Roll No.:..... (147)

National Institute of Technology Hamirpur (HP)-177005
End Semester B.Tech. Examination, Nov.-Dec., 2022

ME-431: Optimization Methods in Engineering

Branch: Mechanical Engineering **Date: 06/12/2022**

Semester: VII **Time: 3 Hrs.**

Max. Marks: 50

Instructions to Candidates: *Answer all the questions. Schematic diagrams must be shown whenever necessary. Any data you feel missing may suitably be assumed and stated clearly.*

Q1. Answer the following: **[4×2]**

a) Define the Posynomial function.

b) Define design constraints and constraint surface

c) Define the unimodal function and give an example of it.

d) Define the gradient of the function. Explain its importance in multi-variable optimization.

Q2. Use the secant method to find a minimum of the function:

$$\text{Minimize } f(x) = 0.65 - \frac{0.75}{1+x^2} - 0.65x\, tan^{-1}\left(\frac{1}{x}\right)$$ **[8]**

Q3. Using Hooke – Jeeves, Minimize $f = 50 + (2.71 - x_1)^2 + (1 - x_2)^2$ by starting point at $(0.5, 0)$. **[8]**

Q4. The owner of a Tea Manufacturer is planning to expand by purchasing some new machines-Electric Dryer and Solar Dryer. The owner has estimated that each Electric Dryer purchased will increase profit by Rs. 100 per day and each Solar Dryer will increase profit by Rs. 150 daily. The number of machines the owner can purchase is limited by the cost of the machines and the available floor space in the shop. The machine purchase prices and space requirements are as follows:

MACHINE	Required floor space (sq. ft)	Purchase price
Solar Dryer	15	Rs. 8000
Electric Dryer	30	Rs. 4000

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The owner has a budget of Rs. 40000 for purchasing machines and 200 sq. ft of available floor space. Solve the problem using branch-and-bound method to know how many of each type of machine to purchase to maximise the daily increase in profit. **[8]**

Q5. 4000 m^3 of gravel is to be ferried across a river on a barge. A box (with the top open) is to be designed for the purpose.

COSTS: Transport: 10 cents per round trip on the barge,

Materials: Sides and bottom of box: Rs. $10/m^2$

Ends of the box: Rs. $20/m^2$

Find the optimal dimensions of the box using Geometric Programming. **[8]**

Q6. Explain the following in detail (Attempt any two) **[5+5]**

a) Genetic Algorithms

b) Tabu Search Optimization,

c) Variable-Metric (DFP) Method.

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