

Section A (Production)

- Answer any 5 questions.
- All questions carry equal marks.
- Use of ordinary calculators is permitted.
- Use of statistical and log tables allowed.
- Necessary explanations, assumptions at intermediate stages must be given.

Q1. PM Computer Services assembles customized personal computers from generic parts. Formed and operated by part-time UMass Lowell students Paulette Tyler and Maureen Becker, the company has had steady growth since it started. The company assembles computers mostly at night, using part-time students. Paulette and Maureen purchase generic computer parts in volume at a discount from a variety of sources whenever they see a good deal. Thus, they need a good forecast of demand for their computers so that they will know how many parts to purchase and stock. They have compiled demand data for the last 12 months as reported below.

Period	Month	Demand	Period	Month	Demand
1	January	37	7	July	43
2	February	40	8	August	47
3	March	41	9	September	56
4	April	37	10	October	52
5	May	45	11	November	55
6	June	50	12	December	54

a. Use exponential smoothing with smoothing parameter $\alpha = 0.3$ to compute the demand forecast for January (Period 13).

b. Use exponential smoothing with smoothing parameter $\alpha = 0.5$ to compute the demand forecast for January (Period 13).

Q2. Given the sales data for 10 months use trend adjusted smoothing with a single smoothing constant $\alpha = 0.4$ and double smoothing constant $\beta = 0.3$ to forecast sales for 11th month.

Month:	1	2	3	4	5	6	7	8	9	10
Sales in units:	700	724	720	728	740	742	758	750	770	775

[TURN OVER

Q3. A dealer supplies you the following information with regard to a product dealt with him : Annual demand = 5,000 units, ordering cost = Rs.25.00 per order, inventory carrying cost is 30% per unit per year of purchase cost Rs.100 per unit. The dealer is considering the possibility of allowing some back-orders to occur for the product. He has estimated that the annual cost of back-ordering the product will be Rs.10.00 per unit.

- i) What should be the optimum number of units of the product he should buy in one lot?
- (II) What quantity of the product should he allow to be back-ordered?
- (III) How much additional cost will he have to incur on inventory if he does not permit back-ordering?

Q4. A machine shop has five machines A,B,C,D and E. Two jobs are to be processed on each of these machines. The processing times (hours) and sequence for each of the jobs are given below:

Job 1 Sequence	A	B	C	D	E
Time	3	4	5	6	6
Job 2 Sequence	C	A	D	E	B
Time	4	7	3	4	6

Q5. Determine an optimum sequence to process the various types of fan blades each day from the following information so as to minimize the total elapsed time:

Types of fan Blades	Number to be processed each Day	Processing times on	
		Machine A (minutes)	Machine B (minutes)
1	4	4	8
2	6	12	6
3	5	14	16
4	2	20	22
5	4	8	10
6	3	18	2

also work out the total elapsed time for an optimum sequence. What is the total idle time on machine 1? On machine 2?

Q6. A bank has two counters, one handling deposits only and the other handling withdrawals only. Past records showed that service time distributors for both deposits and withdrawals follow negative exponential distribution with mean service time of 3 minutes per customer. Depositors arrive in a poisson fashion throughout the day with mean arrival rate of 16 per hour. Withdrawers also arrive in a poisson fashion with mean arrival rate of 14 per hour?

- What is the average waiting time of depositors and withdrawers?
- What will be the effect on the average waiting time if each counter could handle both withdrawals and deposits?

Q7. Explain the following techniques:

- Howard's policy space technique
- Markovian process with rewards

Q8. A transport agency is faced with the problem of deciding the crew size for loading of the trucks. Though the space available is only for one truck, but the unloading /loading time can be reduced by increasing the size of the crew.

Trucks arrive in a purely random fashion throughout the day at an average of 1.50 trucks per hour. The average service rate is one truck per hour for one loader. The service time, of course varies. Additional loaders will increase the service rate proportionately. If the waiting time cost of the truck is 25Rs per hour per truck and the crew members are paid Rs 5/- per hour per person, what size of the crew is best?

Section B (Marketing)

Note:

- Answer any 5 questions.
- All questions carry equal marks.
- Use of ordinary calculators is permitted.
- Use of statistical and log tables allowed.
- Necessary explanations, assumptions at intermediate stages must be given.

Q1. While watching a game of Champions League football in a cafe, you observe someone who is clearly supporting Manchester United in the game. What is the probability that they were actually born within 25 miles of Manchester? Assume that:

- The probability that a randomly selected person in a typical local bar environment is born within 25 miles of Manchester is $1/20$, and;
- The chance that a person born within 25 miles of Manchester actually supports United is $7/10$;

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• The probability that a person not born within 25 miles of Manchester supports United with probability $1/10$.

Q2. A quality control manager found that 30% of worker-related problems occurred on Mondays, and that 20% occurred in the last hour of a day's shift. It was also found that 4% of worker-related problems occurred in the last hour of Monday's shift.

- (a) What is the probability that a worker-related problem that occurs on a Monday does not occur in the last hour of the day's shift?
- (b) Are the events "Problem occurs on Monday" and "Problem occurs in the last hour of the day's shift" statistically independent?

Q3. You are traveling by a canoe down a river and there are n trading posts along the way. Before starting your journey, you are given for each $1 \leq i < j \leq n$, the fee $f_{i,j}$ for renting a canoe from post i to post j . These fees are arbitrary. For example it is possible that $f_{1,3} = 10$ and $f_{1,4} = 5$. You begin at trading post 1 and must end at trading post n (using rented canoes). Your goal is to minimize the rental cost. Give the most efficient algorithm you can for this problem. Be sure to prove that your algorithm yields an optimal solution and analyze the time complexity.

Q4. A jewelry company buys semiprecious stones to make bracelets and rings. The supplier quotes a price of \$5 per stone for quantities of 600 stones or more, \$9 for orders of 400 to 599, and \$10 per stone for lesser quantities. The jewelry firm operates 200 days per year. Usage is 25 stones per day, and ordering costs are \$48.

a. If carrying costs are \$2 per year for each stone, answer the following questions.

- What is the optimal ordering quantity?
- What is the common EOQ?
- What is the total ordering cost for the optimal solution?

Q5. The cost of parameters and other factors for a production inventory system of automobile pistons are given below. Find (i) Optimum lot-size, (ii) number of shortages and (iii) manufacturing time and time between two set-ups.

Demand per year = 6000 units; unit cost = Rs. 40;

Set-up cost = Rs. 500; production rate per year = 36,000 units

Holding cost per year = Rs.8; Shortage cost per unit per year = Rs. 20

Q6. The Metal Discovery Group (MDG) is a company set up to conduct geological explorations of parcels of land in order to ascertain whether significant metal deposits (worthy of further commercial exploitation) are present or not. Current MDG has an option to purchase outright a parcel of land for £3m.

If MDG purchases this parcel of land then it will conduct a geological exploration of the land. Past experience indicates that for the type of parcel of land under consideration geological explorations cost approximately £1m and yield significant metal deposits as follows:

- manganese 1% chance
- gold 0.05% chance
- silver 0.2% chance

Only one of these three metals is ever found (if at all), i.e. there is no chance of finding two or more of these metals and no chance of finding any other metal.

If manganese is found then the parcel of land can be sold for £30m, if gold is found then the parcel of land can be sold for £250m and if silver is found the parcel of land can be sold for £150m.

MDG can, if they wish, pay £750,000 for the right to conduct a three-day test exploration before deciding whether to purchase the parcel of land or not. Such three-day test explorations can only give a preliminary indication of whether significant metal deposits are present or not and past experience indicates that three-day test explorations cost £250,000 and indicate that significant metal deposits are present 50% of the time.

If the three-day test exploration indicates significant metal deposits then the chances of finding manganese, gold and silver increase to 3%, 2% and 1% respectively. If the three-day test exploration fails to indicate significant metal deposits then the chances of finding manganese, gold and silver decrease to 0.75%, 0.04% and 0.175% respectively.

- What would you recommend MDG should do and why?
- A company working in a related field to MDG is prepared to pay half of all costs associated with this parcel of land in return for half of all revenues. Under these circumstances what would you recommend MDG should do and why?

Q7. The table below shows the demand for a particular brand of microwave oven in a department store in each of the last twelve months.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Demand	27	31	29	30	32	34	36	35	37	39	40	42

- Calculate a six month moving average for each month. What would be your forecast for the demand in month 13?

[TURN OVER

- Apply exponential smoothing with a smoothing constant of 0.7 to derive the demand in month 13.
- Which of the two forecasts for month 13 do you prefer and why?

Q8. The table below shows the demand for a new aftershave in a shop for each of the last 7 months.

Month	1	2	3	4	5	6	7
Demand	23	29	33	40	41	43	49

- Calculate a two month moving average for months two to seven. What would be your forecast for the demand in month eight?
- Apply exponential smoothing with a smoothing constant of 0.1 to derive a forecast for the demand in month eight.
- Which of the two forecasts for month eight do you prefer and why?
- The shop keeper believes that customers are switching to this new aftershave from other brands. Discuss how you might model this switching behaviour and indicate the data that you would require to confirm whether this switching is occurring or not.

Section B (Finance)

Note:

- Answer any 5 questions.
- All questions carry equal marks.
- Use of ordinary calculators is permitted.
- Use of statistical and log tables allowed.
- Necessary explanations, assumptions at intermediate stages must be given.

Q1. An auto parts supplier sells Hardy-brand batteries to car dealers and auto mechanics. The annual demand is approximately 1,200 batteries. The supplier pays \$28 for each battery and estimates that the annual holding cost is 30 percent of the battery's value. It costs approximately \$20 to place an order (managerial and clerical costs). The supplier currently orders 100 batteries per month.

- a. Determine the ordering, holding, and total inventory costs for the current order quantity.
- b. Determine the economic order quantity (EOQ).
- c. How many orders will be placed per year using the EOQ?
- d. Determine the ordering, holding, and total inventory costs for the EOQ. How has ordering cost changed? Holding cost? Total inventory cost?

Q2. An investment company is considering which of the two methods it should adopt to market its investment services to the public: direct mailing or newspaper advertisement. The

company has a budget of Rs 1, 50,000 for this purpose. Cost of direct mailing is 30 paise per each shot. Past experience indicates a response rate of between 6% and 12% with an average of 8%. The chances of the lower, higher and average response rate actually occurring are estimated to be 15%, 20% and 65% respectively.

Newspaper advertisements have also been used in the past and they also produce varying response rates. The company would give a weekly insertion in Sunday newspapers, thereby totaling 52 insertions in a year. Response rates vary between 700 and 2000 per insertions with average of 1350. The chances of these response rates actually occurring are 30%, 20% and 50% respectively. In either case, only 40% of the responses are expected to produce a sale. Each sale yields a net income of Rs 10. Which method should the company adopt?

Q3. A vital spare of an equipment costs Rs 1000 and its shortage will lead to a notional loss of Rs 3000 per unit shortage. Its monthly requirement is as follows:

• Monthly demand :	1	2	3	4	5	6	Total
• Frequency:	0	5	10	15	15	5	50

Assuming that the spare part has no salvage value, how many of them should be bought along with the equipment?

Q4. Three locations are being considered for a new plant. Fixed costs per year for the three locations are 30,000Rs, Rs 60,000 and Rs 1,10,000 respectively. Variable costs in Rs/-units are 75, 45 and 25 respectively. The selling price of the product is Rs 120. Find the most economical location for an expected volume of 2000 units per year using the locational break even analysis.

Q5. A. Explain the following in the context of dynamic programming:

- 1) Principle of optimality 2) State 3) Stage

B. What is dynamic programming and what sort of problems can be solved by it?

Q6. In Orange County, 51% of the adults are males. (It doesn't take too much advanced mathematics to deduce that the other 49% are females.) One adult is randomly selected for a survey involving credit card usage.

- Find the prior probability that the selected person is a male.
- It is later learned that the selected survey subject was smoking a cigar. Also, 9.5% of males smoke cigars, whereas 1.7% of females smoke cigars (based on data from the Substance Abuse and Mental Health Services Administration). Use this additional information to find the probability that the selected subject is a male.

Q7. A businessman has two independent investments A and B available to him, but he lacks the capital to undertake both of them simultaneously. He can choose to take A first and then stop, or if A is successful, then take B or vice versa. The probability of success of A is 0.7 while for B it is 0.4. Both investments require an initial capital outlay of Rs 2,000 and both return nothing if the

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venture is unsuccessful. Successful completion of A will return Rs 3,000 (over cost). Successful completion of B will return Rs 5000 (over cost). Draw the decision tree and determine the best strategy.

Q8. Explain:

- Cost volume profit analysis under certainty
- Hertz and Hiller Model in investment analysis under uncertainty
- Sensitivity analysis

(3 Hours)

[Total Marks : 20]

- N.B. : (1) Answer any **five** questions.
 (2) **All** questions carry **equal** marks.
 (3) Use of **ordinary calculator** is **permitted**.
 (4) **Figures** to the **right** indicate **full** marks.
 (5) Necessary explanations at intermediate stages must be given.

(Finance Stream)

1. Use Dual Simplex method to solve L. P. P. : 20

$$\begin{aligned} \text{Minimize } Z &= x_1 + x_2 \\ \text{Subject to } 2x_1 + x_2 &\geq 2 \\ -x_1 - x_2 &\geq 1 \\ x_1, x_2 &\geq 0 \end{aligned}$$

2. Consider the Linear programming problem — 20

$$\begin{aligned} \text{Maximize } Z &= 4x_1 + 6x_2 + 2x_3 \\ \text{Subject to } x_1 + x_2 + x_3 &\leq 3 \\ x_1 + 4x_2 + 7x_3 &\leq 9 \\ x_1, x_2, x_3 &\geq 0 \end{aligned}$$

3. Solve the following Linear Goal programming problem — 20

$$\begin{aligned} \text{Minimize } Z &= (0_3 + 0_4, 0_1, u_2, u_3 + 8/5 u_4) \\ \text{Subject to } g_1 : x_1 + x_2 + u_1 - 0_1 &= 20 \\ g_2 : x_1 + x_2 + u_2 - 0_2 &= 50 \\ g_3 : x_1 + u_3 - 0_3 &= 15 \\ g_4 : x_2 + u_4 - 0_4 &= 8 \\ x_1, u_1, 0_1 &\geq 0 \end{aligned}$$

Where the goals are written in order of priority.

4. Solve the following mixed integer problem by the branch and bound technique — 20

$$\begin{aligned} \text{Maximize } Z &= x_1 + x_2 \\ \text{Subject to } 2x_1 + 5x_2 &\leq 16 \\ 6x_1 + 5x_2 &\leq 30 \\ x_2 &\geq 0 \\ x_1 &\geq 0 \text{ are integer.} \end{aligned}$$

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5. A network with the following activity duration and man power requirement is given. Analyse the project from point of view of resources to bring out the necessary steps involved in the analysis and smoothening of resources.

Activity	1 - 2	2 - 3	2 - 4	3 - 5	4 - 6	4 - 7	5 - 8	6 - 8	7 - 9	8 - 10	9 - 10
Duration (weeks)	2	3	4	2	4	3	6	6	5	4	4
No. of men required	4	3	3	5	3	4	3	6	2	2	9

6. The optimistic, most likely and pessimistic times of a project are given below. Activity 40 - 50 must not start before 22 days, while activity 70 - 90 must end by 35 days. The scheduled completion time of the project is 46 days. Draw the network and determine the critical path. What is the probability of completing the project in scheduled time?

Activity	$t_o - t_m - t_p$	Activity	$t_o - t_m - t_p$
10 - 20	4 - 8 - 12	50 - 70	3 - 6 - 9
20 - 30	1 - 4 - 7	50 - 80	4 - 6 - 8
20 - 40	8 - 12 - 16	60 - 100	4 - 6 - 8
30 - 50	3 - 5 - 7	70 - 90	4 - 8 - 12
40 - 50	0 - 0 - 0	80 - 90	2 - 5 - 8
40 - 60	3 - 6 - 9	90 - 100	4 - 10 - 16

7. Write short notes on the following :—

(a) Application of GP in manpower planning

(b) Advantages of network analysis

(c) Weakness of Gantt Chart

(d) What do you mean by slack? Define critical path in the light of the definition of slack.

8. List of activities for erecting a canteen in a factory is given below with other relevant details. Job A must precede all others while job E must follow others. Apart from this jobs can run concurrently.

Code	Job Description	Normal		Crash	
		Duration (days)	Cost ₹	Duration (days)	Cost ₹
A	Lay foundation and build walls	5	3000	4	4000
B	Tile roofing	6	1200	2	2000
C	Instal electricity	4	1000	3	1800
D	Instal plumbing	5	1200	3	2000
E	Connect services to finish	3	1600	3	1600
			8,000		

(a) Draw a network and identify the critical path.

(b) Crash the network fully to find out minimum duration.

(c) If indirect costs are ₹ 300 / days, determine time cost trade off for the project.

(Marketing Stream)

(N.B. : Answer any five questions. All questions carry equal marks.)

1. Max $Z = 5x_2 - x_1$ 20
 Subject to $2x_1 - x_2 \geq -2$
 $-0.2x_1 + x_2 \leq 2$
 $x_1, x_2 \geq 0$

2. Minimize $Z = 2x_1 + x_2$ 20
 Subject to $3x_1 + x_2 \geq 3$
 $4x_1 - 3x_2 \geq 6$
 $x_1 + 2x_2 \geq 3$
 $x_i \geq 0$

3. Use duality to solve the problem : 20
 Minimize $Z = x_1 - x_2$
 Subject to $2x_1 - x_2 \geq 2$
 $-x_1 + x_2 \geq 1$
 $x_1, x_2 \geq 0$

4. Solve the problem : 20
 Maximize $Z = 5x_1 + 12x_2 + 4x_3$
 Subject to $x_1 + 2x_2 + x_3 \leq 5$
 $2x_1 - x_2 + 3x_3 = 2$
 $x_1, x_2, x_3 \geq 0$

5. (a) Food X contains 6 units of Vitamin A per gram and 7 units of Vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of Vitamin A per gram and 12 units of Vitamin B per gram and costs 20 paise per gram. The daily minimum requirements of Vitamin A and Vitamin B is 100 units and 120 units respectively. Find the minimum cost of Product mix by the Simplex method. 20

- (b) Discuss the effect of changing the requirements vector from $\begin{bmatrix} 5 \\ 2 \end{bmatrix}$ to $\begin{bmatrix} 7 \\ 2 \end{bmatrix}$ on the optimum solution.

6. (a) Solve the following 3×3 matrix game whose pay-off matrix is — 20

$$\begin{bmatrix} 3 & -1 & -3 \\ 2 & 3 & -1 \\ -4 & -3 & 3 \end{bmatrix}$$

[TURN OVER

6. (b) Two firms, had the following four strategies for each :
- Increase profitability by buying a new machine
 - Increase selling price
 - Lower selling price
 - Launch an aggressive Advertising campaign.

The pay-off matrix -

Firm A's Strategies	Firm B's Strategies			
	B ₁	B ₂	B ₃	B ₄
A ₁	2	6	2	-2
A ₂	4	0	-4	-2
A ₃	-2	4	4	4
A ₄	-1	-6	-1	-2

7. The table below provides Cost and Time estimates of seven activities of a project :

Activity	Time Estimates (Week)		Direct Cost Estimates (₹ in thousand)	
	Normal	Crash	Normal	Crash
1-2	2	1	10	15
1-3	8	5	15	21
2-4	4	3	20	24
3-4	1	1	7	7
3-5	2	1	8	15
4-6	5	3	10	16
5-6	6	2	12	36

- Draw the project network corresponding to normal time.
- Determine the critical path and normal duration and normal cost of the project.
- Crash the activities so that the project completion time reduces to a week, with minimum additional cost.

A network with the following activity durations and man power requirement is given. Analyse the project from point of view of resources to bring out the necessary steps involved in the analysis and smoothening of resources.

Activity	Duration (Week)	No. of men required
1-2	2	4
2-3	3	3
2-4	4	3
3-5	2	5
4-6	4	3
4-7	3	4
5-8	6	3
6-8	6	6
7-9	5	2
8-10	4	2
9-10	4	9

(Production Stream)

(N.B. : Answer any five questions) (100 Marks)

1. Consider the problem :

$$\text{Maximise } Z = 2x_1 + 20x_2 - 10x_3$$

$$\text{Subject to } 2x_1 + 20x_2 + 4x_3 \leq 15$$

$$6x_1 + 20x_2 + 4x_3 = 20$$

$$x_1, x_2, x_3 \geq 0 \text{ and integer}$$

Solve the problem as a continuous linear program, then show that it is impossible to obtain feasible integer solution by using simple rounding. Solve the problem using any integer problem algorithms.

20

2. A company manufactures two products, radios and transistors which must be processed through assembly and finishing departments. Assembly has 90 hours available finishing can handle upto 72 hours of work. Manufacturing one radio requires 6 hours in assembly and 3 hours in finishing. Each transistor requires 3 hours in assembly and 6 hours in finishing. If profit is ₹ 120 per radio and ₹ 90 per transistor determine the best combination of radios and transistors to realize profit of ₹ 2,100.

20

3. Consider the parametric problem.

$$\text{Max } Z = (3 - 6\lambda) x_1 + (2 - 2\lambda) x_2 + (5 + 5\lambda) x_3$$

$$\text{Subject to } x_1 + 2x_2 + x_3 \leq 430$$

$$3x_1 + 2x_3 \leq 460$$

$$x_1 + 4x_2 \leq 420$$

$$x_1, x_2, x_3 \geq 0$$

Perform a complete parametric analysis and identify all the critical values of the parameter λ .

20

[TURN OVER

4. Solve by Dual Simplex method the following problem -

$$\begin{aligned} &\text{Minimize } Z = 2x_1 + 2x_2 + 4x_3 \\ &\text{Subject to } \begin{aligned} 2x_1 + 3x_2 + 5x_3 &\geq 2 \\ 3x_1 + x_2 + 7x_3 &\leq 3 \\ x_1 + 4x_2 + 6x_3 &\leq 5 \\ x_1, x_2, x_3 &\geq 0 \end{aligned} \end{aligned}$$

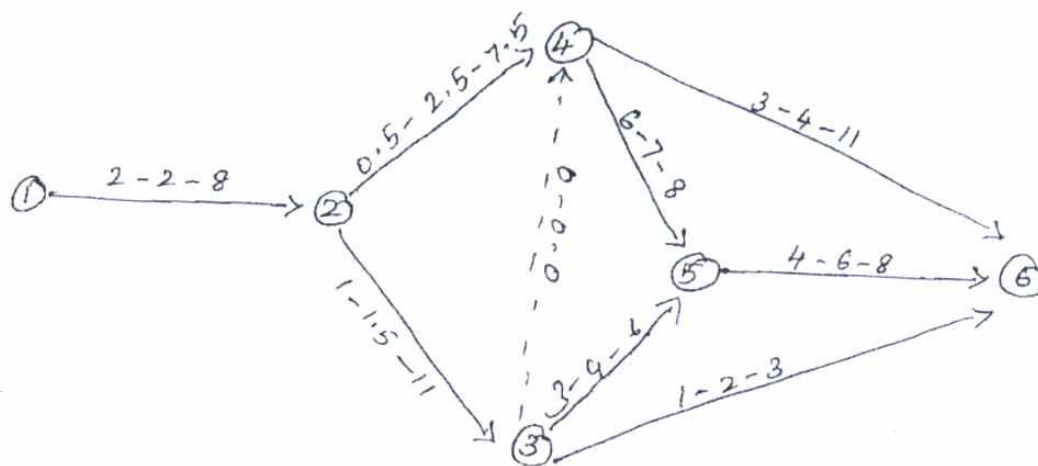
5. Use the Revised Simplex method to solve the following problem -

$$\begin{aligned} &\text{Max } Z = 6x_1 + 3x_2 + 4x_3 - 2x_4 + x_5 \\ &\text{Subject to } \begin{aligned} 2x_1 + 3x_2 + 3x_3 + x_4 &= 10 \\ x_1 + 2x_2 + x_3 + x_5 &= 8 \\ x_1, x_2, x_3, x_4, x_5 &\geq 0 \end{aligned} \end{aligned}$$

6. Consider the product mix problem -

$$\begin{aligned} &\text{Max } Z = x_1 + 5x_2 + 3x_3 + 4x_4 \\ &\text{Subject to } \begin{aligned} 2x_1 + 3x_2 + x_3 + 2x_4 &\leq 800 \\ 5x_1 + 4x_2 + 3x_3 + 4x_4 &\leq 1200 \\ 3x_1 + 4x_2 + 5x_3 + 3x_4 &\leq 1000 \\ x_i &\geq 0 \text{ for all } i. \end{aligned} \end{aligned}$$

7. Consider the network shown in figure. The three time estimates for the activities are given along the arrows. Determine the critical path. What is the probability that the project will be completed in 20 days?



8. Solve by L.P.P.

$$\begin{aligned} &\text{Minimize } Z = x_1 - 2x_2 - 3x_3 \\ &\text{Subject to } \begin{aligned} 2x_1 + x_2 + 3x_3 &= 2 \\ 2x_1 + 3x_2 + 4x_3 &= 1 \\ x_1, x_2, x_3 &\geq 0 \end{aligned} \end{aligned}$$

P.G.D.C.R.M.

Use of Computer in operation

F.H. Exam. April(1)-13-122

Research

BB-95

20 on. 7930-13.

(3 Hours)

[Total Marks : 100

- I.B. : (1) Attempt any **five** questions.
 (2) **All** questions carry **equal** marks i.e. **20** marks.

- 20 1. Comment, giving details and applications of both DBMS and RDBMS systems 20
 with reference to their use in Operation Research.
- 20 2. Define MIS. Features and benefits, various steps involved in designing an effective 20
 and efficient information system in an organisation.
- 20 3. What role computer plays in data analysis ? How co-operation research or models 20
 can be solved by using computer ? Explain one of them.
4. Data warehousing and database MGT similarity and differences. 20
- 20 5. Datamining technique for data analysis. Discuss any three methods. 20
6. Need of Business Intellingence. 20
7. Define MIS, ERP, Expert System. How are they similar or different from each 20
 other ?
8. Discuss the advantages, disadvantage, limitations of various networking 20
 topologist.
