Gurukripa's Guideline Answers for May 2011 CA Final Examination

PAPER 5 – ADVANCED MANAGEMENT ACCOUNTING

Q.No. 1 is Compulsory. Answer any Five Questions from the remaining Six Questions

Question 1 (a): Standard Costing – Sales Variances – Margin Approach 5 Marks

A Company actually sold 8,000 units of A and 10,000 units of B at ₹ 12 and ₹ 16 per unit respectively against a budgeted sale of 6,000 units of A at ₹ 14 per unit and 9,000 units of B at ₹ 13 per unit. The Standard Costs of A and B are ₹ 8 and ₹ 10 per unit respectively and the corresponding actual costs are ₹ 5.50 and ₹ 14.50 per unit. Compute the product–wise Sales Margin Mix and Sales Margin Price Variances, indicating clearly, whether the variances are Favourable or Adverse.

Solution:

1. Computation of Revised Actual Quantity (RAQ)

Total AQ Sold = 8,000 + 10,000 = 18,000 units.

Product	A	B
Budgeted Mix	6	9
RAQ	7,200 units	10,800 units

2. Computation of Budgeted and Actual Margin

	Budgeted Margin(BM) = BP – Std Cost(SC)	Actual Margin (AM) = Actual Price (AP) – Std Cost (SC)
A	₹ 14 – ₹ 8 = ₹ 6	₹ 12 – ₹ 8 = ₹ 4
B	₹ 13 – ₹ 10 = ₹ 3	₹ 16 – ₹ 10 = ₹ 6

3. Sales Variances under Margin / Profit Approach (Impact on Profit)

Particulars	Col. (1): BQ × BM	Col. (2): RAQ × BM	Col. (3): AQ × BM	Col. (4): AQ × AM
A	6,000 × ₹ 6 = ₹ 36,000	7,200 × ₹ 6 = ₹ 43,200	8,000 × ₹ 6 = ₹ 48,000	8,000 × ₹ 4 = ₹ 32,000
B	9,000 × ₹ 3 = ₹ 27,000	10,800 × ₹ 3 = ₹ 32,400	10,000 × ₹ 3 = ₹ 30,000	10,000 × ₹ 6 = ₹ 60,000
Total	**₹ 63,000**	**₹ 75,600**	**₹ 78,000**	**₹ 92,000**

Sales **Margin Quantity** Variance = ₹ 63,000 – ₹ 75,600 = ₹ 12,600 F + Sales **Margin Mix** Variance = ₹ 75,600 – ₹ 78,000 = ₹ 2,400 F + Sales **Margin Price** Variance = ₹ 78,000 – ₹ 92,000 = ₹ 14,000 F

Sales **Margin Volume** Variance = ₹ 63,000 – ₹ 78,000 = ₹ 15,000 F + Sales **Margin Price** Variance b/fd as above = ₹ 14,000 F

Total Sales Margin Variance = ₹ 63,000 – ₹ 92,000 = ₹ 29,000 F

Product–wise Breakup of Variances (Margin Approach):

Particulars		A	B	Total
(a) Sales Margin **Quantity** Variance	= Col. (1) – Col. (2)	₹ 7,200 F	₹ 5,400 F	₹ 12,600 F
(b) Sales Margin **Mix** Variance	= Col. (2) – Col. (3)	₹ 4,800 F	₹ 2,400 A	₹ 2,400 F
(c) Sales Margin **Volume** Variance (a+b)	= Col. (1) – Col. (3)	₹ 12,000 F	₹ 3,000 F	₹ 15,000 F
(d) Sales Margin **Price** Variance	= Col. (3) – Col. (4)	₹ 16,000 A	₹ 30,000 F	₹ 14,000 F
(e) **Total Sales Margin Variance** (c+d)	= Col.(1) – Col. (4)	₹ 4,000 A	₹ 33,000 F	₹ 29,000 F

Question 1 (b): TQM – Cost Classification and Relevant Cost Analysis 5 Marks

A Company makes a single product which sells at ₹ 800 per unit and whose Variable Cost of Production is ₹ 500 per unit. Production and Sales are 1,000 units per month. Production is running to full capacity and there is market enough to absorb an additional 20% of output each month. The Company has two options:

Option – I: Inspect Finished Goods at ₹ 10,000 per month. 4%of production is detected as Defectives and scrapped at no value. There will be no Warranty Replacement, since every defect is detected. A small Spare Part which wears out due to defective material is required to be replaced at ₹ 2,000 per Spare for every 20 units of scrap generated. This Repair Cost is not included in the manufacturing cost mentioned above.

Option – II: Shift the Finished Goods Inspection at no extra cost, to Raw Material Inspection, (since Defective Raw Materials are entitled to free replacement by the Supplier), take up machine–set up tuning and Machine Inspection at an additional cost of ₹ 8,000 per month, so that scrap of Finished Goods is completely eliminated. However, delivery of uninspected Finished Products may result in 1% of the quantity sold to be replaced under free warranty due to minor variation in dimensions, which does not result in the wearing out of the spare as stated in Option – I.

Required:
1. Using monthly figures relevant for decision–making, advise which option is more beneficial to the Company from a financial perspective.
2. Identify the Quality Costs that can be classified as – (a) Appraisal Costs, and (b) External Failure Costs.

Solution: The Relevant Costs are analysed as under –

Particulars	COQ Classification	Option I	Option II
Spare Parts Costs for 40 units = 1 per 20 units = 2 Spares × ₹ 2,000	Appraisal Costs	₹ 4,000	Nil
Finished Goods / Raw Material Inspection	Appraisal Costs	₹ 10,000	₹ 8,000
Warranty Replacement = 1,000 units × 1% × ₹ 500 Variable Cost	External Failure Costs	Nil	₹ 5,000
Total Costs		**₹ 14,000**	**₹ 13,000**

Conclusion: Option II is preferable due to lower costs.

Note:
Alternatively, Warranty Replacement can also be taken at ₹ 800 pu (being Variable Cost ₹ 500+Contribution foregone ₹ 500)
Alternative assumptions relating to Scrap Costs of 40 units and Revenue from Additional Sale Quantity also possible.

Question 1 (c): Relevant Cost Analysis – Theory 5 Marks

Pick out from each of the following items, costs classified under 'Committed Fixed Costs' or 'Discretionary Fixed Costs'.

Item	Classification
1. Annual increase of Salary and Wages of Administrative Staff by 5% as per agreement.	**Committed**
2. 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.	**Discretionary**
3. Rents paid for the Factory Premises for the past 6 months and the Rent Payable for the next six months. Production is going on in the factory.	**Committed**
4. 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.	R&D Cost on Product that has reached Maturity Phase is committed, while R&D Cost on its substitute is Discretionary.
5. Legal Consultancy Fees payable for Patent Rights on a new product. Patenting rights have been applied for.	**Committed**

Question 1 (d): Transportation – Balanced Minimisation – Degeneracy 5 Marks

The following matrix is a Minimization Problem for Transportation Costs. The Unit Transportation Costs are given at the right hand corners of the Cells and the Δ_{ij} values are encircled.

	D_1	D_2	D_3	Supply
F_1	3	4	4	500
F_2	9 [8]	6	7 [2]	300
F_3	4 [0]	6 [2]	5	200
Demand	300	400	300	1000

Find the Optimum Solution(s) and the Minimum Cost.

Solution:

1. **Initial Basic Feasible Solution**

	D1	D2	D3	Quantity	Cost Differences I	II
F1	**100** 3	**400** 4	4	500/ 100	1	1
F2	9	6	**300** 7	300/ 0	1	**2**
F3	**200** 4	6	5	200/ 0	1	1
	300	400/0	300/0			

Cost Diff:

I	1	**2**	1
II	1	–	1

In the above IBFS,

- Number of allocated cells is 4.
- m + n – 1 (i.e. Rows + Columns – 1) = 3+3–1 = 5.

Hence, there is degeneracy.

To overcome degeneracy, a dummy allocation represented by 'e' is made in the least cost unallocated cell falling in a regular row or column, i.e. non dummy row or column.

2. **Optimality Test** (for IBFS obtained under VAM): **Table 1 = U + V for Allocated Cells computed as below:**

U & V	3 – 0 =3	4 – 0 = 4	4 – 0= 4
(base) 0	**100** 3	**400** 4	**e** 4
7 – 4 = 3	9	6	**300** 7
4 – 3 = 1	**200** 4	6	5

Table 2 = Ui + Vj for Unallocated Cells

3 + 3 = 6	4 + 3 = 7	
	4 + 1 = 5	4 + 1 = 5

Table 3: Net Evaluation Table

9 – 6 = 3	6 – 7 = –1	
	6 – 5 = 1	5 – 5 = 0

There is a negative element in the NET, hence the allocation is not optimal. The loop is created as below

	– ve 400	+ ve
9 – 6 = 3	6 – 7 = –1	300
		– ve
	6 – 5 = 1	5 – 5 = 0

ABFS–1: The new U + V for Allocated Cells is computed from the above.

U & V	3 – 0 = 3	4 – 0 = 4	4 – 0 = 4
(base) 0	**100** 3	**100** 4	**300** 4
6 – 4 = 2	9	**300** 6	7
4 – 3 = 1	**200** 4	6	5

Table 2 = Ui + Vj for Unallocated Cells

3 + 2 = 5		4 + 2 = 6
	4 + 1 = 5	4 + 1 = 5

Table 3: Net Evaluation Table

9 – 5 = 4		7 – 6 = 1
	6 – 5 = 1	5 – 5 = 0

Observation: Since all NET are **non–negative**, the IBFS is optimal. Since one entry in NET is zero, the above optimal solution is not unique. One alternative solution exists.

Alternative Optimal Solution – 1:

Alternative Optimal Solution is obtained by drawing a loop from the "Zero" entry in the NET, as indicated here →

+ ve			– ve 300
9 – 5 = 4			7 – 6 = 1
– ve 200	6 – 5 = 1		5 – 5 = 0
			+ ve

→ Least Qtty of –ve corners = 200. So, Alternative Optimal Solution is obtained by adding 200 to +ve corners, subtracting 200 from –ve corners and leaving the other cells undisturbed.

Optimum Solution

3 × 100 = 300	4 × 100 = 400	4 × 300 = 1200
	6 × 300 = 1800	
4 × 200 = 800		

Alternative Optimum Solution 1

3 × 300 = 900	4 × 100 = 400	4 × 100 = 400
	6 × 300 = 1800	
		4 × 200 = 1000

Minimum Cost = Total of above = **₹ 4,500.**

Question 2 (a): Computation of OH Cost of Product using ABC System 8 Marks

During the last 20 years, KL Ltd's manufacturing operation has become increasingly automated with computer–controlled robots replacing Operators. KL currently manufactures over 100 products of varying levels of design complexity. A single Plant–wise Overhead Absorption Rate, based on Direct Labour Hours is used to absorb Overhead Costs.

In the quarter ended March, KL's Manufacturing Overhead Costs were – (₹ '000)

Equipment Operation Expenses	125
Equipment Maintenance Expenses	25
Wages paid to Technicians	85
Wages paid to Component Stores Staff	35
Wages paid to Despatch Staff	40
Total	310

During the quarter, the Company reviewed the Cost Accounting System and concluded that absorbing Overhead Costs to individual products on a labour hour absorption basis was meaningless and that Overhead Costs should be attributed to products using an Activity Based Costing (ABC) System. The following are identified as at most significant activities:

1. Receiving Component Consignments from Suppliers.
2. Setting up Equipment for Production Runs
3. Quality Inspections
4. Despatching Goods as per Customers' Orders.

- Equipment Operation and Maintenance Expenses are apportioned as – Component Stores 15%, Production Runs 70% and Despatch 15%
- Technicians' Wages are apportioned as – Equipment Maintenance 30%, Set Up Equipment for Production Runs 40% and Quality Inspections 30%.

During the quarter –

1. 980 Component Consignments were received from Suppliers.
2. 1020 Production Runs were set up
3. 640 Quality Inspections were carried out.
4. 420 Orders were despatched to customers.

KLs' production during the quarter included Component R. The following information is available on Component R:

Component Consignments received	45
Production Runs	16
Quality Inspections	10
Orders (goods) despatched	22
Quantity produced	560

Calculate the Unit Manufacturing OH Cost of Component R using ABC System.

Solution:

Particulars	Receipt from Suppliers	Set–up	Inspection	Despatch	Total
(a) Technician's Wages (**Note 1**)	–	34,000	25,500	–	59,500
(b) Equipment Operation and Maintenance Expenses apportioned as 15:70:15 (**Note 2**)	26,325	1,22,850	–	26,325	1,75,500
(c)Wages to Storemen & Despatch Staff (Direct)	35,000	–	–	40,000	75,000
1. **Total OH = Activity Cost Pool**	**₹ 61,325**	**₹ 1,56,850**	**₹ 25,500**	**₹ 66,325**	₹ 3,10,000
2. Cost Allocation Base (i.e. Cost Driver)	980 Con–signments	1,020 Prodn Runs	640 Quality Inspections	420 Orders despatched	
3. ABC Recovery Rate = (1 ÷ 2)	₹ 62.58 per Consignment	₹ 153.77 per Prodn Run	₹ 39.84 per Inspection	₹ 157.92 per despatch	
4. Resources required for Component R	45 consignments	16 prodn runs	10 inspections	22 orders	
5. OH Cost of Comp. R (for 560 units) (3 × 4)	₹ 2,816.10	₹ 2,460.32	₹ 398.40	₹ 3,474.24	₹ 9,149.06
6. OH Cost per unit of Component R					**₹ 16.34**

Note:

- Technician's Wages Total ₹ 85,000. 30% thereof = ₹ 25,500 is included in Equipment Maintenance Expenses, and the balance of ₹ 59,500 is apportioned to Set Up and Inspection as 40 : 30, i.e. ₹ 34,000 & ₹ 25,500.
- Total Equipment Operation and Maintenance Expenses = ₹ 1,25,000 + ₹ 25,000 + ₹ 25,500 (from Note 1 above) = ₹ 1,75,500. This is apportioned in the ratio 15% : 70% : 15% to the relevant activities.

Question 2 (b): Network Theory 3 Marks

State any three differences between PERT and CPM.

Solution:

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 3 estimates of activity time t_o, t_m, t_p, 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.

Question 2 (c): Pricing Theory 5 Marks

What are the disadvantages of Cost Plus Pricing?

1. **Ignores demand:** Cost Plus Pricing ignores demand and fails to take into account the buyers' needs and willingness to pay, which govern the sales volume obtainable at each series of prices.

2. **Ignores competition:** It fails to reflect competition adequately.
3. **Arbitrary Cost allocation:** It assumes that the costs have been estimated with exact accuracy. But, this assumption is not true in multi–product firms where the Common Costs are allocated arbitrarily.
4. **Ignores opportunity costs:** For many decisions, Incremental Costs play a vital role in pricing, rather than Full Costs. This aspect is ignored. Also Opportunity Costs, which are most relevant for decision–making, are fully ignored.
5. **Price–Volume relationships:** Since Fixed OH are apportioned based on volume of production, the cost will be more if sales volume is less and vice–versa. The increase or decrease in sales volume is dependent on price. Thus it is a vicious circle – cost plus mark up is based on sales volume, and sales volume is based on price.

Question 3 (a): Assignment – Reverse Working 10 Marks

A Manager was asked to assign Tasks to Operators (one Task per Operator only) so as to minimize the time taken. He was given the Matrix showing the hours taken by the Operators for the Tasks.

First, he performed the Row Minimum Operation. Secondly, he did the Column Minimum Operation. Then, he realized that there were 4 Tasks and 5 Operators. At the third step he introduced the Dummy Row and continued with his fourth step of drawing lines to cover zeros. He drew 2 vertical lines (under Operator III and IV) and two horizontal lines (aside Task T_4 and Dummy Task T_5). As Step 5, he performed the necessary operation with the uncovered element, since the number of lines was less than the order of the matrix. After this, his matrix appeared as follows:

Operators

Tasks	I	II	III	IV	V
T_1	4	2	5	0	0
T_2	6	3	3	0	3
T_3	4	0	0	0	1
T_4	0	0	5	3	0
T_5 (Dummy)	0	0	3	3	0

Required:

1. What was the Matrix after Step II? Based on such Matrix, ascertain (2) and (3) given below.
2. What was the most difficult task for Operators I, II and V?
3. Who was the most efficient operator?
4. If you are not told anything about the Manager's errors, which Operator would be denied any task? Why?
5. Can the Manager go ahead with his assignment to correctly arrive at the optimal assignment, or should he start afresh introducing the Dummy Task at the beginning?

Solution:

1. Row T_5 was a Dummy. If lines are drawn as per the Manager's method, the junction elements in Row T5 are 3rd and 4th Column elements, which bear '3' in the next table, after adjustment for the Least Open Element. Hence, the Least Open Element should be '3', and the previous matrix as per Step 2 of the Manager's method is derived by reverse working –

Given Matrix

	I	II	III	IV	V
T_1	4	2	5	0	0
T_2	6	3	3	0	3
T_3	4	0	0	0	1
T_4	0	0	5	3	0
T_5	0	0	3	3	0

Reverse Working Computations

	I	II	III	IV	V
T_1	4+3=7	2+3=5	5	0	0+3=3
T_2	6+3=9	3+3=6	3	0	3+3=6
T_3	4+3=7	0+3=3	0	0	1+3=4
T_4	0	0	5–3=2	3–3=0	0
T_5	0	0	3–3=0	3–3=0	0

Previous Matrix Step 2

	I	II	III	IV	V
T_1	7	5	5	0	3
T_2	9	6	3	0	6
T_3	7	3	0	0	4
T_4	0	0	2	0	0
T_5	0	0	0	0	0

2. Difficult Task for Operators I, II & V is Task T_2, which has highest time element as per Step 2 matrix computed above.
3. Most Efficient Operator is Operator IV, since Additional Time of Column IV = 0.
4. Assignment as per the Managers' Matrix, i.e. as per the Matrix given in the question will be as under –

	I	II	III	IV	V
T_1	4	2	5	~~0~~	**0**
T_2	6	3	3	**0**	3
T_3	4	~~0~~	**0**	~~0~~	1
T_4	**0**	~~0~~	5	3	~~0~~
T_5	~~0~~	**0**	3	3	~~0~~

Note: The above is a case of multiple optimal solution, since arbitrary allocation is made for Task T_4 and T_5, to Operators I / II. Hence, either Operator I or II would be denied of any job / task, since dummy T_5 gets allotted to them.

5. To arrive at the optimal assignment, the Manager should start afresh after introducing the Dummy Task at the beginning, since Column Operations will result in the same Matrix in such case, and the locations containing zero entries may be different in such case.

Question 3 (b): Balanced Score Card – Performance Measurement 3 Marks

Classify the following measures under appropriate categories in a Balanced Score Card for a Banking Company which excels in its Home Loan Products –

Item	**Classification**
1. 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.	Innovation and Learning / Customer Perspective
2. How different sectors of Housing Loans with different interest rates have been sanctioned, their volumes of growth in the past 4 quarters.	Financial / Internal Business Perspective
3. How many days are taken to service a loan, how many loans have taken longer, what additional loans are to be released soon, etc.	Internal Business Perspective

Question 3 (c) Relevant Costing – Identification of Opportunity Costs – Basics 3 Marks

A Company can make any one of the 3 products X, Y or Z in a year. It can exercise its option only at the beginning of each year. Relevant information about the products for the next year is given below:

	X	Y	Z	
Selling Price	₹ 10 per unit	₹ 12 per unit	₹ 12 per unit	
Variable Costs	₹ 6 per unit	₹ 9 per unit	₹ 7 per unit	
Market Demand (units)	3,000	2,000	1,000	
Production Capacity (units)	2,000	3,000	900	
Fixed Costs				₹ 30,000

You are required to compute the Opportunity Costs for each of the products.

Solution:

Particulars	**X**	**Y**	**Z**
1. Selling Price	₹ 10 per unit	₹ 12 per unit	₹ 12 per unit
2. Variable Costs	₹ 6 per unit	₹ 9 per unit	₹ 7 per unit
3. Contribution per unit	₹ 4 per unit	₹ 3 per unit	₹ 5 per unit
4. Market Demand	3,000 units	2,000 units	1,000 units
5. Production Capacity (units)	2,000 units	3,000 units	900 units
6. Effective Production (least of 4 and 5)	2,000 units	2,000 units	900 units
7. Possible Total Contribution (6 × 3)	₹ 8,000	₹ 6,000	₹ 4,500
8. Opportunity Costs (highest of Opportunity Costs is relevant)	**₹ 6,000**	**₹ 8,000**	**₹ 8,000**

Question 4 (a) Pricing under different Market Conditions – to earn Target Profits 4 Marks

6,000 Pen Drives of 2 GB are to be sold in a Perfectly Competitive Market to earn ₹ 1,06,000 Profit, whereas in a Monopoly market only 1,200 units are required to be sold to earn the same profit. The Fixed Costs for the period are ₹ 74,000. The Contribution per unit in the Monopoly Market is as high as three fourths its Variable Cost. Determine the Target Selling Price under each market condition.

Solution:

Particulars	**Competition**	**Monopoly**
1. Target Contribution=Fixed Cost + Profit = ₹ 74,000 + ₹ 1,06,000	₹ 1,80,000	₹ 1,80,000
2. Contribution per unit	$\frac{₹\ 1,80,000}{6,000\ units}$ = ₹ 30 p.u.	$\frac{₹\ 1,80,000}{1,200\ units}$ = ₹ 150 p.u.
3. Variable Cost per unit (**See Note**)	₹ 200 p.u.	₹ 200 p.u.
4. Target Selling Price per unit (2 + 3)	₹ 230 p.u.	₹ 350 p.u.

Note: Contribution in Monopoly Market = ₹ 150 p.u. = 3/4th of Variable Cost. So, Variable Cost = $\frac{₹\ 150}{3/4th}$ = **₹ 200 p.u.**

Question 4 (b) Overhead Budgets 4 Marks

In a Company, Factory Overheads are applied on the basis of Direct Labour Hours. The following information is given:

	Department A	Department B
Fixed Factory Overheads	₹ 3,36,000	₹ 1,26,000
Variable Overheads per Labour Hour	₹ 0.50 per hour	₹ 1.50 per hour
Direct Labour Hours required as per Direct Labour Hour Budget		
For Product X	1,40,000	70,000
For Product Y	28,000	56,000

Prepare the product–wise budget for Fixed and Variable Overhead Costs.

Solution: Fixed OH Recovery Rates per hour are computed as under –

Dept. A: $\frac{₹\ 3,36,000}{(1,40,000 + 28,000)\ \text{hours}}$ = **₹ 2 per hour.** Dept. B: $\frac{₹\ 1,26,000}{(70,000 + 56,000)\ \text{hours}}$ = **₹ 1 per hour.**

Particulars	Product X	Product Y	Total
1. Department A:			
(a) Fixed OH at ₹ 2 per hour	1,40,000 × ₹ 2 = ₹ 2,80,000	28,000 × ₹ 2 = ₹ 56,000	₹ 3,36,000
(b) Variable OH at ₹ 0.50 per hour	1,40,000 × ₹ 0.5 = ₹ 70,000	28,000 × ₹ 0.5 = ₹ 14,000	₹ 84,000
Sub–Total	**₹ 3,50,000**	**₹ 70,000**	**₹ 4,20,000**
2. Department B:			
(a) Fixed OH at ₹ 1 per hour	70,000 × ₹ 1 = ₹ 70,000	56,000 × ₹ 1 = ₹ 56,000	₹ 1,26,000
(b) Variable OH at ₹ 1.50 per hour	70,000 × ₹ 1.5 = ₹ 1,05,000	56,000 × ₹ 1.5 = ₹ 84,000	₹ 1,89,000
Sub–Total	**₹ 1,75,000**	**₹ 1,40,000**	**₹ 3,15,000**
3. Total Costs: Fixed	₹ 3,50,000	₹ 1,12,000	₹ 4,62,000
Variable	₹ 1,75,000	₹ 98,000	₹ 2,73,000
Sub–Total	**₹ 5,25,000**	**₹ 2,10,000**	**₹ 7,35,000**

Question 4 (c) TOC – Classification of Concepts 4 Marks

Classify the following items under the three measures used in the Theory of Constraints:

Item	Classification	Item	Classification
1. Research and Development Cost	Investments and Inventory	5. Labour Cost	Other Operating Costs
2. Stock of Raw Materials	Investments and Inventory	6. Rent / Utilities	Other Operating Costs
3. Raw Materials used for Production	Throughput Contribution	7. Sales	Throughput Contribution
4. Cost of Equipments and Buildings	Investments and Inventory	8. Depreciation	Other Operating Costs

Question 4 (d) Transportation – Theory 4 Marks

Will the Initial Solution for a Minimization Transportation Problem obtained by Vogel's Approximation Method and the Least Cost Method be the same? Why?

Solution:

The IBFS obtained under Least Cost Cell Method and VAM may **not** be the same due to the following reasons –

1. Availability and Requirement Quantities of Rows and Columns are not considered in Least Cost Cell Method.
2. The concept of Cost Difference / Penalty Cost is not considered in Least Cost Cell Method.
3. It is possible that the Least Cost Cells may get cancelled in the first stage allocation in VAM, and subsequently no further allocation is made in other cell entries in the cancelled Row / Column.

Question 4 (e) Benchmarking – Theory 4 Marks

Name any four stages in the process of Benchmarking.

Solution:
The process of Benchmarking involves the following stages –

Stage	Description
1	Planning, which involves – (a) Determination of Benchmarking Goal Statement, (b) Identification of best performance, (c) Establishment of the Benchmarking or Process Improvement Team, and (d) Defining the relevant benchmarking measures.
2	Collection of Data and Information.
3	Analysis of the findings based on the data collected in Stage 2.
4	Formulation and implementation of recommendations.
5	Constant monitoring and reviewing.

Question 5 (a) Transfer Pricing – Import Substitution – Impact of Opportunity Costs in different scenarios 11 Marks

A Company has two Manufacturing Divisions X and Y. X has a capacity of 96,000 hours per annum. It manufactures two products 'Gears' and 'Engines'. Division 'Y' produces Product 'Wheels'. The following details are given –

Particulars	Gears	Engines	Wheels
Direct Materials	₹ 240 p.u.	₹ 34 p.u.	(See Note) ₹ 736 p.u.
Variable Costs	(at ₹ 64 ph) ₹ 256 p.u.	(at ₹ 64 ph) ₹ 64 p.u.	(at ₹ 40 ph) ₹ 320 p.u.
Selling Price in the Outside Market	₹ 640 p.u.	₹ 128 p.u.	₹ 1,160 p.u.

Note: This includes cost of Imported Component at ₹ 640 p.u. and other Direct Materials ₹ 96 p.u.

The Fixed Overheads for X and Y are ₹ 24 Lakhs and ₹ 4 Lakhs respectively. With a view to minimizing dependence on the Imported Component, the Company has explored a possibility of Division Y using Product 'Gears' instead of the Imported Component. This is possible provided Division Y spends 2 machine hours entailing an additional expenditure of ₹ 64 per component on modification of Product 'Gears' to fit into 'Wheels'. Production and Sales of 'Wheels' in Division Y is limited to 5,000 units per annum.

Required:
1. What will be the Maximum Transfer Price per unit that Y will offer?
2. In each of the following independent situations, state with supporting calculations, the Minimum Transfer Price per unit that X will demand from Y, if 5,000 units are required by Y. (number of units)

Situation	Gears	Engines
A. Market Demand is limited to	20,000	20,000
B. Market Demand is limited to	15,000	10,000
C. Market Demand is limited to	18,000	24,000

3. In which of the above situations in (2) will the Management step in and compel X to sell to Y in the interest of overall Company's Profits?

Solution:
1. Maximum Transfer Price that Division Y will offer = Market Price of Imported Component less Additional Processing Costs
= ₹ 640 p.u. less ₹ 64 p.u. **= ₹ 576 p.u.**

2. Contribution Analysis in Division X in different scenarios, and impact on Minimum Transfer Price

Particulars		Gears	Engines	Total
(a) Sale Price per unit		**₹ 640 p.u.**	**₹ 128 p.u.**	
(b) Variable Costs per unit		240 + 256 = ₹ 496 p.u.	34 + 64 = ₹ 98 p.u.	
(c) Contribution per unit (a – b)		₹ 144 p.u.	₹ 30 p.u.	
(d) Hours required per unit		$\frac{₹\ 256}{₹\ 64}$ = 4 hours	$\frac{₹\ 64}{₹\ 64}$ = 1 hour	
(e) Contribution per hour (c ÷ d)		₹ 36 p.h.	₹ 30 p.h.	
(f) Rank based on (e)		I	II	
(g) Hours required in	Demand Situation A	20,000 × 4 = 80,000 hrs	20,000 × 1 = 20,000 hrs	1,00,000 hours
	Demand Situation B	15,000 × 4 = 60,000 hrs	10,000 × 1 = 10,000 hrs	70,000 hours
	Demand Situation C	18,000 × 4 = 72,000 hrs	24,000 × 1 = 24,000 hrs	96,000 hours

Evaluation of Opportunity Costs:

- Time required for Internal Transfer of 5,000 Gears = 5,000 × 4 = 20,000 hours.
- Comparing the available capacity of 96,000 hours with Line (g) above, it is observed that there will be a need for time diversion from External Sales of Engines (which have lower Contribution per hour), to meet internal transfer requirements, in Demand Situations A and C above.
- Opportunity Costs (i.e. Contribution foregone on Engines sold externally) in such case will be ₹ 30 p.h × 4 hours per Gear = ₹ 120 p.u. of Gear transferred internally.
- Hence, **Minimum Transfer Price** in Demand Situations A and C will be Variable Costs ₹ 496 p.u. + Opportunity Costs ₹ 120 p.u. **= ₹ 616 p.u.** However, in Demand Situation B, there is no Opportunity Costs and hence, in that situation, Minimum Transfer Price will be Variable Costs **₹ 496 p.u.**

3. Evaluation of Import Substitution

(a) Cost of buying Imported Component	**₹ 640 p.u.**
(b) Relevant Cost of Gear used in Wheels = (in Division X) ₹ 496 p.u. + (in Division Y) ₹ 64 p.u.	**₹ 560 p.u.**
(c) Cost Savings to Company in using internally transferred Gear (without considering Opportunity Costs)	**₹ 80 p.u.**
(d) Since Opportunity Costs of internal transfer is ₹ 120 p.u, Company's overall profits can be maximized only in Demand Situation B, when there are no Opportunity Costs. So, Top Management may step in and compel X to sell to Y in the interest of overall Company's Profits in **Demand Situation B only.**	

Question 5 (b) LPP Formulation – Maximisation under Simplex Method – Slack Interpretation 5 Marks

A Company manufactures two products X and Y involving three departments. Machining, Fabrication and Assembly which have limitations on the hours as 720 hours, 1,800 hours and 900 hours respectively. X and Y require 1 and 2 hours of Machining Time per unit, 5 hours and 4 hours of Fabrication Time per unit and 3 hours and 1 hour of Assembly Time per unit respectively. X and Y fetch ₹ 80 and ₹ 100 as respective unit contributions.

1. Write the Linear Program to maximize the Contribution.
2. Introducing appropriate variables, re–state the problem as Linear Equations fit to be incorporated in the Simplex Tableau.
3. What will be the product Mix at Maximum Contribution Level?

Solution:

Basic Data:	**X**	**Y**	
Contrib. p.u.	₹ 80	₹ 100	
Hours conditions:			Available
Machining	1 hr	2 hrs	720 hrs
Fabrication	5 hrs	4 hrs	1,800 hrs
Assembly	3 hrs	1 hr	900 hrs

→

The LPP is as under –

Maximise Z = 80 x + 100 y

Subject to:

$x + 2y \le 720$

$5x + 4y \le 1{,}800$

$3x + y \le 900$

$x, y \ge 0$ (non–negativity)

→

Introducing Slack Variables, we have

Maximise $Z = 80x + 100y + 0S_1 + 0S_2 + 0S_3$

Subject to:

$x + 2y + S_1 = 720$

$5x + 4y + S_2 = 1{,}800$

$3x + y + S_3 = 900$

$x, y, S_1, S_2, S_3 \ge 0$

S_1, S_2 and S_3 are the slacks for the 3 Constraints above.

First Simplex Table:

Fixed Ratio	Program	Profit	Quantity	x	y	S_1	S_2	S_3	Repl. Ratio
NA	**S_1**	0	720	1	**2**	1	0	0	**360** Min non–ve
2	**S_2**	0	1800	5	4	0	1	0	450
1/2	**S_3**	0	900	3	1	0	0	1	900
Decision:		Z (Objective Value)		80	100	0	0	0	
In = Key Column = y		C (Computed Value)		0	0	0	0	0	
Out= Key Row = S_1		**Net Evaluation Row**		80	**100** Max +ve	0	0	0	

Note: For Non–Key Rows, A = (Previous Table Corresponding Row Element) **Less** B = (Key Row Element × Fixed Ratio)

Computation for S_2 Row							**Computation for S_3 Row**						
A	1800	5	4	0	1	0	**A**	900	3	1	0	0	1
– B	1440	2	4	2	0	0	**– B**	360	1/2	1	1/2	0	0
A–B	360	3	0	–2	1	0	**A–B**	540	5/2	0	–1/2	0	1

The above A–B values are carried over to the Second Simplex Table in **S_2 and S_3 Rows** (being Non–Key Rows of 1st Table).

Second Simplex Table:

Fixed Ratio	Program	Profit	Quantity	x	y	S_1	S_2	S_3	Repl. Ratio
1/6	**Y**	100	360	1/2	1	1/2	0	0	720
NA	**S_2**	0	360	**3**	0	–2	1	0	**120** Min non–ve
5/6	**S_3**	0	540	5/2	0	–1/2	0	1	216
Decision:		Z (Objective Value)		80	100	0	0	0	
In = Key Column = x		C (Computed Value)		50	100	50	0	0	
Out= Key Row = S_2		**Net Evaluation Row**		**30** Max +ve	0	–50	0	0	

Note: For Non–Key Rows, A = (Previous Table Corresponding Row Element) **Less** B = (Key Row Element × Fixed Ratio)

Computation for y Row							**Computation for S_3 Row**						
A	360	1/2	1	1/2	0	0	**A**	540	5/2	0	–1/2	0	1
– B	60	1/2	0	–1/3	1/6	0	**– B**	300	5/2	0	–5/3	5/6	0
A–B	300	0	1	5/6	–1/6	0	**A–B**	240	0	0	7/6	–5/6	1

The above A–B values are carried over to the Third Simplex Table in **y and S_3 Rows** (being Non–Key Rows of 2nd Table).

Third Simplex Table:

Fixed Ratio	Program	Profit	Quantity	x	y	S_1	S_2	S_3	Repl. Ratio
	Y	100	300	0	1	5/6	–1/6	0	
	x	80	120	1	0	–2/3	1/3	0	
	S_3	0	240	0	0	7/6	–5/6	1	
Decision: Since all NER ≤ 0 for max. objective, the Third Table is **optimal.**		Z (Objective Value)		80	100	0	0	0	
		C (Computed Value)		80	100	30	10	0	
		Net Evaluation Row		0	0	–30	–10	0	

Answer: The Company should produce 120 units of Product X and 300 units of Product Y.

Maximum Contribution = 80 x + 100 y = (80 × 120) + (100 × 300) = 9,600 + 30,000 = **₹ 39,600.**

Interpretation of Slacks (NER and Quantity):

- Machining and Fabrication Departments (relating to Non–Program Slack Variables S_1 and S_2) are being utilised to full capacity. Any reduction in time thereof, will result in a Contribution Loss of **₹ 30 per hour** and **₹ 10 per hour** respectively (from NER). This constitutes the Marginal Value / Shadow Price per hour for these two Departments.
- Assembly Department (relating to Program Slack Variables S_3) has an idle capacity of **240 hours** (from Quantity Column in the Optimal Table). There is no Contribution Loss in that Department, **upto** 240 hours.

Question 6 (a) MRP – Theory 5 Marks

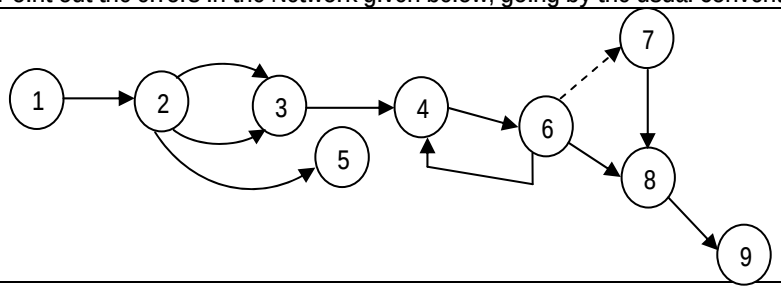
Explain the pre–requisites for successful operation of Material Requirement Planning.

Solution:

1. **Production Schedule:** The latest production and purchasing schedules prepared should be strictly adhered to. Day–to–day change from predetermined schedules will cause chaos.
2. **Standard Material Input:** Raw Materials, Sub–Assemblies and Components required for production should be pre–determined in quantifiable terms. Standards should be set for the consumption quantity, quality, mix and yield of raw materials, for every unit of the finished output.
3. **Workers Co–operation:** Workforce must be appraised of the system and the need for absolute adherence to the schedules prepared. Also, necessary controls should be developed to ensure total adherence to the schedule.
4. **Accuracy of data:** Accuracy of the data supplied is vital to the MRP System. Adherence to the Purchase and Production Schedule becomes difficult in the absence of accurate data.

Question 6 (b) Network Analysis 5 Marks

Point out the errors in the Network given below, going by the usual conventions while drawing a Network to use CPM.



Solution: The errors are –

- Same Head and Tail Event (Duplication) in Activity 2 – 3
- Dangling in Node 5, i.e. not connected to any subsequent Node
- Reverse Flow of time in Activity 4 – 6
- Use of Curves instead of lines in Activity 2 – 3, 2 – 5

Question 6 (c): Machinery Replacement Decision – Relevant Cost Analysis – Incremental Approach 5 Marks

Maruthi Agencies has received an order from a valuable client for supplying 3,00,000 pieces of a Component at ₹ 550 per unit at a uniform rate of 25,000 units a month.

Variable Manufacturing Costs amount to ₹ 404.70 per unit, of which Direct Materials is ₹ 355 per unit. Fixed Production Overheads amount to ₹ 30 Lakhs per annum, excluding depreciation. There is a Penalty / Reward Clause of ₹ 30 per unit for supplying less / more than 25,000 units per month. To adhere to the schedule of supply, the Company procured a machine worth ₹ 14.20 Lakhs which will wear out by the end of the year and will fetch ₹ 3.55 Lakhs at the year–end. After this supply of machine, the Supplier offers another Advanced Machine which will cost ₹ 10.65 Lakhs, will wear out by the year end and not have any re–sale value. If the Advanced Machine is purchased immediately, the Purchaser will exchange the earlier Machine supplied at the price of the New Machine. Fixed Costs of maintaining the Advanced Machine will increase by ₹ 14,200 per month for the whole year. While the Old Machine had the capacity to complete the production in 1 year, the New Machine can complete the entire job in 10 months. The New Machine will have Material Wastage of 0.5%. Assume uniform production throughout the year for both the Machines.

Using Incremental Cost / Revenue Approach, decide whether the Company should opt for the Advanced Version.

Solution: The following items are not relevant for the Incremental Cost / Revenue Approach, since they will be applicable irrespective of the machine used –

- Total Sales Revenue for 3,00,000 units at ₹ 550 per unit
- Other Variable Manufacturing Costs (excluding Raw Materials) = ₹ 404.70 per unit – ₹ 355 per unit = ₹ 49.70 per unit
- Fixed Costs of ₹ 30 Lakhs per annum, (It is assumed that this will be incurred irrespective of the machine used)

Statement of Incremental Revenues / Costs

Particulars	**₹ Lakhs**
Incremental Revenue: Reward (Production with New Machine = $\frac{3,00,000 \text{ units}}{10 \text{ months}}$ = 30,000 units p.m. whereas standard is 25,000 units p.m. Hence, Reward = Additional 5,000 units × ₹ 30 × 10 months	**15.00**
Incremental Costs: (a) Additional Material Costs = ($\frac{₹\ 355}{99.5\%}$ – ₹ 355) × 3,00,000 units	5.35
(b) Additional Maintenance Costs of Advanced Machine (₹ 14,200 per month × 10 months)	1.42
(c) Disposal Value of Old Machine foregone relevant as Opportunity Cost	3.55
Sub–Total	10.32
Net Incremental Benefit	**4.68**

Conclusion: Since there is an incremental Net Benefit, the Company may opt for the Advanced Version.

Question 7 (a): Simulation – Rental Car Demand 5 Marks

A Car Rental Agency has collected the following data on the demand for five–seater vehicles over the past 50 days.

Daily Demand	4	5	6	7	8
No. of days	4	10	16	14	6

The Agency has only 6 cars currently.

1. Use the following 5 Random Numbers to generate 5 days of demand for the Rental Agency. Random Nos: 15, 48, 71, 56, 90
2. What is the average number of Cars rented per day for the 5 days?
3. How many rentals will be lost over the 5 days?

Solution: 1. Random Numbers Allocation Table

Cars	Probability	Cumulative Prob.	Random Nos
4	$\frac{4}{50}$ = 0.08	0.08	00 – 07
5	$\frac{10}{50}$ = 0.20	0.28	08 – 27
6	$\frac{16}{50}$ = 0.32	0.60	28 – 59
7	$\frac{14}{50}$ = 0.28	0.88	60 – 87
8	$\frac{6}{50}$ = 0.12	1.00	88 – 99

2. Simulation Table

Day	R.No.	Demand	Rentals lost for
1	15	5 Cars	–
2	48	6 Cars	–
3	71	7 Cars	1 Car
4	56	6 Cars	–
5	90	8 Cars	2 Cars
Total		**32 Cars**	**3 Cars**

Average Demand = $\frac{32 \text{ Cars}}{5 \text{ days}}$ = 6.4 Cars per day

Question 7 (b): Service Sector– Entertainment Services – BEP with different Seats Mix 11 Marks

Entertain U Ltd hires an air–conditioned theatre to stage plays on week–end evenings. One play is staged per evening. The following are the seating arrangements:

- VIP Rows – the first 3 rows of 30 seats per row, priced at ₹ 320 per Seat.
- Middle Level – the next 18 rows of 20 seats per row, priced at ₹ 220 per Seat.
- Last Level – 6 rows of 30 seats per row, priced at ₹ 120 per Seat.

For each evening, a Drama Troupe has to be hired at ₹ 71,000, Rent has to be paid for the Theatre at ₹ 14,000 per Evening and Air Conditioning and other Stage Arrangement Charges work out to ₹ 7,400 per Evening. Every time a play is staged, the Drama Troupe's friends and guests occupy the first row of the VIP Class, free of charge, by virtue of passes granted to these guests. The Troupe ensures that 50% of the remaining seats of the VIP Class and 50% of the seats of the other two classes are sold to outsiders in advance, and the money is passed on to Entertain U. The Troupe also finds for every evening, a Sponsor who puts up his Advertisement Banner near the stage and pays Entertain U a sum of ₹ 9,000 per evening. Entertain U supplies snacks during the interval free of charge to all the guests in the hall, including the VIP Free Guests. The Snacks Cost Entertain U ₹ 20 per person. Entertain U sells the remaining tickets and observes that for every one seat demanded from the Last Level, there are 3 seats demanded from the Middle Level and 1 seat demanded from the VIP Level. You may assume that in case any level is filled, the Visitor buys the next higher or lower level, subject to availability.

Required:

1. You are required to calculate the number of seats that Entertain U has to sell in order to break–even and give the category–wise total seat occupancy at BEP.
2. Instead of the given pattern of demand, if Entertain U finds that the demand for VIP, Middle and Last Level is in the ratio 2:2:5, how many seats in each category will Entertain U have to sell in order to break–even?

Solution: 1. Basic Computations

	Particulars	VIP	Middle	Last
	Gross Seats	3 × 30 = 90	18 × 20 = 360	6 × 30 = 180
Less:	Free Seats	1 × 30 = 30	Nil	Nil
	Net Saleable Seats	60	360	180
Less:	Firm Booking by Troupe	50% of 60 = 30	50% of 360 = 180	50% of 180 = 90
	Seats available for sale by Entertain U	**30**	**180**	**90**
	Net Contribution per person	₹ 320 – ₹ 20 = ₹ 300	₹ 220 – ₹ 20 = ₹ 200	₹ 120 – ₹ 20 = ₹ 100
	Contribution earned from Firm Booking	30× ₹ 300 = ₹ 9,000	180×₹ 200= ₹ 36,000	90×₹ 100= ₹ 9,000
		₹ 54,000		

2. Fixed Costs to be recovered for BEP

(a) Drama Troupe Hire			₹ 71,000	
(b) Rent for the Theatre			₹ 14,000	
(c) Air Conditioning and other Stage Arrangement Charges			₹ 7,400	
(d) Food for VIP Free Guests (not charged) = 30 persons × ₹ 20			₹ 600	**₹ 93,000**
Less: Recovery by way of	Sponsor	₹ 9,000		
	Contribution from Firm Booking (WN 1)	₹ 54,000		**₹ 63,000**
Net Fixed Costs to be recovered				**₹ 30,000**

3. BEP at different seats mix

Particulars	VIP	Middle	Last	Total
(a) Contribution per person	₹ 300	₹ 200	₹ 100	
(b) Given Demand Ratio	1	3	1	
(c) Overall Contribution Ratio (a × b)	300	600	100	
(d) Apportionment of ₹ 30,000 (WN 2) as per above ratio	₹ 9,000	₹ 18,000	₹ 3,000	₹ 30,000
(e) BEP Number of Seats (d ÷ a)	**30**	**90**	**30**	**150**
This is compared with WN 1 Seats available for sale by Entertain U, and found feasible. Hence, it is a valid BEP.				
(f) Revised Demand Ratio	2	2	5	
(g) Revised Overall Contribution Ratio (a × f)	600	400	500	
(h) Apportionment of ₹ 30,000 (WN 2) as per revised ratio	₹ 12,000	₹ 8,000	₹ 10,000	₹ 30,000
(i) Required BEP Number of Seats (h ÷ a)	40	40	100	
(j) Seats available for sale by Entertain U (WN 1)	30	180	90	
(k) Balance seats not available for sale (i – j)	10	NA	10	
(l) Contribution lost on above seats (a × k)	₹ 3,000		₹ 1,000	₹ 4,000
(m) Additional Seats to make good above Contribution Lost		$\frac{₹\ 4,000}{₹\ 200} = 20$		
(n) Revised BEP (however not in 2 : 2 : 5 Ratio)	**30**	40+20=**60**	**90**	**180**