U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME6DEOPT **Max Marks: 100**
Course: Optimization Techniques **Date: 19.07.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Write a note on vector norms	*CO1*	*PO 1*	**04**
	b)		Solve the system of equation represented $AX = B$ by applying Gauss – Seidel iterative method for three iterations to obtain the final solution correct to four decimal places (Note: All the iterations need to be shown) where $A = \begin{bmatrix} 28 & 4 & -1 \\ 1 & 3 & 10 \\ 2 & 17 & 4 \end{bmatrix}$ $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ $B = \begin{bmatrix} 32 \\ 24 \\ 35 \end{bmatrix}$	*CO 1*	*PO 2*	**06**
	c)		Use the Newton's method to find the minimizer of the given function (Note: at least four iterations to be shown) $f(x) = \frac{x^2}{2} - \sin(x)$ $Initial\ guess, x_0 = 1\ radians, residual = 10^{-4}$	*CO 2*	*PO 2*	**10**
			UNIT - II			
2	a)		Using the Lagrange multiplier method, find the dimensions of a cylindrical tin made of sheet metal (r = radius of the cylinder and h = height of the cylinders). Consider this as a single variable unconstrained problem. Maximize its volume such that the total surface area, As = 24π m^2. Also, show that the volume is maximum at obtained dimensions. (Note: consider both top and bottom surfaces in the calculation).	*CO 2*	*PO 2*	**08**
	b)		Determine the extremisers of the following constrained function using the Lagrange multipliers method and also find out whether the function is maximum or minimum at the obtained extremisers. $y = \frac{1}{2}[x_1^2 + x_2^2 + x_3^2 + x_4^2]$, where $x_1, x_2, x_3,$ and x_4 are variables Subjected to $x_1 + 2x_2 + 3x_3 + 5x_4 = 10$ $x_1 + 2x_2 + 5x_3 + 6x_4 = 15$	*CO 2*	*PO 2*	**12**

B.M.S.C.E. - EVEN SEM 2022-23

			OR			
	3	a)	Find the maximum of the function $f(x) = 2x_1 + x_2 + 10$ subject to $x_1 + 2x_2^2 \leq 3$ using the KKT condition and comment on the Hessian matrix obtained.	*CO 2*	*PO 2*	**08**
		b)	Solve the below minimization problem by establishing the KKT condition. Also show that the function is minimum at the obtained extremisers. Minimize $f(X) = (x_1 - 3)^2 + (x_2 - 2)^2$ Subjected to $-x_1^2 - x_2^2 + 4 \geq 0$ $x_1 + x_2 - 2 \geq 0$ $x_1, x_2 \geq 0$	*CO 2*	*PO 2*	**12**
			UNIT - III			
	4	a)	List the points that need to be followed while solving the quadratic programming problem using active set method	*CO 3*	*PO 1*	**06**
		b)	Minimize $y = 2x_1^2 - 2x_1x_2 + x_2^2$ with an initial guess of (3,5) using Cauchy's steepest Descent Method and perform at least 3 iteration.	*CO 3*	*PO 2*	**14**
			OR			
	5	a)	Maximize $y = -x_1^2 - x_2^2 + 4x_1 + 6x_2$ with an initial guess of (0,0) using Cauchy's steepest Ascent Method and perform at least one iteration.	*CO 3*	*PO 1*	**06**
		b)	Consider a constrained equality optimization problem as given below. Find the optimum using Newton's method. $y = 3x_1^2 + 4x_2^2 + 2x_1x_2 - 2x_1 - 3x_2$ Subjected to $3x_1 + 2x_2 = 6$ $x_1, x_2 \geq 0$	*CO 3*	*PO 2*	**14**
			UNIT - IV			
	6		Write a note on the following practical issues that can occur while solving optimization problem (i) infeasible constraints (ii) discontinuities (iii) rank deficient constraints, (iv) constraint redundancy (v) Taylor series expansion and backward difference method along with order of accuracy	*CO 1*	*PO 1*	**20**

B.M.S.C.E. - EVEN SEM 2022-23

			UNIT - V			
	7		Write down the procedure to solve an optimization problem using Simulated Annealing (SA) algorithm.	*CO 4*	*PO 2*	**05**
			It is desired to maximize the parameter $$y = \frac{2.5 + 6.2x^{0.8}}{1.3 + 0.5x^{1.8}}$$ the range of $0.5 \leq x \leq 2.5$ m/s, Using the Genetic Algorithms (GA), perform 2 iterations with an initial population size of 4n and 2 decimal accuracy to determine the extremisers. (Note: need to show how many numbers of bits selected, number of populations, conversion to binary to decimal and other way and one sample calculation for each iteration) Use the following values as an initial population for x = 0.77, 1.57, 2.11 and 2.33	*CO 4*	*PO2*	**15**

****

B.M.S.C.E. - EVEN SEM 2022-23