Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH END SEMESTER EXAMINATION

DEC-JAN 2020-21

BRANCH: CIVIL ENGINEERING (STRUCTURES)

SUBJECT: OPTIMIZAN TECHNIQUES FOR ENGINEERING DESIGN [MAT5154]

REVISED CREDIT SYSTEM

05-03-2020

Time: 3 hrs. Max. Marks: 50

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitably assumed.

1A	Using Golden search method approximate the location of the maximum of $x(5\pi - x)$ on $[0, 20]$ to within $\epsilon = 1$.	**3**
1B	Solve the non-linear programming problem: $Max\ Z = x_1^2 + x_2^2 + x_3^2$ subject to the constraints $x_1 + x_2 + 3x_3 = 2, 5x_1 + 2x_2 + x_3 = 5, x_1, x_2, x_3 \geq 0$.	**3**
1C	Find all the eigenvalues and eigenvectors of the matrix $\begin{pmatrix} 1 & 1 & 0.5 \\ 1 & 1 & 0.25 \\ 0.5 & 0.25 & 2 \end{pmatrix}$ by Jacobi's method and perform three iteration.	**4**
2A	Solve by dual Simplex method $Max\ Z = -3x_1 - 2x_2$ subject to the constraints $x_1 + x_2 \geq 1, x_1 + x_2 \leq 7, x_1 + 2x_2 \geq 10,\ x_2 \leq 3$ and $x_1, x_2 \geq 0$.	**3**
2B	Find all the eigenvalues of the matrix $\begin{pmatrix} 4 & 2 & 2 \\ 2 & 5 & 1 \\ 2 & 1 & 6 \end{pmatrix}$ by using Given's method.	**3**
2C	Solve by Simplex method $Max\ Z = 3x_1 + 2x_2 + 5x_3$ subject to $x_1 + 2x_2 + x_3 \geq 430, 3x_1 + 2x_3 \leq 430, 3x_1 + 4x_3 \leq 420$ with $x_1, x_2, x_3 \geq 0$	**4**
3A	Fit a second degree parabola of the form $y = ax^2 + bx + c$ to the following data by dividing into three groups.	**3**

x	0	20	40	60	80	100	120	140	160	180	200
y	98	106	112	114	113	110	102	92	79	64	47

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

3B	Find numerically the smallest eigenvalue of the matrix $\begin{pmatrix} -15 & 4 & 3 \\ 10 & -12 & 6 \\ 20 & -4 & 2 \end{pmatrix}$ by power method by taking $x_0 = (1,1,1)'$. Perform 4 iterations.	3
3C	Solve $Max\ Z = 2x_1 + 3x_2$ subject to $-x_1 + 2x_2 \leq 4. x_1 + x_2 \leq 6, x_1 + 3x_2 \leq 9$ where x_1, x_2 are unrestricted in sign.	**4**
4A	Solve by graphical method, $Max\ Z = 3x_1 + 4x_2$ subject to $5x_1 + 4x_2 \leq 200, 3x_1 + 5x_2 \leq 150, 5x_1 + 4x_2 \geq 100, 8x_1 + 4x_2 \geq 80$ with $x_1, x_2 \geq 0$.	**3**
4B	Approximate the location of global maximum on $[0, \pi]$ of $f(x) = x^2 sinx$ using Fibonacci Search of the unrestricted interval with five functional evaluations.	**3**
4C	Use the two-phase simplex method to $Max\ Z = 2x_1 + x_2 + \frac{1}{4}x_3$ subject to, $4x_1 + 6x_2 + 3x_3 \leq 8, 3x_1 - 6x_2 - 4x_3 \leq 1, 2x_1 + 3x_2 - 5x_3 \geq 4$ with $x_1, x_2, x_3 \geq 0$.	**4**
5A	An Air Force is experimenting with three types of bombs P, Q and R in which three kinds of explosives, viz. A, B and C will be used. Taking the various factors into account, it has been decided to use the maximum of 600 kg of explosive A, at least 480 kg of explosive B and exactly 540 kg of explosive C. Bomb P requires $3, 2, 2\ kg$, bomb Q requires $1, 4, 3\ kg$ and bomb R requires $4, 2, 3\ kg$ of explosives A, B and C respectively. Bomb P is estimated to give the equivalent of a 2 ton explosion, bomb Q, a 3 ton explosion and bomb R, a 4 ton explosion respectively. Under what production schedule can the Air Force make the biggest bang ? Form the LPP model and solve by using Big-M method.	**6**
5B	Use Kuhn-Tucker conditions to solve the non-linear programming problem $Max\ z = 3x_1 + x_2$ subject to the constraints $x_1^2 + x_2^2 \leq 5,\ x_1 - x_2 \leq 1$, with x_1, x_2 non negative	**4**