FINAL EXAMINATION **SET - 1**

MODEL ANSWERS **TERM – JUNE 2026**

PAPER – 16 **SYLLABUS 2022**

STRATEGIC COST MANAGEMENT

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

The figures in the margin on the right side indicate full marks.

SECTION – A (Compulsory)

1) Choose the correct answer from alternatives given: [15 × 2=30]

(i) ROB Ltd., has estimated the unit contribution of Product Z to be ₹10. Budgeted Sales for the year are 25000 units. Estimated fixed Costs are follows:

Fixed Cost P. A. (₹)	**100000**	**150000**	**20000**	**300000**
Probability	**0.20**	**0.25**	**0.40**	**0.15**

What is the probability that the company will equal or exceed the target profit of ₹ 48,000?

(A) 85 %
(B) 55 %
(C) 40 %
(D) None of the above

(ii) TUSN Ltd., maintains Margin of Safety (MOS) of 20% on its current sales and earns a profit of ₹ 30 Lakh per annum. If the company has P/V Ratio of 25 %, its current sales will be

(A) ₹ 800 Lakh
(B) ₹ 600 Lakh
(C) ₹ 400 Lakh
(D) ₹ 500 Lakh

iii) BOSS Ltd. operates a marginal costing system. For the forthcoming year, variable costs are budgeted to be 60% of sales and fixed costs are budgeted to be 10% of sales. If selling price is increased by 10% and fixed costs, variable costs and sales volume remain unchanged, the effect on contribution will be

(A) a decrease of 2%
(B) an increase of 5%
(C) an increase of 10%
(D) an increase of 25%

iv) A company uses two activities for overhead allocation: Machine setups (cost ₹60,000, 300 setups) and Quality inspections (cost ₹40,000, 200 inspections). Product A requires 30 setups and 20 inspections. What is the overhead allocated to Product A?

(A) ₹6,000
(B) ₹8,000
(C) ₹10,000
(D) ₹12,000

v) The budgeted production of a company is 20,000 units per month. The standard cost sheet is as under: Direct materials: 1.5 kgs. @ ₹ 6 per kg, Direct labour: 6 hours @ ₹5 per hour, Variable overheads: 6 hours @ ₹ 4 per hour, Fixed overheads: ₹ 3 per unit, Selling price: ₹72 per unit

Actual production and sales for the month is 18,750 units.
The Sales volume variance (in gross margin) is:

(A) ₹ 7800 (F)
(B) ₹ 9000 (F)
(C) ₹ 7500 (A)
(D) None of the above

vi) A transport company must move 100 units from two plants (P1: 40 units, P2: 60 units) to two warehouses (W1: 50 units, W2: 50 units). Costs per unit: P1→W1 ₹4, P1→W2 ₹6, P2→W1 ₹5, P2→W2 ₹3. What is the minimum total transport cost?

(A) ₹460
(B) ₹470
(C) ₹480
(D) None of the above

vii) Two firms A and B compete on pricing. Payoff matrix (profit for A in ₹000) is:

	B: Low Price	B: High Price
A: Low Price	80	120
A: High Price	60	100

What is the Maximin strategy payoff for Firm A?

(A) 60
(B) 80
(C) 100
(D) 120

viii) For a learning curve percentage of 72%, the time to be taken to complete the 4th unit of a job involved in the assembly line, if the initial unit requires 80 hours, will be

(A) 41.47 hours
(B) 43.50 hours
(C) 46.71 hours
(D) 40.95 hours

ix) Which of the following tools for Statistical Data Analysis is used most commonly in the Social Sciences and is considered as easiest to learn among enterprise Statistical tools?

(A) SAS (Statistical Analysis System)
(B) E Views
(C) SPSS (Software Package for Statistical System)
(D) Microsoft Dynamics

x) Which of the following Quality Cost (s) is / are incurred in Warranty replacements?

(A) Appraisal Costs
(B) Prevention Costs
(C) Internal failure Costs
(D) External failure Costs

xi) Which of the following decision making techniques is a technique that determines the best pricing policy for optimizing profits?

(A) Cost leadership
(B) Yield Management
(C) Kaizen Costing
(D) Life Cycle Costing

xii) Which of the following is a critical requirement for successful JIT implementation?

(A) Large safety stocks
(B) Long supplier lead times
(C) Close supplier relationships and frequent deliveries
(D) Higher inspection costs

xiii) Which of the following variances denotes the deviation between revised proposition and the actual incidence ?

(A) Planning variance
(B) Revenue Variance
(C) Operating Variance
(D) Controllable Variance

xiv) A major risk in implementing Business Process Reengineering is

(A) Over dependence on Information Technology
(B) Increase in product prices
(C) Reduced market share
(D) Employee resistance to change

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

(A) ₹37.50
(B) ₹40.00
(C) ₹45.00
(D) ₹48.60

Answer:

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)	(xiv)	(xv)
A	B	D	C	C	D	B	A	C	D	B	C	C	D	C

SECTION – B

Answer any 5 questions out of 7 questions given. Each question carries 14 marks. [5 × 14 = 70]

2) Apex Electricals Ltd. produces Product 'A' for which the company has an assured market. The output has been budgeted at 1,20,000 units at 92% capacity utilisation. The cost sheet based on output (per unit) is as follows:

Particulars	Rs.
Selling Price	100
Direct materials	21
Component 'X'	9
Direct wages @ Rs. 5 per hour	20
Factory overheads (50% fixed)	24
Selling & distribution overheads (75% variable)	12
Administration overheads	4
Total Cost	90

The factory overheads are applied on the basis of direct labour hours.

The Board was of the view that steps should be taken to utilise the idle capacity to improve the profitability of the company. The following proposals were accordingly put up before the Board for consideration:

(i) An order has been received from abroad for 500 units of Product B per month at Rs. 120 per unit. The cost data are:

Direct materials Rs. 40 per unit, Direct labour 8 hours per unit, Selling and distribution overheads applicable to this product order are Rs. 10 per unit, and the Variable factory overheads are chargeable on the basis of direct labour hours.

(ii) The Company at present manufactures component 'X', one unit of which is required for each unit of Product 'A'. The cost details for 10,000 units of component 'X' are as follows:

Particulars	Rs.
Direct materials	24,000
Direct labour	30,000
Variable overheads	18,000
Fixed overheads	18,000
Total	90,000

The component 'X', however, is available for purchase at the market at Rs. 8.00 each.

(iii) In the event of the company deciding to purchase the component 'X' from the market, the company has two alternatives for the use of the capacity so released as under:

(a) Rent out the released capacity at Re. 1 per hour.

(b) Manufacture component 'Y' which can be sold at Rs. 8.00 per unit. The cost data of this component for 10,000 units are:

Particulars	Rs.
Direct materials	**30,000**
Direct labour	**15,000**
Factory variable overheads	**9,000**
Other variable overheads	**21,000**
Total	**75,000**

Required:

(i) Prepare a statement showing the profitability of the company as originally envisaged in the budget.

(ii) Evaluate the export order and state whether it is acceptable or not.

(iii) Make an appraisal of the proposal to manufacture component 'X' and examine whether the component 'X' should be manufactured in the factory or purchased from the market. Assume that no alternative use of spare capacity is available.

(iv) Evaluate the alternative use of the spare capacity and state whether to manufacture or buy the component 'X', and if your decision is to buy the component 'X', which of the two alternatives for the use of spare capacity will you prefer? 14

Answer:

(i) Statement showing the profitability of the company as originally envisaged.

Particulars		Rs.
Sales (1,20,000 × Rs. 100)		1,20,00,000
Less: Variable Cost:		
Direct material 1,20,000 × Rs. 21	25,20,000	
Direct wages 1,20,000 × Rs. 20	24,00,000	
Component X's variable cost @ Rs. 7.20 per unit	8,64,000	
Factory overhead @ Rs. 12 per unit	14,40,000	
S. & D. overhead @ Rs. 9 per unit	10,80,000	83,04,000
Contribution		36,96,000
Factory	14,40,000	
Selling and Distribution	3,60,000	
Component 'X'	2,16,000*	
Administration	4,80,000	24,96,000
Profit as per original budget		12,00,000

*Total cost of X Component as given – Variable cost = Fixed Cost
or (1,20,000 × Rs. 9.00) – (1,20,000 × 7.20) = Rs. 2,16,000

(ii)

Particulars	Rs.	Rs.
Selling Price as per Export Order		120
Direct material	40	
Direct labour (8 × Rs. 5)	40	

Selling and Distribution Overhead	10	
Factory overhead (8 × Rs. 3)	24	114
Contribution		6

Since the product earns a contribution of Rs. 6 per unit, it should be accepted because capacity is available for utilisation, as is clear from the data given below:

Particulars	Hours
Total hours to be used by Product A (1,20,000 × 4 hrs)	4,80,000
Total hours used by X = 1,20,000 × 0.6 hr	72,000
Hours available at 92% capacity	5,52,000
Hours at 100%	6,00,000
Hours remaining to be utilised	48,000
Hours required by Export order = 500 × 8 hrs = 4,000 only	4,000

Contribution per unit of export order and availability of capacity confirm its acceptance.

(iii)

Particulars	**Cost of the decision to manufacture**	**Cost of the decision to buy**
Direct material	Rs. 24,000	
Direct labour	30,000	
Variable overhead	18,000	
Incremental cost of the decision	72,000	80,000

Since the capacity is existing, it is profitable to make the product. The fixed cost of product 'X' is irrelevant to the decision, because this facility has to be provided for product A.

(iv)

Particulars	Rs.
Hours spent on X = 1,20,000 × 0.6 hr	72,000
Cost of making X = 1,20,000 × Rs. 7.20	8,64,000
Cost to buy X = 1,20,000 × Rs. 8.00	9,60,000
Excess of cost of buying to that of making (Rs. 9,60,000 – Rs. 8,64,000)	96,000
Less: Rent income (72,000 hrs × Re. 1)	72,000
Effective cost for not manufacturing 'X'	24,000

Contribution of unit Y = (Rs. 80,000 – Rs. 75,000) ÷ 10,000 units or Re. 0.5 per unit
Number of units of Y that can be produced in 72,000 hours
Direct labour cost per unit of Y = Rs. 15,000 ÷ 10,000 units = Rs. 1.50
Number of hours required for one unit of Y = Rs. 1.5 ÷ 5 = 0.3 hr
Number of units of Y in 72,000 hours = 72,000 ÷ 0.3 = 2,40,000
Total contribution from Y = 2,40,000 × 0.5 = Rs. 1,20,000
It is more than an effective cost for not manufacturing 'X'
Therefore, company should not manufacture component 'X' and component 'Y should be produced.

3) (a) **TINY Ltd. has Profit Centre Division X and Y, making product A and B respectively. Each unit of B requires one unit of A and Y can sell a maximum of 50000 units in the external market at a selling price of Rs 150 per unit. X has the capacity to produce 100000 units of A. The variable cost per unit is Rs 12. Fixed costs are Rs 720000. X can sell the following quantities in the external market:**

Price per unit (Rs.)	Demand Units
18	84000
20	76000
22	70000
24	64000
26	54000 or less

Assume no stock build up for A or B.

Y can purchase its requirement from the external market at Rs 22 per unit, but has to incur a bulk transportation cost of Rs 150000 for any quantity, which will not be incurred on transfer from X.

Required :

(i) **Assuming no demand from Y Analyze what will be the best strategy for X.**

(ii) **Assess what will be the minimum transfer price that X will agree to if X has to supply 50000 units to Y.**

(iii) **Assess the maximum price that Y will offer.** **7**

b) **METCON manufactures a metal trimming device which has been sold at ₹16 per unit for a number of years. The selling price is to be reviewed and the following information is available on costs and likely demand:**

Cost Estimates:

Variable Cost per unit:

	₹	Probability
Pessimistic estimates	11.00	0.5
Most Likely estimates	10.00	0.3
Optimistic estimates	9.50	0.2

Fixed Cost per unit:

	₹	Probability
Pessimistic estimates	90,000	0.2
Most Likely estimates	85,000	0.5
Optimistic estimates	82,000	0.3

Demand Estimates:

	Probability	Selling Price @ ₹17 per unit	Selling Price @ ₹18 per unit
Pessimistic estimates	0.2	21,000	19,000
Most Likely estimates	0.5	19,000	17,500
Optimistic estimates	0.3	16,500	15,500

It can be assumed that all estimates and probabilities are independent. You are required to

(i) Advise management whether they should alter the selling price and if so, the price you would recommend

(ii) Calculate the expected profit at the price you recommend and the resulting margin of safety expressed as a % of expected sales. 7

Answer:

(a) (i) Variable cost is constant at Rs 12. Hence, the value that will give the maximum contribution will be relevant :

Price per unit	Demand Units	Contribution (₹/u)	Contribution Value (₹)
18	84000	6	504000
20	76000	8	608000
22	70000	10	700000
24	64000	12	768000
26	54000	14	756000

The optimal strategy for X would be to manufacture 64000 units for external demand in the absence of demand from Y.

(ii) If X has to supply 50000 units to Y, then, it can supply on 50000 units for external sales at Rs 26, the Contribution being Rs 14 per unit.
Shortfall in contribution from the maximum level Rs 7,68,000- Rs 7,00,000= Rs 68,000
Minimum contribution from Y = Rs 68000/50000 = Rs 1.36 per unit
Hence, the Minimum Transfer Price = VC of Rs 12+ Contr of Rs 1.36 = 13.36 per unit

(iii) However, if X is strong enough, it can demand a price of Rs 22 which Y will be playing to outside suppliers.
Y will not pay anything more than 22 + 150000/50000 i.e., Rs. 25 per unit.

(b) (i) The expected value calculations are as follows:

(i) Variable Cost

	₹
₹ (10 + ₹ x 10%) x 10/20	5.50
₹ 10 x 6/20	3.00
₹ (10 -10 x 5%) x 4/20	1.90
	10.40

ii) Fixed Cost

	₹
₹ 82,000 x 0.3	24,600
₹ 85,000 x 0.5	42,500
₹ 90,000 x 0.2	18,000
	85,100

iii) ₹17 selling price

Particulars	Unit
21000 units x 0.2	4,200
19000 units x 0.5	9,500
16500 units x 0.3	4,950
	18,650

iv) ₹18 selling price

Particulars	Unit
19000 units x 0.2	3,800
17500 units x 0.5	8,750
15500 units x 0.3	4,650
	17,200

Expected contribution:

Selling price ₹ 17 = (₹ 17.00 – ₹ 10.40) x 18,650 = ₹ 1,23,090

Selling price ₹ 18 = (₹ 18 – ₹ 10.40) x 17,200 = ₹ 1,30,720

Using the expected value approach, a selling price of ₹ 18 is recommended as expected contribution is highest.

(ii) Expected Profit = ₹1,30,720 - ₹85,100
= ₹45,620

Break Even Point = ₹85,100 / ₹7.60
= 11,197 units.

Margin of Safety = Expected Demand – BEP
= 17,200 – 11,197
= 6,003 units

Margin of Safety = 6,003 / 17,200
= 34.90%

4. (a) POXIM Ltd., has decided to adopt JIT Policy for materials. The following effects of JIT Policy are identified:

(i) To implement JIT, the company has to modify its production and material receipt facilities at a capital cost of Rs. 200000. The new machine will require a cash operating cost Rs. 216000 p.a. The capital cost will be depreciated over 10 years.

(ii) Raw material stockholding will be reduced from Rs. 4000000 to Rs. 1500000.

(iii) The company can earn 12% on its long-term investments.

(iv) The company can avoid rental expenditure on storage facilities amounting to Rs. 66000 per annum. Property Taxes and Insurance amounting to Rs. 44000 will be saved due to JIT programme.

(v) **Presently there are 7 workers in the Store department at a salary of Rs. 10000 each per month. After implementing JIT scheme, only 4 workers will be required in this department. Balance 3 workers' employment will be terminated.**

(vi) **Due to receipt of smaller lots of Raw Materials, there will be some disruption of production. The costs of stockouts are estimated at Rs. 154000 per annum.**

(vii) **Since the supplier is new having no reputation as yet in the market, an additional inspection cost of Rs. 12000 p.a. has to be incurred.**

Required:

(I) **Analyze the financial impact of the JIT Policy.**

(II) **Critically assess the situations and Advice the Management of POXIM Ltd., on implementation of Just-in Time (JIT) Policy.** **7**

(b) **"Value Analysis provides a structure through initiative in the direction of Cost saving, Cost reduction and Continuous improvement" – In this context, Align the important phases of Value Analysis.** **7**

Answer:

(a) **(i)** **Cost – Benefit Analysis of JIT Policy:**

COSTS	Rs.
Depreciation over 10 years (200000 / 10)	20,000
Interest on capital for modifying production facilities (₹ 2,00,000 × 12%)	24,000
Operating Costs of new production facilities	2,16,000
Stock – Out Costs	1,54,000
Inspection Costs	12,000
Total (A)	**4,26,000**

Benefits	Rs
Interest on investment on release funds (₹ 4000000 – ₹ 1500000) × 12%	300000
Savings in Salary of 3 workers terminated (₹ 10000 × 12 months × 3)	360000
Savings in rental expenditure	66000
Saving in Property tax and insurance	**44000**
Total (B)	**770000**
Net benefit due to JIT Policy (B – A)	**344000**

Note:

The capital expenditure is a proposed future cost. If instead, the company had kept 2 lacs with itself, the amount would have earned income at 12% p.a. and the investment 2 lacs would be available at the end of 10 years. Now, under JIT, not only interest is lost every year, the investment is also lost over 10 years. Hence it is pertinent to count depreciation and interest.

(ii) The Management of Poxin Ltd. is advised implement the JIT Policy as there is a net Benefit of Rs 344000 per annum.

Alternative Answer to Question 4 (a) (i):

COSTS	Rs.
Interest on capital for modifying production facilities (Rs. 200000 × 12 %)	24000
Operating Costs of new production facilities	216000
Depreciation of New Production Facilities	Nil
Stock – Out Costs	154000
Inspection Costs	12000
Total (A)	**406000**

Benefits	Rs.
Interest on investment on release funds	300000
(Rs. 4000000 – Rs. 1500000) × 12 %	
Saving in Salary of 3 workers terminated (Rs. 10000 × 12 months × 3)	360000
Saving in rental expenditure	66000
Saving in property tax and insurance	44000
Total	**770000**
Net Benefit due to JIT Policy (B – A)	**364000**

Hence it is beneficial to implement JIT

(ii) The Management of Poxim Ltd. is advised to implement the JIT Policy as there is a net Benefit of Rs 364000 per annum

(b) The Phases of Value Analysis are aligned as follows:

(1) **Origination:** The phase of origination starts with the identification of a project to undertake value analysis. After selecting the project, a project team consisting of experts from various fields and departments is constituted.

(2) **Information:** The second phase is that of collecting relevant information. In this phase, the relevant facts relating to specifications, drawings, methods, materials, etc. are collected. Costs are, also, ascertained for each of the elements that are being studied.

(3) **Functional Analysis:** Then follows the important phase of functional analysis. After familiarisation with the relevant facts & figures, a functional analysis is carried out to determine the functions and uses of the product and its components. The cost and importance of each function are identified. A value index is computed on the basis of cost benefit ratio for each of the functions),

(4) **Innovation:** This is the creative phase concerned with the generation of new alternatives to replace or remove the existing ones. The objective is to produce ideas and to formulate alternative means and methods for accomplishing the essential functions and improving the value of the element under consideration.

(5) **Evaluation:** During the stage of evaluation, each and every alternative is analysed and the most promising alternatives are selected. These alternatives are further examined for economic and technical feasibility. The alternatives finally selected must be capable of performing the desired functions satisfactorily.

(6) **Choice:** In this phase, the decision makers choose the best of alternatives. The programs and action plans are then developed to implement the chosen alternative.

(7) **Implementation:** The chosen alternative is put to the actual use with the help of the programs and action plans. The progress of implementation is continuously monitored and followed up to ensure that the desired results are achieved.

5. a) The following information relates to deployment of Labour in PKS Limited:

Type of Labour	Skilled	Semi-Skilled	Unskilled	Total
No. of workers in standard gang	4	3	2	9
Standard rate per hour (₹)	6	3	1	
Number of workers in actual gang	?	?	?	9
Actual rate per hour (₹)	7	2	2	

In a 40 hours week, the gang produced 270 standard hours. The actual number of semi-skilled workers is twice the actual number of unskilled workers. The rate variance of semi-skilled workers is ₹160 (F).

Required:

Assess the following Variances:

(i) The actual number of workers in each category

(ii) Total gang variance

(iii) Total labour rate variance

(iv) Total labour cost variance **7**

(b) A Factory of RAMO Ltd. using standard costing system, has normal capacity of 100 Machines working 8 hours per day of 25 days in a month of Year 2025.

The budgeted fixed overheads of a month are Rs. 150000. The Standard time required to manufacture one unit of product is 4 hours. In a particular month the Company worked for 24 days of 750 machine hours per day and produced 4500 units of the product. The actual fixed overhead incurred were Rs 145000.

Required:

Assess the following Variances:

(i) Fixed overhead Expenditure Variance.

(ii) Fixed overhead Calendar Variance.

(iii) Fixed overhead Capacity Variance.

(iv) Fixed overhead efficiency Variance.

(v) Fixed overhead Cost variance.

(vi) Fixed overhead volume variance. **7**

Answer:

(a) (i) Calculation of Actual No. of workers:

Actual hours in a week = 9 × 40 hrs = 360 hrs

It is given that rate variance of semi-skilled worker = ₹160 (F)

Let, a be the actual hrs worked by semi-skilled workers.
Therefore, a (3 – 2) = 160
Or, a = 160.
Further, it is given that, actual semi-skilled hrs = 2 × actual unskilled hrs
Therefore, 160 = 2 × actual unskilled hrs
∴ Actual unskilled hrs = 160/2 = 80
Actual Skilled hrs = 360 – (160 + 80) = 120

	Skilled	Semi-skilled	Unskilled
Actual Hrs	120	160	80
40 hrs week			
No. of actual workers	120/40 = 3	160/40 = 4	80/40 = 2

(ii) Calculation of Total Gang Variance:

Particulars	**Calculation**	**Amount (₹)**
Gang Variance	SR (RSH- Actual Hrs)	
Skilled Workers	6 (160 – 120)	240 (F)
Semi-Skilled Workers	3 (120 – 160)	120 (A)
Unskilled Workers	1 (80 – 80)	NIL
Total Gang Variance		120 (F)

Calculation of Revised Standard Hours (RSH):
Skilled = 4/9 × 360 = 160;
Semi-skilled = 3/9 × 360 = 120 &
Unskilled = 2/9 × 360 = 80

(iii) Calculation of Total Labour Rate Variance:

Particulars	Calculation	Amount (₹)
Rate Variance	Actual Hrs (SR – AR)	
Skilled Workers	120 (6 – 7)	120 (A)
Semi-Skilled Workers	160 (3 – 2)	160 (F)
Unskilled Workers	80 (1- 2)	80 (A)
Total Rate Variance		40 (A)

(iv) Calculation of Total Labour Cost Variance:

Particulars	Calculation	Amount (₹)
Cost Variance	SR X Std Hrs – AR X A Hrs	
Skilled Workers	6 X 120 – 7 X 120	120 (A)
Semi-Skilled Workers	3 X 90 – 2 X 160	50 (A)
Unskilled Workers	1 X 60 – 2 X 80	100 (A)
Total Cost Variance		270 (A)

(b) Working Notes:

$F0_1$	Actual fixed overhead	145000
$F0_2$	Budgeted fixed overhead for the period or Standard fixed overhead	150000
$F0_3$	Fixed overhead for days / hours available of Standard rate during the year (Rs 150000 ÷ 25 days) × 24 days	144000
$F0_4$	Fixed overhead for actual hour worked during the year (8,000 hours × Rs 7.50)	135000
$F0_5$	Standard fixed overhead for actual production (4500 × Rs 30)	135000

Analysis of Variances:

(i)	Fixed overhead expenditure variance = $F0_1 = F0_2 = 145000 – 150000 =$	**50000 (FAV.)**
(ii)	Fixed overhead Callender variance = $F0_2 – Fo_3 = 150000 – 144000 =$	**6000 (Adv.)**
(iii)	Fixed overhead capacity Variance = $F0_3 – Fo_4 = 144000 – 135000 =$	**9000 (Adv.)**
(iv)	Fixed overhead efficiency Variance = $F0_4 – Fo_5 = 135000 – 135000 =$	**Nil**
(v)	Fixed overhead Cost variance = $F0_1 – Fo_5 = 145000 – 135000 =$	**10000 (Adv.)**
(vi)	Fixed overhead Volume variance = $F0_2 – Fo_5 = 150000 – 135000 =$	**15000 (Adv.)**

6. (a) Madmax Variety Stores is interested to determine, how many advertisements to release in selected three magazines namely Stardom, Arrow and Fusion. Its main purpose is to advertise in such a way that exposure to principal buyers of its goods is maximized. Percentage of readers for each magazine are known. Exposure in any particular magazine is the number of advertisements released multiplied by the number of principal buyers. The following data are available:

Particulars	Magazine Stardom	Magazine Arrow	Magazine Fusion
Readers	1,00,000	60,000	40,000
Principal Buyers	30%	20%	10%
Cost per Advertisement	Rs.10,000	Rs.8,000	Rs.6,000

The budgeted amount at the most Rs.2,00,000 for the advertisement. The Stores has already decided that Magazine Stardom should have no more than 14 advertisements and that Magazine Arrow and Magazine Fusion each gets atleast 8 advertisements.
Develop a Linear Programming Model for this problem. 7

(b) BASIN Ltd., a manufacturing company has four JOBS (1, 2, 3, 4) and four Machines (M1, M2, M3 and M4). These Jobs can be processed on four Machines i.e. one Job on one Machine. Resulting Profits (Rs.) vary with assignments. They are given below:

JOBS	MACHINES			
	M_1	M_2	M_3	M_4
(1)	50	43	36	29
(2)	38	33	28	23
(3)	38	33	28	23
(4)	32	28	24	20

Required:
Analyze and assess the optimum assignment of Four Jobs to four Machines and corresponding Profits. 7

Answer:

(a) Let X_1, X_2 and X_3 denote the number of advertisements to be released in three magazines namely Stardom, Arrow and Fusion respectively.

Let Z denote the total exposure to the principal buyers of the goods.

Since the exposure in any magazine is the number of advertisements released multiplied by the number of principal buyers, therefore the value of Z is given by

$Z = (0.30 \times 1{,}00{,}000) \times 1 + (0.20 \times 60{,}000) \times 2 + (0.10 \times 40{,}000) \times 3$

$= 30{,}000 \times 1 + 12{,}000 \times 2 + 4{,}000 \times 3$

The shop wishes to maximize the total exposure to the principal buyers, hence the objective function is given by

Maximise $Z = 30{,}000 \times 1 + 12{,}000 \times 2 + 4{,}000 \times 3$

Subject to the following constraints:

i) The budgeted amount for the advertisement is at the most Rs. 2,00,000

Hence $10{,}000 \times 1 + 8{,}000 \times 2 + 6{,}000 \times 3 \leq 2{,}00{,}000$

ii) Also Magazine Stardom should have no more than 14 advertisements, Magazine Arrow and Magazine Fusion each should get atleast 8 advertisements.

Hence $X1 \leq 14$, $X2 \geq 8$ and $X3 \geq 8$

Thus, the linear programming model for the problem is

Maximise $Z = 30{,}000X1 + 12{,}000X2 + 4{,}000X3$

subject to

$10{,}000X1 + 8{,}000X2 + 6{,}000X3 \leq 2{,}00{,}000$

$X1 \leq 14$, $X2 \geq 8$, $X3 \geq 8$

Where X1, X2 and $X3 \geq 0$

(b) (Reducing all elements from highest element of Profit Matrix)

Loss Matrix

0	7	14	21
12	17	22	27
12	17	22	27
18	22	26	30

Row Operation

0	7	14	21
0	5	10	15
0	5	10	15
0	4	8	12

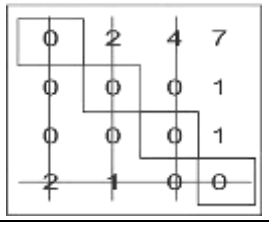
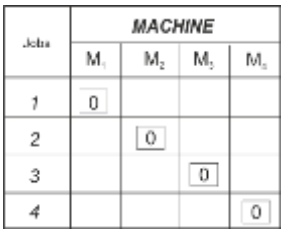
Subtracting the minimum element of each row from all elements of that row, we get the stated matrix.

Column Operation

0	3	6	9
0	1	2	3
0	1	2	3
0	0	0	0

Improved Matrix

0	2	5	8
0	0	1	2
0	0	1	2
1	0	0	0

Subtracting the minimum element of each column from all elements of that column we get, the stated matrix.	Subtracting the minimum uncovered element (1) from all uncovered element and add it to the elements lying on the inter-section of two line, we get, the stated matrix.
Further improved  	
	Since the minimum number of lines to cover all Zeros is 4 which is equal to the order of the matrix, the above matrix will give the optimum solution which is given above:

Allocation :

Jobs	Machines	Profits(P_o) (Rs.)
1	M_1	50
2	M_2	33
3	M_3	28
4	M_4	20
Maximum Profit		**131**

7. (a) TRINT Ltd. a Publishing house has bought out a new monthly magazine, which sells at Rs. 37.5 per copy. The cost of producing it is Rs. 30 per copy. A Newsstand estimates the sales pattern of the magazine as follows:

Demand Copies	Probability
0 < 300	0.18
300 < 600	0.32
600 < 900	0.25
900 < 1200	0.15
1200 < 1500	0.06
1500 < 1800	0.04

The newsstand has contracted for 750 copies of the magazine per month from the publisher.
The unsold copies are returnable to the publisher who will take them back at cost less Rs. 4 per copy for handling charges.
The news stand manager wants to simulate of the demand and profitability. The following random numbers may be used for simulation:
27, 15, 56, 17, 98, 71, 51, 32, 62, 83, 96, 69.

Required:

(i) Allocate random numbers to the demand pattern forecast by the newsstand.

(ii) Simulate twelve months sales.

(iii) Analyze the monthly and annual profit / (Loss).

(iv) Assess the loss on lost sales. **7**

(b) TEXIS Ltd., a Civil Engineering Company has been offered a contract to construct and deliver a Project of Housing Apartment. From the specifications provided by the Developer, project manager of TEXIS Ltd has listed down the various activities and estimated times to be performed to construct the Housing Apartment as under:

Activities	DURATION TIME (DAYS)		
	Optimistic Time	Most likely Time	Pessimistic Time
1 – 2	3	6	15
2 – 3	6	12	30
3 – 5	5	11	17
7 – 8	4	19	28
5 – 8	1	4	7
6 – 7	3	9	27
4 – 5	3	6	15
1 – 6	2	5	14
2 – 4	2	5	8

Required:

(i) Develop the PERT Network and indicate all paths through it.

(ii) Analyze the critical path, expected time for completion of the project and project variance after estimating the earliest and latest event times of all nodes. **7**

Answer:

(a) (i) Allocation of random number

Demand	Probability	Cumulative Probability	Allocated RN
0 < 300	0.18	0.18	00 – 17
300 < 600	0.32	0.50	18 – 49
600 < 900	0.25	0.75	50 – 74
900 < 1200	0.15	0.90	75 – 89
1200 < 1500	0.06	0.96	90 – 95
1500 < 1800	0.04	1.00	96 – 99

(ii) & (iii) Simulation: Twelve months sales, monthly and annual profit / Loss.

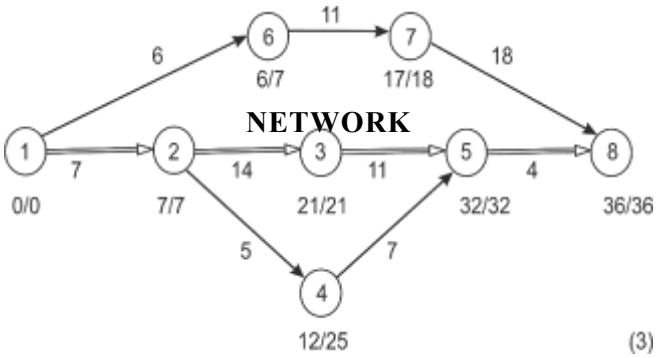
Month	RN	Demand	Sold	Return	Profit on sales (Rs.)	Loss on return (Rs.)	Net (Rs.)	Loss on Loss units
1	27	450	450	300	3375	1200	2175	–
2	15	150	150	600	1125	2400	-1275	–
3	56	750	750	---	5625	---	5625	–
4	17	150	150	600	1125	2400	-1275	–
5	98	1650	750	–	5625	---	5625	900
6	71	750	750	–	5625	–	5625	–
7	51	750	750	–	5625	–	5625	–
8	32	450	450	300	3375	1200	2175	–
9	62	750	750	–	5625	–	5625	–
10	83	1050	750	–	5625	–	5625	300
11	96	1650	750	–	5625	–	5625	900
12	69	750	750	–	5625		5625	–
Total					**54000**	**7200**	**46800**	**2100**

(iv) Loss on lost sale 2100 x 7.5 = Rs 15750

(b)

Activity	Duration Time (Days)			Expected Time	Variance
	Optimistic (t_o)	Most Likely (t_m)	Pessimistic (t_p)	$t_e = \frac{t_o + 4t_e + t_p}{6}$	$S_t^2 = \left(\frac{t_p - t_o}{6}\right)^2$
1 – 2	3	6	15	7	4
2 – 3	6	12	30	14	16
3 – 5	5	11	17	11	4
7 – 8	4	19	28	18	16
5 – 8	1	4	7	4	1
6 – 7	3	9	27	11	16
4 – 5	3	6	15	7	4
1 – 6	2	5	14	6	4
2 – 4	2	5	8	5	1

(i)



(3)

(ii) The Critical path is 1 – 2 – 3 – 5 – 8

Expected time E(T) for completion of the project is 7 + 14 + 11 + 4 = 36 days

Project Variance is obtained by summing variances of all the critical activities, i.e. $\sigma_t^2 = 4 + 16 + 4 + 1 = 25$

Therefore, $\sigma_t = \sqrt{25} = 5$

8. a) When the price of a product X is ₹48, 70 units are demanded each week and when price is increased to ₹78, weekly demand reduced to only 40 units. The manufacturer's fixed costs are ₹ 1,710 a week and variable costs are ₹ 9 per unit.

(i) Establish the demand function.

(ii) Recommend a unit price which would maximise profit and find the quantity demanded at that price. 7

(b) The production (in Thousand Tonnes) of a Sugar Factory of AURO Ltd. for the Year 2016 through 2024 are given below:

Year	2016	2018	2020	2022	2024
Production (in Thousand Tonnes)	18	21	23	27	16

Required:

(i) Fit a Straight-line Trend by the method of Least Squares.

(ii) Assess the estimated Production (in Thousand Tonnes) of Sugar in the year 2019 and year 2032. 7

Answer:

(a) Let the demand function be: P = a + bX

When X =70, P =48, we have 48 = a+ 70b

Similarly, 78 = a+ 40b

Solving the above 2 equations, we get b = 1 and a = 118

Therefore, the demand function is P = 118 -X

Profit (say Y) = Revenue – Cost = $(118X – X^2) – (1710+9X)$

= $109X- X^2- 1710$ = dY/dX = 109-2X

Profit is maximum when $dY/dX = 0$ and $d^2Y/dX^2<0$
Putting $dY/dX = 0$, we get $109-2X = 0$ or $X =109/2 = 54.5$
$d^2Y/dX^2= -2$
Therefore, profit is maximum at X= 54.5
Profit is maximized when either 54 or 55 units are sold
Profit maximizing price is given by P = 118-54 or 118-55 = 64 or 63

(b) **(i)** Here n = 5, i.e., odd, and, therefore, we shift the origin to the middle time period, viz., the year 2020. Let the trend line be given by the equation:

Y = a + b X

Where X = t – 2020 and units X = 1 year and Y is production (in Thousand tonnes).

COMPUTATION OF STRAIGHT LINE TREND

YEAR (t)	Production (in Thousand Tonnes) (Y)	X = t – 2020	XY	χ^2	Trend Value ("Thousand" Tonnes) $Y_e = 21 + 0.1\ X$
2016	18	–4	–72	16	21–0.4 = 20.6
2018	21	–2	–42	4	21–0.2 = 20.8
2020	23	0	0	0	21.0
2022	27	2	54	4	21+0.2=21.2
2024	16	4	64	16	21+0.4=21.4
Total	$\sum Y = 105$	$\sum X = 0$	$\sum XY = 4$	$\sum X^2 = 40$	

The normal equation for estimating a and b in (*) are

$\sum Y = Na + b\sum X$	$\sum X\,Y = a\sum X + b\sum X^2$
$\Rightarrow \quad 105 = 5a + 0$	$\Rightarrow \quad 4 = a \times 0 + 40\,b$
$\Rightarrow \quad a = \frac{105}{5} = 21$	$\Rightarrow \quad b = \frac{4}{40} = 0.1$

Substituting in (*), the trend line is given by:
$Y_e = 21 + 0.1\ X$,
Where origin is July 2020 and unit X = 1 year

(ii) The estimated Production (in Lakh Tonnes) for the year:
Year 2019 (Y_{19}) = 21 + 0.1 x (-1) = 20.90 Thousand Tonnes
Year 2032 (Y_{32}) = 21 + 0.1 x 12 = 22.20 Thousand Tonnes