PAPER 1

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

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July- 2020

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
Q.1.	Gulf South Pipeline company, while transporting gas 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: $$m_f = P_1 - P_2 + 2P_1^2 + 2P_1P_2 + P_2^2$$ 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 FOUR NUMBER of iterations.**	**20**	**CO5**

Q.2.	A research scholar working at "UNIVERSITY OF PETROLEUM AND ENERGY STUDIES" for a pipeline project wishes to minimize the cost of pipeline networks. On investigation, he found that there are two major components that 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: $$\mathbf{T.C. = - I - 2O + 6I^2 - 6I*O + 2O^2}$$ 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.**	**20**	**CO2**
Q.3.	A pipeline operator wishes to minimize the formation of gas hydrates in pipeline. The operator found that the gas hydrates can be minimized by optimizing temperature and pressure in pipeline networks. Further it was found that the gas hydrate was a correlated with temperature and pressure according to the following correlation: $$f(P,T) = 6P^2 - 6P*T+2P^2 - P-2T$$ Perform **TWO ITERATIONS** of the **FLETCHER REEVES** that helps the pipeline operator to minimize the formation of gas hydrates. Take starting point as: $X = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$.	**20**	**CO3**
Q.4.	A pipeline network problem involves minimizing the cost of laying the pipeline by finding the optimum route of pipeline. The cost of the pipeline depends on four decision variables, R_1, R_2, R_3, and R_4 and is obtained from the following co-relation	**20**	**CO3**

	$C = R_1 + 2R_2 + 3R_3 + 4R_4 - 30$ The bounds on various decision variables are as follows $1 < R_1 < 25$; $3 < R_2 < 30$; $4 < R_1 < 28$; $5 < R_1 < 30$ Using **Genetic Algorithms,** *minimize* the cost of Gas Pipeline Network. **Show, manually the step wise procedure involved up-to one generation only.** *Assume the number of chromosome as **six,** crossover rate as **25%** and Mutation rate as **10%***		
Q.5.	A pipeline operator wishes to minimize the cost of pipeline that goes on a hilly terrain. It was found that the cost depends on the slope of hill as per the following equation: $$f(x) = 0.45 - \left[\frac{0.65}{1+x^2}\right] - 0.45x^* \tan^{-1}\left(\frac{1}{x}\right)$$ Use **Fibonacci Search** to minimize the cost: Take the interval as $[0,3]$ and number of experiments to be conducted $n = 6$.	**20**	**CO4**
Q.6.	Use the **two phase simplex** method to minimize the following function: Minimize P = 12X+20Y $$6X + 8Y \geq 100$$ $$7X + 12Y \geq 120$$ $$X \geq 0; \quad Y \geq 0$$	**20**	**CO1**

PAPER 2

ROLL NO: R150219002

CONFIDENTIAL ✓

Name of Examination (Please tick, symbol is given)	:	**MID**		**END**	✓	**SUPPLE**	
Name of the School (Please tick, symbol is given)	:	**SOE**	✓	**SOCS**		**SOP**	
Programme	:	**M.Tech. Pipeline Engineering**					
Semester	:	**II**					
Name of the Course	:	**System Analysis & Optimization**					
Course Code	:	**CHPL 7007**					
Name of Question Paper Setter	:	**Dr. ADARSH KUMAR ARYA**					
Employee Code	:	**40000355**					
Mobile & Extension	:	**9927741369**					
Note: Please mention additional Stationery to be provided, during examination such as Table/Graph Sheet etc. else mention "NOT APPLICABLE":							

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Time of Examination	:	
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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July- 2020

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
Q.1.	Gulf South Pipeline company, while transporting gas 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: $$m_f = P_1 - P_2 + P_1^2 + P_1P_2 + 2P_2^2$$ 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 FOUR NUMBER of iterations.**	**20**	**CO5**

Q.2.	A research scholar working at "UNIVERSITY OF PETROLEUM AND ENERGY STUDIES" for a pipeline project wishes to minimize the cost of pipeline networks. On investigation, he found that there are two major components that 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: $$\mathbf{T.C. = - 2I - O + 5I^2 - 7I*O + 3O^2}$$ 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.**	**20**	**CO2**
Q.3.	A pipeline operator wishes to minimize the formation of gas hydrates in pipeline. The operator found that the gas hydrates can be minimized by optimizing temperature and pressure in pipeline networks. Further it was found that the gas hydrate was a correlated with temperature and pressure according to the following correlation: $$f(P,T) = 5P^2 - 7P*T+3P^2 - P-2T$$ Perform **TWO ITERATIONS** of the **FLETCHER REEVES** that helps the pipeline operator to minimize the formation of gas hydrates. Take starting point as: $X = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$.	**20**	**CO3**
Q.4.	A pipeline network problem involves minimizing the cost of laying the pipeline by finding the optimum route of pipeline. The cost of the pipeline depends on four decision variables, R_1, R_2, R_3, and R_4 and is obtained from the following co-relation	**20**	**CO3**

	$C = R_1 + R_2 + 3R_3 + 4R_4 - 40$ The bounds on various decision variables are as follows $1 < R_1 < 25$; $3 < R_2 < 30$; $4 < R_1 < 28$; $5 < R_1 < 30$ Using **Genetic Algorithms,** *minimize* the cost of Gas Pipeline Network. **Show, manually the step wise procedure involved up-to one generation only.** *Assume the number of chromosome as **six,** crossover rate as **25%** and Mutation rate as **10%***		
Q.5.	A pipeline operator wishes to minimize the cost of pipeline that goes on a hilly terrain. It was found that the cost depends on the slope of hill as per the following equation: $$f(x) = 0.35 - \left[\frac{0.65}{1+x^2}\right] - 0.35x^* \tan^{-1}\left(\frac{1}{x}\right)$$ Use **Fibonacci Search** to minimize the cost: Take the interval as $[0,3]$ and number of experiments to be conducted $n = 6$.	**20**	**CO4**
Q.6.	Use the **two phase simplex** method to minimize the following function: Minimize P = 11X+19Y $6X + 8Y \geq 100$ $7X + 12Y \geq 120$ $X \geq 0; \quad Y \geq 0$	**20**	**CO1**

PAPER 3

ROLL NO: R150219003

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Name of the School (Please tick, symbol is given)	:	**SOE**	✓	**SOCS**		**SOP**	
Programme	:	**M.Tech. Pipeline Engineering**					
Semester	:	**II**					
Name of the Course	:	**System Analysis & Optimization**					
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	$C = R_1 + R_2 + 3R_3 + 4R_4 - 35$ The bounds on various decision variables are as follows $1 < R_1 < 25$; $3 < R_2 < 30$; $4 < R_1 < 28$; $5 < R_1 < 30$ Using **Genetic Algorithms,** *minimize* the cost of Gas Pipeline Network. **Show, manually the step wise procedure involved up-to one generation only.** *Assume the number of chromosome as **six,** crossover rate as **25%** and Mutation rate as **10%***		
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