CS/IS6F3

Reg. No. | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, August 2001

Computer Science and Engineering

Operations Research

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Briefly the various applications of OR. **(6 Marks)**

(b) Solve the following game problem using Linear Programming.

		B			
	2	-1	5	-2	6
A	-2	4	-3	1	0

(14 Marks)

2. (a) A scientist lives in town B and has to be in town A next sunday. On each of the days Thursday, Friday and Saturday he can give one talk in any of the towns A,B,C except that he cannot talk in town B on Friday. (He can give more than one talk in the same town. These talks must be on different days). The fee offered to him for one talk is Rs.120 in A, Rs. 160 in B and Rs.190 in C plus expences for an overnight stay in a town where he gave his talk. Where should he spend the last three days and nights of the week so as to maximize his income from talks less the cost of travel between towns? Travel costs are given in the table below.

		To		
		A	*B*	*C*
From	*A*	—	50	20
	B	50	—	70
	C	20	70	—

answer using Dynamic Programming. **(11 Marks)**

(b) Briefly describe the following

i) Nonexisting feasible solutions

ii) Unbounded solution

iii) Alternative optimal solutions. **(9 Marks)**

3. (a) A man who wants to keep some hens has Rs. 200 with him. The young hens which are available for Rs. 10 each, lay 5 eggs per week. The old hens which are available for Rs. 5 each lay 3 eggs per week. He has capacity to keep 30 hens. Each egg is sold at 40 paise. The feed for young and old hens costs respectively Re. 1 and Rs.0.60 per hen per week. How many young and old hens should he buy so that the profit per week is maximized? Formulate it as Linear Programming Problem and solve using Simplex method. **(14 Marks)**

(b) In a maximization problem, there is a tie between the entering variables x_1 and s_2. For the columns of x_1 and s_2 the value of θ are θ_1 and θ_2 $(\theta_1 \neq \theta_2)$ respectively. Which variable should be preferred as the entering variable in order to have layer increase in the value of objective function? **(6 Marks)**

4. (a) Use Dynamic programming to find the point in the first quadrant nearest to the origin on the straight line. $2x + 3y = 6$ **(6 Marks)**

Contd.... 2

(b) An Institute has purchased sufficient quantity of curtain cloth to meet the curtain requirement of the Institute. The curtain cloth is in pieces each of length 14 feet. the curtain requirement is as follows

Curtains of length (in feet)	Number required
4	1500
6	1000
8	3000

How to cut the pieces to meet the above requirement so that the trim loss is minimized? Assume that the width of required curtains is the same as that of available pieces. Formulate it as a Linear Programming Problem and solve using dual simplex method. **(14 Marks)**

5. (a) Solve the following LPP using Revised Simplex method

Max $x_0 = -x_1 + 3x_2 - 2x_3$

subject to

$3x_1 - x_2 + 2x_3 \leq 7$

$-2x_1 + 4x_2 \leq 12$

$-4x_1 + 3x_2 + 8x_3 \leq 10$

$(x_1, x_2, x_3 \geq 0)$ **(20 Marks)**

6. (a) Solve the following transportation problem. The demand at destination 1 must be shipped only from source 4

	D_1	D_2	D_3	Availability
S_1	5	1	0	20
S_2	3	2	4	10
S_3	7	5	2	15
S_4	9	6	0	15
Requirement	5	10	15	

The entries in the table give the cost of transportation of one unit from source S_1 to destination D_j **(10 Marks)**

(b) Solve the following assignment problem (minimization problem)

	a	b	c	d	e
A	160	130	175	190	200
B	135	120	130	160	175
C	140	110	155	170	185
D	50	50	80	80	110
E	55	35	70	80	105

(10 Marks)

7. (a) Write a note on degeneracy in transportation problem. **(6 Marks)**

(b) Consider the network of the following figure.

Contd.... 3

The normal and crash points for each activity are given in the table. Find the different minimum crash schedules (32 days schedule) that can occur between normal and crash times.

Activity	Normal duration	Normal cost	Crash duration	crash cost
(1,2)	20	2000	15	3000
(1,3)	10	1500	7	2400
(2,5)	15	1000	10	1500
(3,4)	16	3000	12	4000
(3,5)	22	4500	16	5700
(4,5)	14	1500	10	2100

(14 Marks)

8. (a) In a barber's shop with a single barber, there are three chairs. Out of these one chair is for haircutting and the other two for waiting inside the shop. If there are more than three customers in the shop at any time then three will occupy the chairs and rest wait outside. The customers come according to Poisson distribution with average 2 customers per hour. the service time T (per customer) is exponentially distributed with mean 20 minutes.

i) Find the probability that an arriving customer has to wait outside the shop.

ii) Find the probability that an arriving customer gets a chair to sit.

iii) How long is an arriving customer expected to wait before start of service?

iv) How many chairs should be provided so that arriving customer can wait on the chair at least 25 percent of the time? **(12 Marks)**

(b) Find the solution of the following LPP by solving the dual problem.

$$\text{Max } x_0 = 2x_1 + 3x_2$$

subject to

$$-4x_1 + 6x_2 \leq 4$$

$$-5x_1 + 6x_2 \leq 30$$

$$-x_1 + 5x_2 \leq 30$$

$$x_1 + x_2 \leq 15$$

$$x_1 \leq 10, x_2 \leq 7$$

$$(x_1, x_2 \geq 0)$$

(8 Marks)

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IM6F4

Reg. No. | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, July/August 2002

(Common to AU, PM, CH, EC, EE, IS, CS, IT, TE, IR, CV, MI & PT)

Operations Research

Time: 3 hrs.] [Max.Marks : 100

Note: *(i) Answer any FIVE full questions.*
(ii) All questions carry equal marks.
(iii) Use of statistical tables permitted.

1. (a) A used car dealer wishes to stock up his lot to maximize his profit. He can select cars A, B and C which are valued wholesale at Rs 5,000, Rs.7,000 and Rs.8,000 respectively. These can be sold at Rs.6,000, Rs.8,500 and Rs 10,500 respectively. For each car type the probabilities of sales are:

Type of Car :	A	B	C
Prob. of sale in 90days :	0.7	0.8	0.6

For every two cars of B, he should buy one car of type A or C. If he has Rs.1,00,000 to invest, what would he buy to maximize his expected gain? Formulate the linear programming problem. **(10 Marks)**

(b) Solve the following linear programming problem by graphical method

$$Maximize, Z = 120x_1 + 100x_2$$

Subject to

$$10x_1 + 5x_2 \leq 80$$
$$6x_1 + 6x_2 \leq 66$$
$$4x_1 + 8x_2 \geq 24$$
$$5x_1 + 6x_2 \leq 90$$
$$x_1, x_2 \geq 0$$

(10 Marks)

2. (a) Solve the following linear programming problem by simplex method.

$$Minimize, Z = x_1 + x_2 + 3x_3$$

Subject to

$$3x_1 + 2x_2 + x_3 \leq 3$$
$$2x_1 + x_2 + 2x_3 \geq 3$$
$$x_1, x_2, x_3 \geq 0$$

(10 Marks)

(b) Use two phase simplex method of solve the following linear programming problem.

$$Minimize, Z = x_1 + x_2$$

Subject to

$$2x_1 + x_2 \geq 4$$
$$x_1 + 7x_2 \geq 7$$
$$x_1, x_2 \geq 0$$

(10 Marks)

3. A company has factories A, B and C which supply warehouses at D, E, F and G. Monthly factory capacities are 250, 300 and 400 units respectively for regular production. If overtime production is utilized, factories A and B can produce 50 and 75 additional units respectively at overtime incremental costs of Rs.4 and Rs.5 respectively. The current ware house requirements are 200, 225, 275 and 300 units respectively. Unit transportations

Contd.... 2

cost (in Rs.) from factories to warehouses are as follows.

		To D	E	F	G
From	A	11	13	17	14
	B	16	18	14	10
	C	21	24	13	10

Determine the optimum distribution for this company to minimize cost. (Use VAM to find initial basic feasible solution and MODI method for optimality test) **(20 Marks)**

4. (a) A company has four territories open and four sales men available for assignment. The factories are not equally rich in their sales potential; it is estimated that a typical salesman operating in each territory would bring in the following annual sales:

Territory :	I	II	III	IV
Annual Sales (Rs.) :	60,000	50,000	40,000	30,000

The four salesmen are also considered to differ in ability; it is estimated that working under the same conditions, their annual sales will be proportionately as follows:

Sales man :	A	B	C	D
Proportion :	7	5	5	4

If the criterion is to maximize expected total sales, the intuitive answer is to assign the best salesman to the richest territory, the next best salesman to the second richest and so on. Verify this answer by assignment technique. **(12 Marks)**

(b) The demand for a particular item is 18,000 units per year. The holding cost per unit is Rs.1.20 per year and cost of procurement is Rs.400. No shortages are allowed and the replacement is instantaneous. Determine EOQ, number of orders per year, time between orders and annual cost when cost of one unit is Re.1. **(8 Marks)**

5. (a) The project consists of seven activities, whose time estimates are listed below.

Acitivity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
Optimistic time (weeks)	1	1	2	1	2	2	3
Most likely time (weeks)	1	4	2	1	5	5	6
Pessimistic time (weeks)	7	7	8	1	14	8	15

i) Draw the network and identify the critical path.

ii) Find expected duration and variance for each activity.

iii) Calculate length and variance of critical path.

iv) Determine the probability that the project will be completed at least four weeks earlier than expected.

v) Determine the probability that project will be completed no more than four weeks later than the expected time. **(14 Marks)**

(b) A drive in bank window has a mean service time of 2 mins, while the customers arrive at a rate of 20 per hour. Assuming that customers arrive at poisson distribution and service time follows exponential distribution.

i) What percentage of time will the teller be idle?

Contd.... 3

ii) After driving up, how long will it take the average customer to wait in line and be served?

iii) What fraction of customers will have to wait in line? (6 Marks)

6. (a) Explain replacement policy for items whose maintenance costs increase with time and money value changes with time. (6 Marks)

(b) A computer contains 10,000 resistors. When any one of the resistor fails, it is replaced. The cost of replacing a single resistor is Re 1 only. If all the resistors are replaced at the same time, cost per resistor would be reduced to 35 paise. The percent surviving by the end of month is as follows:

Month	0	1	2	3	4	5	6
% Serving by the end of month	100	97	90	70	30	15	0

What is the optimum plan? (14 Marks)

7. (a) Reduce the following game by dominance and find the game value. (10 Marks)

		Player B			
		I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

(b) Use graphical method to solve the following game.

		Player B	
		1	2
Player A	1	1	2
	2	5	6
	3	-7	-9
	4	-4	-3
	5	2	1

(10 Marks)

8. Explain the following in brief:
   a) Revised simplex method.
   b) Travelling salesman problem.
   c) Crashing of network.
   d) Characteristics of a queueing system. (20 Marks)

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IM6F4

U.S.N. Reg. No.

Sixth Semester B.E. Degree Examination, February 2002

(Common to AU, PM, IM, CH, EC, EE, IS, CS, IT, TE, TR, CV, MI & PT)

Operations Research

Time: 3 hrs.] [Max.Marks : 100

Note: *(i) Answer any FIVE full questions.*
(ii) All questions carry equal marks.
(iii) Use of statistical tables permitted.

1. (a) What are the advantages and limitations of OR studies? **(6 Marks)**

(b) A plant makes two types of automobile parts-Part A and Part B. It buys castings that are machined, bored and polished. The data is given in the following table

Capacity	Part 'A'	Part 'B'
Machining	25 / hour	40 / hour
Boring	28 / hour	35 / hour
Polishing	35 / hour	25 / hour

Castings for Part A cost Rs 20/- each and for Part B they cost Rs. 30 /- each. They sell for Rs. 50 and Rs.60 respectively. The running costs of the three machines are Rs200, Rs140 and Rs.175 per hour. Assuming that any combination of Part A and B can be sold, formulate a LPP model. **(14 Marks)**

2. (a) Following is the simplex tableau at some stage of iteration in the maximization problem.

	C_j	10	6	4	0	0	0	-M	
C_B	X_B	X_1	X_2	X_3	X_4	X_5	X_6	X_7	b_i (RHS)
10	X_1	1	0	-1	2	0	1	-2	20
6	X_2	0	1	8 / 3	-4	0	2	4	10
0	X_5	0	0	5	1	1	1	-1	15

Is it possible to improve the solution? If so, proceed and obtain the optimum solution. **(8 Marks)**

(b) Solve the following LPP by dual simplex method .

Minimize $Z = 10X_1 + 6X_2 + 2X_3$

Subject to

$$-X_1 + X_2 + X_3 \geq 1$$
$$+3X_1 + X_2 - X_3 \geq 2$$
$$and\ X_1, X_2, X_3 are \geq 0$$

(12 Marks)

3. (a) Differentiate between transportation and assignment problems. **(4 Marks)**

(b) A company with factories A, B, C and D supply warehouses E, F, G and H.

Contd.... 2

The monthly capacities of factories are 080, 100, 120 and 190 for A, B, C and D respectively. The monthly requirements are 110, 90, 150 and 130 for E, F, G and H respectively. The unit transportation costs are given in the table below. The profit per unit excluding transportation cost are Rs. 70, Rs 50, Rs 60 and Rs 90 at factory A, B, C and D respectively. Find the maximum profit production distribution schedule.

Factory \ Ware House	E	F	G	H
A	15	20	25	30
B	10	40	30	35
C	20	15	40	30
D	30	25	20	30

(16 Marks)

4. (a) The owner of a machine shop has four machinists available to assign to jobs for that day. Five jobs are offered with expected profit for each machinist on each job as follows:

	A	B	C	D	E
1	60	76	48	99	80
2	69	82	59	71	57
3	85	90	109	69	79
4	46	62	85	75	78

Determine the optimum assignment schedule. Which job should be declined. **(8 Marks)**

(b) A company uses 50,000 units of raw material per year. Raw material costs Rs. 1.2 per item. Ordering cost of items is Rs. 45 per order and item carrying cost is 15% per year of the average inventory.

i) Find the economic order quantity.

ii) Suppose that the company follows the EOQ policy and it operates for 300 days a year, that the procurement time is 12 days and safety stock is 500 units, find the reorder point, the maximum, minimum and average inventories.

(12 Marks)

5. (a) Write the rules that are to be followed while constructing a net work. **(5 Marks)**

(b) The following table lists the jobs of a network with their time estimates.

JOB	Duration in days		
	Optimistic	Most likely	Pessimistic
1-2	3	6	15
1-6	2	5	14
2-3	6	12	30
2-4	2	5	8
3-5	5	11	17
4-5	3	6	15
6-7	3	9	27
5-8	1	4	7
7-8	4	19	28

i) Draw the project network.

Contd.... 3

ii) Calculate the length and variance of the critical path.

iii) What is the probabability that the jobs on critical path will be completed by 42 days?

(15 Marks)

6. (a) Define the following terms used in queuing model.

i) Service channel

ii) Arrival rate

iii) Service rate

iv) Infinite Queue

(4 Marks)

(b) A duplicating machine maintained for office use is used and operated by the secretaries. Since the work to be copied varies in length and copies required, the service rate is randomly distributed but it does approximate poisson with a mean service rate of 10 jobs per hour. The requirements for use are random over the entire 8 hour workday but arrive at a rate of 5 per hour. It is observed that a waiting line develops occasionally. If the time of a secretary is valued at Rs 3.50 per hour, make an analysis to determine.

i) Machine utilization.

ii) The present of time that an arrival has to wait.

iii) The average system time.

iv) The average cost due to waiting and operating the machine. **(16 Marks)**

7. (a) What is replacement? Describe some important replacement situations and replacement polices. **(5 Marks)**

(b) The following mortality rates have been observed for a certain electric bulb.

Week	1	2	3	4	5	6	7	8
% failure by end of week	5	13	25	43	68	88	96	100

There are 100 bulbs in a factory and it costs Rs 4.00 to replace an individual bulb which has burnt out. If all bulbs were replaced simultaneously, it would cost Re. 1 per bulb. It is proposed to replace all bulbs at fixed intervals whether or not they have burnt out and to continue replacing burnt out bulbs as they fail. At what intervals should all the bulbs be replaced? **(15 Marks)**

8. (a) Define:

i) Saddle point ii) Pure strategy iii) Mixed strategy iv) Value of the game **(6 Marks)**

(b) Solve the following game with pay off matrix of A given in the table below.

		PLAYER 'B'	
		1	2
PLAYER 'A'	1	-2	0
	2	3	-1
	3	-3	2
	4	5	-4

** * ** **(14 Marks)**

IM6F4

USN

Sixth Semester B.E. Degree Examination, July/August 2003

(Common to AU, PM, CH, EC, EE, IS, CS, IT, TE, TR, CV, MI & PT)

Operations Research

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Normal probability distribution table may be permitted.
3. Missing data (if any) may suitably be assumed.

1. (a) Explain the principal phases for implernenting O.R. model. **(4 Marks)**

(b) A manufacturer of packing material, manufactures two types of packing tins round and flat. Major production facilities involved are cutting and joining. The cutting department can process 300 tins of round or 500 tins of flat per hour. The joining department can process 400 tins of round or 300 tins of flat per hour. If the profit contribution of round tins is Rs.100 per tin and that of flat is Rs. 80 per tin. Formulate (only), the problem as linear programming problem. **(6 Marks)**

(c) Solve the following LPP by graphical method. Draw 2Z-Z lines, one of which must pass through optimal solution :

Maximize $Z = 5x_1 + 4x_2$

Subject to $6x_1 + 4x_2 \leq 24$

$x_1 + 2x_2 \leq 6$ **(10 Marks)**

$-x_1 + x_2 \leq 1$

$x_2 \leq 2$ also $x_1, x_2 \geq 0$

2. (a) From the simplex table how one ascertains that optimal solution is
i) Degenerate ii) Infeasible iii) Unbounded iv) has an alternate solution. **(8 Marks)**

(b) Solve the following LPP by simplex method and also give the optimal values of the dual variable of the given LPP. **(12 Marks)**

Maximize $Z = 3x_1 + 2x_2$

Subjected to $-x_1 + 2x_2 \leq 4$

$3x_1 + 2x_2 \leq 14$

$x_1 - x_2 \leq 3$

$x_1, x_2 \geq 0$

Does the problem have unique solution ? If not, determine the alternate solution also.

Contd.... 2

3. (a) A firm produces four products A, B, C and D. There are four operators (I, II, III and IV), who are capable of producing any of these products. The processing time varies from operator to operator. The firm records 8 hours of working per day and allows 30 minutes for lunch. The products A, B, C & D gives a profit of Rs 8, 6, 5 & 4 per product respectively. The processing time for each product is given below. Find the optimum distribution schedule to maximize profit. **(12 Marks)**

	Products (Processing time in minutes)			
	A	B	C	D
Operators I	15	9	10	6
II	10	6	9	6
III	25	15	15	9
IV	15	9	10	10

(b) The figures in the body of table below are proportional to the cost of transportation of the tonne of food grain from the part given by row heading to the destination given by column heading. Find the optimum distribution schedule to minimize the transportation cost. **(8 Marks)**

Ports	Delhi	Hyderabad	Mysore	Nagpur	Stock (in 1000 tonnes
Bombay	9	5	8	5	225
Calcutta	9	10	13	7	75
Madras	14	5	3	7	100
Requirement in 1000 tonnes	125	80	95	100	

4. (a) What is crashing and its significance. **(5 Marks)**

(b) A project has the following characteristics. Construct the PERT network, number the nodes by Fulkerson's rule. Find the estimated time to complete the project, calculate total float, free float and independent float. What is the probability that project will be completed in 35 days. **(15 Marks)**

Activity	Predecessor activity	Most optimistic time	Most likely time	Most pessimistic time
A	--	6	9	18
B	--	5	8	17
C	A	4	7	22
D	A	4	7	10
E	B	4	7	16
F	B	2	5	8
G	C,E	4	10	22

Contd.... 3

5. (a) Arrivals at a telephone booth are consisted to be poisson with an average of 10 minutes between one arrival and next. The length of a phone call is assumed to be distributed exponentially with a mean of 3 minutes.

   i) What is the probability that a person arriving at the booth will have to wait? (6 Marks)

   ii) What is the average length of queue that form from time to time?

   iii) The telephone company will install a second booth when convinced that an arrival would expect to have to wait at least 3 minutes for the phone. By how much must the flow of arrivals be increased in order to justify the second booth.

   (b) What is inventory? What are the factors determining inventory? (8 Marks)

   (c) What is EOQ and its significance? (4 Marks)

6. (a) Machine 'A' costs Rs.9000, annual operating costs are Rs.200 for first year and then increases by 2000 every year. Determine the best age to replace the machine. There is a machine 'B' which costs Rs.10,000, annual operating costs are Rs.400 for first year and then increase by 800/- every year. Owner has a machine of type 'A' which is one year old, should he replace with 'B', if so when? (10 Marks)

   (b) A computer contains 10,000 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is Re1.00. If all the resistors are replaced at the same time, the cost per resistor would be reduced to 35 paise. The percentage of survival at the end of month 't' is given below (10 Marks)

Month	0	1	2	3	4	5	6
% surviving at end of month	100	97	90	70	30	15	0

   What is the optimum replacement plan. At what group replacement price per resistor would a policy of strictly individual replacement become preferable to adopted policy.

7. (a) Solve the following game, use dominance method to reduce the matrix, write the strategies adopted by each player and value of game. (10 Marks)

	B_1	B_2	B_3	B_4	B_5
A_1	4	4	2	−4	−6
A_2	8	6	8	−4	0
A_2	10	2	4	10	12

   (b) Solve the following game, use graphical method. Write the strategies adopted by each player and value of game. (10 Marks)

	b_1	b_2	b_3
a_1	6	4	3
a_2	2	4	8

8. Write short notes on : (4×5=20 Marks)
   a) Two phase simplex method
   b) Sensitivity analysis
   c) Resource levelling by network techniques
   d) Scope of operations research.

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IM6F4

USN

Sixth Semester B.E. Degree Examination, January/February 2004

(Common to AU, PM, IM, CH, EC, EE, IS, CS, IT, TE, TR, CV, MI & PT)

Operations Research

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Briefly describe various phases of O.R. study. **(8 Marks)**

(b) An oil company has 2 units A and B which produce 3 different grades of oil; superfine, medium and low grade oil. The company has to supply 12,8,24 barrels of superfine, medium and low grade oils respectively per week. It costs the company Rs. 100.00 and Rs. 80.00 per day to run the units A and B respectively. On a day unit A produces 6, 2 and 4 barrels and the unit B produces 2, 2 and 12 barrels of superfine, medium and low grade oil per day. The manager has to decide on how many days per week should each unit be operated in order to meet the requirement at minimum cost. Formulate the LPP and solve it graphically. **(12 Marks)**

2. (a) Solve the following LPP using Simplex algorithm :-

Maximize $Z = 3x_1 + 2x_2 + 5x_3$

Subject to $x_1 + 2x_2 + x_3 \leq 43$

$3x_1 + 0x_2 + x_3 \leq 46$

$x_1 + 4x_2 + 0x_3 \leq 42$

$x_1, x_2, x_3 \geq 0$

(10 Marks)

(b) Solve the following LPP using 2 - phase simplex algorithm. **(10 Marks)**

Min $Z = 2x_1 + 9x_2 + 3x_3$

Subject to $x_1 + 4x_2 + 2x_3 \geq 5$

$3x_1 + x_2 + 2x_3 \leq 4$

$x_1, x_2 x_3 \geq 0$

(10 Marks)

3. (a) Solve the following LPP using dual simplex method.

Min $Z = 3x_1 + 2x_2$

Subject to $3x_1 + x_2 \geq 3$

$4x_1 + 3x_2 \geq 6$

$x_1, +x_2 \leq 3$

$x_1, x_2 \geq 0$

(10 Marks)

(b) Prove that dual of dual problem in primal with an example. **(5 Marks)**

Contd.... 2

(c) Explain the following terms:

i) Alternate optima

ii) Basic feasible solution

iii) Optimum Solution **(5 Marks)**

4. (a) Differentiate between transportation and assignment models. **(5 Marks)**

(b) Find the optimal solution for the following transportation problem. Use Vogels approximate method to find the initial table. Verify for optimality **(15 Marks)**

		Destination A	B	C	D	Availability
Source	I	21	16	25	13	11
	II	17	18	14	23	13
	III	32	10	22	45	19
Requirement		6	10	12	15	

Table 4(b)

5. (a) A firm plans to begin production of 4 new products on its 4 plants. The unit cost of producing i at plant j is given below. Find the assignment that minimises the total cost of production per unit.

		Plants 1	2	3	4
Products	A	15	11	13	15
	B	17	12	12	13
	C	14	15	10	14
	D	16	13	11	17

Table 5(a)

(10 Marks)

(b) Briefly explain the different methods of obtaining initial feasible solution to a transportation problem. **(5 Marks)**

(c) Explain the salient characteristics of a Queue system. **(5 Marks)**

6. (a) Jobs arrive at a computer centre according to a Poisson arrival fashion with a mean of 4.5 per hour. The average time to service a job is 5 min.

i) What is the chance that a new job is straight away processed ?

ii) For what proportion of the time the computer centre is idle ?

iii) What is the average number of jobs in the centre ?

iv) What is the average number of jobs waiting ?

v) What is the average waiting lines? **(12 Marks)**

(b) A certain material with a consumption of 6000kg involves an ordering cost of Rs. 200/- per order. The carrying rate is 20% p.a. The unit cost of the material is Rs. 2000 per kg. Shortages are deemed prohibitively costly. Find EOQ. **(8 Marks)**

Contd.... 3

7. (a) What are the characteristics of game theory? (5 Marks)

(b) Using relation of dominance or otherwise solve the game whose payoff matrix is given below.

		Player Y (Pure Strategy)		
		1	2	3
Player X Pure Strategy	1	0	−2	2
	2	5	4	−3
	3	2	3	−4

Table 7(b)

Find the optimal mixed strategy for player X and Y. (15 Marks)

8. (a) Construct the network diagram comprising the activities A, B, ... and L, such that the following relationships are satisfied :

i) A, B and C are the first activities of the project and can start simultaneoulsy.

ii) A and B preceed D

iii) B preceeds E, F and H

iv) F and C preceed G

v) E and H proceed I

vi) C, F and I proceed K

vii) D proceeds L

viii) L, G and K are the terminal activities of the project. (10 Marks)

(b) Explain with an example, replacement model when value of money changes with time. (10 Marks)

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IM6F4

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Sixth Semester B.E. Degree Examination, January/February 2005

(Common to AU, PM, IM, CH, EC, EE, IS, CS, IT, TE, TR, CV, MI & PT)

Operations Research

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Normal distribution table is allowed.

1. (a) What are the different phases of OR study? List them. (5 Marks)

(b) A company manufactures two types of school bags - a standard one and a deluxe model. Each bag requires four different operations, the details of which are listed below

Sl. No.	Department	Production Time (in hours)		Available Time in hours
		Standard	Deluxe	
1	Cutting and deying	$\frac{7}{10}$	1	630
2	Sewing	$\frac{1}{2}$	$\frac{5}{6}$	600
3	Finishing	1	$\frac{2}{3}$	708
4	Packaging	$\frac{1}{10}$	$\frac{1}{4}$	135

Each standard bag gives a profit of Rs. 10/- and deluxe bag Rs. 9/-. Formulate the LPP and solve graphically for maximizing the profit. (7+6+1+2=15 Marks)

2. (a) Define :

i) Feasible solution

ii) Optimal solution as applied to LPP (4 Marks)

(b) Solve the following LPP

$$\text{Minimum } Z = 2x_1 - 3x_2 + 4x_3$$

$$\text{Subject to } x_1 + x_2 - 2x_3 \geq 12$$

$$x_1 + 4x_3 \leq 20$$

$$3x_2 - x_3 = 15$$

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

(16 Marks)

Contd.... 2

3. (a) Use the dual simplex method to solve

$$\text{Minimize } Z = 2x_1 + x_2$$

$$\text{Subjected to } x_1 + x_2 = 4$$

$$2x_1 - x_2 \geq 3$$

$$x_1 \text{ and } x_2 \geq 0$$

(14 Marks)

(b) Briefly explain the steps involved in revised simplex method. (6 Marks)

4. (a) Solve the following transportation problem -

		Destination			
		x	y	z	Supply
Source	A	1	2	6	7
	B	0	4	2	12
	C	3	1	5	11
	Demand	10	10	10	

The entry in the box gives the unit cost of transportation. (10 Marks)

(b) There are 5 jobs to be assigned to five operators, the cost table of which is given below

		Operator				
		1	2	3	4	5
Job	1	3	8	2	10	3
	2	8	7	2	9	7
	3	6	4	2	7	5
	4	8	4	2	3	5
	5	9	10	6	9	10

Solve for minimising the cost. (10 Marks)

5. The three time estimates for the various activities of a project are given below :

Activity	Time (a, b, m)	Activity	Time (a, b, m)
(1, 2)	(1, 4, 3)	(4, 5)	(10, 15, 12)
(1, 3)	5, 8, 7)	(4, 7)	(8, 12, 10)
(1, 4)	(6, 9, 7)	(5, 6)	(7, 11, 8)
(1, 6)	(1, 3, 2)	(5, 7)	(2, 8, 4)
(2, 3)	(3, 5, 4)	(6, 7)	(5, 7, 6)
(2, 5)	(7, 9, 8)		
(3, 4)	(10, 20, 15)		
(3, 7)	(12, 14, 13)		

Contd.... 3

i) Draw the project network

ii) Find mean and variable of each activity duration.

iii) Find the critical path and expected duration of the project.

iv) What is the probability that the project will be completed in 35 units of time?

(6+5+7+2=20 Marks)

6. (a) Draw the basic block diagram of a queuing system and briefly explain. (8 Marks)

(b) A one man florist shop has an arrival pattern of 10 customers/ hour on a sunday morning following Poisson distribution. The service is FIFO and since the shop has a good reputation, people are ready to wait. The time to serve a customer is 4 minutes and is exponentially distributed. Find

i) Probability that there is a queue

ii) Average size of the queue

iii) Expected waiting time in the queue

iv) The probability that a customer spends less than 12 minutes in the shop. (12 Marks)

7. (a) ABC radio company has a product for which we can have inventory model with bench order (i.e., shortages are permitted). The following information is available

Demand = 2000 units/year
Cost of each item = Rs. 50/-
Holding cost = Rs. 10/- per year per item
Ordering cost = Rs. 25/- per order
back order or shortage cost = Rs. 30/- unit/year.

Find i) Optimal order quality

ii) Cycle time

iii) Total cost

(4+2+4=10 Marks)

(b) A car owner finds from past records that the maintenance cost per year of the car whose purchase price is Rs. 80,000/- are as given below :

Year	1	2	3	4	5	6	7	8
Maintenance cost in Rs.	1000	1300	1700	2200	2900	3800	4800	6000
Resale price in Rs.	40,000	20,000	12,000	6,000	5,000	4,000	4,000	4,000

Determine the time at which it is profitable to replace the car. (10 Marks)

8. (a) As applied to game theory define

i) Strategy ii) Saddle point

iii) Value of the game

(6 Marks)

Contd.... 4

(b) Two armies A and B are fighting for two airfields valued at Rs. 20/- and Rs. 8/- crore respectively. Both the fields are under the control of army B. Army A wants to attack either one or both air fields and inflicting maximum damage to the facility while army B wants to minimize the damage. Each army can assign full force to one of the fields or divide its force in half and cover both air fields with reduced capacity.

A facility will experience 25% damage if it is attacked and defended with full force, 10% damage if attacked and defended by half force. It will have 50% damage if attacked by full force and defended by half force. A facility attacked with half the force and defended by full force will have no damage. Write the payoff matrix for the attacking army. (the damages are calculated in crores of rupees) (14 Marks)

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07MCA25

Second Semester MCA Degree Examination, June/July 08
Operations Research

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. Define OR and list the different phases involved in OR study. Briefly discuss the assumptions of Linear programming that is proportionality and additivity. **(10 Marks)**

b. A firm can produce three types of cloth say A, B and C. Three kinds of wool are required for it say red wool, green wool and blue wool. One unit length of type A cloth needs 2 yards of red wool and 3 yards of blue wool, one unit length of types B cloth needs 3 yards of red wool 2 yards of green wool and 2 yards of blue wool: and one unit of type C cloth needs 5 yards of green wool and 4 yards of blue wool. The firm has only a stock of 8 yards of red wool, 10 yards of green wool and 15 yards of blue wool. It is assumed that the income obtained from one unit length of type A cloth is Rs. 3 of type B cloth is Rs. 5 and of type G cloth is Rs. 4.

Determine how the firm should use the available material so as to maximize the income from the finished cloth. **(10 Marks)**

2 a. Solve the following LPP by graphical method.

Minimize $z = 20x_1 + 10x_2$ subjected to the constraints

$$3x_1 + x_2 \geq 30$$
$$4x_1 + 3x_2 \geq 60$$
$$x_1 + 2x_2 \leq 40 \text{ where } x_1, x_2 \geq 0.$$

(10 Marks)

b. Define:

i) Feasible solution
ii) Optimal solution
iii) Unrestricted variable
iv) Degeneracy and unbounded solution with respect to simplex method. **(10 Marks)**

3 a. Solve the following LPP by Charne's big M method:

Maximize $z = 20x_1 + 10x_2$

Subject to : $x_1 + x_2 = 150$

$$x_1 \leq 40$$
$$x_2 \geq 20 \text{ where } x_1, x_2 \geq 0$$

(15 Marks)

b. Write procedure to solve LPP by two-phase simplex method. **(05 Marks)**

4 a. Use the revised simplex method to solve the following problem.

Maximise: $z = 2x_1 + x_2$,

Subject to: $x_1 + x_2 \leq 3$

$$2x_1 + x_2 \leq 5$$
$$x_1 + 3x_2 \leq 6$$

With: x_1 and x_2 non – negative **(15 Marks)**

b. Summaries the primal dual relationship. **(05 Marks)**

5 a. Write the dual for the following LPP, solve the dual and write the solution of the primal from the solution of the dual.

Minimize $z = x_1 + x_2$

Subject to $2x_1 + x_2 \geq 4$

$x_1 + 7x_2 \geq 7$

Where $x_1, x_2 \geq 0$ **(15 Marks)**

b. What is sensitivity analysis? State any six changes in the parameters of a linear programming problem with respect to sensitivity analysis. **(05 Marks)**

6 a. Solve the following transportation problem starting with the initial solution obtained by VAM. **(10 Marks)**

	D_1	D_2	D_3	D_4	Supply
O_1	2	2	2	1	3
O_2	10	8	5	4	7
O_3	7	6	6	8	5
Demand	4	3	4	4	15 / 15

b. Solve the following assignment problem that minimizes the total cost of production per unit. **(10 Marks)**

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

7 a. Define metaheuristics and write the nature of metaheuristics. **(07 Marks)**

b. What is Tabu search? Explain how the Tabu search is conducted. **(07 Marks)**

c. Define

i) Game ii) Strategy iii) Saddle point. **(06 Marks)**

8 a. Define pay off. Solve the following payoff matrix determine the optimal strategies and the value of game.

$$\begin{matrix} & B \\ A & \begin{bmatrix} 5 & 1 \\ 3 & 4 \end{bmatrix} \end{matrix}$$

(10 Marks)

b. Solve the following game graphically. **(10 Marks)**

		Y_1	Y_2	Y_3
		I	II	III
X_1	I	1	3	11
1-x1	II	8	5	2

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07MCA25

Second Semester MCA Degree Examination, Dec.08/Jan.09
Operation Research

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. Define Operation Research. List six main phases of operation research and briefly explain a linear programming model. **(10 Marks)**

b. A glass company has three plants. Aluminum frames are hardware are made in plant 1, wood frames are made in plant 2, and plant 3 produces the glass and assembles the products. The top management has decided to revamp the company's product line. Unprofitable products are being discontinued, releasing production capacity to launch two new product having large scale potentials.

Product 1: An 8- foot glass door with aluminum framing.

Product 2: A4 × 6 foot double – hung wood framed window.The following data for the glass company is obtained, Find a LP model for the problem. **(10 Marks)**

	Production Time per batch, hours Products		
Plant	1	2	Production Time available per week, hours
1	1	0	4
2	0	2	12
3	3	2	18
Profit per batch	Rs. 30-	Rs. 50-	

2 a. Old hens can be bought at Rs. 20 each and young ones at Rs. 50 each. The old hen lay 3 eggs per week and the young one lay 5 eggs per week, each egg being worth Rs. 3. A hen costs Rs.10 per week to feed. I have only Rs. 800 to spend on the hens. How many of each kind should I buy to give a profit of more than Rs. 60 per week? Assume that I cannot house more than 60 hens. Solve it graphically. **(10 Marks)**

b. Explain the following a) A standard form of the LPP. b) Feasible solution. c) Optimal solution. d) Slack and surplus variables. e) Basic solution of a LPP. **(10 Marks)**

3 a. Solve the following LPP by simplex method.

Max $Z = 3x_1 + 2x_2$

Subject to $x_1 + x_2 \leq 4$

$x_1 - x_2 \leq 2$

$x_1, x_2 \geq 0$ **(10 Marks)**

). Use Big – M method to solve

Minimize $Z = 2x_1 + x_2$

Subject to $3x_1 + x_2 = 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \leq 3$, where $x_1, x_2 \geq 0$ **(10 Marks)**

4 a. Use Two- Phase method to

Minimize $Z = 7.5x_1 - 3x_2$

Subject to $3x_1 - x_2 - x_3 \geq 3$,

$x_1 - x_2 + x_3 \geq 2$, where $x_1, x_2, x_3 \geq 0$. **(10 Marks)**

b. Use Revised simplex method to solve

Max $Z = 3x_1 + 5x_2$

Subject to $x_1 \leq 4$

$2x_2 \leq 12$

$3x_1 + 2x_2 \leq 18$

and $x_1 \geq 0, x_2 \geq$ **(10 Marks)**

5 a. State weak duality property and strong duality property and Duality theorem. **(06 Marks)**

b. Briefly explain the role of Duality theory in sensitive analysis. **(07 Marks)**

c. Write the dual of the LPP

Minimize $Z = 2x_1 + 3x_2 + 4x_3$,

Subject to $2x_1 + 3x_2 + 5x_3 \geq 2$,

$3x_1 + x_2 + 7x_3 = 3$,

$x_1 + 4x_2 + 6x_3 \leq 5$,

$x_1, x_2 \geq 0$ and x_3 is unrestricted. **(07 Marks)**

6 a. Use dual simplex method to solve

Max $Z = -3x_1 - 2x_2$

Subject to $x_1 + x_2 \geq 1$

$x_1 + x_2 \leq 7$

$x_1 + 2x_2 \geq 10$, $x_2 \leq 3$

and $x_1, x_2 \geq 0$ **(12 Marks)**

b. Briefly explain three prominent types of metaheuristics. **(08 Marks)**

7 a. Solve the following transportation problem. **(10 Marks)**

		Destination A	B	C	D	
Source	I	21	16	25	13	11
	II	17	18	14	23	13
	III	32	27	18	41	19
Requirement		6	10	12	15	43

Availability

b. Solve the following assignment problem. **(10 Marks)**

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

8 a. Reduce the following game by dominance and find the game value. **(10 Marks)**

		Player B I	II	III	IV
Player A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

b. Solve the game given below by graphic method. **(10 Marks)**

		B y_1	y_2	y_3	y_4
A	x_1	19	6	7	5
	x_2	7	3	14	6
	x_3	12	8	18	4
	x_4	8	7	13	-1

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07MCA25

Second Semester MCA Degree Examination, June-July 2009
Operations Research

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Briefly explain the different phases of an operations research study. **(12 Marks)**

b. The Prime Insurance Company is introducing 2 new product lines: Special risk insurance and mortgages. The expected profit is \$5/unit on special risk and \$2/unit on mortgages. Management wishes to establish sales quota as for the new product lines to maximize total expected profit. The work requirements are

Department	Work hours/unit		Work hours available
	Special risk	Mortgage	
Underwriting	3	2	2400
Administration	0	1	800
Claims	2	0	1200

Formulate the problem into linear programming problem. **(08 Marks)**

2 a. Explain the terms :
i) Basic solution ii) Basic feasible solution iii) Optional solution iv) Degeneracy. **(08 Marks)**

b. Solve using simplex method
Maximize $Z = 3x_1 + 5x_2$
Subject to $x_1 \le 4$
$2x_2 \le 12$
$3x_1 + 2x_2 \le 18, \quad x_1, x_2 \ge 0.$ **(12 Marks)**

3 a. Find the dual of Max $Z = 3x_1 + 5x_2$
Subject to $x_1 \le 4$
$2x_2 \le 12$
$3x_1 + 2x_2 \le 18, \quad x_1, x_2 \ge 0.$ **(05 Marks)**

b. Solve by revised simplex method
Maximize $Z = 6x_1 - 2x_2 + 3x_3$
Subject to $2x_1 - x_2 + 2x_3 \le 2$
$x_1 + 4x_3 \le 4, \quad x_1, x_2, x_3 \ge 0.$ **(15 Marks)**

4 Given Max $Z = -x_1 + 2x_2 - x_3$
Subject to $3x_1 + x_2 - x_3 \le 10$
$-x_1 + 4x_2 + x_3 \ge 6$
$x_2 + x_3 \le 4, \quad x_1, x_2, x_3 \ge 0.$

i) Obtain optimal solution
ii) Determine the ranges for changes in the components of b_2 & b_3 so as to maintain optimality.
iii) Determine the effect for changes in the components of cost vector which corresponds to basic variables. **(20 Marks)**

5 Apply dual simplex method to
Maximize $Z = -4y_1 - 12y_2 - 18y_3$
Subject to $y_1 + 3y_3 \ge 3$
$2y_2 + 2y_3 \ge 5, \quad y_1, y_2, y_3 \ge 0.$ **(20 Marks)**

6 The child fair company has 3 plants producing child push chairs that are to be shipped to 4 distribution centres. Plants 1, 2 & 3 produce 12, 17, 11 shipments/month. Each distribution centre needs to receive 10 shipments / month. The distances (miles) from each plant to the respective distribution centre is as follows:

		Distribution centre			
		1	2	3	4
Plant	1	800	1300	400	700
	2	1100	1400	600	1000
	3	600	1200	800	900

The freight cost for each shipment is $100 plus 5 cents/unit. Obtain optimal solution. **(20 Marks)**

7 A private firm employs typists on hourly piece rate basis for their daily work. 5 typists are working in that firm and their charges and speeds are different. On the basis of some earlier understanding only one job is to be given to one typist and the typist is paid for full hours even when he/she works for a fraction of an hour. Find least cost assignment.

Typist	Rate/hour	Number of pages / hour
A	5	12
B	6	14
C	3	8
D	4	10
E	4	11

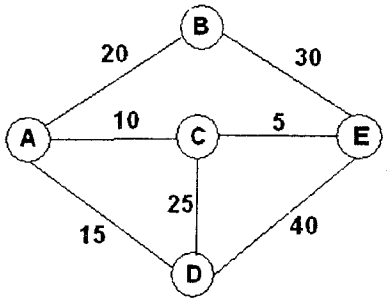
Job	Number of pages
P	199
Q	175
R	145
S	295
T	178

(20 Marks)

8 a. Use minimax criterion to find the best strategy for each player. Does this game have a saddle point? **(10 Marks)**

		Player II			
		1	2	3	4
Player I	1	3	-3	-2	-4
	2	-4	2	-1	1
	3	1	-1	2	0

b. Find minimal spanning tree for the graph



With constraints i) Link AD can be included only if DE is included.
ii) At most one of 3 links AD, CD & AB can be included. **(10 Marks)**

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07MCA25

Second Semester MCA Degree Examination, Dec.09/Jan.10
Operations Research

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define Operations Research. List and explain briefly the phases of Operations Research. **(10 Marks)**

b. The Apex Television Company has to decide on the number of 27 and 20-inch sets to be produced at one of its factories. Market research indicates that at most 40 of the 27-inch sets and 10 of the 20-inch sets can be sold per month. The maximum number of work hours available is 500 per month. A 27-inch set requires 20 work hours and a 20-inch set requires 10 work hours. Each 27-inch set sold produces a profit of Rs.120/- and each 20-inch set produces a profit of Rs.80/-. A wholesaler has agreed to purchase all the television sets produced if the numbers do not exceed the maxima indicated by the market research. Formulate a LP model for this problem. **(10 Marks)**

2 a. Dwight is an elementary school teacher who also raises pigs for supplemental income. He is trying to decide what to feed his pigs. He is considering using a combination of pig feeds available from local suppliers. He would like to feed the pigs at minimum cost while also making sure each pig receives an adequate supply of calories and vitamins. The cost, caloric content and vitamin content of each feed are given in the table below:

Contents	Feed Type A	Feed Type B
Calories (per pound)	800	1000
Vitamins (per pound)	140 units	70 units
Cost (per pound)	Rs.0.40	Rs.0.80

Each pig requires at least 8000 calories per day and at least 700 units of vitamins. A further constraint is that no more than one third of the diet (by weight) can consist of Feed type A, Since it contains an ingredient which is toxic if consumed in too large a quantity.

i) Formulate LP model for this problem.

ii) Use the graphical method to solve this model. What is the resulting daily cost per pig? **(10 Marks)**

b. Explain the following : i) Assumptions of LPP ii) Slack and surplus variables iii) Unbounded solution iv) Optimal solution **(10 Marks)**

3 a. Solve the following LPP by simplex method:

Maximize $z = 3x_1 + 2x_2$

Subject to $x_1 \le 4$

$x_1 + 3x_2 \le 15$

$2x_1 + x_2 \le 10$ and $x_1, x_2 \ge 0$ **(10 Marks)**

b. Use Big-M method to solve

Minimize $z = 3x_1 + 2x_2 + x_3$

Subject to $x_1 + x_2 = 7$

$3x_1 + x_2 + x_3 \ge 10$ and $x_1, x_2, x_3 \ge 0$ **(10 Marks)**

4 a. Use two-phase method to

Maximize $z = 5x_1 + 3x_2$

Subject to $2x_1 + x_2 \le 1$

$x_1 + 4x_2 \ge 6$ and $x_1, x_2 \ge 0$ **(10 Marks)**

4 b. Use revised simplex to solve,

Maximize $z = 4x_1 + 3x_2 + 6x_3$

Subject to $3x_1 + x_2 + 3x_3 \leq 30$

$2x_1 + 2x_2 + 3x_3 \leq 40$ and $x_1, x_2, x_3 \geq 0$ **(10 Marks)**

5 a. Give the generalized form of a primal LP model and its dual LP form. **(10 Marks)**

b. Explain the role of duality theory in sensitivity analysis. **(05 Marks)**

c. Write the dual of the following LPP:

Minimize $z = 3x_1 - 2x_2 + 4x_3$

Subject to $3x_1 + 5x_2 + 4x_3 \geq 7$

$6x_1 + x_2 + 3x_3 \geq 4$

$7x_1 - 2x_2 - x_3 \leq 10$

$x_1 - 2x_2 + 5x_3 \geq 3$

$4x_1 + 7x_2 - 2x_3 \geq 2$ and $x_1, x_2, x_3 \geq 0$ **(05 Marks)**

6 a. Use dual simplex method to solve

Minimize $z = 2x_1 + 2x_2 + 4x_3$

Subject to $2x_1 + 3x_2 + 5x_3 \geq 2$

$3x_1 + x_2 + 7x_3 \leq 3$

$x_1 + 4x_2 + 6x_3 \leq 5$ and $x_1, x_2, x_3 \geq 0$ **(10 Marks)**

b. List the types of metaheausistics and explain any one of them. **(05 Marks)**

c. Explain genetic algorithm with an example. **(05 Marks)**

7 a. Solve the following transportation problem: **(10 Marks)**

		To			
		1	2	3	Supply
From	1	5	1	7	10
	2	6	4	6	80
	3	3	2	5	15
	Demand	75	20	50	

b. Solve the following assignment problem: **(10 Marks)**

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

8 a. Reduce the following game by dominance property and find the game value: **(10 Marks)**

		Player B				
		1	2	3	4	5
Player A	I	1	3	2	7	4
	II	3	4	1	5	6
	III	6	5	7	6	5
	IV	2	0	6	3	1

b. Solve the following game by graphical method: **(10 Marks)**

		B			
		1	2	3	4
A	1	3	3	4	0
	2	5	4	3	7

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07MCA25

Second Semester MCA Degree Examination, May/June 2010
Operations Research

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define a linear programming problem. Mention its standard form and its characteristics. **(08 Marks)**

b. Food X contains 6 units of vitamin A per gram, 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram, 12 units of vitamin B per gram and costs 20 paise per gram. The daily minimum requirements of vitamin A and B are 100 units and 120 units respectively. Find the minimum cost of product mix. Formulate LPP for the above problem and solve it graphically. **(12 Marks)**

2 a. Use simplex method to solve the LPP :

Minimize $z = x_1 - 3x_2 + 2x_3$

Subject to $3x_1 - x_2 + 2x_3 \leq 7$

$-2x_1 + 4x_2 \leq 12$

$-4x_1 + 3x_2 + 8x_3 \leq 10$

and $x_1, x_2, x_3 \geq 0$. **(12 Marks)**

b. Consider the LPP :

Maximize $z = c_1x_1 + c_2x_2 + c_3x_3$

Subject to $x_1 + 2x_2 + x_3 \leq b$

$2x_1 + x_2 + 3x_3 \leq 2b$

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

You are given the resulting final simplex table below, where, x_4 and x_5 are the slack variables.

Basic Variables	Coefficient of						Right
	z	x_1	x_2	x_3	x_4	x_5	
z	1	7/10	0	0	3/5	4/5	z*
x_2	0	1/5	1	0	3/5	-1/5	1
x_3	0	3/5	0	1	-1/5	2/5	3

Use the fundamental insight to find the values of c_1, c_2, c_3, b and z*. **(08 Marks)**

3 a. Explain big M (chare's) method of solving LPP. **(06 Marks)**

b. Solve the following LPP by two phase simplex method.

Maximize $z = 3x_1 - x_2$

Subjected to $2x_1 + x_2 \geq 2$

$x_1 + 3x_2 \leq 2$

$x_2 \leq 4$ and $x_1, x_2 \geq 0$. **(14 Marks)**

4 a. Write the dual of the following LPP:

Minimize $z = 3x_1 - 2x_2 + x_3$

Subjected to $2x_1 - 3x_2 + x_3 \leq 5$

$4x_1 - 2x_2 \geq 9$

$-8x_1 + 4x_2 + 3x_3 = 8$

and $x_1, x_2 \geq 0$, x_3 is unrestricted. **(10 Marks)**

b. Use dual simplex method to solve the LPP :
Maximize $z = -6x_1 - x_2$
Subjected to $2x_1 + x_2 \geq 3$
$x_1 - x_2 \geq 0$
and $x_1, x_2 \geq 0$. **(10 Marks)**

5 a. Solve by revised simplex method the LPP :
Maximize $z = 6x_1 - 2x_2 + 3x_3$
Subjected to $2x_1 - x_2 + 2x_3 \leq 2$
$x_1 + 4x_3 \leq 4$
and $x_1, x_2, x_3 \geq 0$. **(15 Marks)**

b. Explain sensitivity analysis in simplex method. **(05 Marks)**

6 a. Solve the following transportation problem where cell entries represent profit. **(15 Marks)**

	W_1	W_2	W_3	W_4	Supply
F_1	15	51	42	33	23
F_2	80	42	26	81	44
F_3	90	40	66	60	33
Demand	23	31	16	30	

b. Explain degeneracy in transportation problem. **(05 Marks)**

7 a. Solve the assignment problem with the following cost matrix:

	1	2	3	4	5
A	20	15	25	25	29
B	13	19	30	13	19
C	20	17	14	12	15
D	14	20	20	16	24
E	14	16	19	11	22

(12 Marks)

b. State the travelling salesman problem and formulate it as an assignment problem. **(08 Marks)**

8 a. Use a graphical method to determine an optimal strategy for player I in the game defined by the following table:

		Player II		
		B_1	B_2	B_3
Player I	A_1	2	-3	-4
	A_2	-6	-1	1

(10 Marks)

b. i) Explain tabu search. **(05 Marks)**
ii) Explain simulated annealing. **(05 Marks)**

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