TB156520A **Reg. No……………………………….**

Name…………………………………

B. Sc. DEGREE (C.B.C.S.S.) EXAMINATION, MARCH 2018
(2015 Admission Regular)
SEMESTER VI - CORE COURSE (MATHEMATICS)
MT6B13aB - OPERATIONS RESEARCH

Time: Three Hours **Maximum marks: 80**

Part A

I. Answer all questions. Each question carries 1 mark.

1. Define convex hull.
2. When do you need an artificial variable in a linear programming problem?
3. Define loop in a transportation array.
4. What is an assignment problem?
5. What do you mean by queue discipline?
6. Define a queue. **(6×1=6)**

Part B

II. Answer any seven questions. Each question carries 2 marks.

7. Find the Euclidean norm of the vector $[2 \quad -3 \quad 4]$ and the inner product of the vectors $[2 \quad -3 \quad 4]$ and $[4 \quad 2 \quad -3]$.
8. Prove that the intersection of two convex sets is a convex set.
9. What do you mean by cycling in a linear programming problem?
10. Explain Degeneracy in linear programming problem.
11. Write the dual of the following linear programming problem:
$Min\ z = x_1 - 3x_2 - 2x_3$ subject to
$2x_1 - 4x_2 \geq 12$, $3x_1 - x_2 + 2x_3 \leq 7$, $-4x_1 + 3x_2 + 8x_3 = 10$;
$x_1, x_2 \geq 0, x_3$ is unrestricted in sign.
12. What is a transportation problem? Write the mathematical formulation of the transportation problem.
13. Convert the following transportation into a balanced one.

	D_1	D_2	D_3	
O_1	4	2	6	150
O_2	3	8	5	100
	70	80	50	

14. Find an initial basic feasible solution of transportation problem by matrix minima method.

	D_1	D_2	D_3	
O_1	7	3	10	200
O_2	4	8	2	100
O_3	9	7	6	100
	150	100	150	

15. Define transient state and steady state in a queueing process.
16. State Markovian property of inter arrival times. **(7×2=14)**

Part C

III. Answer any five questions. Each question carries 6 marks.

17. Define a convex set. Give an example. Also check whether $S = \{X: |X| = 1\}, X \in S_n$ is a convex set.
18. Solve: $Min\ z = 4x_1 + 2x_2$
    subject to $x_1 + 2x_2 \geq 2$, $3x_1 + x_2 \geq 3$, $4x_1 + 3x_2 \geq 6$; $x_1, x_2 \geq 0$.
19. Use Simplex method to solve the following linear programming problem:
    $Max\ z = 3x_1 + 2x_2$ subject to $x_1 + x_2 \leq 4$, $x_1 - x_2 \leq 2$; $x_1, x_2 \geq 0$.
20. Use Big-M method to solve
    $Min\ z = 4x_1 + 3x_2$ subject to
    $2x_1 + x_2 \geq 10$, $-3x_1 + 2x_2 \leq 6$, $x_1 + x_2 \geq 6$; $x_1, x_2 \geq 0$
21. Determine an initial basic feasible solution for the following transportation problem, using Vogel's Approximation method.

	D_1	D_2	D_3	D_4	Supply
O_1	11	13	17	14	250
O_2	16	18	14	10	300
O_3	21	24	13	10	400
Demand	200	225	275	250	

22. A company has 4 machines to do 3 jobs. Each job can be assigned to one and only one machine. The cost of each job on each machine is given below. Determine the job assignments which will minimize the total cost.

Machines

		M_1	M_2	M_3	M_4
	A	18	24	28	32
Job	B	8	13	17	18
	C	10	15	19	22

23. Briefly describe the structure of a Queueing system.
24. If the number of arrivals in a pure birth process follows Poisson distribution, then find the probability distribution of inter arrival times.

(5×6=30)

Part D

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

25. Use Two Phase Simplex method to solve:
    $Min\ z = \frac{15}{2}x_1 - 3x_2$ subject to
    $3x_1 - x_2 - x_3 \geq 3$, $x_1 - x_2 + x_3 \geq 2$; $x_1, x_2, x_3 \geq 0$.
26. Find the dual of the following linear programming problem:
    $Min\ z = x_1 + x_2$ subject to $2x_1 + x_2 \geq 8$, $2x_1 + 7x_2 \geq 21$; $x_1, x_2 \geq 0$.

Solve graphically the primal and dual of the above problem and hence, verify the optimal vertex.

27. Solve the following transportation problem for optimal solution:

	D_1	D_2	D_3	D_4	Supply
O_1	6	1	9	3	70
O_2	11	5	2	8	55
O_3	10	12	4	7	70
Demand	85	35	50	45	

28. Explain all queue discipline and service mechanisms of a queuing system.

(2×15=30)