Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem 2019-20
Course Code: PET 303
Course Name: PIPELINE ENGINEERING
Program & Sem.: B.Tech (PET) & VII DE

Date: 30.09.2019
Time: 9:30 AM to 10:30 AM
Max Marks: 40
Weightage: 20%

Instructions:

(i) All Questions are compulsory.
(ii) Assume the data, if not given. The assumptions must be reasonable.

Part A [Memory Recall Questions]

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

1. List down different methods to calculate Pseudo-critical Pressure and pseudo-critical Temperature for a mixture of gas. (C.O.NO.1) [Knowledge]

2. Explain Newton's law of viscosity. (C.O.NO.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

3. The viscosity of liquids increases with decrease in temperature. The opposite effect is observed in the case of gases. Why? (C.O.NO.1) [Comprehension]

4. The gas velocity is directly related to the flow rate. As flow rate increases, so does the gas velocity. As the velocity increases, vibration and noise are evident. In addition, higher velocities will cause erosion of the pipe interior over a long period of time. How high can the gas velocity be allowed in a pipeline? How can you calculate that velocity? What is its significance in the designing of the pipelines?

(C.O.NO.1) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carries twenty marks. (1Qx20M=20M)

5. An NPS 20 pipeline of 0.5-inch thickness is carrying a crude oil of specific gravity of 0.8 and viscosity of 5.5 cSt at a flow rate of 7000 bbl/h from point A to point C via peak B which is exactly in the middle. The pipeline is 70 miles long. The elevation of the points A, B, and C are 150 ft, 1700 ft, and 650 ft respectively. Calculate the pressure required at point A to transport the oil, satisfying the minimum delivery pressure of 30 psi at B and 100 psi at C. Assume pipe roughness to be 0.003 inch and initial guess of friction factor 0.02. (C.O.NO.1) [Application]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 7

Course Code: PET 303

Course Name: PIPELINE ENGINEERING

Date: 30/09/2019

Time: 9:30-10:30

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

SET 1

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	CO1	Unit 1 - Pipeline Hydraulics	5			5
2			5			5
3				5		5
4				5		5
5					20	20
	Total Marks		10	10	20	**40**

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby with certify that all the questions are set as per the above guidelines Sugat.

Reviewer's Comments,

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SOLUTIONS

Semester: 7

Course Code: PET 303

Course Name: PIPELINE ENGINEERING

Date: 30/09/2019

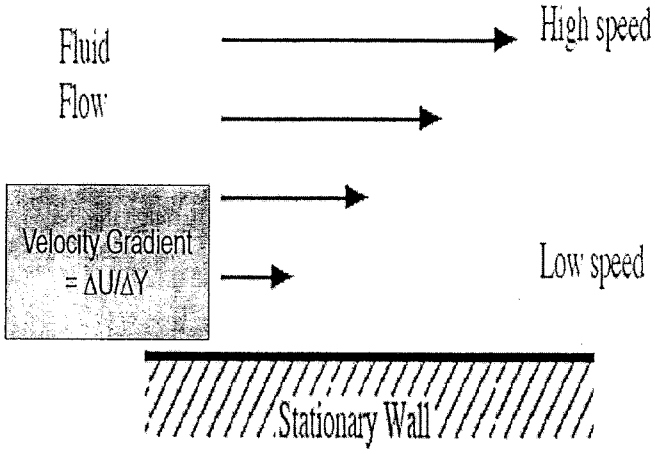
Time: 9:30-10:30

Max Marks: 40

Weightage: 20%

Part A (2 x 5 = 10)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	**1. Weighted mean or Kay's Method** **2. Gas Gravity correlation** **3. Correlation for gases with CO2 and H2S**	**Naming each method – 0.5*3 = 1.5 marks** **Writing formula –** **1.** $T_{pc} = \sum y_i T_c$ $P_{pc} = \sum y_i P_c$ • Using gas gravity only, $T_{pc} = 170.491 + 307.344\ G\ (in\ °R)$ $P_{pc} = 709.604 - 58.718\ G\ (in\ psia)$ • Depending on the amounts of carbon dioxide and hydrogen sulfide present in the sour gas, we calculate an adjustment factor ε from $\varepsilon = 120(A^{0.9} - A^{1.6}) + 15(B^{0.5} - B^{4.0})$ A = Sum of mole fraction of H_2S and CO_2 B = Mole fraction of H_2S $T'_{pc} = T_{pc} - \varepsilon$ $P'_{pc} = \frac{P_{pc} T'_{pc}}{T_{pc} + B(1-B)\varepsilon}$ **1*3 = 3 marks** **Correct units – psia for Pressure and deg R for Temperature – 0.5 marks**	**8 min**
2	**Statement of Newton's Law of Viscosity**	Shear stress is directly proportional to velocity gradient. $\tau \propto \frac{du}{dy}$	**8 min**

		$\tau = \mu \frac{du}{dy}$ where, τ = shear stress = $\frac{shear\ force}{tangential\ area}$ μ = viscosity $\frac{du}{dy}$ = velocity gradient  **Statement – 2 marks** **Well-labeled diagram – 2 marks** **Explaining the terms like viscosity, shear stress, and velocity gradient – 1 marks**	

Part B (2 x 5 = 10)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
3	Liquid viscosity variation – inter-molecular forces Gas viscosity variation – Kinetic energy	Stating each reason – 1.5*2 = 3 marks Explaining them – 1*2 = 2 marks	8 min
4	Erosional velocity is the maximum design velocity limit. Significance – Design limit; vibrations and erosion takes place beyond that	Identifying the name – Erosional Velocity – 1 mark Formula with correct units – $u_{max} = \frac{100}{\sqrt{\rho}}$ or $u_{max} = 100\sqrt{\frac{ZRT}{29GP}}$ in USCS units 2 marks Significance – design limit, above this erosion and vibration takes place inside the pipeline - 2 marks	8 min

Part C (1 x 20 = 20)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	Thickness – 19" Re = 148290.14 f = 0.0176 P_f = 9.709 psi/mile P_A = 952.79 psi P_B = 76.28 psi P_C = 100 psi	Thickness – 1 mark Reynolds number and flow regime – 2 + 1 marks Friction factor using Colebrook – White Equation – 5 marks Pressure drop per unit length due to friction - 3 marks Finding Elevation pressures – 2 marks Finding out pressure at A, B, and C – 4 marks Adjustment and final reporting of the answer – 2 marks	18 min

Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20
Course Code: PET 303
Course Name: PIPELINE ENGINEERING
Program & Sem.: B.Tech. (PET) & VII (DE)

Date: 18.11.2019
Time: 9:30 AM to 10:30 AM
Max Marks: 40
Weightage: 20%

Instructions:

(i) All Questions are compulsory.
(ii) Assume the data, if not given. The assumptions must be reasonable.
(iii) Question 6,7,8 and 9 are linked and in continuation. Attempt those in the sequence.

Part A [Memory Recall Questions]

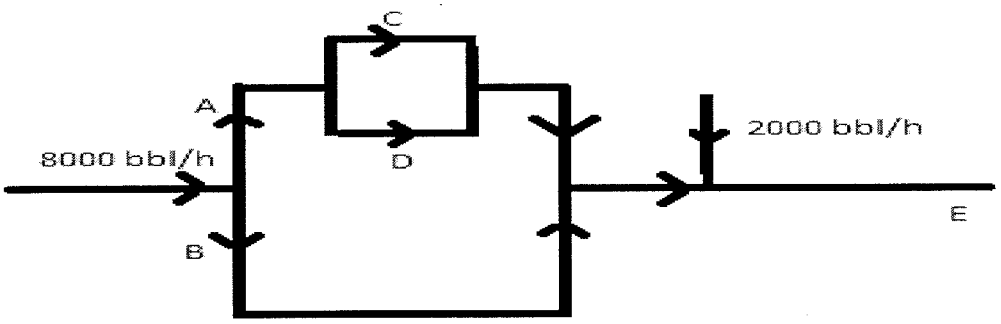
Answer all the Questions. Each Question carries four marks. (3Qx4M=12M)

1. Choose the correct option [4M](C.O.NO.2)[Knowledge]
   i) The temperature difference between inlet and outlet in an isothermal compression is:_____.
   a) Positive b) Negative c) Zero d) Infinity
   ii) Which is the isentropic process out of the following process?
   a) Adiabatic b) Polytropic c) Isothermal d) Isobaric
   iii) Specific speed is used for comparing:_____.
   a) Geometrically similar pumps
   b) Geometrically dissimilar pumps
   c) Flow rates
   d) Heads
   iv) What is the full form of MAOP?
   a) Minimum Annular Operating Pressure
   b) Minimum Allowable Operating Pressure
   c) Maximum Allowable Operating Pressure
   d) Maximum Annular Operating Pressure
2. Write True or False: [4M](C.O.NO.2)[Knowledge]
   i) The head developed by the compressor is defined as the amount of energy supplied to the gas per unit mass of gas.
   ii) $HP = \frac{BHP}{\eta_m}$
   iii) $NPSH_a < NPSH_{req}$
   iv) NPSH is temperature dependent.
3. Define: [4M](C.O.NO.2)[Knowledge]
   i) Surging
   ii) Cavitation

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries four marks. (2Qx4M=8M)

4. Find the flow rates of liquid at following points A, B, C, D and E: (Assume equal distribution of flow at the junctions) [4M](C.O.NO.1)[Application]



5 (a). In compressor maximum volume flow rate is limited by cross-section at the inlet not by the flow rate. What is the maximum velocity limit of the gas?

(b). The flow rate in a series pipeline remains constant in spite of the change in the diameter of the pipe. Why? [2*2M](C.O.NO.2)[Comprehension]

Part C [Problem Solving Questions]

Answer all the questions. The questions nos 6,7,8 and 9 are in continuation. Each question carries five marks. (4Qx5M=20M)

A gas pipeline, NPS 25 with 0.250 in. wall thickness, 140 mi long, transports natural gas (specific gravity = 0.6) at a flow rate of 800 MMSCFD at an inlet temperature of 80°F. Assuming isothermal flow, find where 500 psig suction pressure compressor(s) to be installed in order to maintain the delivery pressure of 500 psig at the pipeline terminus. The MAOP is 1300 psig. The base pressure and base temperature are 14.7 psia and 60°F, respectively. Assume pipeline efficiency to be 0.95 and consider no elevation changes along the pipeline length. Z = 0.85.

6. Out of the given Gas Flow equations, which equation fits perfectly in the above situation? Why? [5M](C.O.NO.1)[Application]

$$Q = 433.5E\left(\frac{T_b}{P_b}\right)\left(\frac{P_1^2 - e^s P_2^2}{GT_f L_e Z}\right)^{0.5} D^{2.667} \quad Weymouth\ Equation$$

$$Q = 435.87E\left(\frac{T_b}{P_b}\right)^{1.0788}\left(\frac{P_1^2 - e^s P_2^2}{G^{0.8539} T_f L_e Z}\right)^{0.5394} D^{2.6182} \quad Panhandle\ A$$

$$Q = 737E\left(\frac{T_b}{P_b}\right)^{1.02}\left(\frac{P_1^2 - e^s P_2^2}{G^{0.961} T_f L_e Z}\right)^{0.51} D^{2.53} \quad Panhandle\ B$$

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 7

Course Code: PET 303

Course Name: **PIPELINE ENGINEERING**

Date: 18/11/2019

Time: 9:30-10:30

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

SET 2

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C/A	A	
1	CO2	Unit 2 -Pumps and Compressors	4			4
2			4			4
3			4			4
4	CO1	Unit 1 – Pipeline Hydraulics		4		4
5	CO2	Unit 2 -Pumps and Compressors		4		4
6	CO1	Unit 1 – Pipeline Hydraulics			5	5
7	CO2				5	5

8		Unit 2 -Pumps and Compressors			5	5
9					5	5
	Total Marks		12	8	20	40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTIONS

Semester: 7

Course Code: PET 303

Course Name: **PIPELINE ENGINEERING**

Date: 18/11/2019

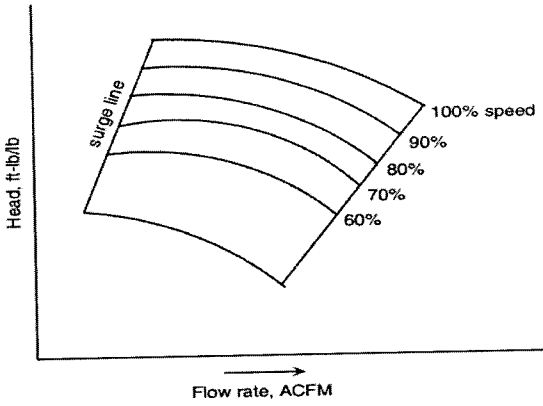
Time: 9:30-10:30

Max Marks: 40

Weightage: 20%

Part A (3 x 4 = 12)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	**i-C** **ii-A** **iii-A** **iv-B**	1 mark for each correct answer	**4 min**
2	**i-True** **ii-False** **iii-False** **iv-True**	1 mark for each correct answer	**4 min**

3	**Definition of Surging and Cavitation**	When compressor surge happens, the operating point of a compressor, which is usually denoted by the pair of the mass flow rate and pressure ratio, orbits along a surge cycle on the compressor performance map.  Cavitation - As the pressure on the suction side of a pump is reduced to a value below the vapor pressure of the liquid being pumped, flashing can occur. The liquid vaporizes and the pump is starved of liquid. At this point the pump is said to cavitate due to insufficient liquid volume and pressure	**6 min**

Part B (2 x 4 = 8)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	A-4000 bbl/hr B-4000 bbl/hr C-2000 bbl/hr D-2000 bbl/hr E-10000 bbl/hr	C&D – 0.5 marks each Rest – 1 mark	6 min
5	5a) 1 mach or speed of sound is the limit of the gas; prove it using equation: Q = Av 5b) Continuity Equation: Av = constant	5a) Identifying the limit – 1 mark Proving it – 1 mark 5b) Identifying the problem – 1 marl Explaining it – 1 mark	8 min

Part C (4 x 5 = 20)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

6, 7, 8, 9	Equation – Panhandle A Equation Location – 75.14 miles Compression Ratio – 2.554 Number of stages - 2 Arrangement – Parallel (Series partially correct)	6. Choosing the correct equation – 1 mark Explaining it using selection criteria – 4 marks 7. Putting the correct values in the equation after conversion – 2 mark Solving the question – 2 marks Reporting the final answer with the correct units – 1 mark 8. Compression ratio = P_d/P_s = 2.554 – 2 marks Identifying the formula for stage compression – 1 mark Number of compressor stage – 2 marks 9. If series chosen – Should explain why – stage compression but still, compression ratio is not too high. – 2 marks only or If parallel chosen – 2 marks Explanation – Flow division, compression ratio is not too high, station can operate even if one compressor breaks down – 3 marks	4 + 6 + 4 + 4 = 18 mins

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: PET 303
Course Name: PIPELINE ENGINEERING
Program & Sem: B.Tech.(PET) & VII (DE–IV)

Date: 24 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.
(ii) Assume the unknown quantities.
(iii) Write precise and to the point.
(iv) Units should be mentioned clearly wherever necessary.

Part A [Memory Recall Questions]

Answer both the Questions. Each Question carries 10 marks. **(2Qx10M=20M)**

1. Write short notes on the following: [10 M]

   a) Erosional Velocity (C.O.No.1) [Knowledge]

   b) Surging (C.O.No.2) [Knowledge]

   c) Fabrication (C.O.No.3) [Knowledge]

   d) CAPEX (C.O.No.4) [Knowledge]

2. Write about the following: [10 M]

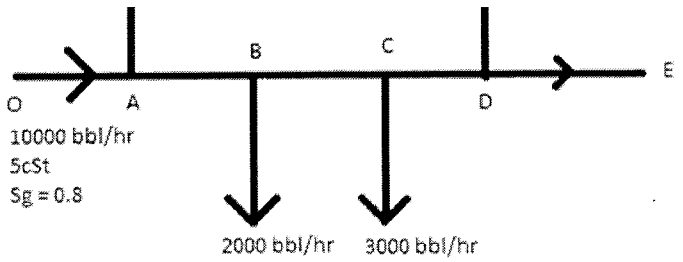
   a) Cost Components of OPEX in Pipeline industry (C.O.No.4) [Knowledge]

   b) Cleaning of Pipelines (C.O.No.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries 12 marks. **(2Qx12M=24M)**

3. Find out Flow rate and Specific Gravity in segments AB, BC, CD and DE: [12 M]



(C.O.No.1) [Comprehension]

4. Answer the following with proper reasons: [12 M]

a) The oil reservoir is a network of capillaries through which the reservoir fluids flow. These capillaries can be considered as a large network of circular pipes of diameters in the range of microns. What will be the Reynolds number of the flow of oil in a reservoir? Use Darcy's law and assume the relevant data. (C.O.No.1) [Application]

b) While designing the pump with open suction tank, we keep in mind the following inequality:

$$P_{vap} < \text{Net Positive Suction Pressure} < P_{suc} < P_{atm}$$

Explain the significance. (C.O.No.2) [Comprehension]

c) Toughness and Hardness are synonymously used in our daily lives. But both are different and represent different mechanical phenomenon. Explain the difference.

(C.O.No.3) [Comprehension]

d) Rs. 100 today worth more than Rs. 100 in year 2020; Rs. 100 is 2015 worth more than Rs. 100 in 2019. How? Which concept regarding economics is applied here?

(C.O.No.4) [Application]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 6 marks. **(6Qx6M=36M)**

A city is proposing to build a 30 miles-long pipeline to transport water (sg=1.0) at a flow rate of 14.4 million gal/day (10000 GPM). They have 3 pipe grades with diameters 20, 22, and 24 inches. There is static elevation head of 200 ft from the originating pump station to the delivery terminus. A minimum delivery pressure of 50 psi is required at the pipeline terminus.

The pipeline operating pressure must be limited to 1200 psi using steel pipe of density 480 lb/ft^3.

$$Q\left(\frac{gal}{day}\right) = 0.1482 * C * D(in)^{2.63} * \left(\frac{\Delta m/l}{Sg}\right) \quad Hazen - Williams\ Equation$$

6. Calculate the total pressure required. (C.O.No.1) [Application]

7. Calculate the BHP of the pumps. Use Efficiency of the pump to be 0.8. Also find out the rating of the motor by taking an over-estimation factor of 1.1. (C.O.No.2) [Application]

8. Calculate Pipe Material Cost, Labor/construction cost, pumping cost. Find CAPEX after considering a contingency fund of 25% of the above sub-total costs. Assume $700/ton for pipe material cost and $20,000/inch-diameter-mile for pipeline construction cost. For pump stations, assume a total installed cost of $1500 per HP. (C.O.No.4) [Application]

9. Find the electricity cost of pumping water at $0.06/kW for 350 days and 24 hours a day. Find OPEX after considering 50% of electricity cost for O&M and G&A costs.

(C.O.No.4) [Application]

10. On the basis of first year OPEX and CAPEX, find the optimum diameter to transport water. Mention the total cost as well. (C.O.No.4) [Application]

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/ Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels K	Thought provoking type [Marks allotted] Bloom's Levels C/A	Problem Solving type [Marks allotted] A	Total Marks
1	CO1 (25%) CO2 (25%) CO3 (25%) CO4 (25%)	Unit 1 Unit 2 Unit 3 Unit 4	10			10
2	CO3 (50%) CO4 (50%)	Unit 3 Unit 4	10			10
3	CO1 (100%)	Unit 1		12		12
4	CO1 (25%) CO2 (25%) CO3 (25%) CO4 (25%)	Unit 1 Unit 2 Unit 3 Unit 4		12		12
5a)	CO1 (100%)	Unit 1			6	6
b)	CO1 (100%)	Unit 1			6	6
c)	CO2 (100%)	Unit 2			6	6
d)	CO4 (100%)	Unit 4			6	6

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Comment:

Format of Answer Scheme

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

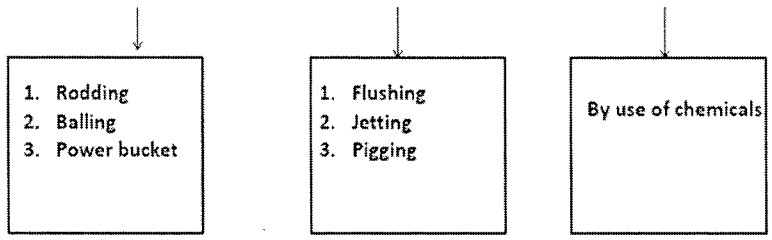
Semester: Odd Sem. 2019-20
Course Code: PET 303
Course Name: PIPELINE ENGINEERING
Program & Sem: B.TECH PET, 7TH SEM

Date: 24.12.2019
Time: 9:30-12:30
Max Marks: 80
Weightage: 40%

Part A (2Q x 10M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

	B) When compressor surge happens, the operating point of a compressor, which is usually denoted by the pair of the mass flow rate and pressure ratio, orbits along a surge cycle on the compressor performance map. C) Pipe fabrication is the process of welding piping components such as pipes, elbows, tees, flanges, etc., into engineered piping systems in exact accordance with our customers' design requirements. D) Capital expenditures, commonly known as CapEx, are funds used by a company to acquire, upgrade, and maintain physical assets such as property, buildings, an industrial plant, technology, or equipment. CapEx is often used to undertake new projects or investments by the firm.		
2	A) 1) Compressor station fuel or electrical energy cost 2) Compressor station equipment maintenance and repair costs 3) Pipeline maintenance costs, such as pipe repair, relocation, aerial patrol, and monitoring 4) SCADA and telecommunication 5) Valve, regulator, and meter station maintenance 6) Utility costs, such as water and natural gas 7) Annual or periodic environmental and permitting costs 8) Lease, rental, and other recurring right of way costs 9) Administrative and payroll costs B) Cleaning is a process that cleans and removes debris on the inside of the pipe using a device called a pig that's propelled through the pipeline by the normal water flow. Pigs are usually cylindrical or spherical to aid movement and cleaning efficiency. **Application:** • Pipeline cleanliness improves product quality, operating efficiency and mitigates debris-inflicted damage to plant such as compressors. • pipeline cleans weld slag, hydro test water and general construction debris such as welding rods. • Cleaning reduce the down time error. • Cleaning increases the production performance. • Cleaning safes the pipeline from getting corroded.	**A) Any 5 – 1 mark each** **B) Covering each part – 5 marks.**	**15 mins**



Part B (2Q x 12M = 24 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3	Segment | Q (bbl/hr) | Sg AB | 13000 | 0.788 BC | 11000 | 0.788 CD | 8000 | 0.788 DE | 10000 | 0.770	Each Segment 3 marks Each quantity 1.5 marks	15 mins
4	A) Darcy Equation – $v = \frac{k}{\mu}\frac{\Delta P}{L}$ – 0.5 mark Assuming values in the correct range – k in D/mD, μ in 1-5 cP, ΔP in 10-100 Pa, L in 1-10 m, ρ = 800-1000 kg/m3, D = 10^5-10^6 m - 1 mark Solving the Darcy Law – 0.5 marks Converting the velocity in SI units – 0.5 marks Finding the Reynolds number – $Re = \frac{\rho v D}{\mu}$ – 0.5 mark B) The rise in suction is due to atmospheric pressure. If the suction head is lower than atmospheric pressure, the fluid can reach the eye of the impeller or the main body to get it pumped. NPSP and Vapor pressure inequality is there to prevent cavitation in the pump. C) T**oughness** is the ability of a material to absorb energy and plastically deform without fracturing. One definition of material **toughness** is the amount of energy per unit volume that a material can absorb before rupturing. Hardness is a measure of the resistance to localized plastic deformation induced by either mechanical indentation or abrasion or scratching. D) Time Value of Money. The time value of money	A) Final Answer – Less than 1 (Creeping Flow) B) Explaining each part – 1.5 mark C) Defining each term – 1.5 mark D) Identifying the concept – 1.5 mark Writing about it – 1.5 mark	25 mins

No		Marking	required for each Question
5a)-f)		Correct answer with correct units – 6 marks each. Correct magnitude without units – 5 marks each Incorrect answer with correct steps – 3 marks (at max)	10 mins each question (60 mins)

OD	Pm (psi/mile)	Pt (psi)	BHP (HP)	BHP motor (HP)	CAPEX ($)	OPEX ($)
20	66.19603721	2122.461	16625.64	17000	51399740	9587592
22	40.95166439	1365.13	10550.2	11000	42110273	6203736
24	26.4510219	930.1107	7060.398	8000	38445807	4511808

Final Answer – Pipeline to be chosen – 24 inch diameter.