NEW SCHEME

USN | | | | | | | | | |

Sixth Semester B.E. Degree Examination, July/August 2005

ME/IM/IP/MA/AU/CC/MI

Operations Research

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

Note: *1. Answer any FIVE full questions.*
2. Use of statistical tables permitted.

1. (a) What are the various phases of O.R. problems? Explain them briefly. **(5 Marks)**

(b) Explain the applications of O.R. in industry. **(5 Marks)**

(c) A toy company manufactures two types of dolls, a basic version doll A and a deluxe version doll B. Each doll of type B takes twice as long to produce as one of type A and the company would have time to make a maximum of 2000 per day. The supply of plastic is sufficient to produce 1500 dolls per day (both A and B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs.3/- and Rs.5/- per doll respectively on doll A and B, then how many of each doll should be produced per day in order to maximize the total profit. Formulate this problem and solve it graphically. **(10 Marks)**

2. (a) Define the following :

i) Unbounded solution

ii) Slack & surplus variable

iii) Basic feasible solution. **(6 Marks)**

(b) Maximize $Z = 5x_1 - 2x_2 + 3x_3$

Subject to

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

$$3x_1 - 4x_2 \leq 3$$

$$x_2 + 3x_3 \leq 5$$

and $x_1, x_2, x_3 \geq 0$ **(14 Marks)**

3. (a) Use M-technique and solve the following:

Minimize $Z = 4x_1 + x_2$

Subject to

$$3x_1 + x_2 = 3$$

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

$$x_1 + 2x_2 \leq 3$$

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

Contd.... 2

(b) The rate of arrival of customers at a public telephone booth follows poisson distribution, with an average time of 10 minutes between one customer and the next. The duration of a phone call is assumed to follow exponential distribution, with mean time of 3 minutes

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

ii) What is the average length of the non-empty queues that form from time to time?

iii) The telephone department will install a second booth when it is convinced that the customers would expect waiting for atleast 3 minutes for their turn to make a call. By how much time should the flow of customers increase in order to justify a second booth?

iv) Estimate the fraction of a day that the phone will be in use. **(10 Marks)**

4. (a) Explain how to solve the degeneracy in transportation problems. **(4 Marks)**

(b) Solve the following transportation problem to maximise profit and give criteria for optimality.

Profit (Rs.) / Unit

Origin \ destination	1	2	3	4	supply
A	42	27	24	35	200
B	46	37	32	32	60
C	40	40	30	32	140
Demand	80	40	120	60	

(16 Marks)

5. Explain the steps involved in solving assignment problem using Hungarian method. **(6 Marks)**

(b) A salesman has to visit five cities A,B,C,D and E. The distance (in hundred km) between the five cities are as follows.

From \ To	A	B	C	D	E
A	-	7	6	8	4
B	7	-	8	5	6
C	6	8	-	9	7
D	8	5	9	-	8
E	4	6	7	8	-

If the salesman starts from city A and has to come back to city A, which route shoud he select so that the total distance travelled is minimum? **(14 Marks)**

6. (a) Define the following terms with reference to PERT.

i) Total float ii) Free float iii) Independent float **(6 Marks)**

Contd.... 3

(b) A project has the following characteristics :

Task	1-2	1-3	2-3	1-4	3-5	4-5	4-6	5-7	5-6	6-8	7-8
Least time	4	5	8	2	4	6	8	5	3	5	6
Greatest time	8	10	12	7	10	15	16	9	7	11	13
Most likely time	5	7	11	3	7	9	12	6	5	8	9

Find the earliest and latest expected times for each event. Also find critical path and variance for each event.

(14 Marks)

7. Explain the Fulkerson's rule of numbering the nodes. **(6 Marks)**

(b) A small project is having seven activities. The relevant data about these activities is given below. Indirect cost per day is Rs. 100/-

Activity	Dependence	Normal duration (days)	Crash duration (days)	Normal cost (Rs.)	Crash cost (Rs.)
A	-	7	5	500	900
B	A	4	2	400	600
C	A	5	5	500	500
D	A	6	4	800	1000
E	B,C	7	4	700	1000
F	C,D	5	2	800	1400
G	E,F	6	4	800	1600

i) Find out the normal duration and the cost.

ii) Crash the network to complete in 21 days. What is the percentage increase in cost to complete in 21 days?

(14 Marks)

8. (a) Define :

i) pay off matrix ii) saddle point iii) pure & mixed strategies. **(4 Marks)**

(b) Solve the following game by dominance method

		B			
		I	II	III	IV
	I	6	8	3	13
A	II	4	1	5	3
	III	8	10	4	12
	IV	3	6	7	12

(8 Marks)

Contd.... 4

(c) Solve the game graphically whose pay off matrix for the player A is given below.

		B	
		I	II
A	I	2	4
	II	2	3
	III	3	2
	IV	-2	6

(8 Marks)

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USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2007
IP/IM/ME/MA/CC/MI/AU
Operations Research

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

Note :1. ***Answer any FIVE full questions.***
2. Use of statistical tables permitted.

1 a. List and explain briefly the phases of operation research. **(05 Marks)**

b. A company has two grades of inspectors A and B. It is required that atleast 1800 pieces to be inspected per day of 8 hours. Grade A inspector can check at the rate of 25 pieces per hour with an accuracy of 98%. Grade B inspector can check at the rate of 15 pieces per hour with 95% accuracy. The wage rate for grade A inspector is Rs.20/hr and that of Grade B inspector is Rs.15/hr. Each time an error is made by an inspector the cost to company is Rs.10. There are 8 grade 'A' inspectors and 10 grade B inspectors available for service. Determine the optimal assignment of inspectors that will optimize the total cost of inspection. Solve graphically the above LPP. **(15 Marks)**

2 a. Find the optimal value Z of the following LPP by inspecting its dual only (Do not solve it).

Minimize $Z = 4x_1 + 5x_2 + 3x_3 + 4x_4$

Subject to the

$2x_1 + 6x_2 - 3x_3 - 4x_4 \geq 50$

$x_1, x_2, x_3, x_4 \geq 0$ **(05 Marks)**

b. Solve the following LPP:

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

Subject to the

$-3x_1 + 2x_2 + 2x_3 = 8$

$-3x_1 + 4x_2 + x_3 = 7$

$x_1, x_2, x_3 \geq 0$ **(15 Marks)**

3 a. At what rate must the clerk of a super market work in order to ensure a probability of 0.9 that the customer will not have to wait longer than 12 minutes in the system? It is assumed that the arrivals follow Poisson distribution at an average rate of 15/hr. The length of service by the clerk has an exponential distribution. **(05 Marks)**

b. A mechanic is to be hired to repair machines which break down at an average rate of 3 /hour. Breakdowns are distributed in time in a manner that may be regarded as Poisson. The non-productive time on any machine is considered to cost the company Rs.5/hour. The company has narrowed the choice of two mechanics A and B. The mechanic A costs Rs. 3/hour and will service the machines exponentially at an average rate of 4/hour. The mechanic B cost Rs.5/hour and can repair machines exponentially at an average rate of 6/hour. Decide which mechanic should be hired. **(15 Marks)**

Contd....2

4 a. Differentiate between PERT and CPM. **(04 Marks)**

b. A project consists of the activities as given in the table below :

Job	A	B	C	D	E	F	G	H	J	K	L	M
Duration (days)	13	5	8	10	9	7	7	12	8	9	4	17

Constraints :

- A and B are starts.
- A controls C, D and E.
- B controls F and K.
- G depends on C.
- H depends on D.
- E and F control J and M.
- L depends on K.
- M is also controlled by L.

i) Draw the network of the above project. **(05 Marks)**

ii) Find the critical path and project duration. **(04 Marks)**

iii) Calculate the EST, EFT, LST, LFT, TF and FF for each activity. **(07 Marks)**

5 Table below shows the activities with their normal duration, normal cost, crash duration and crash cost. The overhead cost is Rs.300/day.

Activity	Normal duration in days	Normal cost in Rs.	Crash duration in days	Crash cost in Rs.
1 – 2	6	1400	4	1900
1 – 3	8	2000	5	2800
2 – 3	4	1100	2	1500
2 – 4	3	800	2	1400
3 – 4	-	-	-	-
3 – 5	6	900	3	1600
4 – 6	10	2500	6	3500
5 – 6	3	500	2	800

a. Draw the network and determine the normal length and its cost. **(06 Marks)**

b. Find the optimum duration and its cost. **(07 Marks)**

c. If all the activities are crashed to the maximum possible extent, what is the corresponding cost of the project? **(07 Marks)**

6 a. Differentiate between transportation problems and assignment problem. **(04 Marks)**

b. A Canning company operates 2 Canning plants. 3 growers are willing to supply fresh fruits in the following amounts:

Grower 1 – 200 quintals at Rs.100/quintal

Grower 2 – 300 quintals at Rs.90/quintal

Grower 3 – 400 quintals at Rs.80/quintal

The shipping cost in rupees per quintal are,

	A	B
G_1	20	25
G_2	10	15
G_3	50	30

Contd.....3

The plant A and B capacity and labor costs are
Plant A capacity – 450 quintals ; Labor cost – Rs. 250 / quintal
Plant B capacity – 350 quintals ; Labor cost – Rs. 200 / quintal
The Canned fruits are sold at Rs.500/quintal to the distributor.
How should the company plan its two plants so as to maximize its profit? **(16 Marks)**

7 a. Solve the following LPP using dual simplex method.

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

Subject to the

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

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

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

$x_1, x_2, x_3 \geq 0$ **(08 Marks)**

b. A college athletic conference has 6 basket ball officials. It must assign to 3 conference games. Two officials must be assigned to each game. The conference office desires to assign the officials such that the total distance traveled by all the six officials will be minimized. The distances each official would have to travel to each game are given below :

		Officials					
		1	2	3	4	5	6
Game	A	20	40	60	20	70	80
	B	45	90	70	60	15	25
	C	10	70	30	40	50	35

The conference office has decided not to assign the officials 4 to game A because of the previous conflicts with one of the coaches. Determine the optimal assignment. **(12 Marks)**

8 a. Deduce the following game by dominance and find the values of the game: **(16 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. Explain the following with respect to game theory:
i) Saddle point.
ii) Two person zero sum game.
iii) Mixed strategy.
iv) Pure strategy. **(04 Marks)**

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(c) Solve the game graphically whose pay off matrix for the player A is given below.

		B	
		I	II
	I	2	4
A	II	2	3
	III	3	2
	IV	-2	6

(8 Marks)

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NEW SCHEME

Reg. No.

Sixth Semester B.E. Degree Examination, January/February 2006

IP/ME/IM/MA/AU/CC/MI
Operations Research

Time: 3 hrs.) (Max.Marks : 100

Note: *1) Answer any FIVE full questions.*
2) use of statistical data book is permitted.

1. (a) What are the steps involved in operations research? Explain in brief. (5 Marks)

   (b) What are the limitations of operations research? (5 Marks)

   (c) Consider the following constraints

   $x_1 + 2x_2 \geq 10$; $-x_1 + x_2 \leq 10$ *and* $x_2 \geq 0$

   Represent the constraints graphically and clearly show the feasible region. Draw two iso-Z lines if $Z = x_1 + x_2$. Show the direction of improvement of Z if Z is to be minimized. Find the minimum value of Z. What can be the maximum value of Z? (10 Marks)

2. (a) Define 'Basic feasible solution'. Find all basic solutions for the following problem and group them into basic feasible solution and basic infeasible solution.

   Maximise $Z = x_1 + x_2 + 7x_3$

   Subject to $x_1 + x_2 - 2x_3 \leq 10$ *and*

   $x_1, x_2, x_3 \geq 0$ (6 Marks)

   (b) Solve the following problem either by Big M method or by dual Simplex method. (10 Marks)

   Minimise $Z = 2x_1 + 2x_2 + 4x_3$

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

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

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

   (c) With reference to the solution of LPP by Simplex method/table, when one can conclude as the problem has

   I) unbounded solution and II) no feasible solution. (4 Marks)

3. (a) Write the dual for the following primal :

   Minimise $Z = 3x_1 + x_2 - 7x_3$

   Subject to $x_1 - 2x_2 + 3x_3 \leq 10$

   $3x_1 + 5x_2 - x_3 \geq 9$

   $-x_1 - 4x_2 + x_3 = 6$

   x_1 unrestricted ; $x_2, x_3 \geq 0$ (6 Marks)

   (b) Explain in brief the term 'Artificial variable' used in Big-M method. (4 Marks)

Contd.... 2

the item presently on the machine and the setup to be made according to the following table :

From \ To	A	B	C	D	E
A	∞	4	7	3	4
B	4	∞	6	3	4
C	7	6	∞	7	5
D	3	3	7	∞	7
E	4	4	5	7	∞

If he processes each type of item once and only once each week, how should he sequence the items on his machine in order to minimize the total setup cost? **(10 Marks)**

4. A company manufacturing air-coolers has two plants located at Bombay and Calcutta with a capacity of 200 units and 100 units per week respectively. The company supplies the air-coolers to its four show rooms situated at Ranchi, Delhi, Lucknow and Kanpur which have a maximum demand of 75, 100, 100 and 30 units respectively. Due to variation in raw material cost and transportation cost, the profit per unit in rupees differs with places which is shown below :

	Ranchi	Delhi	Lucknow	Kanpur
Bombay	90	90	100	110
Calcutta	50	70	130	85

Due to contractual obligation a minimum of 10 aircoolers produced in Calcutta should be supplied to Ranchi. Find the optimum production supply schedule to maximize the profit. **(20 Marks)**

5. (a) The owner of a small machine shop has four machinists available to assign to jobs for the day. Five jobs are offered with the expected profit in rupees for each machinist on each job as shown below :

Machinist \ Job	A	B	C	D	E
1	6.20	7.80	5.00	10.10	8.20
2	7.10	8.40	6.10	7.30	5.90
3	8.70	9.20	11.10	7.10	8.10
4	4.80	6.40	8.70	7.70	8.00

Find the assignment of machinists to jobs that will result in a maximum profit. Which job should be declined? **(10 Marks)**

(b) State the basic elements of a queuing model. **(4 Marks)**

Contd.... 3

(c) In a railway marshalling yard, goods train arrive at a rate of 30 trains per day. Assuming arrival and service as per Poisson and exponential distributions and mean service time of 36 minutes, calculate

i) the mean queue size (including train being served)

ii) the probability that the queue size exceeds 10. **(6 Marks)**

6. (a) The Fig.Q6(a) shown below indicates the project network alongwith three time estimates for each activity.

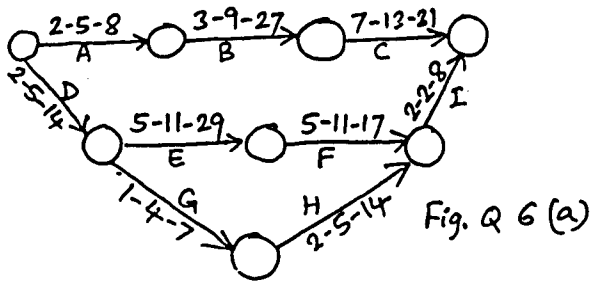

Fig. Q 6 (a)

i) Number the nodes as per Fulkerson's rule.

ii) Value of expected time, standard deviation and variance of each activity.

iii) Critical path.

iv) Variance of critical path.

v) Probability of completion of project in 38 days. **(12 Marks)**

(b) What is the shortest route from plant to site for the network shown in fig.Q6(b).

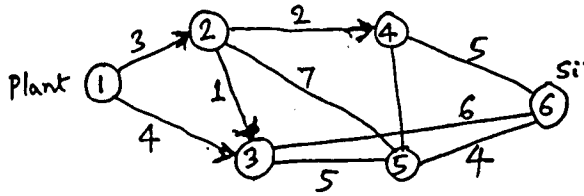

Fig. Q 6 (b).

(8 Marks)

7. (a) The information regarding a project is summarised in the table below. Find out the optimum project duration and the corresponding cost.

Activity	Preceding activity	Normal time (weeks)	Crash time(weeks)	Normal cost(Rs.)	Crash Cost (Rs.)
A	-	5	4	600	800
B	-	3	1	400	600
C	-	8	5	900	1200
D	A	4	2	600	1200
E	B	4	3	500	700

Contd.... 4

NEW SCHEME

USN

Sixth Semester B.E. Degree Examination, July/August 2005

ME/IM/IP/MA/AU/CC/MI

Operations Research

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

Note: *1. Answer any FIVE full questions.*
2. Use of statistical tables permitted.

1. (a) What are the various phases of O.R. problems? Explain them briefly. (5 Marks)

   (b) Explain the applications of O.R. in industry. (5 Marks)

   (c) A toy company manufactures two types of dolls, a basic version doll A and a deluxe version doll B. Each doll of type B takes twice as long to produce as one of type A and the company would have time to make a maximum of 2000 per day. The supply of plastic is sufficient to produce 1500 dolls per day (both A and B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs.3/- and Rs.5/- per doll respectively on doll A and B, then how many of each doll should be produced per day in order to maximize the total profit. Formulate this problem and solve it graphically. (10 Marks)

2. (a) Define the following :
   i) Unbounded solution
   ii) Slack & surplus variable
   iii) Basic feasible solution. (6 Marks)

   (b) Maximize $Z = 5x_1 - 2x_2 + 3x_3$
   Subject to
   $2x_1 + 2x_2 - x_3 \geq 2$
   $3x_1 - 4x_2 \leq 3$
   $x_2 + 3x_3 \leq 5$
   and $x_1, x_2, x_3 \geq 0$ (14 Marks)

3. (a) Use M-technique and solve the following:
   Minimize $Z = 4x_1 + x_2$
   Subject to
   $3x_1 + x_2 = 3$
   $4x_1 + 3x_2 \geq 6$
   $x_1 + 2x_2 \leq 3$
   $x_1, x_2 \geq 0$ (10 Marks)

Contd.... 2

IP61

(20 Marks)

8. (a) Define saddle point. Is it necessary that a game should always possess a saddle point? (4 Marks)

   (b) For what value of λ, the game with the following payoff matrix has a saddle point?

$$A \begin{matrix} \\ A_1 \\ A_2 \\ A_3 \end{matrix} \begin{matrix} B \\ B_1 \quad B_2 \quad B_3 \\ \end{matrix} \begin{bmatrix} \lambda & 6 & 2 \\ -1 & \lambda & -7 \\ -2 & 4 & \lambda \end{bmatrix}$$ (6 Marks)

   (c) Solve graphically

$$A \begin{matrix} \\ 1 \\ 2 \end{matrix} \begin{matrix} B \\ 1 \quad 2 \quad 3 \quad 4 \\ \end{matrix} \begin{bmatrix} -6 & 0 & 6 & -15 \\ 7 & -3 & -8 & 2 \end{bmatrix}$$ (10 Marks)

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IP61

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IP61

Sixth Semester B.E. Degree Examination, June/July 08
Operations Research

Time: 3 hrs. Max. Marks:100

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

1 a. List and briefly explain the various phases of operation research study and state the limitations of O.R **(10 Marks)**

b. Customers arrive at a sales counter managed by a single person, according to a poisson's process with a mean rate of 20 per hour. The time required to serve a customer has an exponential distribution with mean of 100 seconds. Find
i) Average waiting time of a customer in the system
ii) Probability that a customer will have to wait for at least 10 minutes
iii) What time on an average, the sales counter cashier is idle?
iv) If the service can be speeded up to 80 seconds, what will be the effect on probability that a customer will have to wait for at least 10 minutes. **(10 Marks)**

2 a. XYZ Company manufactures two types of leather belts, 'A' and 'B'. Both belts require the same length of leather per belt and both belts use different kinds of buckles. The supply of leather is sufficient to make 800 belts per day (Both types included). The number of buckles available for A and B type are 300/day and 650/day respectively. Each belt of type A requires twice as much time as required by a belt of type B, to manufacture. The speed of production is such that in the absence of any constraints with regard to buckles and leather, the company would be able to produce 1000 belts of type B/day if only belt B is manufactured. The profit margin for belt A is Rs 0.4/belt and for belt B is Rs 0.3/belt. Set up the LP problem and solve the same graphically. **(15 Marks)**

b. Write the Dual of the following LPP

Minimise $Z = 3x_1 - 6x_2 + 4x_3$

Subject to
$4x_1 + 3x_2 + 6x_3 \geq 9$
$1x_1 + 2x_2 + 3x_3 \geq 6$
$6x_1 - 2x_2 - 2x_3 \leq 10$
$x_1 - 2x_2 + 6x_3 \geq 4$
$2x_1 + 5x_2 - 3x_3 \geq 6$
$x_1, x_2, x_3 \geq 0$ **(05 Marks)**

3 a. Solve the following Linear programming problem

Maximise $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subject to
$x_1 + 2x_2 + 3x_3 = 15$
$2x_1 + x_2 + 5x_3 = 20$
$x_1 + 2x_2 + x_3 + x_4 = 10$
$x_1, x_2, x_3, x_4 \geq 0$ **(16 Marks)**

b. Explain "Artificial" and surplus variables with examples. **(04 Marks)**

4 A Car rental agency has 08 outlets in a metropolitan city. The Agency found from experience that is best to began each day with all their cars evenly distributed among the 08 outlets, assuming that all 80 cars are present. Suppose that at the end of a particular day the no of cars at the outlets is as follows

Outlet	A	B	C	D	E	F	G	H
No. of cars	1	11	3	15	20	5	7	18

The agency wish to transport the cars from the surplus outlets to the deficit outlets to attain an even distribution. The best set of movements is that which has the smallest total distance travelled. The distance in kms between the outlets are given below. Solve the problem by transferable Algorithm.

	A	B	C	D	E	F	G	H
A	-	13	3	11	12	5	8	7
B		-	11	11	25	16	23	9
C			-	19	11	16	7	15
D				-	31	26	16	3
E					-	4	9	12
F						-	8	9
G							-	14

(20 Marks)

5 a. Find the minimum cost solution for the 5 × 5 assignment problem whose cost co-efficients are given below **(10 Marks)**

		B				
		1	2	3	4	5
A	1	-2	-4	-8	-6	-1
	2	0	-9	-5	-5	-4
	3	-3	-8	0	-2	-6
	4	-4	-3	-1	0	-3
	5	-9	-5	-8	-9	-5

b. Solve the following traveling salesman problem given the following data **(10 Marks)**

$C_{12} = 20$; $C_{13} = 04$; $C_{14} = 20$; $C_{23} = 05$;
$C_{24} = 06$; $C_{25} = 10$; $C_{35} = 06$; $C_{45} = 20$;
And Cij = Cji and there is no route between the cities i and j if a value of Cij is not given

6 a. Explain the rules devised by FULKERSON **(04 Marks)**

b. A project schedule has the following charecteristics

Activity	Time (Weeks)	Activity	Time (weeks)
1 – 2	4	5 – 6	4
1 – 3	1	5 – 7	8
2 – 4	1	6 – 8	1
3 – 4	1	7 – 8	2
3 – 5	6	8 – 10	5
4 – 9	5	9 – 10	7

i) Draw the network and find the critical path
ii) Compute EST, EFT, LST, LFT, total float for each activity. **(16 Marks)**

7 The following table gives data on a project

Task	Immediate Predecessor	Normal time (weeks)	Normal cost (Rs)	Crash time	Crash cost (Rs)
A		10	20000	7	30000
B		8	15000	6	20000
C	B	5	8000	4	14000
D	B	6	11000	4	15000
E	B	8	9000	5	15000
F	E	5	5000	4	8000
G	A, D, C	12	3000	8	4000

Indirect cost is Rs 4000/day i) Draw the network and find critical path. ii) Find normal duration and normal cost, optimum duration and optimum cost and crash (least) duration and corresponding project cost. **(20 Marks)**

8 a. Solve the Game by Graphical method **(14 Marks)**

		B				
		1	2	3	4	5
A	1	3	0	6	-1	7
	2	-1	5	-2	2	1

b. Explain clearly the following terms:
i) Pay off matrix ii) Saddle point iii) Two person zero sum game. **(06 Marks)**

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06ME74

Seventh Semester B.E. Degree Examination, Dec.09-Jan.10
Operations Research

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, choosing atleast TWO questions from each Part.***
2. ***Use of Normal distribution tables is permitted.***

PART - A

1 a. State the assumptions made in LPP and explain in brief any one of them. **(04 Marks)**

b. A softdrink bottling plant has two machines A and B. Though machines A and B are designed for bottling 8 – ounce and 16 – ounce respectively, each machine can be used on both types with some loss of efficiency. The following data is available :

Machine	8 – ounce bottles	16 – ounce bottles
A	100 / minute	40 / minute
B	60 / minute	75 / minute

Each machine can be run 8 – hour per day, 5 days per week. Profit on each 8 – ounce bottle is Rs 0.50 and that on 16 – ounce bottle is Rs 0.8. Weekly production of the drink cannot exceed 3,00,000 ounces and the market can absorb 25,000 eight – ounce bottles and 7,000 sixteen – ounce bottles per week. The production planner of the bottling plant wishes to plan the production for maximization of profit. Formulate the problem as LPP. **(10 Marks)**

c. Solution space identified by a set of constraints is shown in fig. Q1(c). If one more constraint $x_1 + x_2 \geq 3$ is to be included, then is there any change in the solution space? If so, show the new feasible zone. With respect to the new feasible zone, state the redundant constraint or constraints if there any any. **(06 Marks)**

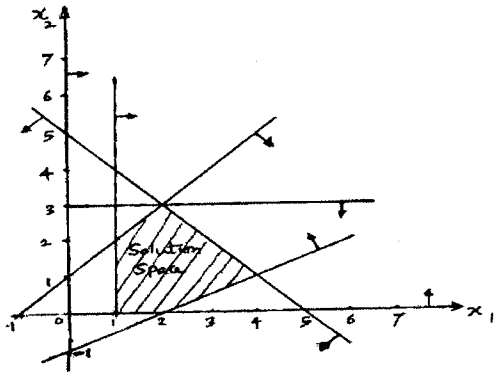

Fig.Q1(c)

2 a. Find the optimum value of Z for the following LPP by inspecting its dual only.
Min $Z = 4x_1 + 5x_2 + 3x_3 + 4x_4$.
Such that $2x_1 + 6x_2 + 3x_3 + 4x_4 \geq 50$ and $x_1, x_2, x_3, x_4 \geq 0$. **(05 Marks)**

b. With reference to the solution of LPP by simplex method / table when do you conclude as follows : i) LPP has no limit for the improvement of the objective function ii) LPP has no feasible solution. **(05 Marks)**

c. Solve the following LPP by 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)**

3 A problem of scheduling the weekly production of certain items for the next four weeks is to be solved. The production cost of the item is Rs 10 for the first two weeks and Rs 15 for the last two weeks. The weekly demands are 500, 800, 1000 and 900, which must be met. The plant can produce a maximum of 700 units per week. In addition, the company can use overtime during second and third week. This increases the weekly production by an additional 200 units, but the production cost increases by Rs 5. Excess production can be stored at a unit cost of Rs 3 per week. How should the production be scheduled so as to minimize the total cost? **(20 Marks)**

4 a. A University examination panel has five examiners. The examiners are to be assigned to two practical examinations, two each for each practical exam. University desires to assign examiners such that the total distance traveled by all the examiners is minimum. The distance each examiner would have to travel to each practical examination centre are given below. Solve the problem. **(10 Marks)**

		Examiner				
		E1	E2	E3	E4	E5
Practicals	A	20	40	60	20	70
	B	45	90	70	60	15

b. It is required to process the following jobs (two jobs) on various machines shown below :

Job I	Sequence	A	B	C	D	E
	Time (in hrs)	7	9	5	13	5
Job II	Sequence	B	C	A	D	E
	Time (in hrs)	11	9	7	5	13

(10 Marks)

Find for each machine which job should be done first and calculate the total elapsed time.

PART - B

5 a. What is service discipline? State various disciplines with examples. **(06 Marks)**

b. Patrons arrive at a reception counter at an average inter arrival time of 2 minutes. The receptionist on duty takes an average of one minute per person. (Arrivals are as per Exponential and Services are as per Poisson distribution).

i) What is the chance that a patron will straight away meet the receptionist? ii) For what portion of time the receptionist is busy? iii) What is the average queue length? iv) What is the average number of patrons in the system? v) What is the average waiting time of a patron? vi) What average time a patron spends in the system? vii) Suppose management wants to keep a second receptionist when the average waiting time of an arrival exceeds 1.5 minutes. Find what should be the inter – arrival time to justify a second receptionist? **(14 Marks)**

6 a. Time estimates for a particular activity are provided by two engineers A and B as follows :

Engineer	Optimistic time	Most likely time	Pessimistic time
A	3	6	7
B	4	5	9

State who is more certain about his estimation. **(05 Marks)**

b. A project is expected to take 12 months with a standard deviation of 4 months. What is the probability of completing the project within i) 10 months ii) 16 months? **(05 Marks)**

c. The utility data for a network is given below : 23

Activity	Normal		Crash	
	Time (days)	Cost (Rs)	Time (days)	Cost (Rs)
1 - 2	8	100	6	200
1 – 3	4	150	2	350
2 – 4	2	50	1	90
3 – 4	5	100	1	200

Indirect cost : Rs 100 per day. Crash systematically and determine the optimum project duration and cost. **(10 Marks)**

7 a. In a game of matching coins, Player 'A' wins Rs 8, if both coins show heads and Rs 1 if both are tails. Player B wins Rs 3 when coins do not match. Given the choice of being Player A or Player B, which would you choose and what would be your strategy? **(10 Marks)**

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

		B			
		I	II	III	IV
A	1	20	15	12	35
	2	25	14	8	10
	3	40	2	19	5
	4	5	4	11	0

8 a. Write a short note on 'Solution methods of integer programming'. **(08 Marks)**

b. Solve the following :

Max. $Z = 5x_1 + 4x_2$.

Subject to $x_1 + x_2 \leq 5$

$10x_1 + 6x_2 \leq 45$

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

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06ME74

Seventh Semester B.E. Degree Examination, May/June 2010
Operations Research

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of statistical tables is permitted.***

PART – A

1 a. Briefly explain the scopes of operation research. **(05 Marks)**

b. A farmer has a 100 acre farm. He can sell all tomatoes, lettuce or radishes and can rise the price to obtain Rs.1.00 per kg for tomatoes, Rs.0.75 ahead for lettuce and Rs.2.00 per kg for radishes. The average yield per acre is 2000 kgs of tomatoes, 3000 heads of lettuce and 1000 kgs of radishes. Fertilizers are available at Rs.0.50 per kg and the amount required per acre is 100 kgs each for tomatoes and lettuce and 50 kgs for radishes. Labour required for sowing, cultivating and harvesting per acre is 5 man-days for tomatoes and radishes and 6 man-days for lettuce. A total of 400 man days of labour are available at Rs.20 per man-day. Formulate this problem as a linear programming model to maximize the farmer's total profit. **(15 Marks)**

2 a. Obtain the dual of the following LP problem:

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. **(06 Marks)**

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

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

Subject to, $5x_1 + 7x_2 + 4x_3 \leq 7$

$-4x_1 + 7x_2 + 5x_3 \geq -2$

$3x_1 + 4x_2 - 6x_3 \geq 29/7$

$x_1, x_2, x_3 \geq 0$ **(14 Marks)**

3 a. List out the differences between transportation and assignment problems. **(06 Marks)**

b. A product is produced by four factories A, B, C and D. The unit production costs in them are Rs 2.00, Rs 3.00, Rs 1.00 and Rs 5.00 respectively. Their production capacities are factory A = 50 units, B = 70 units, C = 30 units and D = 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transport cost in rupees from each factory to each store is given in the table below:

		Stores			
		1	2	3	4
Factories	A	02	04	06	11
	B	10	08	07	05
	C	13	03	09	12
	D	04	06	08	03

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum. **(14 Marks)**

4 a. There are five jobs, each of which must go through machines A, B and C in the order ABC Processing times are given in the table below:

Job	Processing times (Hrs)		
	A	B	C
1	8	5	4
2	10	6	9
3	6	2	8
4	7	3	6
5	11	4	5

Determine a sequence for five jobs that will minimize the elapsed time T. **(10 Marks)**

b. The owner of a small machine shop has four machinists available to do jobs for the day. Five jobs are offered with expected profit for each machinist on each jobs as follows:

	1	2	3	4
A	32	41	57	18
B	48	54	62	34
C	20	31	81	57
D	71	43	41	47
E	52	29	51	50

Find by using assignment method, the assignment of machinist to jobs that will result in a maximum profit. **(10 Marks)**

PART – B

5 a. List out the differences between PERT and CPM. **(06 Marks)**

b. Arrival rate of telephone calls at a telephone booth are according to Poisson distribution, with an average time of 9 minutes between two consecutive arrivals. The length of telephone calls is assumed to be exponentially distributed with mean 3 minutes.

i) Determine the probability that a person arriving at the booth will have to wait.

ii) Find the average queue length.

iii) The telephone company will install a second booth when convinced that an arrival would expect to have to wait at least four minutes for the phone. Find the increase in flow arrivals which will justify a second booth.

iv) What is the probability that an arrival will have to wait for more than 10 minutes before the phone is free? **(14 Marks)**

6 a. Briefly explain queuing system and their characteristics. **(05 Marks)**

b. The below table shows the jobs of a network along with their time estimates. The time estimates are in days :

Jobs	1 – 2	1 – 6	2 – 3	2 – 4	3 – 5	4 – 5	5 – 8	6 – 7	7 - 8
a	3	2	6	2	5	3	1	3	4
m	6	5	12	5	11	6	4	9	19
b	15	14	30	8	17	15	7	27	27

i) Draw the project network ii) Find the critical path

iii) Find the probability that the project is completed in 31 days. **(15 Marks)**

7 a. Explain clearly the following terms : **(06 Marks)**

i) Pay off matrix ii) Saddle point iii) Two person zero sum game

b. In a game of matching coins with two players suppose "A" wins one unit of value when there are two heads, wins nothing when there are two tails and losses half unit of value when there are one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of game to "A". **(14 Marks)**

8 a. Explain the importance of integer programming. **(05 Marks)**

b. Find the optimum integer solution to the following LPP:

Maximum, $Z = x_1 + x_2$; subject to $3x_1 + 2x_2 \leq 5$; $x_2 \leq 2$; $x_1, x_2 \geq 0$, are integers. **(15 Marks)**

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