

**B.C.A. DEGREE (C.B.C.S.S.) EXAMINATION, APRIL 2016****Fourth Semester****Complementary Course—OPERATIONAL RESEARCH****(2013 Admission onwards)****Time : Three Hours****Maximum Marks : 80****Part A***Answer all questions.**Each question carries 1 mark.*

1. Name any *two* models in O.R.
2. Define the term optimum solution.
3. Define slack variable.
4. What is meant by feasible solution of a L.P.P. ?
5. What loop of a transportation table ?
6. What is an unbalanced transportation problem ?
7. What is degeneracy.
8. Define the term zero-sum game.
9. Define saddle point.
10. Define the term dominance associated with a game.

**(10 × 1 = 10)****Part B***Answer any eight questions.**Each question carries 2 marks.*

11. Explain the nature of Operations Research.
12. What are the limitations of O.R ?
13. What are the different phases of O.R. ?
14. Explain the linear programming problem by giving an example.
15. Explain the term objective function indicating the context in which it is used.
16. Explain briefly the term artificial variables.

**Turn over**

17. What do you understand by graphical method. Give its limitations.
18. Solve the game with the pay-off matrix  $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ .
19. Describe the matrix form of the transportation problem.
20. Write the mathematical model for the transportation problem given below :

*Cost of transportation in Rupees*

	<i>Destinations</i>			<i>Availability</i>
	$D_1$	$D_2$	$D_3$	
<i>Sources 0 - 1</i>	$C_{11}$	$C_{12}$	$C_{13}$	$a_1$
$0 - 2$	$C_{21}$	$C_{22}$	$C_{23}$	$a_2$
$0 - 3$	$C_{31}$	$C_{32}$	$C_{33}$	$a_3$
<i>Demand</i>	$b_1$	$b_2$	$b_3$	

21. What are the assumptions made in the theory of games ?
22. Explain the difference between pure strategy and mixed strategy.

(8 × 2 = 16)

### Part C

*Answer any six questions.  
Each question carries 4 marks.*

23. Explain three types of models used in O.R., giving suitable examples.
24. Solve graphically the problem

$$\text{Maximize } Z = 3x_1 + 4x_2$$

$$\text{subject to the constraints } 4x_1 + 2x_2 \leq 80$$

$$2x_1 + 5x_2 \leq 180$$

$$x_1, x_2 \geq 0.$$

25. Find all the basic feasible solutions of the equations,  $2x_1 + 6x_2 + 2x_3 + x_4 = 3$

$$6x_1 + 4x_2 + 4x_3 + 6x_4 = 2.$$

26. Explain the simple method by carrying out one iteration in the problem,

$$\text{Maximize } Z = 5x_1 + 2x_2 + 3x_3 - x_4 + x_5$$

$$\text{subject to the constraints } x_1 + 2x_2 + 2x_3 + x_4 = 8$$

$$3x_1 + 4x_2 + x_3 + x_5 = 7$$

$$x_i \geq 0, i = 1, 2, \dots, 5.$$

27. Use simplex method to solve the L.P.P.

$$\text{Maximize } Z = 10x_1 + 6x_2$$

$$\text{subject to the constraints } x_1 + x_2 \leq 2$$

$$2x_1 + x_2 \leq 4$$

$$3x_1 + 8x_2 \leq 12$$

$$x_1, x_2 \geq 0.$$

28. Determine an initial basic feasible solution of the following transportation problem using the north-west corner rule :—

	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
O <sub>1</sub>	6	4	1	5	14
O <sub>2</sub>	8	9	2	7	16
O <sub>3</sub>	4	3	6	2	5
	6	10	15	4	35

Availability

*Requirements*

where O<sub>i</sub> and D<sub>j</sub> represent the i<sup>th</sup> origin and j<sup>th</sup> destination respectively.

29. The following table presents the cost of assigning three jobs to three workers. Work out the optimal assignment

		Job		
		A	B	C
Workers	1	4	7	8
	2	5	3	2
	3	6	5	4

30. Use dominance property to reduce the following game to  $2 \times 2$  game and hence find the optimal strategies and the value of the game :—

		Player B		
		1	2	3
Player A	1	3	-2	4
	2	-1	4	2
	3	2	2	6

31. Explain the theory of dominance in the solution of rectangular games.

(6 × 4 = 24)

#### Part D

*Answer any two questions.  
Each question carries 15 marks.*

32. Use big M method to solve the L.P.P.

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

$$\text{subject to the constraints } 3x_1 + x_2 = 3$$

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

$$x_1 + 2x_2 \leq 3$$

$$x_1, x_2 \geq 0.$$

33. There are forest areas  $F_1, F_2, F_3$  and  $F_4$  and timber depots  $D_1, D_2, D_3$ . The following table gives the produce of each forest area, the minimum timer required at each depot to attract buyers, and the cost of transportation per unit of timer from each forest area to each depot. Find the distribution of the entire forest produce for minimum cost of transportation

	$D_1$	$D_2$	$D_3$	
$F_1$	3	4	6	100
$F_2$	7	3	8	80
$F_3$	6	4	5	90
$F_4$	7	5	2	120
	110	110	60	

34. (a) Five jobs 1, 2, 3, 4 and 5 are to be assigned to five persons A, B, C, D and E. The time taken by each of them on each job in minutes is given below :—

	1	2	3	4	5
A	16	13	17	19	20
B	14	12	13	16	17
C	14	11	12	17	18
D	5	5	8	8	11
E	5	3	8	8	10

Work out the optimal assignment and the total minimum time taken.

- (b) Explain the difference between transportation problem and an assignment problem.