**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: BE** **SEMESTER : III**
**BRANCH: PRODUCTION** **SESSION : MO/17**

**SUBJECT: PE3003-OPERATIONS RESEARCH**

**TIME: 3. Hours** **FULL MARKS: 60**

**INSTRUCTIONS:**

**1. The question paper contains 7 questions each of 12 marks and total 84 marks.**
**2. Candidates may attempt any 5 questions maximum of 60 marks.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

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Q.1(a) What is operations research? Discuss the application of operation research to managerial decision making. [4]

Q.1(b) A company produces two types of hats. Each hat of first type requires twice as much labour time as the second type. If all hats are of the second type only, the company can produce a total of 500 hats a day. The market limit daily sales of the first and second type to 150 and 250 hats. Assuming that the profits per hat are Rs. 8 for type A and Rs.5 for type B, formulate the problem as a linear programming model in order to determine the number of hats to be produced of each type so as to maximize the profit. [8]

Q.2(a) Define (i) A Feasible Solution (ii) A Feasible region (iii) An unbounded Solution (iv) A Redundant Constraint. [4]

Q.2(b) Solve the following LP problem graphically: [8]

Maximize $Z=8000\ x_1+7000x_2$

Subject to the constraints:

$3x_1+ x_2\leq 66$

$x_1+ x_2\leq 45$

$x_1\leq 20$

$x_2 \leq 40$ , and $x_1, x_2 \geq 0$

Q.3(a) Explain the term 'Artificial Variable' and its use in linear programming. [2]

Q.3(b) Solve the LP problem by using Big-M-method: [10]

Maximize $Z = -2x - y$

Subject to:

$$3x + y = 3$$
$$4x + 3y \geq 6$$
$$x + 2y \leq 4$$
$$x, y \geq 0$$

Q.4 A company has three plants at locations A, B and C which supply to warehouses located at D, E, F, G and H. Monthly plant capacities are 800, 500, and 900 units respectively. Monthly warehouse requirements are 400, 400, 500, 400 and 800 units respectively. Unit transportation costs (in Rs.) are given below (Table1): [12]

**TABLE 1**

**TO**

| **FROM** | | **D** | **E** | **F** | **G** | **H** |
|---|---|---|---|---|---|---|
| | **A** | **5** | **8** | **6** | **6** | **3** |
| | **B** | **4** | **7** | **7** | **6** | **6** |
| | **C** | **8** | **4** | **6** | **6** | **3** |

Determine an optimum distribution for the company in order to minimize the total transportation cost.

PTO

Q.5(a) A company has one surplus truck in each of the cities A,B,C,D and E and one deficit truck in each of the cities 1,2,3,5,5,and 6. The distance between the cities in kilometres is shown in matrix below (Table 2 ).Find the assignment of trucks from cities in surplus to cities in deficit so that the total distance covered by vehicles is minimum. [6]

**TABLE 2**

| TRUCKS→ CITIES ↓ | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| **A** | 12 | 10 | 15 | 22 | 18 | 8 |
| **B** | 10 | 18 | 25 | 15 | 16 | 12 |
| **C** | 11 | 10 | 3 | 8 | 5 | 9 |
| **D** | 6 | 14 | 10 | 13 | 13 | 12 |
| **E** | 8 | 12 | 11 | 7 | 13 | 10 |

Q.5(b) There are seven jobs each of which has to go through the machines M1 and M2 in the order M1, M2. Processing times (in hrs) are given as: [6]

| Job : | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Machine M1: | 3 | 12 | 15 | 6 | 10 | 11 | 9 |
| Machine M2: | 8 | 10 | 10 | 6 | 12 | 1 | 3 |

Determine a sequence of these jobs that will minimize the total elapsed time T. Also find idle time for machine A and B.

Q.6(a) Define : Pay-off matrix, and Saddle Point. [4]

Q.6(b) Reduce the following game by dominance and find the game value: [8]

| **PLAYER A→ PLAYER B ↓** | **I** | **II** | **III** | **IV** |
|---|---|---|---|---|
| **I** | **3** | **2** | **4** | **0** |
| **II** | **2** | **4** | **2** | **4** |
| **III** | **4** | **2** | **4** | **0** |
| **IV** | **0** | **4** | **0** | **8** |

Q.7(a) Describe the various elements of the queue. [4]

Q.7(b) In a railway yard goods train arrive at a rate of 30 trains/day. Assuming that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. calculate the following: [8]
(i) The average number of trains in the queue.
(ii) The average number of trains in the system.
(iii) The Probability that number of trains in the system exceeds 10.

**:::::01-12-2017 E:::::**