**Name:**

**Enrolment No:**

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, May 2022**

**Course: Reservoir Engineering II** **Semester: VI**
**Program: B.Tech APE GAS** **Time : 03 hrs.**
**Course Code: PEAU 4014P** **Max. Marks: 100**

**Instructions:**
**All Questions are Compulsory.**
**Use the attached graphs for any data.**

**SECTION A**
**(5Qx4M=20Marks)**

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Classify and describe the flow regimes that influence the rate of water influx into the reservoir? | **4** | **CO1** |
| Q 2 | List out the limitation of material balance equation (MBE) in estimating the hydrocarbon in place? | **4** | **CO4** |
| Q 3 | List out different models in analyzing decline in production and explain about hyperbolic decline model? | **4** | **CO3** |
| Q 4 | What is an infinite aquifer? | **4** | **CO2** |
| Q 5 | What is two-dimensional displacement in enhancing the oil recovery? | **4** | **CO2** |

**SECTION B**
**(4Qx10M= 40 Marks)**

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|---|---|---|---|
| Q 1 | Discuss different type of decline curve analysis and explain the applicability of each curve type? | **10** | **CO1** |
| Q 2 | Calculate water influx and residual gas saturation in water drive reservoirs.<br>Given:<br>Bulk reservoir volume, Initial = 415.3 MM cu ft.<br>Average Porosity = 0.172<br>Average Connate water = 0.25<br>Initial Pressure = 3200 psia.<br>$B_{gi}$ = 0.005262 cu ft/SCF, 14.7 psia and 60$^{o}$F<br>Final Pressure = 2925 psia.<br>$B_{gf}$ = 0.005700 cu ft/SCF, 14.7 psia and 60$^{o}$F.<br>Cumulative water Production = 15,200 bbl (surface)<br>$B_w$ = 1.03 bbl/surface bbl.<br>$G_p$ = 935.4 MM SCF at 14.7 psia and 60$^{o}$F.<br>Bulk volume invaded by water at 2925 psia = 13.04 MM Cu.ft | **10** | **CO2** |

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Q 3</td><td>a) Calculate initial oil in place in a volumetric, under-saturated reservoir. (5 Marks)<br>Given data:<br>$B_{ti}$ = 1.35469 bbl/STB<br>$B_t$ at 3600 psig = 1.37500 bbl/STB<br>Connate water = 0.20<br>$C_w = 3.6 * 10^{-6}$ $psi^{-1}$<br>$B_w$ at 3600 psig = 1.04 bbl/STB<br>$c_f = 5.0 * 10^{-6}$ $psi^{-1}$<br>$p_i$ = 5000 psig<br>$N_p$ = 1.25 MM STB<br>$\Delta\bar{p}$ at 3600 psig = 1400 psi<br>$W_p$ = 32000 STB<br>$W_e$ = 0.<br>b) The gas filed is produced under a water drive such that the pressure stabilizes at 1350 psi. If the residual gas saturation is 22% and the gas formation volume factor at 1350 psi is 0.02145 cu.ft/SCF. Calculate the unit recovery and recovery factor? (Assume the required data). (5 Marks)</td><td>10</td><td>CO4</td></tr>
<tr><td>Q 4</td><td>Given that a well has declined from 100 stb/day to 96 stb/day during a one-month period, identify a suitable decline model, determine model parameters, and project production rate until a marginal rate of 25 stb/day is reached?</td><td>10</td><td>CO3</td></tr>
<tr><td colspan="4">SECTION-C<br>(2Qx20M=40 Marks)</td></tr>
<tr><td>Q 1</td><td>a) List out various methods for estimating the water influx volume into an oil reservoir and investigate the importance each method? (10 Marks)<br>b) Calculate the cumulative water influx that result from a pressure drop of 200 psi at the oil-water contact with an encroachment angle of 80°. The reservoir-aquifer system is characterized by the following properties: (10 Marks)<br><table><tr><th></th><th>Reservoir</th><th>Aquifer</th></tr><tr><td>radius, ft</td><td>2600</td><td>10 000</td></tr><tr><td>porosity</td><td>0.18</td><td>0.12</td></tr><tr><td>$c_f$, $psi^{-1}$</td><td>$4 \times 10^{-6}$</td><td>$3 \times 10^{-6}$</td></tr><tr><td>$c_w$, $psi^{-1}$</td><td>$5 \times 10^{-6}$</td><td>$4 \times 10^{-6}$</td></tr><tr><td>$h$, ft</td><td>20</td><td>25</td></tr></table></td><td>20</td><td>CO2</td></tr>
<tr><td>Q 2</td><td>a) Given the following data for the oil field<br>Area=24,670acres (10 Marks)<br>Net productive thickness=45 ft</td><td>20</td><td>CO4</td></tr>
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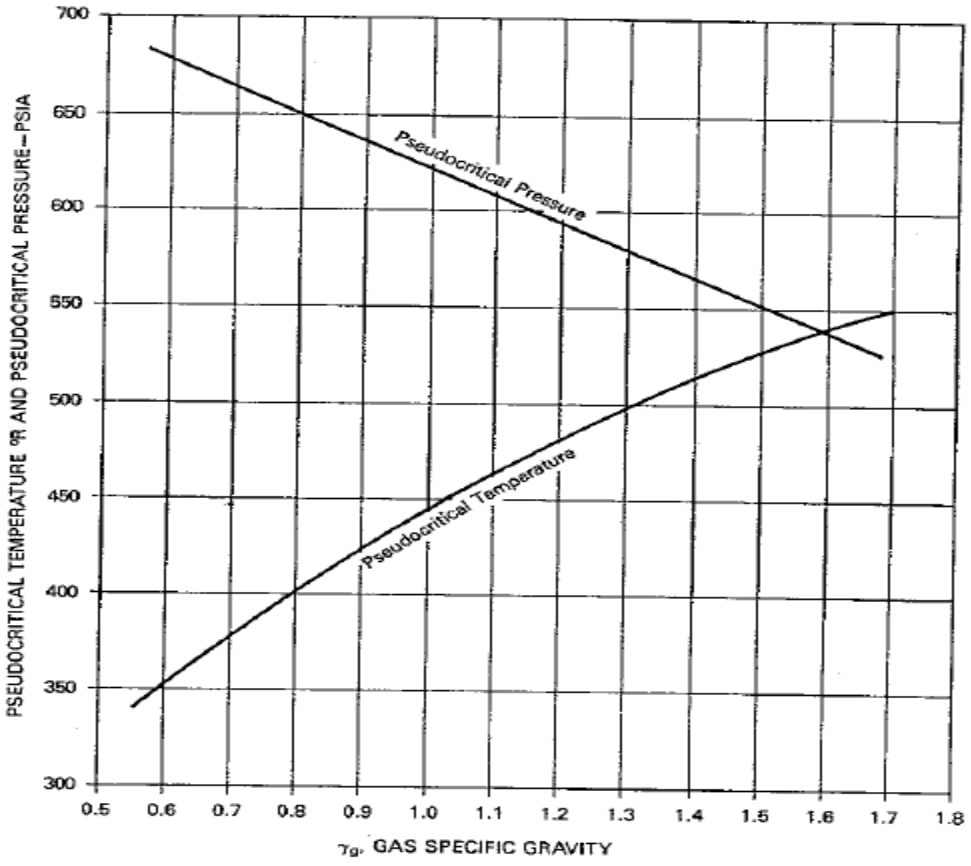
|---|---|---|---|
| | Porosity=6%<br>Average Swi=34%<br>Initial reservoir pressure, pi=2765 psia<br>Abandonment pressure, pa=245 psia<br>Bo at pi=1.67 bbl/STB<br>Bo at pa=1.12 bbl/STB<br>Sg at pa=31%<br>Sor after water invasion=23%<br><br>Calculate:<br>1. Initial oil in place<br>2. Oil in place after volumetric depletion to abandonment pressure<br>3. Oil in place after water invasion at initial pressure<br>4. Oil reserve and Recovery Factor by volumetric depletion to abandonment pressure<br>5. Oil reserve and Recovery factor by full water drive<br>b) Derive an expression for production 'q' bbl at time't' from well initially producing 'qi' bbl of oil by exponential decline analysis. (10 Marks) | | |

**Graph 1: Pseudocritical Properties of Natural Gas**



**Graph 2: Compressibility factors of natural gases**