National Institute of Technology Hamirpur (H.P.)
B.Tech. End-Semester Examination, Nov. 2023

Branch	:	ME	**Course Code** :	ME-431
Semester	:	7th	**Time** :	3 Hrs
Course Name	:	Optimization Methods in Engineering	**Max. Marks** :	50
Time & Session	:	(02:30 PM -05:30 PM) & 'B'	**Date** :	22.11.23

NOTE: Attempt all questions which carry marks as indicated in the [ ]. Assume suitable data if missing.

Q-1. Minimize $f(x_1, x_2) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$ in the interval $0 \leq x_1, x_2 \leq 5$. Take initial point $x^{(0)} = (1,1)$; Size reduction parameter $\Delta = (2,2)$. Solve upto 4 Iterations and achieve the accuracy of less than 1.5 by using Box's Evolutionary Method. **[8]**

Q-2. Explain the Algorithm of Ant colony and Particle swarm optimization with suitable example. **[8]**

Q-3. Minimize the following $f(x)$ using conjugate gradient method (Fletcher Reeves): **[8]**
(i) $f(x) = 5x_1^2 + 2x_2^2 - 2x_1x_2 - 4x_1 - 4x_2 + 4$
(ii) $f(x) = 2x_1^2 + x_2^2 + 2x_1x_2 + x_1 - x_2$
Take Initial Point $x^{(0)} = (0,0)^T$ in both parts.

Q-4. In the following minimization problem **[8]**

$$Minimize\ f(x) = x_1^2 + x_2$$

Subject to
$$g_1(x) = 10exp(x_1^2 + x_2) - 5x_1 + 12 \geq 0$$
$$g_2(x) = 5x_1^3 + 2x_2 - 9 \leq 0,$$
$$0 \leq x_1, x_2 \leq 3$$

For the above optimization problem, check if the following points are KT points.
(a) $(1, 4)^T$
(b) $(3, 0)^T$

Q-5. Use Branch & Bound Method, solve the following LPP **[8]**

$$Max\ Z = 8x_1 + 5x_2$$

Subject to
$$9x_1 + 5x_2 \leq 45$$
$$x_1 + x_2 \leq 6$$
$$x_1, x_2 \geq 0\ \&\ x_1, x_2\ are\ integers$$

Q-6. Minimize the function using Hooke-Jeeves pattern search method. Assume initial point $(1,1)^T$, increment vector $\bar{\Delta} = (0.5, 0.5)^T$, Step reduction factor $\alpha = 2$ desired accuracy $\varepsilon = 0.7$. **[10]**

$$Minimize\ f(x) = (x_1^2 + x_2 - 11)^2 + (x_2^2 + x_1 - 7)^2$$