
6-7	3	5	4

Required:

- Draw the project network and find out the critical path and expected completion time.
- Calculate the standard deviation and variance of the project.
- What is the probability of the project completion at least 2 weeks earlier than the expected time?
- If the project due date for completion is 27 weeks, what is the probability of not meeting the due date?
- If the project manager wants to be 90% sure of the completion, how many weeks before the due date should he commence the project?

Value of $Z_{1.155} = 0.3759$, $Z_{0.58} = 0.2190$, $NT(Z)_{0.40} = 1.28$

(10 Marks)

Topic 49: Simulation

Question No.1 – November 2016 RTP

JCB Ltd. is considering a new project which will require an initial investment of ₹ 25,000. The company has determined the following probabilities for net cash flows for three years generated by this project:

Annual Net Cash Flows

Year 1		Year 2		Year 3	
CF	Prob.	CF	Prob.	CF	Prob.
7,500	0.20	10,000	0.10	7,500	0.10
10,000	0.50	12,500	0.30	10,000	0.20
12,500	0.30	15,000	0.20	12,500	0.50
		17,500	0.40	15,000	0.20

The firm wants to perform 5 simulation runs of this project's life. The firm's cost of capital is 10%.

To simulate the probability distributions of annual net cash flows, use the following sets of random numbers

4, 4, 2; 9, 6, 3; 5, 7, 8; 0, 1, 6; 3, 1, 5

Required

Using simulation results. Calculate the average NPV.

Note

Assign a value ranging from 0 to 9 (in digits) to each year's cash flow in such a way that the number of digits assigned is proportionate to the probability of cash flow.

Question No.2 – May 2016 RTP, Nov 2017 RTP

Finance Controller of Dunk Limited has drawn the following projections with probability distribution:

Raw Material		Wages & Other Variable Overheads		Sales	
₹ in 000	Probability	₹ in 000	Probability	₹ in 000	Probability
08 – 10	0.2	11 – 13	0.3	34 – 38	0.1
10 – 12	0.3	13 – 15	0.5	38 – 42	0.3
12 – 14	0.3	15 – 17	0.2	42 – 46	0.4
14 – 16	0.2			46 – 50	0.2

Opening cash balance is ₹ 40,000 and fixed cost is estimated at ₹ 15,000 per month.

Required

Simulate cash flow projection and expected cash balance at the end of the sixth month. Use the following single digit random numbers.

Raw Material	4 3 1 0 4 6
Wages & Other Variable Overheads	2 7 9 1 8 9
Sales	0 6 6 0 2 8

Question No.3 - November 2016

A book-store wishes to carry systems analysis and design in stock. Demand is probabilistic and replenishment of stock takes 2 days (i.e, if an order is placed on March 1, it will be delivered at the end of the day on March 3).

The probabilities of demand are given below:

Demand of books (Daily)	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of ₹ 100 per order. The store also incurs a carrying cost of ₹ 5 per book per day. The inventory carrying cost is calculated on the basis of stock at the end of each day. The manager of the book-store wishes to compare two options for his inventory decision:

- Order 5 books, when the inventory at the beginning of the day plus orders outstanding is less than 8 books
- Order 8 books, when the inventory at the beginning of the day plus orders outstanding is less than 8 books.

Currently (beginning of the first day) the store has stock of 8 books plus 6 books ordered 2 days ago are expected to arrive next day. Further it can be assumed that the demand occurring during the day can be met out of stock received at the end of the day.

Required

Using Monte-Carlo simulation for 10 days, recommend which option the manager should choose?

The two digit random numbers are given below:

89, 34, 78, 63, 61, 81, 39, 16, 13, 73

(8 Marks)

Question No.4 - November 2015

The following information is given for a certain project:

Activity	Normal Duration (Days)	Crash Duration (Days)	Difference (Days)	Normal Cost (₹)	Crash Cost (₹)	Difference (₹)	Activity Slope (₹/day)
	I	II	III = I - II	IV	V	VI = V - IV	VII = VI/ III
1-2	9	6	3	640	700	60	20

1-3	8	5	3	500	575	75	25
1-4	15	10	5	400	550	150	30
2-4	5	3	2	100	120	20	10
3-4	10	6	4	200	260	60	15
4-5	2	1	1	100	140	40	40

- (i) What is the normal project duration?
- (ii) Perform step-by step crashing to reduce the project duration by 5 days. What is the cost incurred for the optional crashing exercise?
- (iii) Independent of (ii) above, if the Project Manager is able to save as per rates in Column VII of the above table for every day relaxed for the activities, compute the number of days and associated savings for 5 days of relaxation, in the order of optimality, without extending the project duration as per (i). The Project Manager is interested in this exercise to schedule resources. (8 Marks)

Question No.5 – November 2015

A dietician wants to simulate arrivals of her patients and her consultation time with the following random numbers. Her assistant has already prepared the random number allocation tables.

The dietician wants to have an idea of her idle time and patients' waiting time. She starts her consultation at 10:00 a.m. and wants to give an appointment an interval of 20 minutes. The Random Number table is as follows:

Arrival of patient	15	4	35	67	75	86	25
Consultation time	17	15	12	58	60	72	30

Random Number Allocation Table: 1

Patient Punctuality	Probability	Cumulative Probability	Random No.
Minutes early 3	0.05	0.05	00 – 04
2	0.18	0.23	05 – 22
1	0.40	0.63	23 – 62
On time	0.25	0.88	63 – 87
Minutes late 2	0.08	0.96	88 – 95
4	0.04	1.00	96 – 99

Random Number Allocation Table: 2

Consultation Time	Probability	Cumulative Probability	Random No.
15	0.13	0.13	00 – 12
18	0.15	0.28	13 – 27

20	0.28	0.56	28 – 55
25	0.34	0.90	56 – 89
30	0.10	1.00	90 – 99

- (i) Simulate the arrival and consultation times and find out the dietician's idle times and patients' waiting times.
- (ii) If clients are sensitive to waiting, how would you advise the dietician as a Management Accountant, based on the results of your exercise? (8 Marks)

Question No.6 – May 2015

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 carryover 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:

9, 98, 64, 98, 94, 01, 78, 10, 15, 19

- (i) Estimate the profit/loss for the next ten days using the above random numbers and assuming 100 cakes are produced per day.
- (ii) If the bakery decides to produce 97 cakes per day, will the profits as per (i) above increase or decrease? Why? (8 Marks)

Question No.7 – November 2014, May 2015 RTP

A cake vendor buys pieces of cake every morning at ₹4.50 each by placing his order one day in advance and sale them at ₹7.00 each. Unsold cake can be sold next day at ₹ 2.00 per piece and there after it should be treated as no value. The pattern for demand of cake is given below:

Fresh Cake:

Daily Sale	100	101	102	103	104	105	106	107	108	109	110
Probability	.01	.03	.04	.07	.09	.11	.15	.21	.18	.09	.02

One day old cake:

Daily Sale	0	1	2	3
Probability	.70	.20	.08	.02

Use the following set of random numbers:

Fresh Cake	37	73	14	17	24	35	29	37	33	68
One day old cake	17	28	69	38	50	57	82	44	89	60

The vendor adopts the following rule.

If there is no stock of cake with him at the end of previous day, he orders for 110 pieces otherwise he orders 100 or 105 pieces whichever is nearest actual fresh cake sale on the previous day. Starting with zero stock and a pending order of 105 pieces, simulate for 10 days and calculate vendor's profit. (7 Marks)

Question No.8 – May 2014

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 a period of 100 days.

No. of computers	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 10 days and find out the average number of laptops held for more than one day for service. Assume FIFO method is followed for service/repair and there is one laptop held from previous day for repair at the beginning of the first day.

Use the following series of random numbers:

Arrivals	69	45	46	10	82	16	35	70	57	92
Service	52	36	62	49	68	77	55	66	51	88

(6 Marks)

Question No.9 – November 2013

A bakery sells a popular brand of bread. Cost price per bread is ₹ 16 and selling price per bread is ₹ 20. Shelf life of the bread is 2 days and if it is not sold within two days, then it has no sale value at the end of second day. Daily demand based on past experience is as under:

Daily Demand	0	20	25	35	40	45
Probability	.01	.15	.30	.40	.10	.04

Consider the following sequence of random numbers:

58, 80, 51, 09, 47, 26, 64, 43, 86, 35

Using the sequence, simulate the demand for the next 10 days and find out the total profit or loss for 10 days assuming 35 breads are purchased every day in the morning and there is an opening stock of 5 breads (purchased the previous day) on the 1st day morning. Assume LIFO basis (Last In First Out basis - where the fresh bread is sold first).

(8 Marks)

Question No.10 – November 2012

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:

- Describe how you would simulate the operation of the travel agency based on the use of random number tables;
- 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); and
- Calculate the weekly cost of vouchers; assuming the proportion of clients receiving vouchers derived from (ii) applies throughout a week of 75 operating hours.

Random Numbers

Line 1	03	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

Question No.11 – May 2012

A refreshment centre in a railway station has two counters - (i) self-service (opted by 60 % of the customers) and (ii) attended service (opted by 40 % of the customers). Both counters can serve one person at a time. The arrival rate of customers is given by the following probability distribution:

No. of arrivals	1	3	4	0	2
Probability	0.10	0.30	0.05	0.20	0.35

Formulate the associated interval of 2 digit random numbers for generating

- the type of service and
- the arrival rate

(4 Marks)

Question No.12 – November 2015 RTP

The following table gives the activities in a construction project and the time durations with associated probability of each activity:

Activity	Predecessors	Time (in Days)	Probability
A	---	6	0.50
		8	0.50
B	---	4	0.30
		5	0.20
		6	0.50
C	A	8	0.50
		16	0.50
D	A, B	8	0.30
		10	0.70
E	C, D	2	0.20
		4	0.80

To simulate the project, use the following random numbers taking the first five random numbers digits (representing the five activities) for each trial and so on:

11, 16, 23, 72, 94; 83, 83, 02, 97, 99; 83, 10, 93, 4, 33; 53, 49, 94, 37, 7

Required:

Determine the 'Critical Path' and the 'Project Duration' for each trial.

Question No.13 – November 2014 RTP

An Investment Corporation wants to study the investment projects based on four factors: market demand in units, contribution per unit, advertising cost and the investment required. These factors are felt to be independent of each other. In analyzing a new consumer product, the corporation estimates the following probability distributions:

Demand (units)		Contribution per unit		Advertising Cost	
No.	Probability	₹	Probability	₹	Probability
10,000	0.20	25	0.25	50,000	0.22
20,000	0.25	35	0.30	60,000	0.33
30,000	0.30	45	0.35	70,000	0.44
40,000	0.25	55	0.10	80,000	0.01

The data for proposed investments are as follows:

Investment (₹)	50,00,000	55,00,000	60,00,000	65,00,000
Probability	0.10	0.30	0.45	0.15

Using simulation process, repeat the trials 5 times, compute the Return on Investment (ROI) for each trial and find the highest likely return.

Using the sequence (First 4 random numbers for the first trial, etc)

09 24 85 07 84 38 16 48 41 73 54 57 92 07 99
64 65 04 78 72

Question No.14 – May 2014 RTP

ABC Co-operative Bank receives and disburses different amount of cash in each month. The bank has an opening cash Balance of ₹15 crores in the first month. Pattern of receipts and disbursements from past data is as follows:

Monthly Cash Receipts		Monthly Cash Disbursements	
(₹ in Crores)	Probability	(₹ in Crores)	Probability
30	0.20	33	0.15
42	0.40	60	0.20
36	0.25	39	0.40
99	0.15	57	0.25

Simulate the cash position over a period of 12 months.

Required:

- Calculate probability that the ABC Cooperative Bank will fall short in payments.
- Calculate average monthly shortfall.

- (iii) If ABC bank can get an overdraft facility of ₹ 45 crores from other Nationalized banks. What is the probability that they will fall short in monthly payments?

Use the following sequence (row-wise) of paired random numbers.

1778 4316 7435 3123 7244 4692 5158 6808 9358 5478 9654 0977

Question No.15 – May 2013 RTP

'Super Egg Products' a retail shop deals in a perishable commodity. The daily demand and supply are variables. The data for the past 50 weeks show the following demand and supply:

Supply		Demand	
Availability (Kg)	No. of days	Demand (Kg)	No. of days
5	20	5	25
10	25	10	55
15	95	15	100
20	75	20	50
25	35	25	20

The retail shop buys the commodity at ₹20 per kg and sells it at ₹30 per kg. Any commodity remains at the end of the day, has no saleable value. Moreover, the loss (unearned profit) on any unsatisfied demand is ₹8 per kg. 'Supper Egg Products' retail shop opens five days in a week.

Given the following pair of random numbers, simulate 5 days sales, demand and profit.

(20, 32); (85, 65); (35, 17); (33, 07) (80, 45)

The first random number in the pair is for demand and the second random number is for supply.

Question No.16 – November 2017

MN Ltd. is a confectionery company and it sells confectionery items. Past data of demand per day with frequency is given below:

Demand (in kgs)	0	5	10	15	20	25
No. of days	4	22	16	42	10	6

The company has scope to meet 12 kg demand per day. The life of the product is one day. It will be produced according to demand. It cannot hold as inventory. The contribution is ₹10 per kg.

Using the following random numbers, simulate 10 days demand for the confectionery items.

35, 52, 90, 13, 23, 73, 34, 57, 35, 83

Required:

- (i) Allocate random numbers and simulate for 10 days.
- (ii) Calculate average demand of confectionery items per day fulfilled.
- (iii) Calculate amount of loss (Due to not fulfilling the demand). **(6 Marks)**

Topic 50: Learning Curve Theory

Question No.1 – May 2017 RTP

The Crocodile Ltd. makes mementos for offering chief guests and other dignitaries at functions. A customer wants 4 identical pieces of hand-crafted gifts for 4 dignitaries invited to its function.

For this product, Company estimates the following costs for the 1st unit of the product.

Particulars of Costs	₹ / unit
Direct Variable Costs (excluding labour)	1,000
Direct Labour (20 hours @ ₹ 25 hour)	500

90 % learning curve ratio is applicable and one labourer works for one customer's order.

Required

- What is the price per piece to be quoted for this customer if the targeted contribution is ₹ 750 per unit?
- If 4 different labourers made the 4 products simultaneously to ensure faster delivery to the customer, can the price at (i) above be quoted? Why?

Question No.2 – May 2016 RTP

Marketing manager of AV Ltd. has conducted a market research on the price-demand relationship for its consumer durable product 'K-2'. K-2 is a recently launched product. The price-demand pattern will be as follows:

Price per unit (₹)	Demand (units)
11,100	1,000
10,700	2,000
9,600	3,000
8,700	4,000

K-2 is produced in batches of 1,000 units. Production manager of AV Ltd. has also researched and studied the production pattern and has believe that 50% of the variable manufacturing cost would have learning and experience curve effect. This learning & experience curve effect will be continued upto 4,000 units of production at a constant rate. But after 4,000 units of production, unit variable manufacturing cost would be equal to the unit cost at the 4th batch. The manufacturing unit cost of the first batch will be ₹ 4,400 of which only 50% is subjected to learning and experience curve effect. The average unit variable cost of all 4 batches will be ₹4,120.

Required

- Calculate the rate of learning that has been expected by the Production manager.
- Calculate the price at which AV Ltd. should sell the K-2 in order to maximise its contribution.

$$\log 0.93 = -0.0315, \log 2 = 0.3010, 2^{-0.1047} = 0.9299, 3^{-0.1047} = 0.8913, 4^{-0.1047} = 0.8649$$

Question No.3 – November 2016

A company which has developed a new machine has observed that the time taken to manufacture the first machine is 600 hours.

Required

Calculate the time which the company will take to manufacture the second machine if the actual learning curve rate is (i) 80% and (ii) 90%.

Explain which of the two learning rates will show faster learning. (5 Marks)

Question No.4 – May 2016

MP Ltd. has developed a special product. Details are as follows:

The product will have a life cycle of 5,000 units. It is estimated that market can absorb first 4,500 units at ₹ 64 per unit and then the product will enter the "decline" stage of its life cycle.

The company estimates the following cost structure:

Direct Labour..... ₹ 6 per hour

Other variable costs..... ₹ 19 per unit

Fixed costs will be ₹ 40,000 over the life cycle of the product. The labour rate and both of these costs will not change throughout the product's life cycle.

The first batch of 100 units will take 1,000 labour hours to produce. There will be an 80% learning curve that will continue until 2,500 units have been produced. Batches after this level will each take the same amount of time as the 25th batch. The batch size will always be 100 units.

Calculate:

- (i) The cumulative average time per batch for the first 25 batches.
- (ii) The time taken for the 25th batch if average time for 24 batches is 359.40 hours.
- (iii) The average selling price of the final 500 units that will allow the company to earn a total profit of ₹ 80,000 from the product.

(Note: Learning coefficient is -0.322 for learning rate of 80%).

The values of Logs have been given for calculation purpose:

$\log 2 = 0.30103$, $\log 3 = 0.47712$, $\log 5 = 0.69897$, antilog of 2.534678 = 342.51, antilog of 2.549863 = 354.70, antilog of 2.555572 = 359.40, antilog of 2.567698 = 369.57 (8 Marks)

Question No.5 – May 2015

State whether and why the following are valid or not for learning curve theory:

- (i) Learning curve theory applies to a division of a company which is fully automated.
- (ii) Learning curve theory helps in setting standards.
- (iii) Learning curve helps in pricing decisions.
- (iv) Experienced workmen are more prone to learning effect. (4 Marks)

Question No.6 – November 2014

A labour intensive product is made and sold by XY Ltd. Its labour force has a learning rate of 80%, applicable only to direct labour and not to variable overheads.

The cost per unit of the first product is as follows:

	₹
Direct Materials	20,000
Direct Labour (@ ₹8 per unit)	16,000
Variable Overheads	4,000
Total Variable Cost	40,000

XY Ltd. has received an order from P Ltd. for 4 units of the product. Another customer, Q Ltd. is also interested in purchasing 4 units of the product. XY Ltd. has the capacity to fulfill both the orders. Q Ltd. presently purchases this product in the market for ₹34,400 and is willing to pay this price per unit of XY Ltd. product. But P Ltd. lets XY Ltd. choose one of the following options:

- (i) A price of ₹33,000 per unit for the 4 units it proposes to take from XY Ltd.

OR

- (ii) Supply P Ltd.'s idle labour force to XY Ltd. for only 4 units of production, with XY Ltd. having to pay only ₹2 per labour hour to P Ltd.'s workers. P Ltd.'s workers will be withdrawn after the first 4 units are produced. In this case, XY Ltd. need not use its labour for producing P Ltd.'s requirements. P Ltd. assures XY Ltd. that its labour force also has a learning rate of 80%. In this option, P Ltd. offers to buy the product from XY Ltd. at only 28,000 per unit.

P Ltd. and Q Ltd. shall not know of each other's offer.

If both orders came before any work started, what is the best option that XY Ltd. may choose? Present suitable calculations in favour of your arguments. (9 Marks)

Question No.7 –November 2013

State whether the learning curve theory can be applied to the following independent situations briefly justifying your decision:

- (i) A labour intensive sculpted product is carved from the metal provided to the staff. The metal is sourced from different suppliers since it is scarce. The alloy composition of the input metal is quite different among the suppliers.
- (ii) Pieces of hand-made furniture are assembled by the company in a far off location. The labourers do not know anything about the final product which utilizes their work. As a matter of further precaution, rotation of labour is done frequently.
- (iii) Skilled workers have been employed for a long time. The company has adequate market for the craft pieces done by these experts.
- (iv) A company finds that it always has an adverse usage of indirect material. It wants to apply learning curve theory to improve the way standards have been set. (4 Marks)

Question No.8 – November 2015 RTP

AUD International Co. is a multiproduct firm. It is planning to launch a new product 'X-500' in coming months. Production will be in batches of 1,000 units throughout the life of the product. It is also possible to achieve 90% learning rate but the learning would cease after 64th batch. Other relevant data of product 'X-500' is as follows:

Expected Life	2,56,000 units
Selling Price per unit	₹123
Direct Material per unit	₹36
Direct Labour Cost first batch	₹52,500
Other Variable Costs	₹24
Specific Fixed Cost	₹38,75,000

Required:

- (i) Calculate the 'Expected Profit' to be earned from the product over its lifetime.
Note: The learning index for a 90% learning curve is -0.152 ; $(64)^{-0.152} = 0.5314$; $(63)^{-0.152} = 0.5327$
- (ii) It is now thought that a learning effect will continue for all of the 256 batches that will be produced. Calculate the 'Rate of Learning' required to achieve a lifetime product profit of ₹1,00,00,000, assuming that a constant rate of learning applies throughout the product's life.

Question No.9 – May 2015 RTP, Nov 2017 RTP

B-Parts Inc., USA based firm, has just invented a new part 'B-20'. New part has a budgeted total profit of ₹75,000 from the first 256 parts. The time taken to produce the first part was 112.50 hours. The labour rate is ₹20 per hour. A 90% learning curve is expected to apply indefinitely.

Required:

CALCULATE the SENSITIVITY of the budgeted total profit from the first 256 parts to changes in the learning rate.

Question No.10 – November 2014 RTP

City International Co. is a multiproduct firm and operates standard costing and budgetary control system. During the month of June firm launched a new product. An extract from performance report prepared by Sr. Accountant is as follows:

Particulars	Budget	Actual
Output	30 units	25 units
Direct Labour Hours	180.74 hrs.	118.08 hrs.
Direct Labour Cost	₹1,19,288	₹ 79,704

Sr. Accountant prepared performance report for new product on certain assumptions but later on he realized that this new product has similarities with other existing product of the company. Accordingly, the rate of learning should be 80% and that the learning would cease after 15 units. Other budget assumptions for the new product remain valid.

The original budget figures are based on the assumption that the labour has learning rate of 90% and learning will cease after 20 units, and thereafter the time per unit will be the same as the time of the final unit during the learning period, i.e. the 20th unit. The time taken for 1st unit is 10 hours.

Show the variances that reconcile the actual labour figures with revised budgeted figures in as much detail as possible.

Note:

The learning index values for a 90% and a 80% learning curve are -0.152 and -0.322 respectively.

[log 2 = 0.3010, log 3 = 0.47712, log 5 = 0.69897, log 7 = 0.8451, antilog of 0.6213 = 4.181, antilog of 0.63096 = 4.275]

Question No.11 – November 2013 RTP

Great Eastern Appliances Ltd. (GEAL) manufactures consumer durable products in a very highly competitive market. GEAL is considering launching a new product 'Kitchen Care' into the market and gathered the following data:

Expected Market Price- ₹5,000 per unit

Direct Material Cost- ₹1,850 per unit

Direct Labour Cost- ₹80 per hour

Variable Overhead Cost- ₹1,000 per unit

Packing Machine Cost (specially to be purchased for this product)- ₹5,00,000

GEAL expects the selling price for the new product will continue throughout the product's life and a total of 1,000 units can be sold over the entire lifetime of the product.

Direct labour costs are expected to reduce as the volume of output increases due to the effects of 80% learning curve (index is -0.3219). The expected time to be taken for the first unit is 30 hours and the learning effect is expected to end after 250 units have been produced. Units produced after first 250 units will take the same time as the 250th unit.

You are required to-

- (i) Calculate the expected total labour hours over the life time of the product 'Kitchen Care'.
- (ii) Profitability of product 'Kitchen Care' that GEAL will earn over the life time of the product.
- (iii) Average target labour cost per unit over the life time of the product if GEAL requires average profit of ₹ 800 per unit, to achieve its long term objectives.

Note: $250^{-0.3219} = 0.1691$, $249^{-0.3219} = 0.1693$

Question No.12 – November 2013 RTP

Genting Mfg Co. has developed a product for which the following standard cost estimates have been made for the first batch to be manufactured in Jan'13:

	₹
Direct Materials	5,500
(100 Kgs. @ ₹ 55 per Kg.)	
Direct Labour	4,000
(100 hours @ ₹ 40 per hour)	
Variable Overhead	
(100 hours @ ₹ 75 per hour)	<u>7,500</u>
	<u>17,000</u>

From experience the firm knows that labour will benefit from a learning effect and labour time will be reduced. This is expected to approximate to an 80% learning curve. In addition, the growing expertise of labour is expected to improve the efficiency with which materials are used. The usage of materials is expected to approximate to a 95% learning curve.

The actual production for Jan'13 to Jun'13 was 320 batches. During Jun'13 following results were recorded for the 320th batch made:

Direct Materials (80 Kgs.)	₹ 4,000
Direct Wages (20 hours)	₹ 1,000
Variable Overhead	₹ 1,800

You are required to calculate variances in connection with 320th batch.

[Note: Learning Coefficient is -0.322 and -0.074 for learning rate of 80% and 95% respectively, $\log 2 = 0.30103$, $\log 5 = 0.69897$, $\log 319 = 2.50379$, Antilog of 1.81462 = 65.26, Antilog of 1.81472 = 65.27, Antilog of 1.19334 = 15.61, Antilog of 1.19378 = 15.62]

Question No.13 – May 2013 RTP

The chief officer at manufacturing plant of '789 Dreamliner' aircraft observed that workers performing manufacturing operations at the plant showed signs of a definite learning pattern. He noted that most aircraft manufacturing tasks experienced what he called an 80 percent learning rate, meaning that workers need 20 percent fewer hours to make a part each time their cumulative experience making that part doubled. Thus, if the first part took 100 minutes, the second would require 80 minutes, the fourth would require 64 minutes, and so on. Accordingly he requires calculating the time required for parts 41 to 60. [Note: learning coefficient is -0.322 for learning rate of 80%, $\log 2 = 0.30103$, $\log 3 = 0.47712$, $\log 5 = 0.69897$, Antilog of 1.484 = 30.48, Antilog of 1.4274 = 26.75]

Question No.14 – May 2017

PAL Limited is considering manufacture and launch of 1,000 units of a special product 'L X 4' into the market.

The Direct labour Rate budgeted is ₹96 per hour.

Direct labour costs are expected to reduce as the volume of output increase due to the effects of 80% learning curve (index is -0.3219). The expected time to be taken for the first unit is 40 hours and the learning effect is expected to end after 250 units have been produced. The units produced after the first 250 units will take the same time as the 250th unit.

- (i) Calculate the standard labour hours expected over the 1,000 units.
- (ii) If the actual hours were 6,000, compute the labour efficiency variance over the 1,000 units.
- (iii) Without the learning curve application, how would you have reported the efficiency variance, taking the standard time per unit as the expected time for the first unit?

[Note: $250^{-0.3219} = 0.1691$; $249^{-0.3219} = 0.1693$]

(6 Marks)

Question No.15 – November 2017

RST Co. manufactures products purely carried out by labour. It has 25 direct workers who work for 25 days a month of 8 hours a day. However, the company may resort to overtime if required, at one and half the normal rate of wages. The company has received an order of 8,000 units of a new product at a price of ₹ 160 to be executed within 30 days. The contract stipulates a penalty of ₹ 10,000 per day for delivery beyond 30 days. It is estimated that at the current level of efficiency each unit requires one hour for the first 2,000 units. Company expects 90% learning curve for this type of work. The cost data is as under:

Direct materials	₹ 75 per unit
Direct labour (1 hour/unit)	₹ 30 per unit
Variable overhead	₹ 12 per direct labour hour
Fixed overhead	₹ 1,20,000 per month (Fixed overheads are to be incurred evenly throughout the month)

Calculate:

- (i) Overtime hours if the option of overtime is exercised to avoid the penalty.
- (ii) The cost and profit under both the options i.e. to pay the penalty by working in normal hours or to work overtime to avoid penalty.

(5 Marks)