FINAL EXAMINATION

June 2023

P–16(SCM)
Syllabus 2022

STRATEGIC COST MANAGEMENT

Time Allowed: 3 Hours | Full Marks: 100

The figures in the margin on the right side indicate full marks.
Working Notes should form part of the respective answers.
Wherever considered necessary, suitable assumptions may be made and clearly indicated in the answer.

Section-A : Strategic Cost Management for Decision Making

Answer to Question No. 1 and 6 *in* Section A, *are compulsory.*

Further, answer any three *from* Question Nos. 2, 3, 4 *and* 5.

1. Choose the most appropriate answer to the following questions with justification. 1 mark will be awarded for correct answer and 1 mark for justification. 8×2=16

(i) Which one of the following is not a support activity of value chain?

(A) Human Resource Management
(B) Technological Development
(C) Service
(D) Infrastructure

(ii) Warranty period return of finished goods sold falls under the following quality cost:

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

(iii) Target Costing is the answer to

(A) Market Driven Prices
(B) Seller's Market
(C) No Profit Situation
(D) None of the Above

(iv) Producing more non-bottleneck output

(A) creates more inventory and increases throughput contribution.
(B) creates more inventory but does not increase throughput contribution.
(C) creates less pressure for the bottleneck workstations.
(D) allows for the maximisation of overall contribution.

(v) Which one of the following is not true for a Red ocean strategy and why?

(A) Beat the competition

(B) Exploit existing demand

(C) Make the value cost trade-off

(D) Break the value cost trade-off

(vi) SINT Ltd. determine its selling price by marking up the variable cost 50%. In addition, the company uses frequent selling price mark down to stimulate sales. If the mark down average is 20%, what is the company's contribution margin Ratio?

(A) 16.67%

(B) 18.50%

(C) 20.30%

(D) None of the above

(vii) At ROXIN LTD., cost of personnel department has always been charged to production department based upon number of employees. Recently opinion gathered from the department managers indicate that number of new hires might be better predictor of personnel cost. Total personnel department costs are ₹ 3,00,000.

Department	C	D	F
Number of Employees	40	300	160
Number of new Hires	10	32	8

If the number of new hire is considered the cost driver, what amount of cost will be allocated to Department D ?

(A) ₹ 2,00,000

(B) ₹ 1,92,000

(C) ₹ 1,50,000

(D) ₹ 1,30,000

(viii) BOSAN LTD. using standard costing system provides the following information pertaining to Direct Labour for its product JUM for the month of May, 2023:

Standard Direct Labour Rate per hour:	₹ 16
Actual Direct Labour Rate per hour	₹ 14.50
Labour Rate variance	₹ 15,000 (Fav)
Standard hours allowed for Actual production	8000 hours

Actual output is 800 units.

How many Direct Labour hours were worked during the month of May, 2023?

(A) 12,000 hours

(B) 11,000 hours

(C) 10,000 hours

(D) None of the above

2. (a) "Business Process Re-engineering involves the radical redesign of core business processes to achieve dramatic improvements in productivity, cycle times and quality." In this context, state what are the characteristics and principles of Business Process Re-engineering. 6

   (b) Summarize the essential steps to be taken in the implementation of Total Quantity Management (TQM) (Any Six) 6

3. (a) The following financial information has been extracted from the records of ASHREEN LTD. for analyzing the cost of quality for the year 2022-2023:

   (i) Sales Revenue for the year: ₹ 400 lakh

   (ii) During the year, customers returned 40,000 units needing repair, repair cost averages ₹ 8 per unit.

   (iii) Six Inspectors are employed each earning an annual salary of ₹ 2,00,000. These six inspectors are involved only with final inspection (Product acceptance).

   (iv) Total Scrap is 30,000 units. All scraps are quality related. The cost of scrap is about ₹ 20 per unit.

   (v) During the year, approximate 1,20,000 units are rejected in final inspection. Of these units, 90 per cent can be recovered through rework. The cost of rework is ₹ 8 per unit.

   (vi) The company employs 5 full time employees in the complaint department. Each earns ₹1,00,000 for this year.

   (vii) The company requires all new employees to take three hour quality training programme. The estimated cost for the programme is ₹ 1,50,000.

   (viii) Inspection of the final products requires testing equipment. The annual cost of operating and maintaining this equipment is ₹ 1,80,000.

   Required:

   (I) Analyse the costs of quality showing its elements separately with workings.

   (II) If the selling price per unit is ₹ 50 and variable cost is 60% of the sales and fixed costs ₹ 70 lakh per annum, determine what will be the profit (Net of quality costs) of the Company for the year 2022-2023. 4+3=7

   (b) SUNRISE PRAKASHAN LTD. is in the business of publishing a leading news paper which has a wide customer base. It measures quality of service in terms of:

   (i) Print quality

   (ii) On time delivery

   (iii) Number of damaged and unsold paper.

   To improve its business prospects and performance, the company is considering installing a scheduling and tracking system which involve an annual additional cost of ₹ 3,00,000 besides equipments costing ₹ 4,00,000 needed for the installation of system.

To purchase the equipment, the company is planning to utilize the proceeds of an investment fetching an income @ 9%. Details regarding the present and future performance are given as under:

	Present	Expected
On time delivery	80%	95%
Variable cost per lot of newspaper damaged and unsold (₹)	40	40
Fixed Cost (₹)	60,000	60,000
No. of lots of newspaper damaged and unsold	6,000	1,000

It is expected that each percentage increases in on time performance will result in revenue increase of ₹ 35,000 per annum. Required contribution margin is 40%.

Required:

Draw inference from the information given above and evaluate, whether Sunrise Prakashan Ltd. should install the new system. 5

4. (a) SONTECH LTD., a machine manufacturing company, had nearly completed a job relating to construction of specialized equipment when it discovered that the customer had gone into liquidation. At this stage, the position of the job was as under:

	₹
Original cost estimated	1,75,200
Costs incurred so far	1,48,500
Costs to be incurred	29,700
Progress payments received from original customer	1,00,000

After searches, a new customer for the equipment has been found. He is interested to take the equipment if certain modifications are carried out. The new customer wants the equipment in its original condition, but without its control device and with certain other modifications. The costs of these additions and modifications are estimated as under:

Direct materials at cost	₹ 1,050
Direct Wages	₹ 3,500

Variable overheads: 25% of direct wages

Delivery costs: ₹ 1,350

Fixed overheads will be absorbed at 50% of direct wages.

The following additional information is available:

(i) The direct materials required for the modification are in stock and if not used for modification of the order, they will be used in another job in place of materials that will now cost ₹ 2,250.

(ii) The Department is extremely busy. Its direct wages is ₹ 2,500 and currently yielding a contribution of ₹ 3.20 per rupee of direct wages.

(iii) Supervisory overtime payable for the modification is ₹ 1,050.

(iv) The cost of control device that the new customer does not require is ₹13,500. If it is taken out, it can be used in another job in place of a different mechanism. This latter mechanism has otherwise to be bought for ₹ 10,500. The dismantling and removal of the control mechanism is ₹ 120.

(v) If the conversion is not carried out, some of the materials in the original equipment can be used in another contract in place of materials that would have cost ₹ 12,000. It would have taken wages cost of ₹ 240 to make them suitable for this purpose. The remaining materials will realize ₹ 11,400 as scrap. The drawings, which are included as part of the job, can be sold for ₹ 1,500.

Required:

Analyse the relevant costs of equipment in deciding at what minimum price that the company can afford to quote for the new customer. 7

(b) PANIT LTD., a video company sells package of blank video tapes to its customers. It purchases video tapes from VISAN (I) Company @ ₹ 140 a packet. VISAN (I) Company pays all freight to PANIT LTD. No incoming inspection is necessary because VISAN (I) Company has a superb reputation for delivery of quality merchandise. Annual demand of PANIT LTD. is 13,000 packages. PANIT LTD. requires 15% annual return on investment. The purchase order lead time is two weeks. The purchase order is passed through internet and it costs ₹ 3 per order. The relevant insurance, material handling etc. ₹ 5.10 per package per year. PANIT LTD. has to decide whether or not to shift to JIT purchasing. VISAN (I) company agrees to deliver 100 packages of video tapes 130 times per year (5 times every two weeks) instead of existing delivery system of 1,000 packages 13 times a year, with additional amount of ₹ 0.50 per package. PANIT LTD. incurs no stock out under its current purchasing policy. It is estimated, PANIT LTD. incurs stock out cost on 50 video tape packages under a JIT purchasing policy. In the event of a stock out, PANIT LTD. has to rush order tape packages which costs ₹ 4 per package.

Required:

Assess the information as stated supra and advise PANIT LTD. as to whether it should implement JIT Purchasing system? 5

5. (a) Director-Operations of ABC Ltd.(ABCL) is of the view that Standard Costing has little to offer in the reporting of material variances due to frequently change in price of materials.

ABCL can utilize one of two equally suitable raw materials and always plan to utilize the raw material which will lead to cheapest total production costs. However ABCL is frequently trapped by price changes and the material actually used often provides, after the event, to have been more expensive than the alternative which was originally rejected.

During last accounting period, to produce a unit of 'Gama', ABCL could use either 5 kg. of 'Exe' or 5 kg. of 'Wye'. ABCL planned to use 'Exe' as it appeared it would be cheaper of the two and plans were based on a cost of 'Exe' of ₹ 3 per kg. Due to market movements the actual price changed and if ABCL had purchased efficiently the cost would have been:

'Exe' ₹ 4.50 per kg

'Wye' ₹ 4 per kg

Production of 'Gama' was 1,000 units and usage of 'Exe' amounted to 5,400 kg at a total cost of ₹ 25,920.

Calculate the material variance for 'Gama' by:

(i) Traditional Variance analysis and

(ii) An approach which distinguishes between Planning and Operational Variances. 8

(b) SUZIN LTD. using a detailed system of standard costing finds that the cost of investigation of variances is ₹ 20,000. If after investigation an out of control situation is discovered, the cost of correction is ₹ 30,000. If no investigation is made, the present value of extra cost involved is ₹ 1,50,000. The probability of the process being in control is 0.82 and the probability of the process being out of control is 0.18.

You are required to advise:

(I) Whether investigation of the variances should be undertaken or not

(II) the probability at which it is desirable to institute investigation into variance. 4

6. You have been approached by a friend who is seeking your advice as to whether he should give up his job as an engineer, with a current salary of ₹ 14,800 per month and go into business on his own, assembling and selling a component which he has invented. He can procure the parts required to manufacture the component from a supplier.

It is very difficult to forecast the sales potential of the component, but after some research, your friend has estimated the sales as follows:

(i) Between 600 to 900 components per month at a selling price of ₹ 250 per component.

(ii) Between 901 to 1,250 components per month at a selling price of ₹ 220 per component for the entire lot.

The costs of the parts required would be ₹ 140 for each completed component. However, if more than 1,000 components are produced in each month, a discount of 5% would be received from the supplier of parts on all purchases.

Assembly costs would be ₹ 60,000 per month upto 750 components. Beyond this level of activity assembly costs would increase to ₹ 70,000 per month.

Your friend has already spent ₹ 30,000 on development, which he would write off over the first five years of the venture.

Required:

(I) Analyse the information stated supra and formulate by way of calculating for each of the possible sales levels at which your friend could expect to benefit by going into the venture on his own.

(II) Formulate by way of calculating the breakeven point of the venture for each of the selling price and suggest your friend on each level of break-even point.

(III) Advise your friend as to the viability of the venture. 8

Section-B : Quantitative Techniques in Decision Making

Answer to Question No. 7 and 11 *in* Section B, *are compulsory.*

Further, answer any two *from* Question Nos. 8, 9 *and* 10.

7. Choose the most appropriate answer to the following questions giving justification. 1 mark will be awarded for correct answer and 1 mark for justification. 2×2=4

(i) Assignment Problem can be considered as a particular case of

(A) Transportation problem

(B) Sequencing problem

(C) Queuing problem

(D) All of the above

(ii) In PERT CHART, the Activity time distribution is

(A) Normal

(B) Binomial

(C) Beta

(D) Poisson

8. (a) UTKARSH Bank is in the process of formulating its loan policy involving a maximum of ₹ 600 million. Table below gives the relevant types of loans. Bad debts are not recoverable and produce no interest revenue. To meet competition from other banks, the following policy guidelines have been set. At least 40% of the funds must be allocated to the Agricultural and Commercial loans. Funds allocated to Housing must be at least 50% of all loans given to personal, car, housing. The overall bad debts on all loans may not exceed 0.06.

Type of Loan	Interest Rate (%)	Bad Debt (Probability)
Personal	17	0.10
Car	14	0.07
Housing	11	0.05
Agricultural	10	0.08
Commercial	13	0.06

Required:

Develop and formulate a linear programming model to determine optimal loan allocation. 6

(b) A travelling salesman has to visit five cities. S,T, X,Y and Z. The inter city distances are tabulated below. Note the distance between two cities need not be same both ways.

From/To	S	T	X	Y	Z
S	-	14	26	27	17
T	8	-	18	20	9
X	12	13	-	20	14
Y	16	19	24	-	18
Z	14	15	25	27	-

The distance are in km.

Required:

If the travelling salesman starts from City S and has to come back to city S, by applying the principle of quantitative technique,which route would you advise him to take so that total distance travelled by him is minimized? 8

9. (a) A and B play game in which each has three coins, a 5R, 10R and 20R. Each selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, A wins B's coin, if the sum is even B wins A's coin.

Required:

(i) Prepare the pay-off matrix for two players (A and B).

(ii) Find the best strategy for each player and

(iii) Calculate the value of Game using Dominance Principle. 8

(b) (i) What do you mean by Business Intelligence (BI) software?

(ii) Discuss in brief what are the features of R Programming Language. 2+4=6

10. (a) GANGOTRI LTD. is developing a new product. During its expected life, 16,000 units of the product will be sold for ₹ 102 per unit. Production will be in batches of 1,000 units throughout the life of the product. The direct labour cost is expected to reduce due to the effects of learning for the first eight batches, produced. Thereafter, the direct labour cost will remain constant at the same cost per batch as in the 8th batch.

The direct labour cost of the first batch of 1,000 units is expected to be ₹ 55,000 and a 90% learning effect is expected to occur. The direct material and other non-labour related variable costs will be ₹ 50 per unit throughout the life of the product.

There are no fixed costs that are specific to the product.

[Given: The learning index for a 90% learning curve = – 0.152; $8^{-0.152} = 0.729$; $7^{-0.152} = 0.744$, $9^{-0.152} = 0.716$ and $\sqrt[4]{0.4532} = 0.8205$, $\sqrt[4]{0.3773} = 0.7837$, $\sqrt[4]{0.2636} = 0.7166$]

Required:

(i) Calculate the expected direct labour cost of the 8th batch.

(ii) Assess the expected contribution to be earned from the product over its lifetime.

(iii) Infer the rate of learning required to achieve a lifetime product contribution of ₹ 6,00,000, assuming that a constant rate of learning applies throughout the product's life. 3+2+3=8

(b) The total cost function of a firm $C = \frac{x^3}{3} - 5x^2 + 28x + 10$,

where C is total cost and 'x' is the output. A GST @ ₹ 2 per unit of output is imposed and the producer adds it to his cost. If the demand function is given by $D = 2530 - 5x$, where ₹ D is the price per unit of output.

Required:

Evaluate the profit maximizing output and the price at the level. 6

11. DHAMIN & CO., an Audit firm having numerous clients with identical financial years, is faced with a problem of framing the audit programme in such a way that reports of all its clients do not get delayed. Manpower and time are its chief constraints. Mr. Panth, partner of the firm, an auditor, is a Manager in the same that he has to plan his audit programme, organize the firm's articles and it's clerks, direct them to achieve their pre-determined objectives, control quality of work, time and cost, and lastly report his observations to the firm's clients. Thus, the knowledge of sophisticated techniques PERT/CPM helps him as an auditor to plan his audit programme logically and control avoidable and unnecessary delays and costs. In order to simplify the analysis, the following assumptions are made:

(i) The audit is a medium sized limited company.

(ii) A final or complete audit is undertaken.

(iii) The size of the audit team is one senior and three juniors.

(iv) No significant fraud or irregularities are observed to hamper the audit time schedule.

(v) All queries are clarified during the process of audit itself.

(vi) Expected time (duration) is based on past experience.

Activity and identification		Activity description	Preceded by	Expected Time (Days)		
				Optimistic	Most likely	Pessimistic
A	1-2	Pursue the memorandum and Article of Association, prospectus etc. of the company	–	1	1	7

Activity and identification		Activity description	Preceded by	Expected Time (Days)		
				Optimistic	Most likely	Pessimistic
B	1-3	Scrutinize the Board Minutes and Important resolutions which have a bearing on accounts	–	1	4	7
C	1-4	Vouch and post cash book involving receipts and payments etc.	-	2	2	8
D	2-5	Test the efficiency of internal control in operation	A	1	1	1
E	3-5	Vouch and post purchases and sales ledger and check purchases and sales ledger balances	B	2	5	14
F	4-6	Examine journal entries and check their posting and examine and check trial balance	C	2	5	8
G	5-6	Verify and value various assets and liabilities of the company and check all the schedules forming part of P&L A/c and Balance Sheet	D & E	3	6	15
H	6-7	Ensure the truth and fairness of P&L A/c and Balance Sheet and finalise report keeping in mind the requirements of Sec. 143 of the Companies Act and forward it for approval and signature	F& G	1	2	3

Required:

(I) Design the PERT network.

(II) Identify the critical path and assess the expected project (Audit) completion time.

(III) Evaluate what duration will have 95% confidence for project (Audit) completion.

(IV) If the average duration for Activity F increases to 14 days (assume its variance = 1), assess what will be its effect on the expected project (Audit) completion time which will have 95% confidence.

Given:

Z Value	1.00	1.50	1.645	2.00
Probability	0.8413	0.9332	0.950	0.9772

8

SUGGESTED ANSWERS TO QUESTIONS
SECTION – A

1.

(i) (C)
(ii) (D)
(iii) (A)
(iv) (B)
(v) (D)
(vi) (A)
(vii) (B)
(viii) (C)

2. (a)

Characteristics and Principles of Re-engineering Process are enumerated below:

(i) Several jobs are combined into one
(ii) Often workers make decisions
(iii) The steps in the process are performed In a logical order
(iv) Work is performed, where it makes most sense
(v) Quality is built in.
(vi) Manager provides a single point of contact
(vii) Centralized and decentralized operations are combined.

Seven Principles of BPR:

(i) Processes should be designed to achieve a desired outcome rather than focusing on existing tasks.
(ii) Personnel who use the output from a process should perform the process
(iii) Information processing should be included in the work, which produces the information
(iv) Geographically disperesed resources should be treated, as if they are centralized
(v) Parallel activities should be linked rather than integrated
(vi) Doers should be allowed to be self-managing
(vii) Information should be captured once at source.

2. (b)

The essential steps to be taken in the implementation of Total Quality Management are summarized below:

Step 1: Identification of customers / customer groups:

Through a team approach (a technique called Multi-Voting), the Firm should identify major customer groups. This helps in generating priorities in the identification of customers and critical issues in the provision of decision-support information.

Step 2: Identifying customer expectations:

Once the major customer groups are identified, their expectations are listed. The question to be answered is - What does the customer expect from the Firm?

Step 3: Identifying customer decision-making requirements and product utilities:

By identifying the need to stay close to the customers and follow their suggestions, a decision support system can be developed, incorporating both financial and non-financial and non-financial information, which seeks to satisfy user requirements.

Step 4: Identifying perceived problems in decision-making process and product utilities:

Using participative processes such as brainstorming and multi-voting, the Firm seeks to list out its perception of problem areas and shortcomings in meeting customer requirements.

Step 5: Comparison with other Firms and benchmarking:

Detailed and systematic internal deliberations allow the Firm to develop a clear idea of their own strengths and weaknesses and of the areas of most significant deficiency. Benchmarking exercise allows the Firm to see how other Companies are coping with similar problems and opportunities.

Step 6: Customer Feedback:

Steps I to 5 provide a information base developed without reference to the customer. This is rectified at Steps *6* with a survey of representative customers, which embraces their views on perceived problem areas. Interaction with the customers and obtaining their views helps the Firm in correcting its own perceptions and refining its processes.

Steps 7& 8: Identification of Improvement opportunities and Implementation of Quality Improvement Process:

The outcomes of the customer survey, benchmarking and Internal analysis, provides the inputs for Steps 7 and 8, i.e. the identification of improvement opportunities and the implementation of a formal improvement process. This is done through a six-step process called **PRAISE,** for short.

3. (a)

(i) Cost of Quality = ₹ 38,14,000

(ii) Net Profit = ₹ 51,86,000

3. (b)

Costs and Benefits for installation of the New System:

	Rs.
Total Cost for the New System	3,36,000
Total Benefits from the New System	4,10,000
Net Benefits	74,000

Decision: By installation the Scheduling and Tracking System, the Company (Sunrise Prakashan Ltd.) will be able to save Rs. 74000 per annum. Hence the Company should install the New System.

4. (a)

The minimum price that SONTECH Ltd. can afford to quote for the new Customer is Rs. 60945.

4. (b)

Comparative statement of cost for purchasing from VISAN (I) Company under current policy & JIT.

Particulars	**Current purchasing Policy**	**JIT Purchasing Policy**
Total Relevant Cost	₹ 18,33,089	₹ 18,28,398.75

Advice: As may be seen from above, the relevant cost under the JIT purchasing policy is lower than the cost incurred under the existing system. Hence PANIT Ltd. is advised to implement the JIT Purchasing System.

5. (a)

Traditional Variance:

Total Cost variance = ₹ 10,920 (A)

Operational Variance:

Total Cost variance = ₹ 3,420 (A)

Planning variance:

Total variance = ₹ 7,500 (A)

Traditional variance

Operational variance + Planning Variance

₹ 3,420(A) + ₹ 7,500(A)

= ₹ 10,920 (A)

5. (b)

(i) Total Cost of investigate = ₹ 25,400
Cost of not to investigate = ₹ 27,000

Since cost when investigation is undertaken is less than the cost of no Investigation it should be done.

(ii) Probability at which Investigation into Variance should be instituted
Finding out the probability at which both costs are equal.
Let χ be the probability of process being in control.
$\therefore 1 - \chi$ is probability of process being out of control

Equating two costs:

$50000 - 30000\ \chi = 150000 — 150000\ \chi$

$120000\ \chi = 100000$ or $\chi = 0.833$

At the probability level of 0.83 (Process-in-Control), both costs are equal. As this probability level declines, the cost of not investigating will be grater than cost of Investigating. If probability level is anywhere below 0.83, investigation should be instituted.

6.

I. The salary of Rs. 14,800 per month is a benefit foregone by going into business. It should therefore be considered as a minimum profit which must be earned p.m. from the new venture in order to be not worse-off than before.

II. Sum of Rs.30,000 spent on the development work of the new venture cannot be recovered irrespective of the decision and thus it should be ignored.

III. Advise on the viability of the venture:

(a) At a selling price of Rs. 250 he will not be at a loss if the demand of the component exceeds 680 units to 749 units and 770.909 units to 900 units.

(b) At a selling price of Rs. 220, it is not worthwhile to sell if the demand is less than 1000 components without availing a discount of 5%.

SECTION – B

7.

(i) (A)
(ii) (C)

8. (a)

Let X_1 , X_2 , X_3 , X_4 and X_5 be loan to the 5 sectors In Rs. million

The objective function will be :

Maximize, $Z = 0.17\ X_1 + 0.14\ X_2 + 0.11\ X_3 + 0.10\ X_4 + 0.13\ X_5$

Subject to the Constraints :

$X_1+X_2+X_3+X_4+X_5. \leq 600$(Fund limit)

$X_4+X_5 \geq 240$((Ag+com loan at least 40%) (.40 x 600) = 240

$X_3 \geq 0.50\ (X_1+ X_2 ,+X_3)$ i.e. $0.5X_3 -0.5X_1-0.5X_2 \geq 0$ (Housing Loan)

Bad Debt - Limit = 0.06 x 600 = Rs. 36 million

$0.10\ X_1 + 0.07\ X_2 + 0.05\ X_3 + 0.08\ X_4 + 0.06\ X_5 \geq 36$

With non-negative constraints

$X_1 , X_2 , X_3 , X_4 , X_5 \geq 0$

8. (b)

	Profit matriX				
	S	T	X	Y	Z
S	-	14	26	27	17
T	8	-	18	20	9
X	12	13	-	20	14
Y	16	19	24	-	18
Z	14	15	25	27	-

Step 1- Row operation					
	S	T	X	Y	Z
S	-	0	12	13	3
T	0	-	10	12	1
X	0	1	-	8	2
Y	0	3	8	-	2
Z	0	1	11	13	-

Step 2- Column operation					
	S	T	X	Y	Z
S	-	0	4	5	2
T	0	-	2	4	0
X	0	1	-	0	1
Y	0	3	0	-	1
Z	0	1	3	5	-

Assignment allocation					
	S	T	X	Y	Z
S	-	**0**	4	5	2
T	0	-	2	4	**0**
X	0	1	-	**0**	1
Y	0	3	**0**	-	1
Z	**0**	1	3	5	-

S-T-Z -Y -X -S

14+9+20+24+14

= 81 KMs

The Optimum Distance is 81 KMs.

9. (a)

(i) The pay – off matrix for two players is given by

		Player B		
		B_1	B_2	B_3
Player A	A_1	-5	10	20
	A_2	5	-10	-10
	A_8	5	-20	-20

(ii) As all elements of 2nd Row of the above matrix are either greater than or equal to the corresponding elements of the 3rd Row, the 2nd row can be considered to dominate the 3rd Row. So 3rd Row is ignored and new matrix is shown below :

		Player B		
		B_1	B_2	B_3
Player A	A_1	-5	10	20
	A_2	5	-10	-10

Again all the elements of 3rd Column are greater than or equal than the all elements of 2nd column, the 2nd column is dominated by 3rd Column. Hence 3rd column is ignored and the new matrix is shown below :

		Player B	
		B_1	B_2
Player A	A_1	-5	10
	A_2	5	-10

The game, clearly, has no saddle point and using the principle of dominance, the reduced 2 x 2 pay – off matrix will be :

		Player B	
		B_1	B_2
Player A	A_1	-5	10
	A_2	5	-10

The optimum mixed strategy for player A:

$P_1 = \frac{1}{2}$ and $P_2 = \frac{1}{2}$

And for the player B:

$q_1 = \frac{2}{3}$ and $q_2 = \frac{1}{3}$

(iii) The expected value of the game: $v = 0$

9. (b)

(i) Business Intelligence (BI) Software is a set of business analytics solutions used by companies to retrieve, analyse and transform data into useful business insights usually within easy-to-read visualization - like charts, graphs and dashboards. Examples of the best BI Tools include data visualization, data warehouses, interactive dashboards and BI reporting tools. A BI Solution pulls internal data produced by a company, into an Analytics platform for deep insights as to how different parts of a business affect one another.

BI software interprets a sea of quantifiable customer and Business actions and queries based on patterns in the data.

(ii) Features of R Programming language are stated below:

1. Statistical features of R : -

- Basic Statistics - Most common terms of basic statistics are Mean, Median and Mode which are the Measures of Central Tendency for a dataset. These can be very easily computed using R.
- Static Graphics - R is rich with facilities for creating and developing interesting Static Graphics. R contains functionality for many plot types including graphic maps, mosaic plots, bi-plots and the list goes on.
- Probability Distributions - Probability Distributions play vital role in statistics. By using R various types of problems related to probability distributions (such as Binomial Distribution, Normal Distribution, Student's Distribution, Chi Square Distribution etc.) can be handled very easily.
- Data Analysis - It provides a large, coherent and integrated collection of tools for data analysis. (Any 2**)**

2. Programming features of R : -

- R Packages - One of the major features of R is the fact that it has a wide availability of libraries. R has CRAN (Comprehensive R Archive Network) which is repository holding more than 10,000 packages.
- Distributed Computing - Distributed computing is a model in which components of a software system are shared among multiple computers to improve efficiency and performance. Packages like ddR and multidplyr are used for distributed programming in R.

10. (a)

(i) The Expected direct labour cost for 8th batch = ₹ 34,320

(ii) Contribution to be earned from the product over its lifetime = ₹ 2,36,680

(iii) Rate of Learning = 71.65%

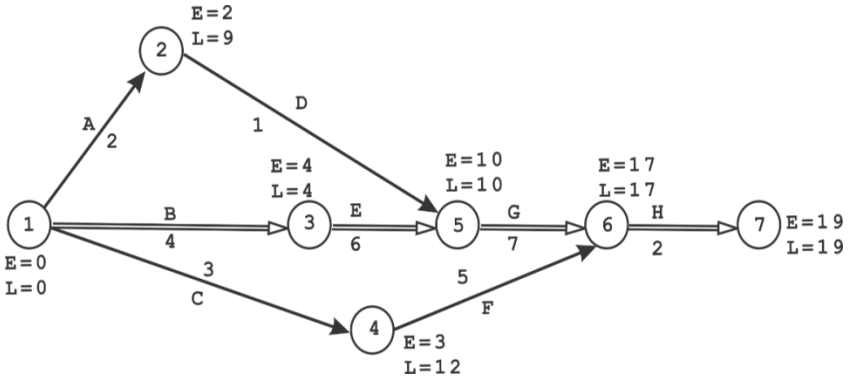
10. (b)

Maximum profit is at 50 units

Price = ₹ 2,280

11.

(i) The required network is designed below:



(ii) The critical path is 1 – 3 – 5 – 6 – 7 or B – E – G – H and the expected project (Audit) completion time is 19 days.

(iii) 24 days of project (Audit) completion time will have 95% probability of its completion.

(iv) The project (Audit) duration of 24.48 days will have 95% confidence of completion.

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