Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

VII Semester End Semester Examination

Natural Gas Engineering [CHE 4051]

Marks: 50

Duration: 180 mins.

Descriptive Questions

Answer all the questions.

Section Duration: 180 mins

1)		Classify the gas and oil wells based on the gas-oil-ratio (GOR).	(2)
	A)		
	B)	Calculate the (a) gas formation volume factor in (ft³/SCF) (b) gas expansion factor in (SCF/ft³) at reservoir conditions 4000 psia and 340 °F.	(3)
	C)	Derive the mechanical energy balance equation for single phase flow along the tubular string using schematic and solve the balance equation using the Average TZ method.	(5)

2) A gas well produces 0.65 specific gravity natural gas. The average reservoir pressure is 4,505 psia. (5) Reservoir temperature is 180 °F. The well was tested at two flow rates:

A)

	Test Point 1	Test Point 2
Flow rate	1,152 Mscf/d	1,548 Mscf/d
Bottom hole pressure	3,025 psia	1,685 psia

Estimate & construct IPR curve for well specified above with backpressure model with pressure-squared approach. Use five intervals between base pressure 14.7 psia to average reservoir 4,505 psia.

B) Explain how the operating gas flow rate is evaluated using the numerical and graphical method for nodal analysis at wellhead node. (3)

C) Explain real gas pseudo-pressure using the real gas pseudo pressure vs pressure plot. (2)

3) Describe gas dehydration absorption process using basic flow diagram and list all the solvents which can be used. (4)

A)

B) A well produces, from a gas reservoir (6000 psia and 200 °F), the gas mixture with following compositions. (4)

Component	C1	C2	C3	C4	C5	H_2S	CO_2	N_2
Molefraction	0.82	0.08	0.028	0.009	0.02	0.02	0.013	0.01

Evaluate the value of (a) apparent molecular weight (b) specific gravity assuming air molecular weight as 29.

C) Compare different types of separators used in separation of gas and liquids. (2)

4)

A)

The well is producing at a stabilized bottom-hole flowing pressure of 2000 psi. The wellbore radius (4) is 0.4 ft. The following data is available k = 0.06 d, h = 20 ft, T = 700 °R, P_e = 4000 psi, r_e = 1000 ft, s = 0, D = 0, μ = 0.0269 cp, z = 0.827

m(p) at reservoir pressure (P_e) is 934126349 psi^2/cp

m(p) at wellbore pressure (P_{wf}) is 296208907 psi^2/cp

Calculate the gas flow rate in Mscf/Day at P_{wf} = 2000 psia using the (a) pressure-squared approach (b) m(p) approach.

B)

Explain hydrocarbon dew point depression system using the basic process flow diagram and (3) working of the throttle valve in the process.

C)

Design a number of trays and water rate for trayed-type glycol contactor for a field installation to (3) meet the following requirements:

Gas flow rate: 10 MMscfd

Gas specific gravity: 0.65

Operating line pressure: 1,000 psig

Maximum working pressure of contactor: 1,440 psig

Gas inlet temperature: 90 °F

Outlet gas water content: 7 lb H_2O/MMscf

Design criteria: GWR = 3 gal TEG/lbm H_2O with 99.5% TEG

Please refer constants data sheet and graph sheets if required.

5)

A)

Draw the preliminary block diagram of natural gas processing unit and list all the process units (3) involved in the gas field.

B)

Explain solid desiccant gas dehydration process plant using basic flow diagram. (4)

C)

Explain gas pipeline cleaning operation using typical sketch of a pig launcher. (3)

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