

Name: \_\_\_\_\_

Roll No: \_\_\_\_\_



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2021

Program: Chemical Engg. B. Tech. (Refinery and Petrochemicals); CE-RP

Semester: II

Course Name: Process Optimization

Max. Marks: 100

Course Code: CHCE 3020/CHEG 455

Duration (*cumulative*): 3 Hrs

No. of pages: 1 + 2 = 3

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In this **OPEN BOOK(S) (any number and kind) and NOTES EXAM**, you are allowed to have any books, *all* handouts provided (including your textbook in xeroxed form or in its printed form), *your own class-notes* and your solutions to assignment problems, *etc. EVERYTHING EXCEPT DISCUSSIONS AMONG YOURSELVES*.

**Please REMEMBER to return the Question Paper IF THERE IS ANY WORK DONE ON THAT**

1. Show *ALL intermediate steps* of your answers (and not just the final answers) to earn marks
  2. You are allowed to use only simple scientific calculators
  3. *Please scan YOUR ANSWERS and submit their pdf files on-line on BB to the questions in the sequence of your page numbers: 1, 2, 3. In addition, please submit a copy to me at [skgupta@iitk.ac.in](mailto:skgupta@iitk.ac.in)* (This is necessary since come of you may have connectivity issues)
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**Section A: ALL QUESTIONS ARE COMPULSORY [30 x 2 = 60 Marks]**

Q.1 Consider the problem:

$$\text{Minimize } f(x_1, x_2) \equiv (x_1 - 1)^2 + (x_2 - 1)^2 - 9 = 0$$

subject to the equality constraint:

$$g(x_1, x_2) \equiv x_1 - 4 = 0$$

and bounds

$$-\infty \leq x_1 \leq \infty$$

$$-\infty \leq x_2 \leq \infty$$

Plot  $f(x_1, x_2)$  and  $g(x_1, x_2)$  and find the solution graphically. (30 Points)

Q. 2 We would like to use the *binary-coded* genetic algorithm (GA) with **two** binaries (bits) to represent *each* of  $x_1$  and  $x_2$ . Use (the conventional) binary number = 0 if  $0 \leq R \leq 0.5$

and binary number = 1 if  $0.5^+ \leq R \leq 1.0$ . Use the sequence of random numbers in Table 2.6 on page 78 (or Table 4.1 page 167) of your textbook to fill up the Table (of binaries) below for only three chromosomes, 1 - 3. **CO2 (30 points)**

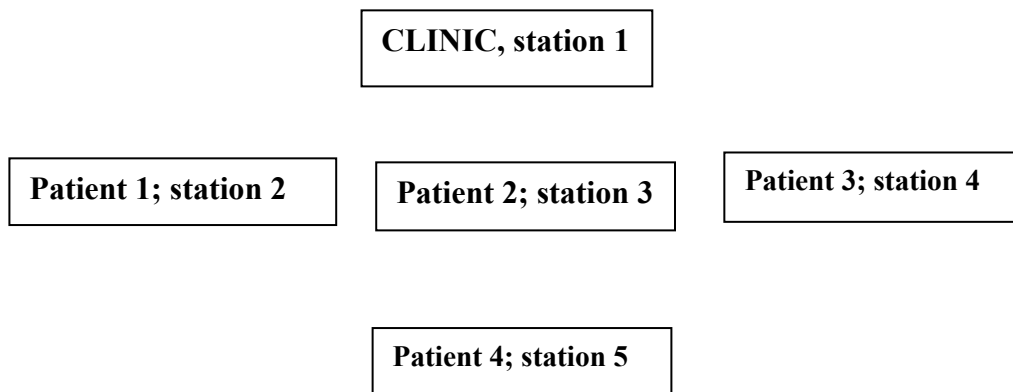
**Chromosomes (binary):**

Chromosome No.	$x_1$		$x_2$	
	(binary)		(binary)	
1				
2				
3				

**Section B: COMPULSORY QUESTION|Total 40 Marks|**

Q. 1: A doctor in her/his clinic, station 1 (location:  $x_1, y_1$ ), has to visit **four** (*influential*) patients in their homes (stations 2, 3, 4 and 5), with their  $x, y$  locations given as  $x_i, y_i$  ( $i = 2, 3, 4, 5$ ), in any *convenient* sequence once her/his clinic is over (say, at 1 pm). (S)He wishes to minimize the total distance (s)he travels. Find the optimal sequence of her/his visits.

(40 Points)



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