Paper- 15: MANAGEMENT ACCOUNTING – ENTERPRISE PERFORMANCE MANAGEMENT

Time Allowed: 3 Hours **Full Marks: 100**

The figures in the margin on the right side indicate full marks.
Attempt Question No. 1 (carrying 25 marks), which is compulsory and any five more questions (each carrying 15 marks) from the rest.

Please: (i) Answer all part of a question at one place only.
(ii) Open a new page for answer to a new question.
Working Notes should form part of the answer.
Whenever necessary, suitable assumptions should be made and indicated in answer by the candidates.

1. (a) In each of the cases given below, only one is the most appropriate option. Indicate the correct answer (=1 mark) and show your workings/reasons briefly in support of your answer (=1 mark): [2×5=10]

(i) A company proposes to undertake a capital project. The life of the project is 4 years and the annual cash inflows are estimated at ₹40,000. The internal rate of return of the project is 15% and the cumulative present value factor for 15% for 4 years is 2.855. The profitability index is 1.064.
The net present value of the project is
(A) ₹ 6,870
(B) ₹ 10,000
(C) ₹ 12,670
(D) ₹ 14,200

(ii) A company is preparing a quotation for a new product. The time taken for the first unit is 30 hours. The company expects 85% learning curve (index is −0.2345). The company desires that the quotation should be based on the time taken for the final output within the learning period which is expected to end after the company has produced 200 units.
The time per unit of product to be used for the quotation is:

(A) 13.34 hours
(B) 25.50 hours
(C) 30.00 hours
(D) 6.67 hours

(iii) The current price of a product is ₹8,000 per unit and it has been estimated that for every ₹200 per unit reduction in price, the current level of sale, which is 10 units, can be increased by 1 unit. The existing capacity of the company allows a production of 15 units of the product. The variable cost is ₹4,000 per unit for the first 10 units; thereafter each unit will cost ₹400 more than the preceding one. The most profitable level of output for the company for the product will be
(A) 11 units
(B) 12 units
(C) 13 units
(D) 14 units

(iv) Nova Manufacturing Company manufactures two products using common material handling facility. The total budgeted material handling cost is ₹ 60,000. The other details are:

	Product X	Product Y
Number of units produced	30	30
Material moves per product line	5	15
Direct labour hour per unit	20	20

Under Activity Based Costing system the material handling cost to be allocated to product X (per unit) would be:

(A) ₹1,000
(B) ₹500
(C) ₹1,500
(D) ₹2,500

(v) A company makes and sells a single product. The selling price and marginal revenue equations are: Selling price = ₹ 50 – ₹ 0.001X

Marginal revenue = ₹50 –₹0.002 X

Where X is the no. of product the company makes. The variable costs amount to ₹ 20 per unit and the fixed costs are ₹1,00,000.

In order to maximize the profit, the selling price should be

(A) ₹ 32
(B) ₹ 25
(C) ₹ 35
(D) ₹ 40

(b) Expand the following abbreviation: **[1×5]**

(i) AQL
(ii) PIS
(iii) CIM
(iv) OPT
(v) TOC

(c) Define the following terms: **[1×5]**

(i) Succession Planning
(ii) Linear Programming
(iii) Master Production Schedule (MPS)
(iv) Bill-of-Materials (BOM)
(v) Functional Structure

(d) State whether the following statements given below are 'True' or 'False'. If True, simply rewrite the given statement (1 mark). If False, state it as False (½ mark) and rewrite the correct statement (½ mark): **[1x5]**

(i) Data Mining is the process of analyzing empirical data. It also enables the extrapolation of information. Such extrapolated results are then used in forecasting and defining trends.

(ii) Bench marking is a process of continuously comparing an organization's business process against the business leader anywhere in the world to gain information that will help the organization to take action to improve performance.

(iii) A Chase Strategy implies matching demand and capacity period by period. This could result in a considerable amount of hiring, firing or laying off of employees; insecure and unhappy employees; increased inventory carrying cost; problems with labour unions and erratic utilization of plant and equipment.

(iv) Rope is the constraint and therefore sets the pace for the entire system. In simpler terms, the rope is the rate or pace of production set by the system's constraints.

(v) In VAT Analysis, a T-logical structure (many-to-many flow) starts with one or a few raw materials, and the product expands into a number of different products as it flows through its routings.

Answer to 1 (a):

(i) 'A' is the correct answer.

Present values of Cash Inflows = 40,000 x 2.855 = 1,14,200

$$\text{Profitability Index} = \frac{\text{P.V. of Cash inflow}}{\text{P.V. of Cash outflow}}$$

$$\text{or, } 1.064 = \frac{1{,}14{,}200}{\text{P.V. of Cash Outflow}}$$

$$\text{or, P.v. of Cash Outflow} = \frac{1{,}14{,}200}{1.064}$$

Or, P.V,. of Cash outflow = 1,07,330

Therefore N.P.V = 1,14,200 – 1,07,330 = ₹ 6,870

(ii) 'D' is the correct answer.

Average time per 200 units

$Y = 30 \times 200^{-0.2345}$

Taking logarithm of both sides:-

log Y = log 30 – 0.2345 log 200

or, log Y = 1.4771 – 0.2345 x 2.3010

or , log Y = 1.4771 – 0.5396

or, log Y = 0.9375

Taking antilog of both sides

Antilog (log Y) = Antilog (0.9375)

Y = 8.66 hours

Average time per 199 units

$Y = 30 \times 199^{-0.2345}$

Taking logarithm of both sides:-

log Y = log 30 – 0.2345 log 199

or, log Y = 1.4771 – 0.2345 x 2.2989

or , log Y = 1.4771 – 0.5391

or, log Y = 0.938

Taking antilog of both sides
Antilog (log Y) = Antilog (0.938)
Y = 8.67 hours

Total hours for 200 units = 8.66 x 200 = 1732.00
Total hours for 199 units = 8.67 x 199 = 1725.33
6.67 hours

(iii) 'C' is the correct answer.

Selling Price = ₹ (50-0.001 x)
Marginal revenue = ₹ (50-0.002x)
Variable cost per unit= Marginal cost per unit = ₹20
Optimal output for maximum profit: 20 = 50 - 0.002x
When, X = 30/0.002= 15,000 units
SP = 50 - 0.001x = 50 - 0.001 (15,000)= 50-15 = ₹35

(iv) 'B' is the correct answer.

Total moves in material handling = 5+15=20
Percentage move for Product X = 5/20=25%

Material handling cost to be allocated to Product X
= ₹60,000/25% = ₹15,000 i.e., ₹15,000/30 = ₹500 per unit.

(v) 'B' is the correct answer.

Units	Total Variable Cost	Selling Price Per unit	Total Revenue	Total Contribution
	₹	₹	₹	₹
10	40,000	8,000	80,000	40,000
11	40000+4400=44,400	7,800	85,800	41,400
12	44000+4800=49,200	7,600	91,200	42,000
13	49200+5200=54,400	7,400	96,200	41,800
14	54400+5600=60,000	7,200	1,00,800	40,800

Answer to 1 (b):

(i) AQL : Acceptable Quality Level

(ii) PIS : Productivity Improvement System

(iii) CIM : Computer Integrated Manufacturing

(iv) OPT : Optimized Production Technology

(v) TOC : Theory of Constraints

Answer to 1 (c):

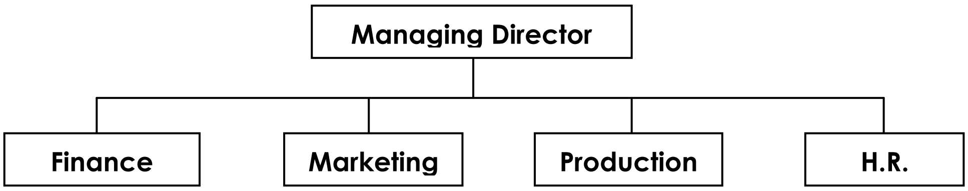
(i) Succession Planning is the systematic process of defining future management requirements and identifying candidates who best meet those requirements. It involves using the supply of labour within the organization for future staffing needs.

(ii) Linear Programming is an optimization technique that allows the user to find a maximum profit/revenue or a minimum cost, based on the availability of limited resources and certain constraints.

(iii) Master Production Schedule (MPS) is basically a production schedule for finished goods. It is derived from current orders plus any forecast requirements. MPS is divided into units of time called "brackets". The MPS is also said to be the aggregated plan "disaggregated".

(iv) Bill of Materials (BOM) is a hierarchical listing of the type and number of parts needed to produce one unit of finished product.

(v) In Functional Structure, each manager is responsible for a specified function as Finance or Marketing.



It is based on the principle of division of labour and achieving excellence in each function.

Answer to 1 (d):

(i) True, Data Mining is the process of analysing empirical data. It also enables the extrapolation of information. Such extrapolated results are then used in forecasting and defining trends.

(ii) True, Bench marking is a process of continuously comparing an organisation's business process against the business leader anywhere in the world to gain information that will help the organisation to take action to improve performance.

(iii) True, A Chase Strategy implies matching demand and capacity period by period. This could result in a considerable amount of hiring, firing or laying off of employees; insecure and unhappy employees; increased inventory carrying cost; problems with labour unions and erratic utilisation of plant and equipment.

(iv) False, Drum is the constraint and therefore sets the pace for the entire system. In simpler terms, the drum is the rate or pace of production set by the system's constraints.

(v) False, In VAT Analysis, a T-logical structure (on-to-many flow) consists of numerous similar finished products assembled from common assemblies and subassemblies.

Q2. (a) After observing heavy congestion of customers over a period of time in a petrol station, Mr. Khan has decided to set up a petrol pump facility on his own in a nearby site. He has compiled statistics relating to the potential customers arrival pattern and service pattern as given below. He has also decided to evaluate the operations by using the simulation technique.

Arrivals		Services	
Inter-arrival time (minutes)	Probability	Inter-arrival time (minutes)	Probability
2	0.22	4	0.28
4	0.30	6	0.40
6	0.24	8	0.22
8	0.14	10	0.10
10	0.10		

Assume:

(1) The clock starts at 8.00 hours
(2) Only one pump is set up
(3) The following 12 Random Numbers are to be used to depict the customer arrival pattern.
78, 26, 94, 08, 46, 63, 18, 35, 59, 12, 97 and 82.
(4) The following 12 Random Numbers are to be used to depict the customer service pattern.
44, 21, 73, 96, 63, 35, 57, 31, 84, 24, 05 and 37.

Your are required to find out the
(i) Probability of the pump being idle and
(ii) Average time spent by a customer waiting in queue [10+2]

(b) What is the 5-S Concept? [3]

Answer to 2 (a):

Random no. Table:

Inter-arrival time				Service time			
Minutes	**Probability**	**Cumulative Probability**	**Range**	**Minutes**	**Probability**	**Cumulative Probability**	**Range**
2	0.22	0.22	00-21				
4	0.30	0.52	22-51	4	0.28	0.28	00-27
6	0.24	0.76	52-75	6	0.40	0.68	28-67
8	0.14	0.90	76-89	8	0.22	0.90	68-89
10	0.10	1.00	90-99	10	0.10	1.00	90-99

Sl.no.	Random no. for inter arrival	Inter arrival time	Entry time in queue	Service start time	Random no. for service	Service time	Service end time	Waiting time of customer	Idle time
1	78	8	8.08	8.08	44	6	8.14	-	8
2	26	4	8.12	8.14	21	4	8.18	2	-
3	94	10	8.22	8.22	73	8	8.30	-	4
4	08	2	8.24	8.30	96	10	8.40	6	-
5	46	4	8.28	8.40	63	6	8.46	12	-
6	63	6	8.34	8.46	35	6	8.52	12	-
7	18	2	8.36	8.52	57	6	8.58	16	-
8	35	4	8.40	8.58	31	6	9.04	18	-
9	59	6	8.46	9.04	84	8	9.12	18	-
10	12	2	8.48	9.12	24	4	9.16	24	-
11	97	10	8.58	9.16	05	4	9.20	18	
12	82	8	9.06	9.20	37	6	9.26	14	
Total time								**140**	**12**

Average waiting time spent by the customer = 140/12 = 11.67 mins.

Probability of idle time of petrol station = 12/86 = 0.1395 i.e., 14%

Answer to 2 (b):

The 5-S Concept is an integrated concept for house-keeping or workplace management evolved by the Japanese. The 5-Ss are:

(i) SEIRI - Organization or Re-organization.
(ii) SEITON – Neatness
(iii) SEISO – Cleaning
(iv) SEIKETSU – Standardization
(v) SHITSUKE - Discipline.

While 'SEIRI helps us to decide what are the items needed, "SEITON" involves safety and productivity. 'SEISO' means to take up the job of cleaning, while 'SEIKETSU' is nothing but standardization. 'SHITSUKE' stands for disciplining the system.

Q3. (a) X uses traditional standard costing system. The inspection and setup costs are actually ₹ 1,760 against a budget of ₹ 2,000.

ABC system is being implemented and accordingly, the number of batches is identified as the cost driver for inspection and setup costs. The budgeted production is 10,000 units in batches of 1,000 units, whereas actually, 8,800 units were produced in 11 batches.

(i) Find the volume and total fixed overhead variance under the traditional standard costing system.

(ii) Find total fixed overhead cost variance under the ABC system. [4+6]

(b)Write down the quality management principle for improved organization performance. [5]

Answer to 3 (a):

(i) Calculation of volume and total fixed overhead under Traditional Standard Costing System.

Budgeted overhead cost per unit	₹ 2,000/10,000 units	₹ 0.20
Actual overhead cost per unit	₹ 1,760/8,800 units	₹ 0.20
Total fixed over head variance	Absorbed budgeted overhead – Actual overhead = (₹ 0.20 x 8,800 units) – ₹ 1,760	Nil
Fixed overhead expenditure variance	Budgeted overhead – Actual overhead = 2,000 – 1,760	₹ 240 (F)
Standard absorption rate	₹ 2,000 / 10,000 units	₹ 0.20 per unit
Verification:	Standard absorption rate x (Budgeted units – Actual units) = ₹ 0.20 (10,000 units – 8,800 units)	₹ 240 (A)
Total fixed overhead variance	Expenditure variance + Volume variance = 240 (F) + 240 (A)	Nil

(ii) Calculation of fixed overhead cost variance under ABC System

Particulars	Budget	Actual	ABC standard
Total cost (₹)	2,000	1,760	1,800
Production (units)	10,000	8,800	8,800
No. of batches	10	11	9
Batch size (units/batch)	1,000	800	1,000
Cost per batch	200	160	200

Under ABC 8,800 units should have been produced in standard batch size of 1,000 units/ batch.

No. of batches = 8,800/1,000 = 9 approx.

Standard cost under ABC =
(Budgeted cost per batch x ABC standard number of batches)
= ₹ 200 x 9 = 1,800

Under ABC, variability is with respect to batches and not units

Absorbed overheads = 9 batches x Standard rate per batch
= 9 x ₹ 200 = ₹ 1,800

Actual overheads = ₹ 1,760

Total overheads cost variance = ₹ 40 (F)

Answer to 3 (b):

Quality management principles for improved organization performance

The adoption of a QMS should be a strategic decision by top management for survival and growth of the organization. It has been clearly demonstrated and proven that those organizations that focus their efforts firmly onto understanding the needs and expectation of their customers and then systematically set about planning and managing their operations in order to deliver in a consistent and reliable fashion at an overall acceptance cost generally survive and grow.

A Quality Management Principle is a comprehensive and fundamental rule or belief, for leading and operating an organization aimed at continually improving performance over the long-term by focusing on customers while addressing the needs of all other stakeholders,

PRINCIPLE-1: CUSTOMER FOCUS
Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.

PRINCIPLE-2: LEADERSHIP
Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving organization's objectives.

PRINCIPLE-3: INVOLVEMENT OF PEOPLE
People of all levels are the essence of an organization and their full involvement enables their abilities to be used for the organizations benefit.

PRINCIPLE-4: PROCESS APPROACH
A desired result is achieved more efficiently when activities and related resources are managed as a process.

PRINCIPLE-5: SYSTEM APPROACH TO MANAGEMENT
Identifying, understanding and managing interrelated processes as a system contributes to organization's effectiveness and efficiency in achieving its objectives.

PRINCIPLE-6: CONTINUAL IMPROVEMENT
Continual improvement of the organization's overall performance should be a permanent objective of the organization.

PRINCIPLE-7: FACTUAL APPROACH TO DECISION MAKING
Effective decisions are based on the analysis of data and information.

PRINCIPLE-8: MUTUALLY BENEFICIAL SUPPLIER RELATIONSHIPS
An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

Q4. (a) An oil Refinery can blend 3 grades of crude oil to produces Quality A & Quality B Petrol. Two possible blending processes are available. For each production run, the older process uses 5 units of Crude Q, 7 units of Crude P and 2 Units of Crude R and produces 9 Units of A and 7 Units of B. The newer process uses 3 units of Crude Q, 9 units of Crude P & 4 units of Crude R to produces 5 units of A & 9 units of B.

Because of prior contract commitments, the refinery must produce at least 500 units of A and at least 300 units of B for the next month. It has 1,500 units of Crude Q, 1900 units of Crude P and 1,000 units of Crude R. For each unit of A, refinery receives ₹60 while for each unit of B, it receives ₹90. [7]

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

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

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

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

[Given PVIF (10,10) = 0.39
PVIF (10,5) = 0.62
PVIFA (10,10) = 6.15
PVIFA (10,5) = 3.80
PV factor @ 10% for 4 years = 0.68
PV factor @10% for 8 years = 0.47]

PVIF means present value interest factor.
PVIFA means present value interest factor for an Annuity. **[4+4]**

Answer to 4 (a):

Crude Oil type	**Older Process**	**Newer Process**	**Available Crude Oil**
Q	5 units	3 units	1,500 units
P	7 units	9 units	1,900 units
R	2 units	4 units	1,000 units
Output obtained per process	A = 9 units, B = 7 units	A = 5 units, B = 9 units	
Revenue obtained per process	(60 × 9) + (90 × 7) = ₹1,170	(60 × 5) + (90 × 9) = ₹1,110	

Let X, Y the number of times the refinery decides to use Older process and Newer process respectively.

The LPP is: **Objective:** Maximize Revenue Z = 1,170X + 1,110Y

Subject to
$5X + 3Y \leq 1,500$ (Crude Old Q available)
$7X + 9Y \leq 1,900$ (Crude Old R available)
$2X + 4Y \leq 1,000$ (Crude Oil P available)
$9X + 5Y \geq 500$ (Demand of A)
$7X + 9Y \geq 300$ (Demand of B)
$X, Y \geq 0$ (Non-Negativity Assumption)

Answer to 4 (b):

Machine-AB: – 10yrs. Life.

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

Annualized equivalent = ₹32,010/6.15 = ₹5,205

Machine-CD: – 5 yrs. Life.

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

Annualized equivalent = ₹22,380/3.80 = ₹5,890.

Conclusion: Machine - AB should be purchased.

Q5. (a) F Manufacturing Ltd. uses the three variances method to analyze the manufacturing overhead variances. Manufacturing overhead variances for the fiscal year just ended were computed as follows:

Spending - ₹ 86,000 Adverse
Efficiency- ₹ 36,000 Favorable
Volume - ₹ 80,000 Favorable

The manufacturing overhead application rate for the year was ₹ 160 per machine hour of which ₹ 60 per machine hour was the variable component. The year-end balance in the Manufacturing Overhead Control Account was ₹ 16,50,000 and the standard machine hours for the year were 11,300.

From the above data compute: (i) Budgeted machine hours, (ii) Actual machine hours, (iii) Applied manufacturing overhead, (iv) Total amount of fixed overhead cost. **[2.5 × 4]**

(b)What are the benefits of Kaizen Procedure? **[5]**

Answer to 5 (a):

(i)Calculation of Budgeted Machine Hours

Volume variance = ₹ 80,000 (F) given

Volume variance = Std. fixed overhead rate per hour (Std. machine hours for actual output - Budgeted machine hours for actual output)

₹ 80000(F) = ₹ 100 (11,300 - x)
800 = 11,300 - x
x = 11,300 - 800
x = 10,500

∴ Budgeted Machine hours for actual output = 10,500 hours

(ii) Actual Machine Hours

Efficiency variance = ₹ 36,000 (F) (given)

Efficiency variance = Std. variable overhead rate per hour (Std. hours for actual output - Actual hours for actual output)

₹ 36000(F) = ₹ 60 (11300 hours - x)
600 = 11300 -x
x = 10,700

∴ Actual Machine hours = 10,700 hours

(iii) Applied Manufacturing overhead

= Actual overhead incurred + Total variance
= ₹ 16,50,000 + ₹ 30,000 = ₹ 16,80,000

Working Notes Total variance = Spending variance + Efficiency variance + Volume variance
= ₹ 86,000 (A) + ₹ 36,000 (F) + ₹ 80,000 (F) = ₹ 30,000 (F)

(iv)Total amount of Fixed overhead cost

Spending variance = Budget for actual hours - Actual factory overhead incurred

₹ 86,000 (A) = (10,700 hours × ₹ 60 + Total amount of fixed overhead) - ₹ 16,50,000

₹ 86,000 (A) = ₹ 6,42,000 + Total amount of fixed overhead (budgeted) - ₹ 16,50,000

Total amount of fixed overhead = ₹ 10,08,000 - ₹ 86,000 = ₹ 9,22,000.

Answer to 5 (b):

Due to proper implementation of Kaizen Procedure, the following Tangible and Intangible benefits can be made available to the organizations:

Tangible Benefits – Sum total of small improvements contributed by all levels of employees can results in a big pile of improvements viz. Reduced Time/ Rejection/ Energy consumption etc. along with improved quality.

Intangible Benefits – There are many intangible benefits that go a long way in developing participative culture. These are:

- As the stress is on number (of small step improvements) it can be a single motivating factor for individual employees. They take pride in increasing this number.
- As these are small step improvements calling for very negligible investment, it is virtually risk free.
- It results in better team work due to certain principles of spiral thinking involved in basic philosophy.

- With increased emphasis on waste elimination it gives the employees a sense of belonging towards organization while building a culture of loyalty.
- With emphasis on energy savings it helps the society as a whole in conserving improvement resources like electricity, fuel etc.
- It results in change in attitude of work force from hostile to loyal, from destructive to constructive.

Q6. (a) Shoaib Ltd. makes tow products – X and Y, with the following cost patterns.

	Product X	Product Y
Direct materials	27	24
Direct Labour at ₹ 5 per hour	20	25
Variable production overheads at ₹ 6 per hour	3	6
	50	55

Production fixed overheads total ₹3,00,000 per month and these are absorbed on the basis of direct labour hours. Budgeted direct labour hours are 25,000 per month. However, the company has carried out an analysis of its production support activities and found that its 'fixed cost' actually vary in accordance with non-volume-related factors.

Activity	Cost-driver	Product X	Product X	Total cost (₹)
Set-ups	Production runs	30	20	40,000
Materials handing	Production runs	30	20	1,50,000
Inspection	Inspections	880	3,520	1,10,000
				3,00,000

Budget Production is 1,250 units of product X and 4,000 units of product Y.
Required:
Given that the company wishes to make a profit of 20% on full production costs calculate the prices that should be charged for products X and Y using the following.
(i) Full cost pricing
(ii) Activity based cost pricing
(iii) Offer your comments on the figures arrived at (i) and (ii). [3+5+2]

(b) A Company produces three products A, B and C. The following information is available for a period:

Product	A	B	C	Throughout Accounting Ratio
Contribution (₹ per unit) (Sales – Direct Materials)	30	25	15	
Machine hours required per unit of production:				
Machine 1	10 hours	2 hours	4 hours	133.33%
Machine 2	15 hours	3 hours	6 hours	200.00%
Machine 3	5 hours	1 hour	2 hours	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 analyze the above information and apply Theory of Constraints process to remove the constraints. How many units of each product will be made? [5]

Answer to 6 (a):

(i) The full cost and mark-up will be calculated as follows.

	Product X (₹)	Product Y (₹)
Variable Costs Fixed Production overhead (₹3,00,000/25,000 = ₹12 per direct labour hour)	50.00 48.00	55.00 60.00
 Profit mark-up (20%)	98.00 19.60	115.00 23.00
Selling Price	117.60	138.00

(ii) Using activity based costing, overheads will allocated on the basis of cost drivers.

	Product X (₹)	Product Y (₹)	Total (₹)
Set-ups (30:20) Materials handling (30:20) Inspections (880:3,520)	24,000 90,000 22,000	16,000 60,000 88,000	40,000 1,50,000 1,10,000
	1,36,000	1,64,000	3,00,000
Budget units Overheads per unit (₹)	1,250 units 108.80	4,000 units 41.00	

The price is then calculated as before

	Product X (₹)	Product Y (₹)
Variable Costs Production overhead	50.00 108.00	55.00 41.00
 Profit mark-up (20%)	158.80 31.76	96.00 19.20
	190.56	115.20

(iii) Comments. The result in (ii) is radically different from those in (i). On this basis it appears that the company has previously been making a huge loss on every unit of Product X sold for ₹117.60. If the market will not accept a price increase, it may be worth considering ceasing production of product X entirely. It also appears that there is scope for a reduction in the price of product Y, and this would certainly be worthwhile if demand for the product is elastic.

Answer to 6(b):

TA Ratio is highest for 'Machine 2'. So, 'Machine 2' is the bottleneck. Total 'Machine2' hours available = 6,000

Particulars	A	B	C
1.Throughput Contribution per unit (given) (₹)	30	25	15
2.'Machine 2' hours required per unit	15	3	6

3. Contribution per 'Machine 2' hour (1÷ 2) (₹)	2	8.33	2.5
4. Ranking	III	I	II
5. Maximum Sales Demand (units)	500	500	500
6. 'Machine 2' hours required (2 × 5)	7,500	1,500	3,000
7. 'Machine 2' hours allocated based on ranking	(bal. fig)	(I Rank)	(II Rank)
	1,500	1,500	3,000
8. Possible Output Quantity (7 ÷ 2) (units)	100	500	500

Q7. (a) A Company has sales of 1,00,000 units at a price of ₹200.00 per unit and profit of ₹40.00 Lakhs in the current year. Due to stiff competition, the Company has to reduce its price of product next year 5% to achieve same volume target of sales. The cost structure and profit for the current year is given as below:

Particulars	(₹ Lakhs)
Direct Materials	**60.00**
Direct Wages	**45.00**
Variable Factory Overheads	**20.00**
Fixed Overheads including Sales & Admin Expenses	**35.00**
Total Cost	**160.00**

To achieve the Target Cost to maintain the same profit, the Company is evaluating the proposal to reduce Labour Cost and Fixed Factory Overheads. A Vendor supplying the Machine suitable for the Company's operations has offered an advanced technology Semi-Automatic Machine of ₹20 Lakhs as replacement of Old Machine worth ₹5.0 Lakhs. The Vendor is agreeable to take back the Old Machine at ₹2.70 Lakhs only. The Company's policy is to charge depreciation at 10% on WDV. The Maintenance Charge of the Existing Machine is ₹1.20 Lakhs per annum whereas there will be warranty of services free of cost for the New Machine first two years. There are ten (10) Supervisors whose Salary is ₹1.50 Lakhs per annum. The New Machine having Conveyor Belt is expected to help in cost cutting measures in the following ways –

(1) Improve productivity of workers by 20%
(2) Cut-down Material Wastage by 1%
(3) Elimination of services of Supervisors because of automatic facilities of the machine
(4) Saving in Packaging Cost by 1.5 Lakhs

Assuming Cost of Capital to be 15%, calculate how many supervisors should be removed from the production activities to achieve the Target Cost. [9]

(b) S Ltd engaged in manufacturing activities. It has received a request from one of its important customers to supply a product which will require conversion of Material M, which is a non moving item. The following details are available

Book Value of Material M	**₹60**
Realizable value of Material M	**₹80**
Replacement Cost of Material M	**₹100**

It is estimated that conversion of one unit of M into one unit of finished product will require one unit of labour hour. At present labour is paid @ ₹20 per hour. Other costs are as follows:

Out of Pocket Expenses	**₹30 per unit**
Allocated Overheads	**₹10 per unit**

The labour will be re-deployed from other activities. It is estimated that the temporary redeployment will not result in loss of contribution. The employees to be redeployed are permanent employees of the Co.

Estimate the minimum price to be charged from the customer so that the company is not worse off by executing the order. [6]

Answer to 7 (a):

For the same quantity, Sales Value will reduce by 5% of (1,00,000 units × ₹200.00) = ₹10.00 lakhs. For maintaining the same amount of profit, cost also has to be reduced by ₹10.00 Lakhs, which can be achieved as under –

Particulars	Lakhs (₹)
Savings: Reduction in Wages (**Note:** Due to higher Labour Productivity, Wages will be $\frac{45}{1.20}$ = ₹37.50 Lakhs)	7.50
Elimination of wastage of Materials = 1% of ₹60 Lakhs	0.60
Savings in Packing Cost (given)	1.50
Saving in Maintenance Cost (given)	1.20
Sub-Total (A)	**10.80**
Costs: Loss in Disposals of Old Machine (₹5 Lakhs – ₹2.70 Lakhs)	-2.30
Difference in Depreciation (₹20 Lakhs – ₹5 Lakhs) × 10%	-1.50
Cost of Capital Investment ₹20 Lakhs × 15%	-3.00
Sub-Total (B)	**6.80**
Effective Cost Reduction before considering removal of Supervisors	4.00
Additional Reduction required for meeting Target Cost, by removing Supervisors = (₹10 Lakhs – ₹4 Lakhs)	**6.00**

Hence, number of Supervisors to be removed = $\frac{₹6\text{Lakhs}}{₹150\text{Lakhs per Supervisor}}$ = 4 Supervisors.

Answer to 7 (b):

Statement Showing Minimum price to be charged based on Relevant Cost

Particulars	Nature & Computation	₹
Material M	Slow moving material. Realizable value is relevant as opportunity cost	80.00
Labour Cost	The workers are permanent employees. Assume no	Nil

	retrenchment policies exist. Committed Cost are not relevant	
Out of Pocket Expenses	Specially Incurred. Hence relevant.	30.00
Allocated Overhead	Allocation is not specifically incurred. Hence irrelevant	Nil
	Minimum Price to be charged	**110.00**

Q8. Write short notes on any three: **[5×3=15]**

(a) Uses of the learning curve.

(b) DRUM-BUFFER-ROPE.

(c) Step in strategies bench trending

(d) PDCA

Answer to 8:

(a) Uses of the learning Curve:

The learning curve theory has gained significant importance as a technique for cost prediction and cost control. Some of the uses to which the learning rate may be put to are as follows:-

(i) Developing bid prices for contracts

(ii) Work Scheduling - The learning curve concept assists the management in work scheduling and production control in three ways:

1. It predicts man-hours and the workforce required for meeting the production plan so that timely action may be taken to procure the required workforce.
2. It indicates the time required for production so that schedule deliveries can be maintained.
3. It enables production control to take advantage of reducing the time per unit of production by increasing the product lot sizes.

(iii) Planning Inventory - The learning curve indicates how with increased efficiency of the worker, the pace of production increases consequent to which more materials are required and work-in-progress and finished goods stocks grow rapidly in size. Awareness of the growth rate enables the management to plan the inventories properly.

(iv) Planning working capital - When unit prices are based on average cumulative cost per unit, the cost of the first few units produced will be higher than the cost on which the bid price was based. As a result, the profit level may not be high enough to provide sufficient working capital. In such a situation, the learning curve will indicate the quantum of the shortage of working capital so that suitable action may be taken on time to meet the shortfall.

(v) Make or buy decision - The learning curve is usedful in make or buy decision-making. While purchasing from outside on long term basis, it is to be seen whether the supplier has already reached the maximum efficiency in which case no learning curve will apply and no reduction in price in future can be expected. In another situation where instead of purchasing, internal production is speeded up, new inexperienced workers may have to be employed resulting in high costs now but gradual lower costs may be expected when the improvement process operates.

(b) DRUM-BUFFER-ROPE:

Drum-buffer-rope is a TOC production application and the name given to the method used to schedule the flow of materials in a TOC facility. Srikanth and Umble (1997), define each component as follows:

- **Drum**: The drum is the constraint and therefore sets the pace for the entire system. The drum must reconcile the customer requirements with the system's constraints. In simpler terms, the drum is the rate or pace of production set by the system's constraint.
- **Buffer**: A buffer includes time or materials that support throughput and/or due date performance. A buffer establishes some protection against uncertainty so that the system can maximize throughput. A time buffer is the additional planned lead time allowed, beyond the required setup and run times, for materials to reach a specified point in the product flow. Strategically placed, time buffers are designed to protect the system throughput from the internal disruptions that are inherent in any process. A stock buffer is defined as inventories of specific products that are held in finished, partially finished, or raw material form, in order to fill customer orders in less than the normal lead-time. Stock buffers are designed to improve the responsiveness of the system to specific market conditions.
- **Rope**: The rope is a schedule for releasing raw materials to the floor. The rope is devised according to the drum and the buffer. The rope ensures that non-capacity constraint resources are subordinate to the constraint. Restated, the rope is a communication process from the constraint to the gating operation that checks or limits material released into the system to support the constraint.

(c) The Steps in strategies bench trending are as follows:

(i) Firstly the market is defined by determining its size, customer preferences, competitors and relative business position of the company within the market.

(ii) The industry direction, technology shifts, geopolitical changes, customer changes and potential threats from outside sources are assessed.

(iii) The strongest current and potential competitors are then determined by evaluating the trends in industry.

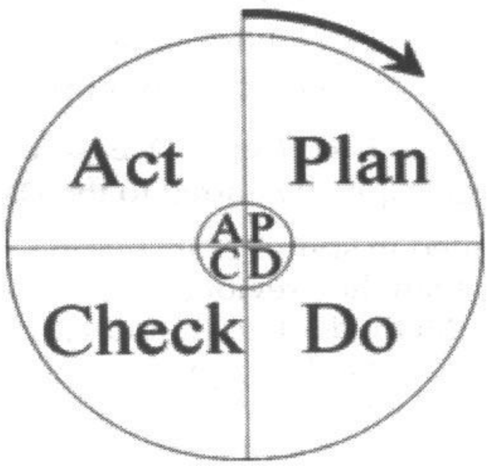
(iv) Data on performance of competitors is gathered and the current and future performance of the unit is compared with that of its competitor.

(v) A performance baseline for the business units, is then established and the relative performance of current and projected competition is estimated.

(vi) A set of initiatives which form the basis of an improvement plan are identified to maintain strengths while reducing projected gaps.

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

PDCA-PDCA ("Plan-Do-Check-Act") is an iterative four-step problem-solving process typically used in quality control. It is also known as the Deming Cycle, Shewhart cycle, Deming Wheel, or Plan-Do-Study-Act.



The shewhart Cycle:
Plan: establish the objectives and processes necessary to deliver results in accordance with the specifications.
Do: Implement the processes.
Check: Monitor and evaluate the processes and results against objectives and specifications and report the outcome.
Act: Apply actions to the outcome for necessary improvement. This means reviewing all steps (Plan, Do, Check, Act) and modifying the process to improve it before its next implementation.

PDCA was made popular by Dr. W. Edwards Father of modern quality control; however it was always referred to by him as the “Shewhart cycle.” Later in Deming’s career, he modified PDCA to “Plan, Do, Study, Act” (PDSA) so as to better describe his recommendations.

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