Second year PGDORM
Paper VI - Advance Operation Research - I
8th may 2009

1 sthalf-09-nkDC-119

Con. 2305&(a-b)-09. **BB-8766 to 8768**

(3 Hours) **[Total Marks : 100**

N.B.: (1) Attempt any **five** questions.
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of statistical tables and non-programmable calculator is **permitted**.
(4) Answers must be **brief** and to the **point**.
(5) Intermediate explanations and calculations **must** be given.
(6) Assumptions wherever **necessary** must be given.

1. (a) Solve the following LPP using Graphical method. **10**

Minimize $Z = 5x_1 + 3x_2$
Subject to $2x_1 + 5x_2 \geq 480$
$8x_1 + 5x_2 \geq 720$, $x_1, x_2 \geq 0$

(b) Write down the Dual praoblem of the following LPP. **10**

Maximize $Z = 2x_1 - 3x_2 + 5x_3$
Subject to $x_1 + 2x_2 \geq 40$
$x_1 - x_2 \leq 3$
$x_1 + 3x_2 = 60$
$x_1 \geq 0$ and x_2 unrestricted.

2. (a) Solve the following LPP using Gomery's cutting plane method :— **10**

Maximize $Z = 7x_1 + 4x_2$
Subject to $-x_1 + 3x_2 \leq 6$
$7x_1 + x_2 \leq 35$
$x_1, x_2 \geq 0$ and integer.

Optimum non-integer solution of the above LPP is—

Basic	C	x_1	x_2	s_1	s_2	b
x_2	9	0	1	7/22	1/22	7/2
x_1	7	01	0	– 1/22	3/22	9/2
	$Z_j - C_j$	0	0	28/11	15/11	63

(b) What are the artificial variables and why we need them ? How do they differ from slack/surplus variables ? **10**

3. Optimal simplex table for a LPP is given below :— **10**

Basis	C	x_2	x_1	s_1	s_2	b
x_1	4	1	—	1	—	
s_2	0	1	—	– 1	—	2
	Δ	1	0	—	—	24

(i) Write down the mising figures (–) in the above table.
(ii) Obtain the original LPP.
(iii) What is the optimal solution ? Interpret it,
(iv) Determine the range for C_1 so that the variables in the Basis will not change.
(v) If a constraint $3x_1 + 5x_2 \leq 25$ is added, what will be the optimal solution ?
(vi) Determine the range for b_1 so that the basic variables will not change.
(vii) When will x_2 enter the basis ?

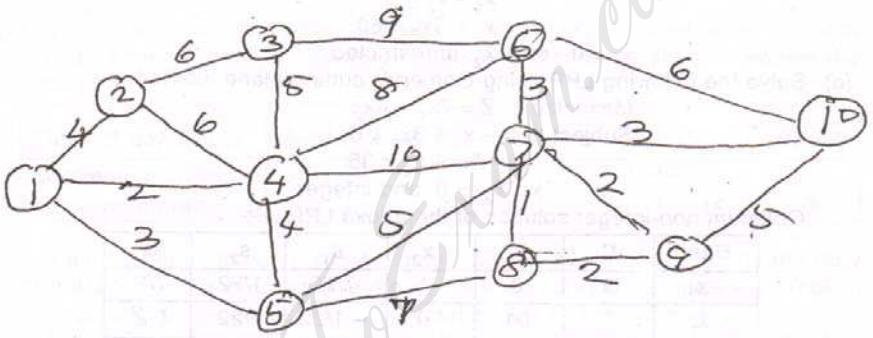
[TURN OVER

4. (a) A manufacturer produce 4 products A, B, C and D by using 2 types of machines M_1 and M_2. The times required on the 2 machines to manufacture one unit of each product, the profit per unit of the product and the total time available on the 2 types of machines M_1 and M_2, are given below :— 10

Machine	Time required, in mins. per unit of each of the product				Total time, in mins., available per day
	A	B	C	D	
M_1	7	10	4	9	1200
M_2	3	40	1	1	800
Profit, in Rs. per unit	45	100	30	50	

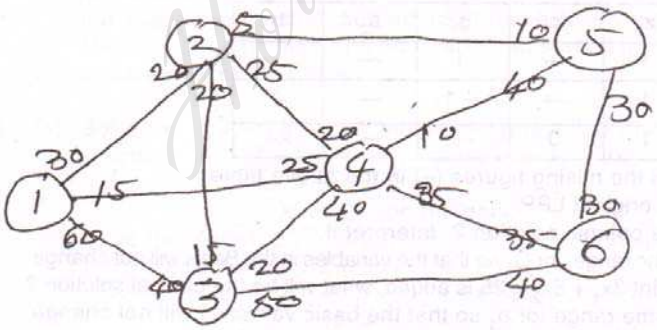
Find the number of units to be manufactured of each product per day for maximize the profit.

(b) Sole the following spanning tree problem. 10



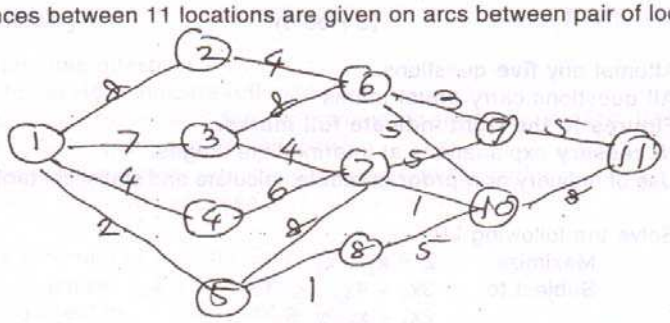
Figures on arcs are distances between the nodes.

5. Consider the pipe net-work below, showing the flow capacities between various pairs of locations. 20



Find the maximal flow from Node (1) (source) to Node (6) (sink).

6. (a) Distances between 11 locations are given on arcs between pair of locations. 10



Find the shortest path from node (1) to node (11) and also corresponding distances.

(b) Solve the following LPP by Revised Simplex method 10

Maximize $Z = 2x_1 + 3x_2$

subject to $2x_1 + 3x_2 \leq 30$, $x_1 + 2x_2 \geq 10$, $x_1, x_2 \geq 0$

7. (a) The table below gives estimates of Normal Duration (ND), Crash Duration (CD), Normal cost (NC) and Crash Cost (CC) for each of the project activities. 10

Activity	1—2	1—3	2—3	3—4	4—5
MD, days	5	6	4	5	7
CD, days	2	3	2	2	4
NC, Rs. 100	70	170	100	120	220
CC, Rs. 100	120	190	130	280	295

Indirect cost is Rs. 80 pr day.

Determine (i) the minimum project cost duration and (ii) minimum project duration and the corresponding project cost.

(b) Solve the following paramatric problem. 10

Maximize $Z = (6 + 2t)\, x_1 + (3 - t)\, x_2$

subject to $6x_1 + 3x_2 \leq 6$

$-3x_1 + 4x_2 \leq 3$, $x_1, x_2, t \geq 0$

8. (a) Solve the following LPP by Dual Simplex method : 10

Minimize $Z = 3x_1 + 4x_2$

Subject to $3x_1 + x_2 \geq 20$

$2x_1 - x_2 \geq 25$

$x_1, x_2 \geq 0$

(b) Two products P_1 and P_2 are manufactured on two sequential machines M_1 and M_2. 10
The following table gives machine times, in hours, per unit of the two products.

	Machine time in hours	
	P_1	P_2
M_1	5	3
M_2	6	2

The daily production quotas for P_1 and P_2 are 80 and 60 units respectively. Each machine runs 16 hours, a day. Overtime, though, not desirable, may be used if necessary to meet the production quota. Firmulate the problem as a Goal Programming Problem.

[TURN OVER

Con. 2305 & (a)-09. 4 **BB-8767**

(3 Hours) **[Total Marks : 100**

N.B.: (1) Attempt any **five** questions.
(2) **All** questions carry **equal** marks.
(3) **Figures to the right indicate full marks.**
(4) **Necessary** explanations at intermediate stages.
(5) Use of ordinary **non-programmable** calculate and statistical **table** is **allowed**.

1. (a) Solve the following LPP. **10**

Maximize $Z = x_1 + x_2$
Subject to $3x_1 + 4x_2 \leq 15$
$2x_1 + x_2 \geq 5$
$3x_1 + 5x_2 = 16, \quad x_1, x_2 \geq 0$

(b) Write down the Dual of the following LPP. **10**

Minimize $Z = 20x_1 + 16x_2$
Subject to $x_1 > 2{\cdot}5, \ x_2 \geq 6, \ 2x_1 + x_2 \geq 13 \quad 2x_1 + x_2 \geq 17$

2. (a) A progressive university has decided to keep the Library open round the clock and gathered that the following number of attendants are to reshelve the books. **10**

Time of day hours	0—4	4—8	8—12	12—16	16—20	20—24
Maximum number of attendent required	4	8	10	9	14	3

If each attendant works 8 consecutive hours. per day, and starts the duty at the beginning of any one of the above stated period formulate the problem as a LPP to meet the necessary requirement at each period.

(b) A worker must carry 3 spare parts if he is to perform the job efficients. The spare parts to be carried have the volumes of 1, 2 and 3 cubic meters respectively. Only 10 cubic meters of storage space is available to the spare parts. Past experience suggests that the demand for the spare parts follow the Poisson distribution with means 4, 2 and 1 repectively. **10**
It has also been estimated the costs of running out spare parts (i.e. stock out costs) are Rs. 800, 600 ad 1300 respectively.
Determine the number of spare parts that should be carried if the stock out costs are to be minimized.

3. (a) Solve the following Linear Integer Programming Problem. **10**

Minimize $Z = 5x_1 + 4x_2$, subject to $x_1 + 3x_2 > 2, \ 4x_1 + x_2 > 5,$
$2x_1 + 3x_2 > 7$
$x_1 x_2 > 0$ and integers.

(b) Solve the following LPP by Revised Simplex method. **10**

Maximizie $Z = 2x_1 + 3x_2 - 6x_3$
Subject to $-x_1 + 2x_2 + 2x_3 \leq 2$
$4x_1 + x_2 \leq 4, \quad x_1, x_2, x_3 \geq 0$

4. (a) Solve the following integer programming problem by Branch and Bound Technique. **10**

Maximize $Z = 7x_1 + 6x_2$, subject to

$2x_1 + x_2 < 8$, $5x_1 + 3x_2 < 30$, $x_1\ x_2 >$, 0 and integer.

(b) Six cities A, B, C, D, E and F are to be connected through ST bus routes. Distances, in Kms, are give below :

AB = 4, AC = 10, AD = 3, BC = 7, BE = 4 BE = 5, BF = 6, CD = 12, CE = 8, DE = 10 DF = 8, EF = 9. Determine the optimal routs connecting all cities.

5. A flight is scheduled to leave Bombay for Nagpur every day at 8 a.m. Past experience shows that the patient of delay in departure is a sfollows : **20**

Delay, in minutes	**0**	1	2	3	4	5	6
% of flights delayed	58	15	10	7	5	3	2

Flight time between Bombay and Nagpur varies as follows :

Flight time in minutes	55	57	59	61	63	65	67
% of flights	10	20	30	20	10	6	4

If scheduled arrival at Nagpur is 9 a.m. Use Monteo Carlo method of simulation to determines what percentage of flights will arrive late at Nagpur.

Carry out 15 iterations. Use the following random minutes.

3102 8963 4830 9172 0983 8352
0012 3542 9173 6384 0132 6834

6. (a) Probability distribution of demand for cakes on every day is given below **10**

No. of cakes demanded in a day	0	1	2	3	4	5
Probability	.0 5	·10	·25	·30	·20	·10

Preparation cost is Rs. 3 per unit and price is Rs. 4 per unit, Unsold cakes are waste.

Determine the number of cakes ordering which will maximise the daily profit.

(b) A maintenance project consists of the job shown below. Normal Duration (ND) and crash. Duration (CD), in days, and Normal cost (NC) and Crash cost (CC) in Rs. for each activity are given below : **10**

Activity	**ND**	**CD**	**NC**	**CC**
1—2	5	2	100	200
1—3	2	1	50	80
1—4	2	1	150	180
2—4	5	3	20	40
3—4	3	1	60	80
4—5	3	1	200	240

The indirect cost per day, is Rs. 40

Find the EST, LFT and Total Float for each activity.

Determine the total project cost when duration is minimum, and the project duration when the total cost is minimum.

[TURN OVER

7. (a) Times of completion for each activity of a project are uncertain. However, past experience gives, in the table below optimistic (A) Most likely (M) and Pessimistic (B) estimates of their durations, in weeks. **10**

Activity	1–2	1—3	1—4	2—5	3—5	4—6	5—6
A	1	1	2	1	2	2	3
M	1	4	2	1	5	5	6
B	7	7	8	1	14	8	15

Find the expected duration and variance for each activity. What is the expected project completion time ? Calculate the S.D. of the project duration. What is the probability that the project will be completed in 4 weeks later then the expected project duration ?

(b) Duration, indays, and number of men required for each activity of the project are as given below : **10**

Activity	1—2	1—3	2—4	3—4	3—5	4—5
Duration	1	2	1	2	4	3
No. of men	4	3	2	2	3	4

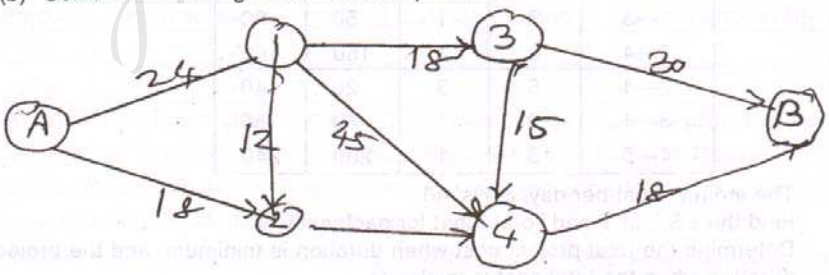
Find the number of men on each day required for the project, Level out the number of men without increasing the project duration.

8. (a) Two firms, F_1 and F_2 are competing for higher share of the market. Each firm has 3 courses of action in the following table. The expected outcome (in terms of changes in market shares) of these actions is given in the following pay-off matrix to F_1. **10**

	Advertising	Cutting price	Selling on terms
Advertising	5	1	0
Cutting price	3	4	2
Selling on terms	1	0	0

Determine the optimal solution for each firm.

(b) Solve the following maximum flow problem : **10**



Figures on areas are capacities.

Con. 2305 & (b)-09. 7 **BB-8768**

(3 Hours) **[Total Marks : 100**

N.B.: (1) Attempt any **five** questions.
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of **statistical table** and **non-programmable calculator** is **permitted**.
(4) Explanations at intermediate stages much be given.
(5) Make **suitable** assumptions wherever **necessary**.
(6) Answer should be **brief** and to the **points**.

1. (a) Solve the following LPP by Dual Simplex Method. **10**

Minimize $Z = 3x_1 + 6x_2$
Subject to $x_1 + 6x_2 \geq 9$
$3x_1 + 2x_2 \geq 10 \quad x_1, x_2 \geq 0$

(b) Write down Dual problem of the following LPP> **10**

Maximize $Z = 3x_1 + 4x_2$
Subject to $2x_1 + x_2 = 5$
$5x_1 - x_2 > 3$
$4x_1 + x_2 \leq 4$, x_1 is intertiated $x_2 > 0$.

2. (a) Solve the following LPP by Revised Simplex method. **10**

Maximize $Z = 2x_1 + 5x_2$
Subject to $3x_1 + 7x_2 \leq 400$
$2x_1 + 6x_2 \leq 420$
$4x_1 + x_2 \leq 450, \quad x_1, x_2 \geq 0$

(b) From the following table, find— **10**
(i) the project duration with minimum, project cost.
(ii) project cost with minimum project duration.

Activity	1—2	1—3	2—4	3—4	4—5
Normal Duration, Days	6	3	2	4	2
Crash Duration, Days	5	1	1	2	1
Normal Cost, Rs. (100)	25	15	16	15	14
Crash Cost, Rs. (100)	30	33	25	35	18

3. (a) Find the maximum flow (units) of a commodity that can be transported through a network with the paths listed below from source 1 to sink 4. The paths and capaciteis are listed below. **10**
Indicate the path that fully utilizes their capacities.(Units)

Paths	1—2	1—3	2—4	1—4	3—4
Capacities	10	15	5	12	9

(b) Solve the following LPP **10**

Maximize $Z = 3x_1 + x_2$
Subject to $4x_1 - 3x_2 \leq 2$
$x_1 - 3x_2 \leq 5$
$x_1, x_2 \geq 0$ and integers.

[TURN OVER

4. (a) The following table gives estimates of Normal Duration (ND), Crash Duration(CD),in days, NOrmal Cost (NC) and Crash Cost (CC), in Rs. for each activity. Indirect Cost is Rs. 100 per day. **10**

Activity	*1—2*	*1—3*	*2—4*	*3—4*	*4—5*
ND	5	6	8	5	4
CD	2	3	5	2	2
NC	10	22	30	35	40
CC	25	37	45	56	60

Find : (i) the minimum project cost and the corresponding project duration.
(ii) The minimum project duration and the corresponding project cost.

(b) Explain the following terms with illustrations. **10**
(i) Degenerecy in LPP.
(ii) Gomrry's Cutting plane algorithm for integer LPP.
(iii) Dynamic Programming.

5. (a) Solve the following parametric Programming Problem. **10**
Maximize $Z = 3x_1 + 2x_2$
Subject to $x_1 + 2x_2 \leq 10–50$, $4x_1 - x_2 \leq 8 - 4t$.

(b) The following table gives activities, duration, in days and manpower requirements for a certain project. **10**

Activity	**1—2**	**1—3**	**2—4**	**3—4**	**4—5**
Duration	2	1	1	2	1
Man power	3	2	1	4	2

Level out and the resources withour increasing the porject duration.

6. A company panuractures 2 products P_1 and P_2. The following table give, the requirements of two resources (Technical and Labour), in hours, and Profit, in Rs. **10**

Product	Technical service hours	Labour in hours	Units Project in Rs.
P_1	3	2	7
P_2	2	2	5

Demand for $P_2 \leq 7$, 9 hours of capacity, in Technical service hours represents requalr time hours and it is possible to work overtime in each department. Regular time in labour hoours is 8 hours. Total overtime, in both the departments together, iin excess of 15 hours, should be minimum.
Formulate the problem as a Goal Programming Problem and obtain the optimum solution.

7. (a) The following table gtives, optimistic, most likelyand pessimistic durations, in hours for each activity of a project. **10**

Activity	1—2	1—3	2—4	3—4	4—5
Optimistic	2	3	1	1	3
Most likely	3	4	2	2	5
Persimistc	4	5	3	3	7

(i) Find the mean and variance of each activity duration.

(ii) Waht is the probability that the project will be completed, in 4 days more thanexpected duration of the project ?

(b) A company produces 2 products A and B on two machines M_1 and M_2. The processing time of P_1 on M_2 per unit, 5 hours end on M_2 4 hours. The processing time of P_2 on M_1 is 10 hours and on M_2 is 4 hours per unit. The maximum number of hours available per week on M_1 and M_2 are 60 and 40 hours respectively. Also profit per unit selling P_1 and P_2 are Rs. 600 and Rs. 800 respectively. **10**

Formualte a LPP to determine the production volume of each of the proeucts such that the total profit is maximized.

8. The optimal solutin is given below with some missing figures. **20**

Basis	C	x_2	x_1	s_1	s_2	b
x_2	8	—	—	—	$-\frac{1}{4}$	—
x_1	6	—	—	$-\frac{1}{5}$	—	8
	Δ	—	—	$+\frac{2}{5}$	1	64

Find the missing figures and then obtain the original LPP.

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Second year PGDORM
Paper VIII

13th may 2009

Con. 2315-09. Use of Computer in operation Research. BB-8778

(3 Hours) [Total Marks : 100

N.B. : (1) Attempt any **five** questions.
(2) **All** questions carry **equal** marks. (**20** each)

1. Discuss various input and output devices.
2. Discuss the types of computers and its evolution in the past.
3. Using examples in business, explain the E-R diagrams.
4. What are database management systems ? Discuss its limitations with respect to RDBMS.
5. What are high level and low level programming languages ? Give examples of the both. Discuss the current computer programming scenario.
6. Discuss the stages in software development.
7. What do you understand by simulation ? Where do you find its applications ? Discuss one of the applications of simulation mentioning the type of simulation.
8. What role computer plays in data analysis ? How Operations Research Models can be solved using computers ? What softwares are available for this purpose ? Explain one of them.
9. What is Management Information System ? How is it beneficial for decision making in business ? Discuss the stages in MIS development.

P4–Exam.–09–201

Second year PGDORM. 15 m may 2009,
Paper IX – Integrated Approach to operation Research

Con. 2529–09. **BB–8782**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Answer question No. **1** which is **compulsory** and any **four** from the **rest**.
(2) **Real** life examples will **receive** more **weightage.**
(3) Answers must be **brief** and to the **point**.
(4) **Figures** to the **right** indicate **full** marks.

1. The new paradigm for an organization is now focusing on TRIPLE BOTTOM LINE – Financial profitability, Environmental sustainability and social responsibility. Highlight applications of suitable OR techniques towards increased effectiveness in each of the above three dimensions or an organisation's long term success. **20**

OR

Write contribution of OR techniques to achieve breakthrough improvements in Health Care Services (eg. Hospitals) or Educational Institutions or any other service industry you are familiar with. **20**

2. (a) Itemise at least three OR techniques which are applicable in Deterministic, Probabilistic and uncertain situations. **10**

(b) In each of the above cases provide at least one example each from Industry, Business, Administration and Marketing. **10**

3. (a) Explain the application of OR in Environmental, Scanning and Resource Planning with examples in each case. Your explanation must include brief description of methodology and technique to be used. **10**

(b) Briefly describe phases of Planning and Execution of a Management Information System (MIS). You must highlight linkages between its elements and steps for its implementation. **10**

4. (a) Discuss the relationship between theory and practice in different stages of a typical OR study. Illustrate with examples. **10**

(b) Compare old and new approaches and corresponding application of or techniques to decision making processes for programmed (repetitive) and non-programmed (one-shot) problems. **8**

5. (a) As you are aware the popular Linear Programming (LP) model has five basic limitations. Itemise them with your logic. **5**

(b) In tackling each of them, at least one or technique was developed. Highlight one specific OR technique developed to tackle each limitation. **10**

(c) What problems do you anticipated during implementing solution of LP problems brought out by computer packages. **5**

6. (a) Explain concept of Decision Support Systems and the role of OR in their development. **10**

(b) Highlight synergies between decision support systems and information systems towards overall improvement of bottom line of an organization. **10**

7. Write briefly on any **four** of the following :– **20**
   (a) Satisficing, optimising and Adaptising
   (b) Critical factors for slow progress of OR as a discipline in India.
   (c) Role of OR in the midst of Computer Revolution.
   (d) Application of OR in Advertising Budget Decision.
   (e) Integration of OR with Lean six sigma
   (f) Strategic, Tactical and Operational decisions.

Second year PGDORM
Paper VII – Advance Operation Research – II
7th may 2009.

1 sthalf-09-nkD 100
Con. 2327 & (a - b)-09.

BB-8772 to 8774

(3 Hours) **[Total Marks : 100**

N.B.: (1) Attempt any **five** questions.
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of **non programmable** calculator and statistical tables is **permitted.**
(4) Answers should be **brief** and to the **points.**
(5) Assumptions **required** in the question wherever **necessary** must be explained.
(6) Necessary explanations and calculations at intermediate stages **must be given.**

1. (a) Annual demand for an item is 400 units per day, ordering cost is Rs. 20 per batch. Production cost per item is Rs. 15. Unit cost is Rs. 6 per unit, Inventory cost is per units, 10% of unit cost per year. Discount is 5%. Determine the breakdown order quantity. **10**

(b) Discuss the following terms with illustrations :— **10**
(i) Bayesian Approach in Decision Making
(ii) Advantages of Decision Trees in Decision Making.

2. (a) There are 3 products P_1, P_2 and P_3. The necessary information is given below : **10**
K = Production Rate, in 100 units per day.
r = Demand Rate, in 1000 units per day.
C_1 = Inventory cost per unit per year Rs.,
C_3 = Set up cost, in Rs.

Product	K	r	C_1	C_3
P_1	8	35	·010	10
P_2	10	50	·015	12
P_3	7	20	·020	20

(i) Determine the optimum no. of runs per year.
(ii) Find the optimum runs length for each products.

(b) A contractor has been assinged for the supply of the following number of items at the end of each month :— **10**

Month No.	1	2	3	4
No. of items	90	185	305	330

Production during a month is available for supply at the end of the month or it may be stocked for the next month or later at a cost of Re. 1 per item per month. The cost of production is Rs. 1000 per batch and Rs. 3 per item. In which months is a batch to be made and of what size, if the total costs are to be minimised.

3. (a) The following table gives reliability and investment, in Rs. 1,000, for 3 parallel units for each of the 3 components of a machine. If any one components fails, number of parallel units, when used, the system will not stop working. Total budget available is Rs. 10,000. **10**
R = Reliability, C = Cost, in Rs. 1,000.

No. of parallel units	Component 1		Component 2		Component 3	
	R	C	R	C	R	C
1	·3	2	·6	4	·5	2
2	·6	4	·7	5	·7	3
3	·8	5	·8	6	·8	4

Within the available budget determine the maximum reliability of the system.

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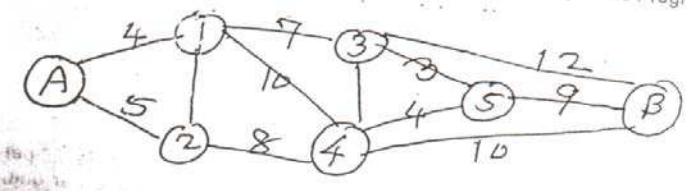
(b) Find the shortest route from node A to node B using Dynamic Programming. 10



4. A company has 3 projects P_1, P_2 and P_3. There are 4 proposals for each project in lacs of Rs. The following table gives the cost (c) and the corresponding revenue (R) in lacs of Rs. for each project. 20

Proposal No.	P_1		P_2		P_3	
	C	R	C	R	C	R
1	0	0	0	0	0	0
2	2	6	3	8	2	4
3	3	9	4	9	3	6
4	4	11	5	11	4	7

If the total budget available is Rs. 10 lacs, determine one proposal for each project, which will maximize the total revenue.

5. (a) A company maintains on 5 of its A category items with the following characteristics :— 10

Item No.	1	2	3	4	5
Annual Demand (units 100)	5	8	16	90	140
Price per unit, in Rs.	3	9	5	7	2

Currently the company follows a constant frequency ordering policy and orders each item once a month. Determine :—

(i) the optimal ordering policy which gives the same total average inventory.

(ii) Optimal ordering policy which gives the same total number of orders.

(b) Demand for an item is 20 units p.m.. Set up cost is Rs. 15, Production cost per unit is Rs. 1·2, Inventory Carrying Cost is 30 paise per unit p.m. Shortage cost is Rs. 2 per unit p.m. Determine how often to make production runs and what size should it made, if shortages are permitted. 10

6. A company maintains inventory on 3 items A_1, A_2 and A_3 with the following characteristics. 20

Item	A_1	A_2	A_3
Yearly Demand (units 100)	40	240	10
Price, Rs. per unit	20	10	15

(i) What is the ordering policy which gives the same total number of orders ?
(ii) What is the optimal ordering policy which gives the same total average inventory ?
(iii) What is the equation of the optimal policy curve ?
(iv) Suppose the company can afford an average inventory investment of only Rs. 12,000, what should be the change in the ordering policy, so as to minimize total cost under this restriction ?

7. (a) A company has to choose one of the 3 types of tooth pastes. Clove, Floride and Mint for its customers. The sales expected during the next year are highly uncertain. Marketing Department estimated the profits at different levels of sales based on manufacturing costs, distribution set up etc. for each type as given below : **10**

Profits for each tooth paste at different sales levels :

Type \ Sales Level	200 Units	1000 Units	300 Units
Clove	30	20	15
Floride	40	50	20
Mint	70	30	5

Which tooth paste should be selected ?

(b) A company orders for a new machine after a certain fixed time. The cost of spare part when ordered with the machine is Rs. 500. The cost of spare part with down time of the machine and the cost of arranging when new is Rs. 10,000. Spare part demand has the following probability distribution :— **10**

Demand (x)	0	1	2	3	4 or more
Prob. (x)	·90	·05	·02	·02	·01

Determine the optimal number of spare parts which should be ordered with the order of the machine.

8. A company has to decide whether or not to drill for oil in a particular spot. The drilling operation costs Rs. 75 lacs. There are 3 possible outcomes of the drilling operation : (1) a high yield of the oil which can be sold for Rs. 3,100 lacs. A moderate yield of oil which can be sold at Rs. 175 lacs or no oil at all. A seismic test is performed to find the geological formation of land. The result of the test is either good or fair or bad. The past drilling operations experience indicating the chances of high yield, moderate yield or no oil at all. On various types of surfaces as indicated by good, fair and bad readings of the seismatic test, are as given below : **20**

S.T. Results	Drilling Operation Result			Total
	High Yield	Moderate Yield	No Oil	
Good	50%	25%	25%	100%
Fair	30%	30%	40%	100%
Bad	10%	20%	70%	100%

S.T. results indicate : Prob. (Good) = 40%, Prob. (Fair) = 30% and Prob. (Bad) = 30%. The company wants to know whether or not to drill on this land. Draw Decision Tree and then obtain the solution.

[TURN OVER

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BB-8773

(3 Hours) [Total Marks : 100

N.B.: (1) Attempt any **five** questions.
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of **non programmable** calculator and statistical tables is **permitted**.
(4) **Necessary** explanations and calculations at the intermediate stages must be given.
(5) **Assumptions** wherever **required** must be explained.
(6) **Answers** should be **brief** and to the **points**.

1. (a) Monthwise demand during January-May 2008 of a particular item is given below : 10

Month	January	February	March	April	May
Actual Demand	200	135	195	310	175

(i) Forecast demand for June, 2008 by taking α = ·2, ·6 and ·8.
(ii) Find Mean Absolute Derivation (MAD) and Mean Squared Error (MSE) in each case and comment on selection of α.

(b) A company has 5 salesmen for allocation in 3 areas A_1, A_2 and A_3. Sales volumes, in units, in each area for number of posted salesmen are given below : 10

Area	No. of Salesmen					
	0	1	2	3	4	5
A_1	50	60	80	85	100	130
A_2	40	50	85	90	120	150
A_3	70	40	70	80	110	140

Determine the optimal allocation in order to maximise the total sales volume.

2. (a) The following table gives the transition probabilities for 2 states S_1 and S_2. Determine : (i) the transition probabilities after 3 periods (ii) Steady state. 10

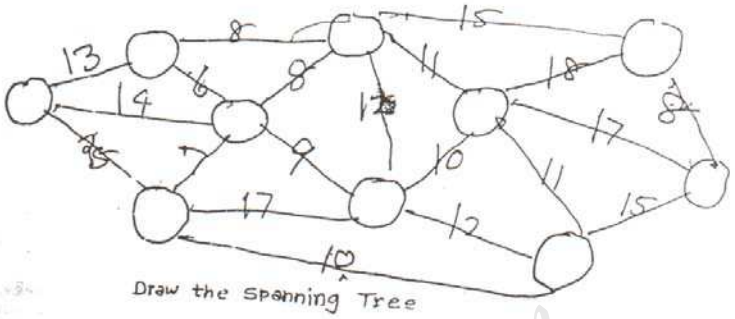
From \ To	S_1	S_2
S_1	·6	·4
S_2	·3	·7

(b) Demand distribution of Banana's was as follows : 10

Demand in dozens	20	21	22	23	24
Probability	·15	·20	·22	·23	·20

Purchase price is Rs. 12 per dozen.
Selling price is Rs. 15 per dozen for fresh bananas.
One day old = Rs. 10 per dozen.
Determine the optimum stock.

3. (a) **Figures** on arcs in the following Net-Work indicate distances between places. 10



(b) **Demand for an item is 400 units per week. Set up cost is Rs. 40 per run. Unit cost is Rs. 6 and holding cost is 5 paise per week per unit. If, shortage cost is Rs. 2 per unit per week, determine how often to order and what size it should be.** 10
Alsc find reorder points when a constant delivery time of one week is specfied.

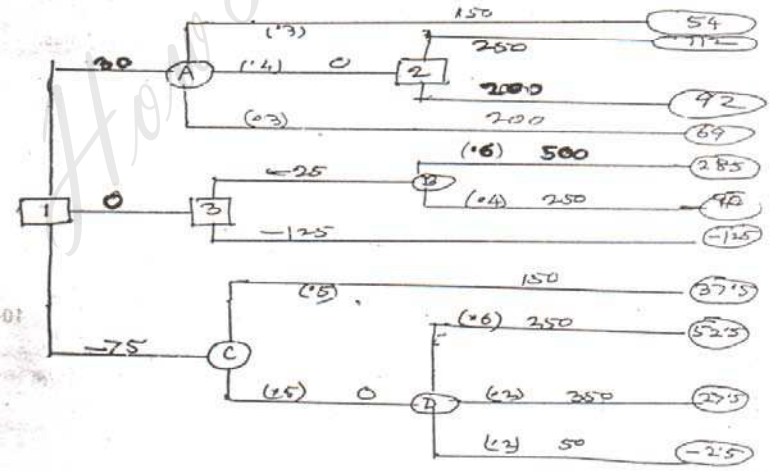
4. (a) Distribution of lead time and daily demand during lead time, are givewn below : 10

Lead time (days)	0	1	2	3	4	5	6	7	8	9	10
Frequency	0	0	0	2	3	4	4	2	2	2	1

Demand (no. of units)	0	1	2	3	4	5	6	7
Frequency	2	4	5	5	5	4	2	2

Determine the buffer stock.

(b) Evaluate the decision tree given below and identify the optimal strategies. Write down the expected pay-off at each action and outcome points. The partial cash flows associated with any path are shown on each, and the corresponding probability is indicated in paranthesis. 10



[TURN OVER

5. (a) The following table gives for activities of a project, Normal Duration (ND), Crash Duration (CD), in Days, and Normal Cost (NC), Crash Cost (CC), in Rs. Indirect Cost is Rs. 60 per day :— **10**

Activity	1—2	1—3	2—4	2—5	3—4	4—5
ND	8	4	2	10	5	3
CD	6	2	1	5	1	1
NC	100	150	50	100	100	80
CC	200	350	90	400	200	100

Determine (i) the minimum project duration and corresponding project cost
(ii) the minimum project cost and the corresponding project duration.

(b) (i) Explain with numerical illustration Markovian and Ergodic Process. **10**
(ii) State how exponential smoothing is a special case of weighted moving average.

6. A company has 3 projects P_1, P_2 and P_3. There are 4 proposals for each project, in lacs of Rs. The following table gives the cost (C) and the respective Revenue (R) in lacs of Rs. for each project :— **20**

Proposal No.	P_1		P_2		P_3	
	C	R	C	R	C	R
1	0	0	0	0	0	0
2	1	5	2	7	1	3
3	2	8	4	9	2	5
4	4	10	5	11	3	7

If total budget available is Rs. 8 lacs, determine the proposal for each project, which will maximise the total Revenue.

7. (a) There are 3 market areas A_1, A_2 and A_3 and 5 workers. The following data indicates the sales volumes, in Rs. 100 in each area, with number of workers. **10**
In area A_3 minimum 2 workers are required.
Allocate the 5 workers in 3 areas in order to maximize the total sales volumes.

Area	No. of Workers					
	0	1	2	3	4	5
A_1	3	8				
A_2	4	6				
A_3			14	16	15	20

(b) Distances, in kms, between cities are as follows : **10**
AB = 5, AC = 4, AD = 7, BD = 8, BE = 6, CD = 9, CF = 6, DE = 8, DF = 5, DG = 14, EG = 5, FG = 7.
Use Dynamic Programming to find the shortest route from A to G.

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8. (a) An electronic device has 3 components **A, B** and **D** connected in series so that the failure of any one of them will cause the failure of the device. The reliability (probability of not failure) of the device can be increased by installing one or more additional units of each of the component, in parallel. The following data gives Reliability (R) and Cost (C) for each components parallel units. 10

No. of parallel units	A		B		D	
	R	C	R	C	R	C
1	·6	600	·7	900	·5	1000
2	·8	1100	·8	2000	·7	1900
3	·9	1600	·9	3000	·9	2800

If the total available budget is Rs. 6,000, determine the Optimal allocation.

(b) Explain the following terms with illustrations : 10
(i) EMV, EPPI and EVPI
(ii) Prior analysis
(iii) Posterior analysis
(iv) Preposterior analysis.

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BB-8774

(3 Hours) [Total Marks : 100

N.B.:(1) Attempt any **five** questions.
(2) **Figures** to the **right** indicate **full** marks.
(3) **Necessary** explanations and calculations **must** be given at intermediate stages.
(4) Use of ordinary pocket calculator, statistical tables and log tables is **permitted.**
(5) Assumptions wherever **necessary** must be explained.
(6) Answers should be **brief** and to the **points.**

1. Monthwise demand during January-May 1995 of a particular item is given below : 20

Month	January	February	March	April	May
Actual Demand	200	136	195	310	175

(i) Forecast demand for June, 1998 by taking exponential smoothing factor, α = 0·1, 0·5, 0·6.
(ii) Compute Mean Absolute Deviation and Mean Square Error in each case and comment on selection of α.

2. (a) The following data represents monthly sales, in number of units :— 10

Month	1	2	3	4	5
Sales	70	72	74	75	77

Given sales data for 5 months as stated above use trend adjusted smoothing with a single smoothing factor α = 0·4 and a double smoothing factor β = 0·3 to forecast sales for 6th month.

(b) Explain the difference between exponential smoothing forecast and regression equation forecast. 10

[TURN OVER

3. (a) Demand for an item is 20 units p.m. The Fixed or Set up cost is Rs 25 each time a production run is made. The Inventory cost is 80 paise per item per month. The Shortage cost is Rs. 1·50 per item per month. Production rate is 40 units per month. Determine : **10**
   (i) How often to make a production run ?
   (ii) Quantity produced in each cycle
   (iii) The minimum average cost.

   (b) There are 9 jobs and their processing times in minutes, are given for 2 machines M_1 and M_2 as follows : **10**

Job No.	1	2	3	4	5	6	7	8	9
M_1	3	4	7	2	4	6	9	5	4
M_2	5	8	4	10	9	11	13	16	8

Order of machines is M_1, M_2 for each job.
Determine the minimum time completion of all jobs and their sequence.

4. (a) A contractor has been assigned for supply of the following number of items at the end of each month. **10**

Month No.	1	2	3	4
No. of items	70	120	280	400

Production during a month is available for supply at the end of the month or it may be kept in stock for the next month or later at a cost of Re 1 per item per month. The cost of production is Rs. 1,000 per batch and Rs. 3 per item. In which months is a batch to be made and of what size, if the total costs are to be minimized ?

   (b) Explain the following terms with illustration : **10**
   (i) Ergodic process
   (ii) Markovian precast
   (iii) Transition matrix.

5. (a) The following table gives activities, their durations and manpower requirements for ascertain project :— **10**

Activity	1—2	1—3	2—4	3—4	3—5	4—5
Durations in days	2	1	5	6	4	3
No. of men	2	3	1	3	2	3

Level out the manpower without increasing the project duration.

   (b) There area 3 market zones Z_1, Z_2 and Z_3 and 5 workers. The following table indicates the sales volumes, in Rs. 100 in each zone with number of workers. Z_3 requires minimum 2 workers. **10**

Market Zones	No. of Allotted Workers					
	0	1	2	3	4	5
Z_1	3	5	6	7		
Z_2	4	5	6	8		
Z_3			10	15	16	20

Allocate the 5 workers, in the corresponding zones, in order to maximize the total sales volume.

6. (a) Find out the steady state probabilities for the following transition matrix for 2 states S_1 and S_2. **10**
Also determine the transition probability matrix for the third period.

	S_1	S_2
S_1	2/3	1/3
S_2	1/4	3/4

(b) Explain Markovian Decision Process and its application to determine steady state probabilities. **10**

7. (a) 6 jobs are processed on three machines M_1, M_2, and M_3 with machine order M_1, M_2 M_3 for each job, **10**
Processing times, for each on each machine in minutes are given below :

Job No.	1	2	3	4	5	6
M_1	9	13	6	12	8	5
M_2	5	5	4	4	3	4
M_3	4	2	5	5	3	1

Determine the optimum sequence for the jobs which will complete them in shortest possibel time. Represent this optimum sequence by Gnatt chart.

(b) The time spent on a T.V. Repairman's job has an exponential distribution with mean 30 minutes. The repairs T.V. sets in the order in which they come in. The number of arriving sets for repairing follows a Poisson distribution with an average rate of 10 per 8-hour day. **10**
(i) Find the expected idel time of the repairman each day. (ii) How many jobs are ahead of the average set just brought in ?

8. (a) A super market has 3 girls at the sales counters. Service time for each counter has exponential distribution with mean 4 minutes. Customers arrival at Poisson fashion at the counter at the rate of 10 per hour. **10**
(i) What is the probability of having to wait for service ? (ii) Find the percentage of idle time for each girl (iii) What is the expected time of a customer to wait before he is served ? (iii) What is the expected number of customers in the system in the queue ?

(b) Using CDS alongwith, find the sequence of jobs in the following data :— **10**
Processing time, in hours. Machine order is M_1, M_2, M_3.

Job No.	1	2	3	4	5
M_1	2	1	2	1	3
M_2	1	2	1	3	2
M_3	3	1	2	1	1