(REGULAR Exam) VII SEMESTER
2023-2024
Total → 16 Students

Question Paper

Exam Date & Time: 30-Nov-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VII SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2023

Natural Gas Engineering [CHE 4051]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Explain (a) gas density (b) gas formation volume factor (c) compressibility factor and (d) real gas pseudo pressure along with respective units. (4)

A)

B) Prove that for the real gas (3)

$$C_g = \frac{1}{p} - \frac{1}{z}\frac{\partial z}{\partial p}$$

C) Analyze the Natural Gas Industry in context of India/USA. (3)

2) Compare how the operating gas flow rate is evaluated using the numerical and graphical method using (5)

A)

a) Nodal analysis at bottom-hole node (IPR and TPR)

b) Nodal analysis at wellhead node (WPR and CPR)

Clearly mention the parameters of both the axis of each plot.

B) Explain the following flow regimes along with schematic (a) Churn flow (b) Slug flow (c) Annular flow (d) Mist flow. (2)

C) Explain the sonic and subsonic flow regime using the typical choke performance curve. (3)

3) Discuss the importance of the gas reservoir deliverability. Outline flow conditions in which performance relationship can be established along with relevant equations. (4)

A)

B) A Big-Butte gas field produces, from a gas reservoir (5000 psia and 100°F), the gas mixture has the following composition. Consider z = 0.9 (3)

Component	C1	C2	C3	C4	C5	H_2S	CO_2	N_2
Molefraction	0.72	0.18	0.028	0.009	0.02	0.02	0.013	0.01

Evaluate the following gas properties (a) apparent molecular weight (b) specific gravity (c) gas density.

C) Outline and explain the process used to estimate water content in natural gas. (3)

4) The well is producing at a stabilized bottom-hole flowing pressure of 1600 psi. The wellbore radius (5)

A) is 0.4 ft. The following data is available k = 0.06 d, h = 20 ft, $T = 700\ ^0R$, $P_e = 4400$ psi, $r_e = 1000$ ft, s = 0, D = 0, $\mu = 0.0269$ cp, $\overline{Z} = 0.827$, $B_g = 0.0006712$ rb/SCF

m(p) at reservoir pressure (P_e) is 1.072210926 psi^2/cp

m(p) at wellbore pressure (P_{wf}) is 196869120 psi^2/cp

Estimate the gas flow rate in Mscf/Day at P_{wf} = 1600 psia using the (a) pressure approach

(b) pressure-squared approach (c) m(p) approach

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

Gas flow rate: 20 MMscfd

Gas specific gravity: 0.60

Operating line pressure: 900 psig

Maximum working pressure of contactor: 1,440 psig

Gas inlet temperature: 100 °F

Outlet gas water content: 6 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.

C) Illustrate double barrel separator along with neat sketch. (2)

5) Explain gas sweetening absorption process plant using detailed flow diagram and list the solvents used for gas sweetening absorption process. (4)

A)

B) Explain the role of API 610 code and plot the characteristics curve of the centrifugal pump. (3)

C) Construct the typical sketch of a pig launcher and pig receiver with labelling. (3)

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