

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY**MBA Semester –II Examination Dec. - 2011****Subject code: 820007****Date: 21/12/2011****Subject Name: Research Methodology and Operations Research (RM&OR)****Time: 10.30 am – 01.30 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) A company assembles and sells two versions of a certain product, the Basic **07**

model and the Deluxe model. To make either model requires certain inputs, as well as processing time using one of Process 1 or Process 2. The details are as follows. The Basic model sells for \$25. To make a unit of the Basic model, 1 unit of raw material and 2 hours of Process 1 time are needed; The Deluxe model sells for \$45. To make a unit of the Deluxe model, you start with a completed Basic model, and augment it using 2 additional units of raw material and 2 hours of Process 2 time. There are 1300 hours of Process 1 time available, at an operating cost of \$10 for each hour used. As for Process 2 time, there are 500 hours available, and it costs the company \$12 for each hour of Process 2 usage. Raw material is available from two sources. It can be purchased from an external supplier at a cost of \$6/unit; or it can be produced on site from recycled materials the company has on hand. It takes one half-hour of Process 1 time to make a unit of raw material this way. The company believes it can sell all the Basic and Deluxe models it makes. Naturally, its goal is to set a production schedule for the next production run in a way that will maximize its net profit. Formulate a linear programming problem. Be sure to explain, *precisely*, the meaning or interpretation of each variable you introduce. (Do not solve)

(b) Solve the following problem graphically, and determine the amounts of **07**
ingredients XA and XB that will go into each bag. Also indicate which are binding constraints and non binding constraints?

MINIMIZE $Z = 4XA + 5XB$ (the cost in dollars of a 10 kg bag),
subject to the constraints

- i) $0.25XA + 0.40XB > 3$;
- ii) $0.10XA + 0.06XB > 0.7$;
- iii) $0.04XA + 0.05XB < 0.5$
- iv) $XA + XB < 10$
and $XA, XB \geq 0$

Q.2 (a) Write the steps involved in research process? Explain with one hypothetical **07**
example?**(b)** What is primary and secondary data? Write its advantages and **07**
disadvantages?**OR****(b)** Solve the following Travelling salesman problem: **07**

	A	B	C	D	E
A	∞	10	3	6	9
B	5	∞	5	4	2
C	4	9	∞	7	8
D	7	1	3	∞	4
E	3	2	6	5	∞

- Q.3 (a)** Write short notes on the following: **07**
 i) Null Hypothesis
 ii) Type I and Type II error
 iii) Power of the Test

- (b)** Write dual to the following primal problem: **07**

$$\text{Min } Z = 8x_1 + 6x_2$$

subject to:

$$4x_1 + 2x_2 \geq 20$$

$$-6x_1 + 4x_2 \leq 12$$

$$x_1 + x_2 = 6$$

$$x_1, x_2 \geq 0$$

OR

- Q.3 (a)** What is parametric and non parametric test? Explain with one example from each? **07**

- (b)** For the transportation simplex worksheet below, where the goal is to minimize a cost, use any of the IBFS method to find an initial basic feasible solution. Find the Optimal solution by using u-v method? **07**

Source	P	Q	R	S	Supply
A	40	45	35	36	300
B	48	50	52	46	200
C	43	44	55	50	400
D	44	50	40	30	400
Demand	250	300	350	400	

- Q.4 (a)** ABC Company produces two products, chandeliers and fans. Both these products require process involving wiring and assembly. It takes about 2 hours to wire each chandelier and 3 hours to wire a ceiling fan. Final assembly of chandeliers and fans requires 6 and 5 hours respectively. The production capability is such that only 12 hours of wiring time and 30 hours of assembly time are available. If each chandelier nets the firm Rs. 700 and Rs. 600 respectively. Formulate the above as a goal programming problem with following goals: **07**

Priority 1: Produce at least 4 chandeliers and 3 fans.

Priority 2: Limit overtime in the assembly department to 10 hours and in the wiring department to 6 hours

Priority 3: maximize profit

- (b)** Shah owns a rental property that needs some repairs quickly. Four areas need repair, and he has obtained estimates from five contractors for the jobs. Each of the areas of work will be given to a different person since the work has to be completed very quickly. The estimates (including taxes) were as follows: **07**

	Contractor				
Repairs to	Arvind	Bharat	Charles	Darpan	Eman
Floors	377	329	338	370	354
Plumbing	434	331	442	347	418
Roofing	333	285	389	304	336
Walls	292	264	296	285	311

Shah wants to see all four repair jobs completed at the lowest possible total cost. Use the "Hungarian Method" algorithm to solve this problem.

OR

- Q.4 (a)** Vladimir Pushkin, Russian athlete who frequently visits the US, is allowed to return with a limited number of consumer items not generally available in Russia. The items, which he carries in a small knapsack, cannot exceed a weight of 25 Kilograms (5,000 grams). Once home, Vlad sells his booty at highly inflated prices. His four most popular items are denim jeans, silk **07**

shirts, portable CD players, and heavy metal music CD's. If he brings any CD Players, he needs to bring back at least twice that many Music CDs (or what is there to play?). About half of his customers want silk shirts with their jeans so Vlad needs to satisfy this demand. Finally, Russian customs gets suspicious if a traveler brings in too many of electronic products, so Vlad limits the number of CD Players he carries to three. The weight (in grams) and profit (in Rubles) of these items are shown in the table here:

	Weight	Profit
Jeans	1500	2000
Silk Shirts	500	1250
CD Player	900	1500
Music CD	250	750

Formulate an integer program for Vlad that will select a mix of items for him to take home that will maximize his profits.

- Q.4 (b)** The manufacturer of a sports car wants to estimate the proportion of people in a given income bracket who are interested in the model. The company wants to know the population proportion p to within 0.10 with 99% confidence. The company records indicate that the proportion p may be around 0.25. What is the minimum required sample size for this survey? **07**

- Q.5 (a)** Explain the questionnaire design process with different steps involved in it? **07**
(b) How should a research report be organized? Explain. **07**

OR

- Q.5 (a)** Going from Ahmedabad to Delhi there are 10 possible roads that Each one can take. Each road can be considered a branch in the shortest-route problem. Determine the best way to get from Ahmedabad (node 1) to Delhi (node 8) that will minimize total distance travelled. All distances are travelled are in hundreds of kilometers) **07**

Branch	Start Node	End Node	Distance(in hundreds kms)
Branch 1	1	2	3
Branch 2	1	3	2
Branch 3	2	4	3
Branch 4	3	5	3
Branch 5	4	5	1
Branch 6	4	6	4
Branch 7	5	7	2
Branch 8	6	7	2
Branch 9	6	8	3
Branch 10	7	8	6

- (b)** A tourist car operator finds that the past few months the car's use has varied so much that the cost of maintaining the car has varied considerably. During the past 200 days the demand for the car fluctuated as below. **07**

Trips per week	Frequency
0	16
1	24
2	30
3	60
4	40
5	30

Using the following random numbers and simulate the demand for a 10 week period. (82, 95, 18, 96, 20, 84, 56, 11, 52, 03)

GUJARAT TECHNOLOGICAL UNIVERSITY

M.B.A. Sem-II Examination May 2011

Subject code: 820007

Subject Name: Research Methodology
& Operations Research

Date: 30/05/2011

Time: 10.30 am – 01.30 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** What are the different kinds of data collection instruments? State their suitability according to their applications. **07**
- (b)** Explain Focused Group Discussions. **07**

- Q.2 (a)** A firm is engaged in producing two products, A and B. Each unit of product A requires two kg of raw material and four labour hours for processing whereas each unit of product B requires three kg of raw material and three hours of labour, of the same type. Every week, the firm has an availability of 60 kg of raw material and 96 labour hours. One unit of product A sold yields Rs 40 and one unit of product B sold gives Rs 35 as profit. Formulate this problem as linear programming problem and determine how many units of each of the products should be produced per week so that the firm can earn the maximum profit. **07**

- (b)** A market research firm wanted to discover the prime motivations behind inclination towards smoking in females. Devise an appropriate research instrument in form of a questionnaire to obtain relevant insights in this area. **07**

OR

- (b)** Write a Short Note on: Non probability methods of sampling. **07**

- Q.3 (a)** The simplex table for a maximization problem of linear programming is given below. Answer the following questions, giving reasons in brief: **07**
1. Is this solution optimal?
 2. How many units of the two products x_1 & x_2 are being produced according to this solution and what is the total profit?
 3. If S_1 is slack in machine A (in hours/week) and S_2 is slack in machine B (in hours/week), which of these machines is being used to the full capacity, when producing according to this solution?
 4. How much would you be prepared to pay for another hour (per week) of capacity each on machine A and machine B?

Optimal Solution

Basis	x_1	x_2	S_1	S_2	b_i
x_2 5	1	1	1	0	10
S_2 0	1	0	-1	1	3
C_j	4	5	0	0	

- (b)** List the six W's of descriptive research and give an example of each. **07**

OR

- Q.3 (a)** Mr. Contractor is a builder and owner of Ashiana Construction Company. Currently he has three large housing projects in hand. They are located at Andheri, Bandra and Chinchwad. He procures cement from four plants located at Dumdum, Ellora, Feroza and Guna. The basic feasible solution as determined by North West Corner rule is given below: **07**

Projects	A	B	C	Availability
Plants				
1	2 [50]	7	4	50
2	3 [20]	3 [60]	1	80
3	5	4 [30]	7 [40]	70
4	1	6	2 [140]	140
Demand	70	90	180	340

Mr. Contractor wants to plan movement of cement in such a manner that the optimal minimum transportation cost is reached. Assist him.

- (b)** What is a research problem? How are the research questions related to components of the problem? **07**
- Q.4 (a)** Verify that dual of dual is primal:
 Maximise $Z = 2x_1 - 3x_2$
 subject to
 $x_1 + x_2 \leq 1$
 $2x_1 - 3x_2 \geq 2$
 $2x_1 + x_2 = 2$
 $x_1, x_2 \geq 0$ **07**
- (b)** Give suitable examples of usage and application of the following: **07**
1. Chi-square Test
 2. Regression Analysis

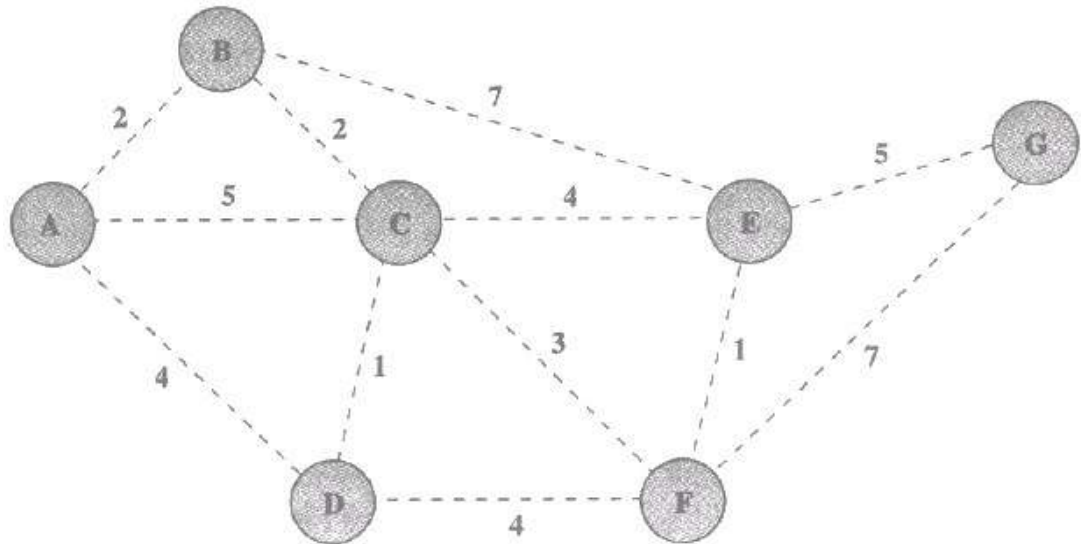
OR

- Q.4 (a)** Fix-It Shop has received three new rush projects to repair: a radio, a toaster oven, and a broken coffee table. Three repair persons, each with different talents and abilities, are available to do the jobs. The Fix-it Shop owner estimates that it will cost in wages to assign each of the workers to each of the three projects. The costs, shown in the table differ because the owner believes that each worker will differ in speed and skill on these quite varied jobs. The owner's objective is to assign the three projects to the workers in a way that will result in lowest total cost to the shop. What is the optimal assignment? **07**

Person	Project		
	1	2	3
Adams	11	14	6
Brown	8	10	11
Cooper	9	12	7

- (b)** Suggest sources of secondary data. **07**

- Q.5 (a)** Management of the Modern Corporation has decided to have a state-of-the-art fiber-optic network installed to provide high-speed communications between its major centers. The nodes in the figure show the geographical layout of the corporation's major centers. The dashed lines are the potential locations of fiber-optic cables. The number next to each dashed line gives the cost of that particular cable chosen for installation. Any pair of centers does not need to have a cable directly connecting them in order to take full advantage of the fiber-optic technology for high-speed communications between these centers. All that is necessary is to have a series of cables that connect the centers. Determine which cables should be installed to minimize the total cost of providing high-speed communications between every pair of centers. **07**



- (b)** Explain the difference between: **07**
1. Type I and Type II error
 2. One tailed and two tailed test

OR

- Q.5 (a)** A firm produces two products P and Q, which yield a contribution margin of Rs 200 and Rs 300 per unit, respectively. The firm has a limited capacity in the two departments where these products need processing. The availability and requirements are given below. Formulate it. **03**

Department	Processing Time (hours)		Daily Availability (hours)
	Product P	Product Q	
I	4	2	45
II	4	4	70

The management of the firm has specified the following goals as per their importance:

1. Produce a product-mix to make a daily profit of at least Rs 4800.
2. Achieve daily sales of at least 15 units of product Q.
3. Achieve daily sales of at least 5 units of product P.

(b) What are the advantages and disadvantages of simulation? **03**

(c) Identify the type of scale being used in each of the following questions: **08**

1. During which season of the year were you born?

_____ Winter _____ Spring _____ Summer

2. Which are your three most preferred eating joints?

Rank them from 1 to 3 according to your preference, with 1 as most preferred

_____ Honest _____ US Pizza
_____ PizzaHut _____ Subway
_____ McDonalds

3. How much time do you spend traveling to the institute everyday?

_____ Under 5 minutes
_____ 5-10 minutes
_____ 11-15 minutes
_____ 16 minutes and above

4. How satisfied are you with your current job profile?

_____ Very satisfied
_____ Satisfied
_____ Neither Satisfied nor Dissatisfied
_____ Dissatisfied
_____ Very Dissatisfied

GUJARAT TECHNOLOGICAL UNIVERSITY**MBA. Evening Sem-III Regular Examination January 2011****Subject code: 820007****Subject Name: Research Methodology and Operations Research****Date: 07 /01 /2011****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain descriptive studies and causal studies. **07**
- (b) How do secondary data differ from primary data? What factors should one examine when judging the validity and appropriateness of secondary data? **07**
- Q.2** (a) Do you agree or disagree with the following statements? If not than explain. **07**
- (i) Validity is more critical to measurement than reliability.
 - (ii) Semantic differential scales are often used to describe a respondent to specify a degree of agreement or disagreement with a variety of statements related to the attitude or object.
 - (iii) A major distributor of office equipment is considering a new sales presentation program for its sales persons. The largest sales territory is selected, the new program is implemented, and the effect on sales is measured. This design is pre-experimental design in which one-shot case study done.
- (b) Explain what a ratio scale is. What are its superiorities over other scales of measurement? **07**

OR

- (b) Describe briefly the sampling design process. **07**
- Q.3** (a) Define and explain coding rules. **07**
- (b) Discuss the type of statistical tests that apply in each of the following situations: **07**
- (i) Ordinally scaled data in which there are two related samples being compared.
 - (ii) Nominally scaled data when the two samples are related, such as with pre-test and post-test situation.

OR

- Q.3** (a) Distinguish between the following: **07**
1. Type I error and Type II error.
 2. Null hypothesis and alternative hypothesis.
- (b) Describe the research report components. **07**
- Q.4** (a) The Harrison Electric Company, located in Chicago's Old Town area, produces two products popular with home renovators: old fashioned chandeliers and ceiling fans. Both the chandeliers and fans require a two-step production process involving wiring and assembly. It takes about 2 hours to wire each chandelier and 3 hours to wire a ceiling fan. Final assembly of chandeliers and fans requires 6 and 5 hours, respectively. The production capability is such that only 12 hours of wiring time and 30 hours of assembly time are available. If each chandelier produced net the firm \$7 and each fan \$6. Harrison's management wants to achieve several goals, arranged in order of their importance to the company. **07**
- Goal 1: To produce profit of 30 \$ if possible during the production period.
- Goal 2: To fully utilize the available wiring department hours.
- Goal 3: To avoid overtime in the assembly department.
- Goal 4: To meet a contract requirement to produce at least seven ceiling fans.
- Formulate and solve the problem as a goal programming model.

(b) In relation to the LP problem, explain the implications of the following assumptions of the model: 07

- (i) Linearity of the objective function and constraints,
- (ii) Divisibility
- (iii) Certainty.

OR

Q.4 (a) Write differences between the linear programming and goal programming. 07

(b) JOBCO produces two products on two machines. A unit of product 1 requires 2 hours on machine 1 and 1 hour on machine 2. For product 2, a unit requires 1 hour on machine 1 and 3 hours on machine 2. The revenues per unit of products 1 and 2 are \$30 and \$20, respectively. The total daily processing time available for each machine is 8 hours. 07

- (i) Use the graphical method of linear programming problem to determine the number of units that of product 1 and product 2 that maximizes of revenue.
- (ii) Determine the dual prices for the machine 1 and the feasibility range of it.
- (iii) Suppose that the unit revenue of product 2 is changed to \$40. Will the current optimum solution remain the same? If not then determine new optimum solution.

Q.5 (a) What is simulation? What are the advantages and limitations of simulation? 07

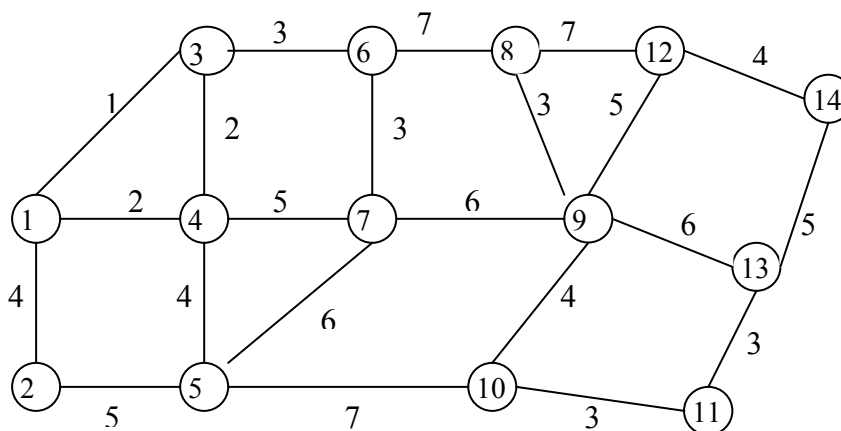
(b) A company has three factories A, B and C which supply goods to four dealers D₁, D₂, D₃ and D₄. The production capacities of these factories are 1000, 700 and 900 units per month, respectively. The requirements from the dealers are 900, 800, 500 and 400 units per month, respectively. The per unit return (excluding transportation costs) are Rs. 8, Rs. 7 and Rs. 9 at the three factories respectively. The following table gives the unit transportation cost from the factories to the dealers. Determine the optimum solution to maximize the profit. 07

	D ₁	D ₂	D ₃	D ₄
A	2	2	2	4
B	3	5	3	2
C	4	3	2	1

OR

Q.5 (a) What is a transshipment problem? Explain how it can be formulated and solved as a transportation problem. 07

(b) AMB Construction is in the process of installing power lines to a large housing development. AMB Construction wants to minimize the total length of wire used, which will minimize his costs. The housing development is shown as a network in following figure. 07



Each house has been numbered, and the distances between houses are given in hundreds of feet. What do you recommend?

GUJARAT TECHNOLOGICAL UNIVERSITY

MBA. Sem-II Remedial Examination December 2010

Subject code: 820007

Subject Name: Research Methodology and operations Research

Date: 24 /12 /2010

Time: 10.30 am – 01.00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Find the graphical solution of the following problem. **07**
 Find x and y so as to Minimize $Z = X + Y$ subject to the following constraints;
 $5X + 10Y \leq 50$, $X + Y \geq 1$, $Y \leq 4$, $X, Y \geq 0$. Observe the solution and comment on it.
 Write the dual of this problem.
- (b)** State and explain the following important features of 'Explanatory Data Analysis' **07**
 (1) Frequency table and Histogram (2) Stem and Leaf displays (3) Boxplots

- Q.2 (a)** Explain salient features of 'Goal Programming'. **07**
 Construct a goal programming problem using the following facts. Show the deviational variables in the constraints.

Resource type	Product 1	Product 2	Available Resource
Labor hours	2	4	600
Material 1	4	5	1000
Material 2	5	4	1200
Profit per Unit	Rs. 20	Rs. 32	

It is known that production of one unit of product 1, would maintain 0.3 person and one unit of production of product 2 would maintain 0.75 person. The manager has set up two goals (1) profit of Rs. 5400 and (2) A total staff of 108 persons.

- (b)** Identify the differences between Parametric and non-Parametric tests. in the context of χ^2 test, comment on 'Goodness of fit is identified by badness of fit'. It is hypothesized by a researcher that the three cities A, B, and C have selling potential of a product in the ratio 2:3:4. The sales manager of the company gave the actual sales figures 380, 640, and 780 in the respective cities. What test do you suggest? Perform basic steps towards the solution and find the calculated value. (There is no need of searching for 'Table value'.) **07**

OR

- (b)** What is a research? State each aspect of a good research and write distinct features or characteristics of that aspect. **07**

- Q.3 (a)** Define hypothesis in research terminology. What is a null hypothesis? Give important features on each of the followings. **07**
 (1) Descriptive Hypothesis (2) Relational Hypothesis (3) Co relational Hypothesis, and (4) Explanatory Hypothesis. Explain type-I and type-II errors.
- (b)** It was claimed that persons crossing certain age group may not like to change their reading habits. The study of 22 randomly selected persons divided in two equal groups, the total numbers of books or magazines they read during a span of one year are as follows. **07**

	Group A	Group B
Average books read	1500	1300
Standard Deviation	225	251

Do the two groups means differ from each other? (Use 0.05 % level of significance)

OR

- Q.3 (a)** Briefly discuss the two important features –(1) Accuracy and (2) Precision of a good sample. Discuss Cluster Sampling and Double Sampling. **07**
- (b)** Find a simple (linear) regression using the following data and also graph the relation you obtain. **07**

X	Y
12	2000
16	3000
20	4000
24	5000

- Q.4 (a)** Describe the complete procedure of finding graphical solution of a linear programming problem. What do you understand by ‘convex region’? Discuss one special case in the graphical solution of such problem. **07**

- (b)** What do we mean by ‘Duality’? Write some important features of ‘Primal & Dual’ problem. **07**

Write the dual of the following problem.

Maximize $10 Y_1 + 8 Y_2 - 6 Y_3$ subject to the following constraints.

$$3 Y_1 + Y_2 - 2 Y_3 \leq 10, \quad -2Y_1 + 3 Y_2 - Y_3 \geq 12, \quad Y_1, Y_2, Y_3 \geq 0$$

OR

- Q.4 (a)** Write the dual of the following problem. Graph both the Primal and its Dual. **07**

Maximize $Z = 5X + 7Y$, Subject to $X + Y \leq 4, \quad 3X + 8Y \leq 26, \quad 10X + 7Y \leq 35$

$$X, Y \geq 0$$

- (b)** Find an initial basic feasible solution to the following transportation problem. Is it an optimal one? **07**

TO \ FROM	D1	D2	D3	D4	AVAILABLE UNITS
O1	5	4	2	1	130
O2	2	3	7	5	100
O3	5	4	5	6	30
DEMAND	40	50	70	100	

- Q.5 (a)** Solve the following assignment problem. (Assign one machine to one worker so that total time in hours is minimized.) **07**

Time Matrix

Machine \ Man	M1	M2	M3	M4	M5
A	3	2	7	4	8
B	5	4	3	8	5
C	3	7	9	1	2
D	4	2	6	5	7
E	2	8	4	6	6

- (b)** Explain the basic concepts of Sensitivity Analysis. What are the different factors affecting the given solutions and how do we resolve them? Give a brief comment on each of them. **07**

OR

- Q.5 (a)** What is a travelling salesman’s problem? **07**

Stating an upper bound of the solution, solve the problem.

You are required to design a complete route for a salesman who begins from the city ‘A’ and he is required to return to the same city ‘A’. The distances in miles between the cities are given as follows.

TO FROM	A	B	C	D	E	F
A	---	25	18	35	50	39
B	21	---	28	16	30	13
C	22	28	----	14	16	20
D	35	12	14	-----	12	12
E	50	30	16	12	-----	8
F	39	15	20	12	7	-----

- (b) What is Simulation? Describe Monte Carlo Simulation. Explain applications of simulation in business environment.

07

GUJARAT TECHNOLOGICAL UNIVERSITY
MBA Second Semester (Regular / Evening) Examination May 2010

Subject code: 820007

Subject Name: Research Methodology and Operations Research

Date: 28 / 05 / 2010

Time: 11.00 am – 01.30 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Prepare a research plan for marketing manager of tata Nano car who wants to know about customer satisfaction level across India who recently purchased newly Introduced car. **07**
- (b)** A farm is engaged in breeding pigs. The pigs are fed on various products grown on the farm. With a view to ensuring certain minimum nutrition for the growth of the pigs, two types of feeds A and B are purchased from the market. The contents of these feeds per unit, in nutrient constituents are as given in the following table. Formulate and solve graphically. **07**

Nutrient	Nutrient content in feeds		Minimum requirement of feed nutrient for a pig
	A	B	
M ₁	12	6	108
M ₂	3	9	81
M ₃	15	10	150

If feed A costs Rs. 20 and B Rs. 40 per unit, how much of each of these two should be bought, so that the total cost is minimized?

- Q.2 (a)** Test the given data using Kolmogorov –Smirnov test. **07**

	Freshman	Sophomore	Junior	Senior	Graduate
Number in each class	5	9	11	16	19

Given that critical value for D is $1.36 / \sqrt{N}$ at $\alpha = 0.05$

Take the KS test, with an analysis of the results of the dining club study, in terms of various class levels.

- (b)** Describe the Qualitative vs. Quantitative Research **07**

OR

- (b)** What is Sample Size? What features would you consider in designing a Sample Size? **07**

- Q.3 (a)** Obtain the dual of the following primal linear programming problem. **04**

Maximize $Z_X = X_1 - 2X_2 + 3X_3$

Subject to the constraints,

$$-2X_1 + X_2 + 3X_3 = 2$$

$$2X_1 + 3X_2 + 4X_3 = 1$$

$$\text{And } X_1, X_2, X_3 \geq 0$$

- (b)** Define Type I and Type II errors with illustration. **03**

(c) (i) How PERT and CPM differ in their approach to network analysis. **07**

(ii) Calculate the Average Expected time and draw network for a project with the following activity times.

Activity	Optimistic time (hrs)	Pessimistic time (hrs)	Most likely time (hrs)
2-4	1.0	5.0	3.0
2-6	1.0	7.0	4.0
4-8	4.0	16.0	7.0
6-8	1.0	5.0	1.5
8-10	1.5	14.5	3.5

OR

Q.3 (a) What do you mean by hypothesis? Should every research problem have hypothesis? Discuss. **07**

(b) Discuss the parameters to be kept in mind while structuring an instrument for primary data collection? **07**

Q.4 (a) A traveling salesman has to visit 5 cities. He wishes to start from a particular city, visit each city once and then return to his starting point. The traveling cost (in Rs. '000) of each city from a particular city is given below. **07**

		TO CITY				
		A	B	C	D	E
FROM CITY	A	∞	2	5	7	1
	B	6	∞	3	8	2
	C	8	7	∞	4	7
	D	12	4	6	∞	5
	E	1	3	2	8	∞

What is the sequence of visit of the sales man so that the cost is minimum?

(b) Explain coding, editing, and tabulation of a data. **07**

OR

Q.4 (a) Maruti Machines company has plants at Delhi, Calcutta and Bombay. Its major distribution centers are located at Bangalore and Jaipur. The capacity of the three Plants during next Quarter are 1000, 1500 and 1200 machines. The quarterly demand at the two distribution centers are 2300 and 1400 machines. The transportation cost per Kilometer is Rs.0.08. The Distance (kms) between the plants and the distribution centers is as given below. **07**

	Jaipur	Bangalore	Calcutta	Bombay	Delhi
Delhi	500	3000	3000	2000	-
Calcutta	2500	2000	-	2500	3000
Bombay	1500	1000	2500	-	2000
Jaipur	-	2500	2500	1500	500
Bangalore	2500	-	2000	1000	3000

Give the minimum transportation cost distribution in case the entire supply from all sources could pass through any source or destination before it is redistributed.

(b) What is a Research Problem? State the main issue which should receive the attention of the researcher. Give examples to illustrate your answer. **07**

Q.5 (a) What is Sensitivity Analysis? From the following Optimal Solution find **07**

(i) The range of the profit contribution of product C (i.e. co-efficient C_3 of variable X_3) in the objective function such that current optimal product mix remains unchanged.

(ii) What shall be the new optimal product mix when profit per unit from product C increased from Rs. 2 to Rs. 10.

C_j		4	6	2	0	0	
Basis		X_1	X_2	X_3	S_1	S_2	b_i
X_1	4	1	0	-1	4/3	-1/3	1
X_2	6	0	1	2	-1/3	1/3	2
Z_j		4	6	8	10/3	2/3	
$C_j - Z_j$		0	0	-6	-10/3	-2/3	

(b) Solve the following linear programming problem using simplex method. **07**

Maximize $Z = 2X_1 + 4X_2$

Subject to the constraints

$$2X_1 + X_2 \leq 18$$

$$3X_1 + 2X_2 \geq 30$$

$$X_1 + 2X_2 = 26 \text{ and}$$

$$X_1, X_2 \geq 0$$

OR

Q.5 (a) Distinguish between null hypothesis and alternative hypothesis **04**

(b) Obtain optimal solution of the following problem using modified distribution method **05**

FROM	TO				Supply
	P	Q	R	S	
A	12 ⁽¹⁸⁰⁾	10 ⁽¹⁵⁰⁾	12 ⁽¹⁷⁰⁾	13	500
B	7	11	8 ⁽¹⁸⁰⁾	14 ⁽¹²⁰⁾	300
C	6	16	11	7 ⁽²⁰⁰⁾	200
Demand	180	150	350	320	1000

(c) Explain Internal and External source of Secondary data. **05**

Please segregate questions of Research Methodology from these GTU, papers. In case of any difficulty contact your subject teacher.