

PAPER – 5 : ADVANCED MANAGEMENT ACCOUNTING

Answer **all** questions.

Working notes should form part of the answer.

Question 1

- (a) E Ltd. is engaged in the manufacturing of three products in its factory. The following budget estimates are prepared for 2009-10 : (10 Marks)

	Products		
	A	B	C
Sales (Units)	10,000	25,000	20,000
Selling price per unit. (Rs.)	40	75	85
Direct Materials per unit. (Rs.)	10	14	18
Direct wages per unit @ Rs. 2 p.hr.	8	12	10
Variable overhead per unit (Rs.)	8	9	10
Fixed overhead per unit (Rs.)	16	18	20
Profit/Loss	-2	22	27

After the finalisation of the above manufacturing schedule, it is observed that presently only 80% capacity being utilised by these three products. The production activities are made at the same platform and it may be interchangeable among products according to requirement. In order to improve the profitability of the company the following three proposals are put for consideration:

- (a) Discontinue product A and capacity released may be used for either product B or C or equally shared. The fixed cost of product A is avoidable. Expected changes in material cost and selling price subject to the utilisation of product A's capacity are as under:

Product B : Material cost increased by 10% and selling price reduced by 2%

Product C : Material cost increased by 5% and selling price reduced by 5%.

- (b) Discontinue product A and divert the capacity so released and the idle capacity to produce a new product D for meeting export demand whose per unit cost data are as follows:

	Rs.
Selling Price	60
Direct material	28
Direct wages @ Rs. 3 p. hr.	12
Variable overheads	6
Fixed cost (Total)	1,05,500

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- (c) Product A, B and C are continuously run and hire out the idle capacity fixing a price in such a way that the same rate of profit per direct labour hour is obtained in the original budget estimates.

Required:

- (i) Prepare a statement of profitability of products A, B and C in existing situation.
 - (ii) Evaluate the above proposals independently and calculate the overall profitability of the company under each proposal.
 - (iii) What proposal should be accepted, if the company wants to maximise its Profit?
- (b) A Company is engaged in manufacturing two products A and B. Product A uses one unit of component X and two units of component Y. Product B uses two units of component X and one unit of component Y and two units of component Z. Component Z which is assembled in the factory uses one unit of component Y. (7 Marks)

Components X and Y are purchased from the market. The company has prepared the following forecast of sales and inventory for the next year:

	Product A	Product B
	(Units)	(Units)
Sales	80,000	1,50,000
Stock at the end of the year	10,000	20,000
Stock at the beginning of the year	30,000	50,000

The production of both the products and the assembling of the component Z will be spread out uniformly throughout the year. The company at present orders its inventory of X and Y in quantities equivalent to 3 months production. The company has compiled the following data related to the two components:

	X	Y
Price per unit (Rs.)	20	8
Order placing cost per order (Rs.)	1,500	1,500
Carrying cost per annum	20%	20%

Required:

- (i) Prepare a budget for production and requirements of components for the next year.
 - (ii) Suggest the optimal order quantity of components X and Y.
- (c) Identify the characteristics movement such as regular, irregular, cyclical, seasonal, long-term trend, short-term etc. of time series in the following situations:
- (i) A factory delaying its production due to demolition of factory shed in earthquake.
 - (ii) An era of depression in business.

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- (iii) The country needs more and more food grains due to constant growth of population.
 (iv) Decline in death rate due to availability of proper health care facilities.
 (v) A continuous increase in demand of small cars.
 (vi) A demand of gold products is increasing during the festival time. (3 Marks)

Answer

- (a) (i) Budgeted profitability statement under existing situation

	A (Rs)	B(Rs)	C (Rs)	Total
Selling price	40	75	85	
Total Variable costs (Direct Material + Direct Labour + Variable overhead)	<u>26</u>	<u>35</u>	<u>38</u>	
Contribution	<u>14</u>	<u>40</u>	<u>47</u>	
Sales units	10000	25000	20000	
Contribution in (Rs.)	140000	1000000	940000	2080000
Fixed cost (Rs)	<u>160000</u>	<u>450000</u>	<u>400000</u>	<u>1010000</u>
Profit/loss (Rs)	<u>-20000</u>	<u>550000</u>	<u>540000</u>	<u>1070000</u>

- (ii) Proposal (a) Alternative use of A's Capacity for Product B or C or B & C Equally
 Hours released for discontinuance of A = 10,000 x 4 = 40,000 hours

	Product B	Product C	B & C
No of Units Possible	40000/ 6 = 6666	40000/ 5 = 80000	B=3333 C= 4000

Revised Contribution of Product B and Product C

Particulars	B (Rs)	C (Rs)
Selling price	73.50	80.75
Variable cost: Direct Material	15.40	18.90
Direct wages	12.00	10.00
Variable overheads	9.00	10.00
Total Variable cost	36.40	38.90
Contribution	37.10	41.85
Number of Hours	6	5
Contribution per hour	6.18	8.37

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Decision : It is better to produce C

Taking both changes in the selling price and material cost are for the entire production or the incremental production. Profitability is calculated below:

Proposal (a) : Profitability statement if A's capacity utilized by C

Particulars	Option 1 Changes for entire production (Rs)	Option 2 Changes for incremental production (Rs)
Sales Volume	28000	8000
Contribution per unit	41.85	41.85
Total Contribution	1,17,1800	3,34,800
Less Fixed Cost	400000	0
Profit	771800	334800
Existing Profit of B	550000	550000
Existing Profit of C		540000
Total Profit	1321800	1424800

Proposal (b)

Existing capacity = (4X 10,000 + 6 x 25,000 + 5x 20,000) = 290000 hrs

Then, Idle capacity of 20% = 290000 /4 = 72500 hours

Capacity for product 'D' = (idle + A's spare) capacity = 72500 + 40000 = 112500 hours,

No. of units 'D' produced = 112500/4 = 28125 units.

Profitability Statement – proposal (b)

Units	D (Rs)
Selling price	60
Less : Variable cost : Direct Material	28
Direct wages	12
Variable Overheads	6
Contribution	14
Contribution amount (Rs.)	393750
Less fixed cost	105500
Profit	288250
Add : Existing Profit B & C	1090000
Total Profit	1378250

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Proposal © Hiring Out idle capacity

Particulars	(Rs)
Idle Hours	72,500
Existing Profit per hour (1070000/290000)	3.69
Revenue from Hire out	267500
Existing Profit	1070000
Total Profit	1337500

Profit Summary of alternatives (Rs in 000's)

Existing	Proposal(a) Option 1	Proposal (a) Option 2	Proposal (b)	Proposal (c)
1070.00	1321.80	1424.80	1378.25	1337.50

Decision on option on the basis of profitability :

- If price and cost under proposal (a) is for entire production of C: Proposal (b) of Export
- If price and cost under proposal (a) is for incremental prod C : Proposal (a) – Option 2

(b) (i)

Production Budget:

	Product "A"	Product "B"
	Units	Units
Sales	80000	150000
Closing stock	10000	20000
Opening stock	30000	50000
Production Budget	60000	120000

Budget of Component Requirements

Components	X	Y	Z
Product A: Production 60000 units	60000	120000	
Product B: Production 120000 units	240000	120000	240000
Component Z : 240000 units		240000	
Total	300000	480000	240000

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(ii) **Optimal order quantity of components X and Y**

Components	X	Y
Order placing costs Rs.	1500	1500
Price of the component Rs.	20	8
Carrying cost @ 20% Rs.	4	1.60

$$EOQ = \sqrt{\left(\frac{2 * 300000 * 1500}{4}\right)} \sqrt{\left(\frac{2 * 480000 * 1500}{1.60}\right)}$$

$$= 15000 \text{ components} = 30000 \text{ components}$$

- (c) (i) Irregular
(ii) Cyclical
(iii) Long Term Trend
(iv) Long term Trend
(v) Long Term Trend
(vi) Seasonal

Question 2

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

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

<u>Activity</u>	<u>Cost Rate</u>
Ordering	Rs. 800 per purchase order
Delivery	Rs. 700 per delivery
Shelf stocking	Rs. 199 per hour
Customer support and assistance Rs. 1.10 p.u. sold.	

The other relevant information for the products are as follows:

	Coco	Strawberry	Vanilla
Direct Material p.u. (Rs.)	8	6	5
Direct Labour p.u. (Rs.)	5	4	3

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No. of purchase orders	35	30	15
No. of deliveries	112	66	48
Shelf stocking hours	130	150	160

Under the traditional costing system, store support costs are charged @ 30% of prime cost. In ABC these costs are coming under customer support and assistance.

Required:

- (i) Calculate target cost for each product after a reduction of selling price required to achieve the sales equal to the production capacity.
 - (ii) Calculate the total cost and unit cost of each product at the maximum level using traditional costing.
 - (iii) Calculate the total cost and unit cost of each product at the maximum level using activity based costing.
 - (iv) Compare the cost of each product calculated in (i) and (ii) with (iii) and comment on it. (12 marks)
- (b) What are the essential requisites for the installation of Uniform costing system? (4 Marks)

Answer

2 (a) (i) Cost of products under target costing

Demanded unit and selling price

Coco		Strawberry		Vanilla	
Selling Price	Demand	Selling Price	Demand	Selling Price	Demand
25	50000	20	20000	15	60000
24	55000	19	22000	14	66000
23	60500	18	24200	13	72600

Target cost of each product after reduction in selling price

	Coco	Strawberry	Vanilla
Selling price after reduction	23.00	18.00	13.00
Profit marks up 25% on cost i.e 20 % on selling price	4.60	3.60	2.60
Target cost of production (per unit)	18.40	14.40	10.40

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(ii) Cost of product under traditional costing

	<i>Coco</i>	<i>Strawberry</i>	<i>Vanilla</i>
	(Rs.)	(Rs.)	(Rs.)
Units	60500	24200	72600
Material cost (8,6,5 per unit)	8	6	5
Labour cost (5,4,3 per unit)	<u>5</u>	<u>4</u>	<u>3</u>
Prime cost	13	10	8
Store support costs (30% of prime)	<u>3.90</u>	<u>3</u>	<u>2.40</u>
Cost per unit	<u>16.90</u>	<u>13.00</u>	<u>10.40</u>

(iii) Cost of product under activity based costing

	<i>Coco</i>	<i>Strawberry</i>	<i>Vanilla</i>
	(Rs.)	(Rs.)	(Rs.)
Units	60500	24200	72600
Material cost (8,6,5 per unit)	484000	145200	363000
Labour cost (5,4,3 per unit)	<u>302500</u>	<u>96800</u>	<u>217800</u>
Prime cost	786500	242000	580800
Ordering cost @ Rs. 800 (35, 30, 15)	28000	24000	12000
Delivery cost @ Rs. 700 (112, 66, 48)	78400	46200	33600
Shelf stocking @Rs 199, (130,150,160)	25870	29850	31840
Customer Support Rs 1.10	66550	26620	79860
Total Cost	985320	368670	738100
Cost Per unit	16.29	15.23	10.17

(iv) Comparative Analysis of cost of production (Rs)

	<i>Coco</i>	<i>Strawberry</i>	<i>Vanilla</i>
	(Rs.)	(Rs.)	(Rs.)
(a) As per Target Costing	18.40	14.40	10.40
(b) As per traditional Costing	16.90	13.00	10.40
(c) As per Activity Based Costing	16.29	15.23	10.17
(a) -(c)	2.11	-0.83	0.23
(b) - (c)	0.61	-2.23	0.23

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Note : The cost of product of strawberry is higher in ABC method in comparison to target costing and traditional methods. It indicated that actual profit under target costing is less than targeted. For remaining two products, ABC is most suitable.

(b) Essential Requisites for Installation of Uniform Costing System:

- A. Firms should be willing to share or furnish relevant data /information.
- B. Spirit of mutual trust and co-operation should prevail among participating firms.
- C. Mutual exchange of ideas, methods used, special achievements made, research and know – how should be frequent.
- D. Bigger firms should lead in sharing their experience to enable smaller firms to improve their performance.
- E. Uniformity should be established with regard to the size of units, production methods, accounting methods, procedures and principles used.

Question 3

- (a) *X Ltd. produces and sells a single product. Standard cost card per unit of the product is as follows* (12 Marks)

	Rs.
Direct materials :	50.00
B 5 kg @ Rs. 6 per kg	30.00
Direct wages 5 hours @ Rs. 5 per hour	25.00
Variable production overheads 5 hours @ 12 per hour	60.00
Fixed production overheads	<u>25.00</u>
Total Standard cost	<u>190.00</u>
Standard gross profit	<u>35.00</u>
Standard selling price	<u>225.00</u>

A fixed production overhead 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 the actual results for an actual production of 2,000 units:

	Rs.
Sales 2,000 units @ Rs. 225	<u>4,50,000</u>
Direct materials :	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

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<i>Fixed production overheads</i>	<u>56,600</u>
<i>Total</i>	<u>3,82,500</u>
<i>Gross profit</i>	<u>67,500</u>

The material price variance is extracted at the time of receipt of materials. Material purchase were a 20,000 kg. @ Rs. 5.25 per kg; B 11,500 kg @ Rs. 5.70 per kg.

Required:

- (i) Calculate all variances.
 - (ii) Prepare an operating statement showing Standard gross profit, Variances and Actual gross profit.
 - (iii) Explain the reason for the difference in actual gross profit given in the question and calculated in (ii) above. (12 Marks)
- (b) What is Backflushing in JIT? State the problems that must be addressed for the effective functioning of the system. (4 Marks)

Answer

- (a) (i) Material Price variance = (SP-AP) AQ
 A = (5-5.25) x 20000 = 5000(A)
 B (At the time of receipt of Materials) = (6.5.70) x 11500 = 3450(F)
 = 1550 (A)
- Material usage variance = (SQ – AQ) * SP
 A = (20000 – 18900)x 5 = 5500 (F)
 B = (10000 – 10750) x 6 = 4500 (A)
 = 1000 (F)
- Standard quantity for actual output for
 A = 2000 x 10 = 20000 kg
 B = 2000 x 5 = 10000 kg
- Material Mix variance = SP (RSQ –AQ)
 A = (19766.67 – 18900) x5 = 4333.33 (F)
 B = (9883.33 – 10750) x6 = 5200.00 (A)
 = 866.67 (A)
- Revised standard quantity
 A = 20000/30000 x 29650 = 19766.67
 B = 10000/30000 x 29650 = 9883.33

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Material yield variance	= SR (AY- SY) (2000- 1976.67) x 80 = 1866.67 (F)
SY	= (2100/31500) x 29650 = 1976.67
Labour rate variance	= (SR- AR) AH = (5-4.8) x 10500 = 2100 (F)
Labour efficiency variance	= SR(SH – AH) = (10000- 10300) x 5 = 1500(A)
Labour idle time variance	= Idle hours x SR = 200 x 5 = 1000 (A)
Variable overhead cost variance	= Recovered overhead – Actual overhead = (2000 x 60 – 115000) = 5000(F)
Variable overhead exp. Variance	= Standard variable overhead – Actual variable overhead = 10300 x 12 – 115000 = 8600 (F)
Variable overhead efficiency variance	= Recovered – Standard variable overhead = 120000 – 123600 = 3600(A)
Fixed overhead cost variance	= Recovered overhead – actual overhead = (2000 x25 – 56600) = 6600 (A)
Fixed overhead exp. Variance	= Budgeted overhead – Actual overhead = (2500 /12 x 25) – 56600) = 4100(A)
Fixed overhead volume variance	= Recovered – Budgeted overhead = (50000 – 52500) = 2500 (A)

(ii)

Reconciliation Statement

	(Rs.)	(Rs.)	(Rs.)
Standard Profit (35 * 2000)			70000
Variances	Favourable	Adverse	
Material : Price (at the time of receipt)		1550	
Mix	1866.67	866.67	
Yield			
Labour : Rate	2100		
Efficiency		1500	
Idle time		1000	
Variable overheads Expenditure	8600		

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	Efficiency		3600	
Fixed overheads	Expenditure		4100	
	Volume		2500	
		12566.67	15116.67	2550 (A)
Actual Profit				67450

- (iii) Actual gross profit given in the question is Rs. 67500 while calculated operating profit in statement is Rs. 67450. The difference amount is due to material price variance that is calculated at the time of receipt of material instead of consumption of material.

$$\text{MPV A} = 18900 \times (5 - 5.25) = 4725 \text{ (A)}$$

$$\text{B} = 10750 \times (6 - 5.70) = \underline{3225 \text{ (F)}}$$

$$1500 \text{ (A)}$$

Over recovery in the operating statement is $(1550 - 1500) = 50$, should be added in actual profit $67450 + 50 = \text{Rs. } 67500$.

- (b) Back flushing requires no data entry of any kind until a finished product is completed. At the 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.

To work system properly some serious problems must corrected.

- Production reporting: The total production figure entered into the system must be absolutely correct.
- 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 the 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: Maintain accurate set of inventory records.

Question 4

- (a) An electronics firm which has developed a new type of fire-alarm system has been asked to quote for a prospective contract. The customer requires separate price quotations for each of the following possible orders: (11 Marks)

Order	Number of fire-alarm systems
First	100
Second	60
Third	40

The firm estimates the following cost per unit for the first order:

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Direct Materials Rs. 500

Direct Labour

Deptt. A (Highly automatic) 20 hours at Rs. 10 per hour.

Deptt. B (Skilled labour) 40 hours at Rs. 15 per hour.

Variable overheads absorbed 20% of direct labour

Fixed overheads absorbed

Deptt. A Rs. 8 per hour

Deptt. B Rs. 5 per hour

Determine a price per unit for each of the three orders, assuming the firm uses a mark up of 25% on total costs and allows for an 80% learning curve. Extract from 80% learning curve table:

X	1.0	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
Y(%)	100.0	91.7	89.5	87.6	86.1	84.4	83.0	81.5	80.0

X represents the cumulative total volume produced to date expressed as a multiple of the initial order.

Y is the learning curve factor, for a given X value, expressed as a percentage of the cost of the initial order.

(b) What are the applications of incremental/differential costs? (5 Marks)

Answer

(a) (i) **Price /Unit for First 100 Units**

		Rs.
Direct materials		500
Direct labour : Deptt. A 20 hrs. @10	200	
Deptt. B 40 hrs. @ 15	600	800
Variable O/H 20% of Rs. 800/-		160
Fixed O/H Deptt. A 20 hrs. @ 8	160	
Deptt. B 40 hrs @ 5	200	360
Total cost		1,820
Profit		455
Selling price per unit		2,275

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(ii) Price/Unit for Second Order of 60 Units :

Learning will be applicable only in Dept. B

Cumulative output becomes 100 units + 60 units = 160 units

i.e. i.6 times for which learning is 86.1% from the table.

∴ total hours for 160 units = $160 \times 40 \times 0.861 = 5510.4$ units.

∴ hours for 60 units = Hrs for 160 units – Hrs for 100 units.
= $5510.40 - 4000$ hrs = 1510.40 hrs.

∴ Hours per unit = $1510.40 / 60 = 25.17$

Calculation of selling Price unit :

		Rs.
Direct materials		500.00
Direct labour: Deptt. A 20 hrs@ 10	200.00	
Deptt. B 25.17 hrs@ 15	<u>377.55</u>	577.55
Variable O/H 20% of Rs. 577.55		115.51
Fixed O/H : Deptt. A 20 hrs@ 8	160.00	
Deptt. B 25.17@ 5	<u>125.85</u>	<u>285.85</u>
Total Cost		1478.91
Profit		<u>369.73</u>
Selling price per unit		1848.64

(iii) Price/Unit for Third Order of 40 Units:

Cumulative Output becomes $100+60+40 = 200$ units

i.e. 2 times for which Learning is 80% from the table

∴ Total hours for 200 units = $200 \times 40 \times .80 = 6400$ hrs

∴ Hours for 40 units = Hrs for 200 units – Hrs for 160 units. = $6400 - 5510.4 = 889.6$ hrs.

∴ Hours per unit = $889.6/40 = 22.24$ hrs

Calculation of selling price/ unit :

		Rs.
Direct materials		500.00
Direct labour: Deptt. A 20 hrs @ 10		200.00
Deptt. B 22.24 hrs @ 15		333.60
Variable O/H 20% of Rs. 533.60		106.72
Fixed O/H : Deptt. A 20 hrs @ 8		160.00
Deptt. B 22.24 @ 5		<u>111.20</u>

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Total Cost	1411.52
Profit	<u>352.88</u>
Selling Price/Unit	<u>1764.40</u>

(a) Alternative solution

Particulars	Amt. in First order	Second Order at *86.1%	Third Order at **80%
	(Rs.)	(Rs.)	(Rs.)
Direct Material	500.00	500.00	500.00
Direct Labour			
Dept A (20 hours @ Rs.10 per hour)	200.00	200.00	200.00
Dept B (40 hours @ Rs. 15 per hour)	600.00	516.60	480.00
Variable overheads (20% of direct labour)	160.00	143.32	136.00
Fixed Overheads			
Dept A (20 hours @ Rs. 8 per hour)	160.00	160.00	160.00
Dept B (40 @ Rs. 5 per hour)	200.00	172.20	160.00
Total Cost	1820.00	1692.12	1636.00
Profit (25% of Cost)	455.00	423.03	409.00
Selling Price per Alarm	2275.00	2115.15	2045.00

Note : Learning Curve is not applicable for Department A as it is highly automated.

*Second Order – 60 fire-alarms, Cumulative Total = 160 fire-alarms

The cumulative total is now 160 Alarm, which is denoted by the multiple of 160/100 i.e. 1.6. From the 80% learning curve table the relevant percentage factor is 86.1% of the labour cost.

Cumulative order 160 @ Rs. 2115.15	3,38,424
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Previous order 100 @ Rs.2275	2,27,500
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Increment order 60	1,10,924
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Therefore, charge price per Alarm	1848.73
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**Third Order-40 Alarm, Cumulative Total = 200 Alarm

The cumulative total is now 200 fire alarms, which is denoted by the multiple of 200/100 i.e. 2. From the 80% learning curve table the relevant percentage factor is 80% of the labour cost.

Cumulative orders 200 @ Rs.2045	409000
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Previous order 160 @ 2115.15	338424
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Incremental order 40	70576
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Therefore, charge price per Alarm (Rs.)	1764.40
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(b) Applications of Incremental/Differential Cost:

1. Whether to process a product further or not.
2. Dropping or adding a product line.
3. Optimizing investment plan.
4. accepting an additional order from a special customer at lower than existing price.
5. Make or buy decision.
6. Opening a new sales territory or branch.
7. Optimizing investment plan out of multiple alternatives.
8. Submitting tenders.
9. Lease or buy decisions.
10. Equipment replacement decisions.

Question 5

- (a) ABC Cooperative Bank receives and disburses different amount of cash in each month. The bank has an opening cash Balance of Rs. 15 crores in the first month. Pattern of receipts and disbursements from past data is as follows: (7 Marks)

Monthly Cash receipts		Monthly Cash disbursements (Rs crores)	
Rs. in Crores	Probability	Rs. in Crores	P 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:

- (i) Calculate probability that the ABC Cooperative Bank will fall short in payments.
- (ii) Calculate average monthly shortfall.
- (iii) If ABC bank can get an overdraft facility of Rs. 45 crores from other Nationalized banks.

What is the probability that they will fall short in monthly payments?

Use the following sequence (rowwise) of paired random numbers.

1778 4316 7435 3123 7244 4692 5158 6808 9358 5478 9654 0977

- (b) A small project is composed of seven activities, whose time estimates are listed below. Activities are identifies by their beginning (i) and ending (j) note numbers:

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Activity		Estimated durations (in days)		
(i-j)	Optimistic	Most likely	Pessimistic	
1-2	2	2	14	
1-3	2	8	14	
1-4	4	4	16	
2-5	2	2	2	
3-5	4	10	28	
4-6	4	10	16	
5-6	6	12	30	

(a) Draw the project network.

(b) Find the expected duration and variance for each activity. What is the expected project length?

Given :	Z	0.50	0.67	1.00	1.33	2.00
	P	0.3085	0.2514	0.1587	0.0918	0.0228

(4 Marks)

(c) Brief the principles associated with synchronous manufacturing. (5 Marks)

Answer

(a)

Monthly Cash receipts (Rs crores)				Monthly Cash disbursements (Rs crores)			
Cash	Probability	Cumulative	R.N.	Cash	Probability	Cumulative	R.N.
30	0.20	0.20	00-19	33	0.15	0.15	00-14
42	0.40	0.60	20-59	60	0.20	0.35	15-34
36	0.25	0.85	60-84	39	0.40	0.75	35-74
99	0.15	1.00	85-99	57	0.25	1.00	75-99

	Opening	Receipt			Payment		Closing
Months	(Rs in Crores)	Random Number.	(Rs in Crores)	Total	Random Number.	(Rs in Crores)	(Rs in Crores)
1	15	17	30	45	78	57	-12
2	-12	43	42	30	16	60	-30
3	-30	74	36	06	25	39	-33

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4	-33	31	42	09	23	60	-51
5	-51	72	36	-15	44	39	-54
6	-54	46	42	-12	92	57	-69
7	-69	51	42	-27	58	39	-66
8	-66	68	36	-30	08	33	-63
9	-63	93	99	36	58	39	-3
10	-3	54	42	39	78	57	-18
11	-18	96	99	81	54	39	42
12	42	09	30	72	77	57	15

(i) In 12 months, the bank falls short of cash in 10 months to meet payment.

Thus, probability of shortfall = $10/12 = 0.83$

(ii) Total short fall of Rs. 399 crores over 10 months

Average monthly shortfall during 10 months = Rs 39.9 crores

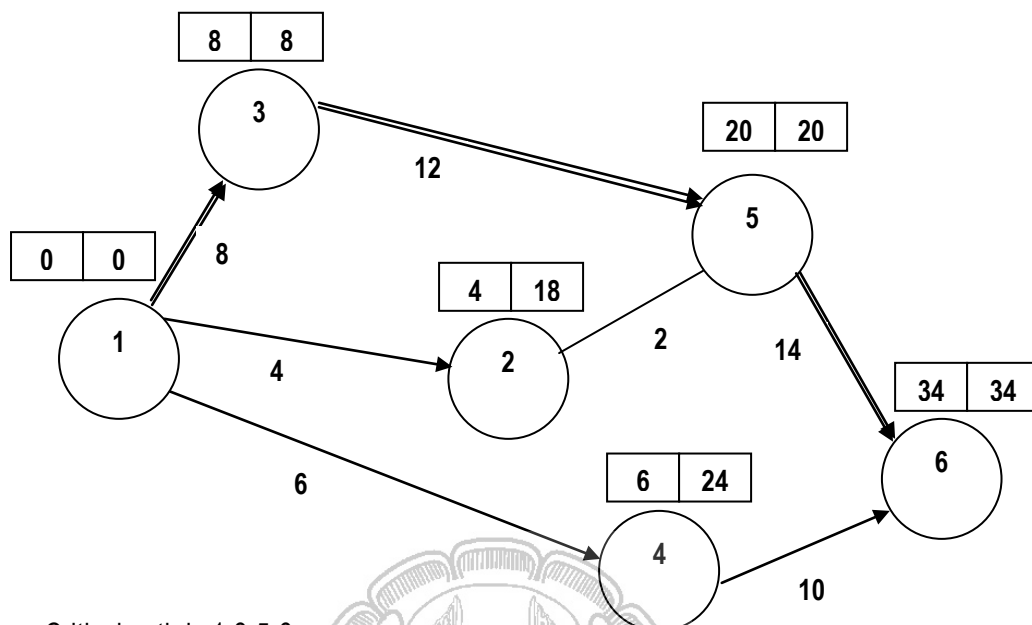
(iii) With an overdraft facility of Rs. 45 crores is available, there will be a shortfall in 5 months (4,5,6,7,8). Therefore, probability is = $5/12 = 0.42$

(b) Activity Estimated Durations :

Activity estimated durations (days) $t_e = \frac{(a + 4m + b)}{6}$ Duration

Activity	a	m	b	t_e	$\sigma = [(b-a)/6]^2$
1-2	2	2	14	4	4
1-3	2	8	14	8	4
1-4	4	4	16	6	4
2-5	2	2	2	2	0
3-5	4	10	28	12	16
4-6	4	10	16	10	4
5-6	6	12	30	14	16

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Critical path is 1-3-5-6.

The expected project duration = $8+12+14 = 34$ days

(c) Synchronous Manufacturing

It is an all encompassing manufacturing management philosophy which includes a set of principles, procedures, and techniques where every action is evaluated in terms of common goals of the organization.

The 7 principles are :

- Focus on synchronizing the production flow than on idle capacities.
- Value of time at a bottleneck resource is equal to the throughput rate of products processed by the bottle neck.
- Value of time at a non bottleneck resource is negligible.
- Level of utilization of a non bottleneck resource is controlled by other constraints within the system.
- Resources must be utilized, not simply activated.
- Transfer batch should not be equal to the process batch.
- A process batch should be variable both along its route and overtime.

Question 6

- (a) X Ltd. supplies spare parts to an air craft company Y Ltd. The production capacity of X Ltd. facilitates production of any one spare part for a particular period of time. The following are the cost and other information for the production of the two different spare parts A and B:

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<i>Per unit</i>	<i>Part A</i>	<i>Part B</i>
<i>Alloy usage</i>	<i>1.6 kgs.</i>	<i>1.6 kgs.</i>
<i>Machine Time : Machine A</i>	<i>0.6 hrs.</i>	<i>0.25 hrs.</i>
<i>Machine Time : Machine B</i>	<i>0.5 hrs.</i>	<i>0.55 hrs.</i>
<i>Target Price (Rs.)</i>	<i>145</i>	<i>115</i>

Total hours available : Machine A 4,000 hours

Machine B 4,500 hours

Alloy available is 13,000 kgs. @ Rs. 12.50 per kg.

Variable overheads per machine hours:

Machine A : Rs. 80

Machine B : Rs. 100

You are required to identify the spare part which will optimize contribution at the offered price.

If Y Ltd. reduces target price by 10% and offers Rs. 60 per hour of unutilized machine hour, what will be the total contribution from the spare part identified above? (8 Marks)

- (b) *What do you mean by Degeneracy in transportation problem? How this can be solved? (4 Marks)*
- (c) *What is Price Discrimination? Under what circumstances it is possible? (4 Marks)*

Answer

- (a) (i) Number of parts to be manufactured:

	Part A	Part B
Machine "A" (4,000 hours)	6666	16000
Machine "B" (4,500 hours)	9000	8181
Alloy available (13,000 hours)	8125	8125
Maximum number of parts to be manufactured	6666	8125
Cost per unit	Rs.	Rs.
Material (12.5 x 1.6)	20.00	20.00
Variable Overhead : Machine "A"	48.00	20.00
Variable Overhead: Machine "B"	50.00	55.00
Total variable cost per unit	118.00	95.00
Price offered	145.00	115.00
Contribution per unit	27.00	20.00
Total contribution for units produced (I)	179982	162500
Spare part A will optimize the contribution		

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(ii)

	Part A
Parts to be manufactured numbers	6666
Machine A : to be used	4000
Machine B : to be used	3333
Underutilized machine hours (4500 – 3333)	1167
Compensation for unutilized machine hours (II) (Rs. 1167 x 60)	70020
Reduction in price by 10% causing fall in contribution of Rs 14.50 per unit i.e (Rs.6666 x 14.5) (III)	96657
Total contribution (I + II -III)	153345

(b) In a transportation problem, if the no of occupied cells is less than $m+n+1$, such a solution, in transportation problem, is called as degeneracy. Degeneracy can occur two ways :

- i) The initial basic solution can turn out to be a degenerate solution. Or
- ii) an improved solution can turn out to be a degenerate solution

This can be solved by introducing an infinitesimally small allocation e (epsilon) to least cost empty cell so that the total number of allocated cells is equal to $m+n+1$ independent cells.

(c) Price discrimination is charging different prices with respect to customers, products, places and time

It is possible when

- the market being capable of being segmented
- the customers is not able to resell the product at a higher price
- The competitors' underselling is not possible