ROLL NO. _____

**Code: CS42 Subject: OPERATIONS RESEARCH AND SYSTEM SIMULATION**

## ALCCS - OLD SCHEME

**Time: 3 Hours** **AUGUST 2012** **Max. Marks: 100**

***PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.***

**NOTE:**

- **Question 1 is compulsory and carries 28 marks. Answer any FOUR questions from the rest. Marks are indicated against each question.**
- **Parts of a question should be answered at the same place.**
- **All calculations should be up to three places of decimals.**

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**Q.1** a. What is Operational Research? Write a short note on it.

b. Write the dual of the following linear programming problem

Maximize : $4x_1 + 2x_2 - x_3$

Subject to $4x_1 + 7x_2 - x_3 \le 7$

$2x_2 + 8x_3 \ge 7$

$x_1, x_2, x_3 \ge 0$

c. Solve the following linear programming problem by graphical method.

Minimize : $9x + 6y + 11$

Subject to $x + 3y \le 15$

$3x + 2y \le 21$

$3x - y \le 12$

$x \ge 0, y \ge 0$

d. Explain in briefly the common methods to obtain an initial basic feasible solution for a transportation problem.

e. Discuss the 'Hungarian' method of solving an assignment problem.

f. What are the essential characteristics of dynamic programming problem?

g. Mention any four reasons for solving Operations Research problems by simulation. **(7 × 4)**

**Q.2** a. Consider the following system of equations:

$$\begin{aligned} x_1 + 2x_2 - 3x_3 + 5x_4 + x_5 &= 4 \\ 5x_1 - 2x_2 + 6x_4 + x_6 &= 8 \\ 2x_1 + 3x_2 - 2x_3 + 3x_4 + x_7 &= 3 \\ -x_1 + x_3 - 2x_4 + x_8 &= 0 \\ x_1, x_2 ....., x_8 &\geq 0 \end{aligned}$$

Let $x_5, x_6...$, and $x_8$ be a given initial basic feasible solution. Suppose that $x_1$ becomes basic. Which of the given basic variables must become nonbasic at zero level to guarantee that all the variables remain nonnegative, and what is the value of $x_1$ in the new solution? Repeat this procedure for $x_2$, $x_3$ and $x_4$. **(9)**

b. Use simplex method to solve the following linear programming problem

Maximize : $Z = 3x_1 + 2x_2$

Subject to $-x_1 + 3x_2 \leq 12$

$x_1 + x_2 \leq 8$

$3x_1 - x_2 \leq 12$

$x_1, x_2 \geq 0$ **(9)**

**Q.3** a. Four jobs are to be processed and four machines are available. Any machine can process any job with the associated cost (in rupees) as follows:

| | | **Jobs** | | | |
|---|---|---|---|---|---|
| | | ***A*** | ***B*** | ***C*** | ***D*** |
| | **1** | 18 | 26 | 17 | 11 |
| **Machines** | **2** | 13 | 28 | 14 | 26 |
| | **3** | 38 | 19 | 18 | 15 |
| | **4** | 19 | 26 | 24 | 10 |

What is the minimum cost that may be expected if optimum assignments made? **(9)**

b. Obtain the initial basic feasible solution using

(i) North-West corner rule

(ii) Vogel's approximation method **(9)**

| | 1 | 2 | 3 | 4 | Supply |
|---|---|---|---|---|---|
| 1 | 10 | 2 | 20 | 11 | 15 |
| 2 | 12 | 7 | 9 | 20 | 25 |
| 3 | 4 | 14 | 16 | 18 | 10 |
| Demand | 5 | 15 | 15 | 15 | |

Compare the two methods and comment.

**Q.4** a. A man is engaged in buying and selling identical items. He operates from a warehouse that can hold 500 items. Each month he can sell any quantity that he chooses up to the stock at the beginning of the month. Each month, he can buy as much as he wishes for delivery at the end of the month so long as his stock does not exceed 500 items. For the next 4 months he has the following error free forecasts of costs and sales prices:

| Month (i) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Cost (Ci) | 27 | 24 | 26 | 28 |
| Sale Price (Pi) | 28 | 25 | 25 | 27 |

If he currently has a stock of 200 units, what quantities should he sell and buy in next four months? Solve it using dynamic programming. **(10)**

b. Explain different phases in an Operations Research study. Explain the role of computers in this field. **(8)**

**Q.5** a. Solve the following integer linear programming problem:

Maximize : $Z = 7x_1 + 9x_2$

Subject to $-x_1 + 3x_2 \le 6$

$7x_1 + x_2 \le 35$

$x_2 \le 7$

$x_1, x_2 \ge 0$ and are integers. **(10)**

b. Write short note on the following:
(i) Economic interpretation of duality in linear programming.
(ii) Revised Simplex Method. **(8)**

**Q.6** a. Define Simulation. What are the steps in simulation? Give advantages and disadvantages of simulation. **(9)**

b. The automobile company manufactures around 150 bikes. The daily production varies from 146 to 154 depending upon the availability of raw materials and other working conditions:

| Production(per day) | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 |
|---|---|---|---|---|---|---|---|---|---|
| Probability | 0.04 | 0.09 | 0.12 | 0.14 | 0.11 | 0.10 | 0.20 | 0.12 | 0.08 |

The finished bikes are transported in a lorry accommodating 150 bikes. Using following random numbers: 80, 81, 76, 75, 64, 43, 26, 10, 12, 65, 68, 69, 61, 57.
Simulate the process to find out:
(i) What will be the average number of bikes waiting in the factory?
(ii) What will be the average number of empty space on the lorry? **(9)**

**Q.7** a. Write short note on the following:
(i) Acceptance-Rejection method for the generation of pseudo-random numbers.
(ii) GPSS Simulation Language. **(10)**

b. Discuss any three tools that are used for reducing the variance of simulation experiments. **(8)**