Reg. No………………………………………….. Name…………………………………………… **20U655**

B. Sc. DEGREE END SEMESTER EXAMINATIONS - MARCH 2020

SEMESTER **–6: MATHEMATICS (CORE COURSE)**

COURSE: **15U6CRMAT13: OPERATIONS RESEARCH**

(Common for Regular 2017 Admission & Supplementary 2016 /2015 /2014 Admissions)

Time: Three Hours Max Marks: 75

SECTION A

Answer all questions

1. Examine whether the set $\{X / |X| \leq 1\}$ is convex.
2. Check whether the vectors $\begin{bmatrix}1\\2\\1\end{bmatrix}, \begin{bmatrix}1\\2\\3\end{bmatrix}, \begin{bmatrix}3\\6\\5\end{bmatrix}$ are linearly independent.
3. State Cauchy- Schwartz inequality.
4. Reduce the following LPP to its standard form: Maximize $Z = 5x_1 + 3x_2$

   Subject to $3x_1 + 5x_2 \geq 15$

   $5x_1 + 2x_2 \leq 10$

   $x_1, x_2 \geq 0.$
5. What type of problems can be solved by the dual simplex method.
6. Define triangular basis.
7. What is an unbalanced transportation problem?
8. Define queue size.
9. State the Markovian property of inter arrival times.
10. Define the term Reneging. (1 x 10 = 10)

SECTION B

Answer any Eight questions

11. Define a separating and supporting hyper planes of a convex set.
12. Define the Euclidean norm of a vector and find the Euclidean norm of the vector $\begin{bmatrix}2\\-3\\4\end{bmatrix}$.
13. Obtain all the basic solutions to the system $x_1 + 2x_2 + x_3 = 4, 2x_1 + x_2 + 5x_3 = 5$.
14. Prove that the dual of the dual is the primal.
15. Define artificial variables. Explain the use of artificial variables in solving linear programming problems.
16. Write steps for solving an assignment problem.
17. Give the mathematical model of transportation problem.
18. What are the components of a queuing system.
19. What is traffic intensity. If traffic intensity is 0.30, what is the percent of time a system remains idle.
20. Customers arrive at a sales counter manned by a single person according to a Poisson process with a mean rate of 20 per hour. The time required to serve a customer has an exponential distribution with a mean of 100 seconds. Find the average waiting time of a customer in the queue.

(2 x 8 = 16)

SECTION C

Answer any Five questions

21. Prove that the vertex of the set of feasible solutions S_F is a basic feasible solution.
22. Solve graphically: Minimize $Z = 20x_1 + 10x_2$
subject to $x_1 + 2x_2 \leq 40$
$3x_1 + x_2 \geq 30$
$4x_1 + 3x_2 \geq 60$, $x_1, x_2 \geq 0$.
23. Solve the following problem by the Big M method:
Maximize $f = 2x_1 + x_2 + 3x_3$, subject to
$x_1 + x_2 + 2x_3 \leq 5$, $2x_1 + 3x_2 + 4x_3 = 12$, $x_1, x_2, x_3 \geq 0$.
24. Explain Vogel's approximation method.
25. Solve the following assignment problem:

	A	B	C
I	10	8	12
II	18	6	14
III	6	4	2

26. Explain distribution of arrival and distribution of departure.
27. Discuss the various measures of performance of queuing system. (5 x 5 = 25)

SECTION D

Answer any Two questions

28. Solve the following problem by the dual simplex method.
Minimize $Z = x_1 + 2x_2 + 3x_3$ subject to
$2x_1 - x_2 + x_3 \geq 4$, $x_1 + x_2 + 2x_3 \leq 8, x_2 - x_3 \geq 2$, $x_1, x_2, x_3 \geq 0$.
29. Solve Maximize $Z = 5x_1 - 4x_2 + 3x_3$ subject to
$2x_1 + 2x_2 - x_3 \geq 2$, $3x_1 - 4x_2 \leq 3, x_2 + x_3 \leq 5$, $x_1, x_2, x_3 \geq 0$.
30. Solve the following transportation problem:

supplier / consumer	A	B	C	Available
I	6	8	4	14
II	4	9	8	12
III	1	2	6	5
Required	6	10	15	

31. Explain in brief the main characteristics of the queuing system. (12 x 2 = 24)