

Dr. S. Puneet Singh

29/11/2023

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राष्ट्रीय प्रौद्योगिकी संस्थान, हमीरपुर
National Institute of Technology, Hamirpur
B. Tech. (Chemical Engineering) - 7th Semester
Final Term Exam (29th November 2023)
CH-453 Reservoir Engineering

Duration: 3 Hours

Max. Marks: 50

Instructions:

1. All questions are compulsory.
2. Assume the data wherever necessary.
3. Tailor your responses according to the allocated marks.

Ques: 1 (a) Discuss the principles and mechanisms of various enhanced oil recovery (EOR) techniques, including gas injection, chemical flooding, microbial EOR, and thermal EOR. Evaluate the advantages and disadvantages of each technique. **8 Marks**

(b) A waterflooding project is being considered for a reservoir with the following properties:

Viscosity of oil (μ_o) = 10 cP

Viscosity of water (μ_w) = 1 cP

Relative permeability of oil (k_{ro}) = 0.5

Relative permeability of water (k_{rw}) = 1.0

Calculate the mobility ratio (M) for this reservoir. Explain how the mobility ratio affects fingering, and suggest some methods for reducing fingering and improving displacement efficiency. **5 Marks**

Ques: 2 (a) Elaborate any four reservoir drive mechanisms and how they impact oil recovery. Explain the conditions for each above discussed drive mechanism is dominant. **8 Marks**

(b) A gas reservoir has a current reservoir pressure of 1000 psi. The reservoir production data and PVT information are given below:

Parameter	Initial Condition	Current Condition
p (psi)	2000	1000
R_s (scf/STB)	600	400
B_g (bbl/scf)	0.002	0.0024
N_p (STB)	0	100,000 STB
G_p (MMscf)	0	500 MMscf
W_e (MMbbl)	0	0
W_p (MMbbl)	0	0
C_R	0.1	0.1
C_w	0	0
Volume of gas zone (ac-ft)	100,000	100,000

Assuming:

- The same porosity and connate water for the oil and gas zones.
- No water or gas injection.

Calculate the cumulative oil production and the hydrocarbon quantity remaining in place using the material balance equations. **4 Marks**

Ques: 3 (a) Derive the basic radial differential equation for reservoir flow using the mass conservation principle, compressibility and Darcy's law. After including the boundary conditions, simplify the equation as Laplace equation for steady state. **5 Marks**

(b) What is well testing? Discuss the factors that can affect the accuracy of well test results and propose methods for improving well test accuracy. **5 Marks**

Ques: 4 Describe the relationship between wettability, surface tension, and interfacial tension in reservoir systems. Explain how these properties influence fluid distribution and capillary pressure. Discuss the implications of different wetting conditions for oil and gas recovery. **5 Marks**

Ques: 5 (a) Explain how crude oil is classified into different types based on its properties and phase behavior. Utilize a typical pressure-temperature (p-T) diagram to illustrate your explanation. **6 Marks**

(b) What are the most important physical properties of crude oil that petroleum engineers need to know. Please elaborate them. **4 Marks**