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Indian Institute of Technology, Kharagpur

Department of Mechanical Engineering

Date: ; Time: 2 hours; Full Marks: 30; No. of students: 45

Autumn Sem. 2009-2010 (Mid. Sem.); Subject No. MF 41601

4-th Year B. Tech. and DD students; Subject Name: Soft Computing

Instructions: Answer all the questions. Assume suitable data, if necessary.

Marks:=20(6+14)+2+8(3+3+2)=30

Q. 1

Let us consider the following optimization problem:

$$\begin{aligned} \text{Minimize } f(x_1, x_2) &= x_1 + x_2 + x_1^2 + x_2^2 + 2x_1x_2 \\ \text{subject to } &-10.0 \leq x_1, x_2 \leq 10.0 \end{aligned}$$

- Use Steepest Descent Method. Start with a random initial solution:  $X_1 = \{0.0, 0.0\}^T$ . Show one iteration only.
- Solve the above optimization problem using a Real-Coded GA. Show hand calculations for one generation assuming a population size  $N$  of 4 only. Use tournament selection; Simulated Binary Crossover assuming the probability distributions for the contracting and expanding zones as follows:

$$\begin{aligned} c(\alpha) &= 0.5(q+1)\alpha^q, \\ px(\alpha) &= 0.5(q+1)\frac{1}{\alpha^{q+2}} \end{aligned}$$

where  $\alpha$  is the spread factor and  $q = 4$ . Assume random numbers lying between 0.0 and 1.0;  $p_c = 1.0$ ;  $p_m = 0.0$ .

Q. 2

In scheduling GA, use Position-based Crossover (considering 2-nd, 3-rd and 5-th as the crossover points) to determine two children solutions from the two parents given below.

Pr 1 : A B C D E F

Pr 2 : C A B F D E

Q. 3

Write short notes on

- Visualized Interactive Genetic Algorithm
- Schema Theorem of Binary-Coded GA
- Pareto-Optimal Front of Multi-Objective Optimization Problem