Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: System Analysis & Optimization
Semester: 2
Program: M.Tech. Pipeline Engineering **Time: 03 hrs.**
Course Code: CHPL7007 **Max. Marks: 100**
Instructions: *Attempt* ***ANY FIVE*** *questions*

S. No.		Marks	CO
Q1	Gaz De France, a French Gas transporting pipeline company utilizes a certain part of the natural gas flowing in the pipeline as an energy source for running the compressor. Researchers found that around 3-4% of the total gas transported through pipeline was consumed in turbine run compressors. This energy consumption was quite large as huge amount of the gas is being transported through pipelines. Researches formulated the problem and found that the fuel consumed in compressor is dependent on the inlet and outlet pressure of the compressors and is obtained from the following relation: $$m_f = P_1^2 + P_2^2 + 2P_1 + 4P_2 + 5$$ Here: m_f = Natural Gas consumed in compressor. P_1 = Pressure at inlet of compressor P_2 = Pressure at outlet of compressor Using **Cauchy's Steepest Descent** method and taking starting point as: $X = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$, calculate the optimum value of the pressures P_1 and P_2 at which the fuel consumed in compressor gets **minimized.** **Solve up to TWO NUMBER of iterations.**	**20**	**CO1, CO5**
Q2	A researcher working in a pipeline company wishes to minimize the cost of pipeline networks. On investigation, he found that there are two major components that	**20**	**CO2,**

	contribute for the cost of pipeline networks. These are **i.** Investment Cost of pipe line Network (I) **ii.** Operating Cost of pipeline network (O). The researcher found that the total cost of pipeline networks is obtained from the following relation: $$T.\mathrm{C} = 4I^2 - 5IO + 3O^2 - 8I$$ T.C. = Total Cost of Pipeline Networks. I = Investment Cost of Pipeline Networks. O = Operating cost of pipeline networks With initial starting point as $X = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$, probe length as $\theta = 0.01$ and using **UNIVARIATE** method, minimize the cost of pipeline network. Solve up to **TWO NUMBER OF ITERATIONS.**		
Q3	Perform **TWO ITERATIONS** of the **FLETCHER REEVES** method to minimize the function given as follows: $$f(x_1, x_2) = 6x_1^2 - 6x_1x_2 + 2x_2^2 - x_1 - 2x_2$$ Take starting point as: $X = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$.	**20**	**CO2, CO3**
Q4	An offshore pipeline transportation problem involves minimizing the cost of pipeline network by finding the optimum route of pipeline. The cost of the pipeline depends on four decision variables, $x_1, x_2, x_3,$ and x_4 and is obtained from the following co-relation $$C = x_1 + 2x_2 + 3x_3 + 4x_4 - 30$$ The bounds on various decision variables are as follows: $$1 \prec x_1 \prec 25; \quad 3 \prec x_2 \prec 30; \quad 4 \prec x_3 \prec 28; \quad 5 \prec x_4 \prec 30;$$ Using **Genetic Algorithms,** *minimize* the cost of Gas Pipeline Network. **Show, manually the step wise procedure involved up-to one generation only.**	**20**	**CO4**

	*Assume the number of chromosome as **six,** crossover rate as **25%** and Mutation rate as **10%***		
Q5	Use **Fibonacci Search** to minimize the following function: $$f(x) = 0.65 - \left[\frac{0.75}{1+x^2}\right] - 0.65x * \tan^{-1}\left(\frac{1}{x}\right)$$ Take the interval as $[0,3]$ and number of experiments to be conducted $n = 6$.	**20**	**CO2, CO4**
Q6	Use the two phase simplex method to minimize the following function: Minimize $Z = 5x_1 + 6x_2$ $x_1 + x_2 \le 5; \quad 3x_1 + x_2 = 10; \quad x_1 + 3x_2 \ge 6;$ $x_1 \ge 0; \quad x_2 \ge 0;$	**20**	**CO3**