**Name:**

**Enrolment No:**

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

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

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

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

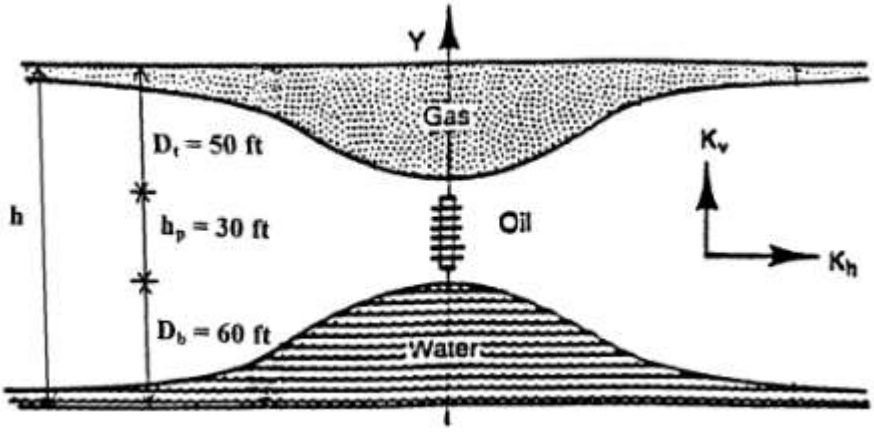
| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Identify the various expansion terms in the MBE and their sources. | **4M** | **CO3** |
| Q 2 | Define diffusive flow and mention the conditions at which it would occur. | **4M** | **CO2** |
| Q 3 | State the two methods for determining the hydrocarbon in place. What is the fundamental difference between the two methods. | **4M** | **CO1** |
| Q 4 | List various types of decline curves used to analyze production rates. | **4M** | **CO3** |
| Q 5 | Define coning and mobility ratio and mention the significance of mobility ratio in coning. | **4M** | **CO4** |

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

| | | | |
|---|---|---|---|
| Q 1 | 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: | **10M** | **CO1** |

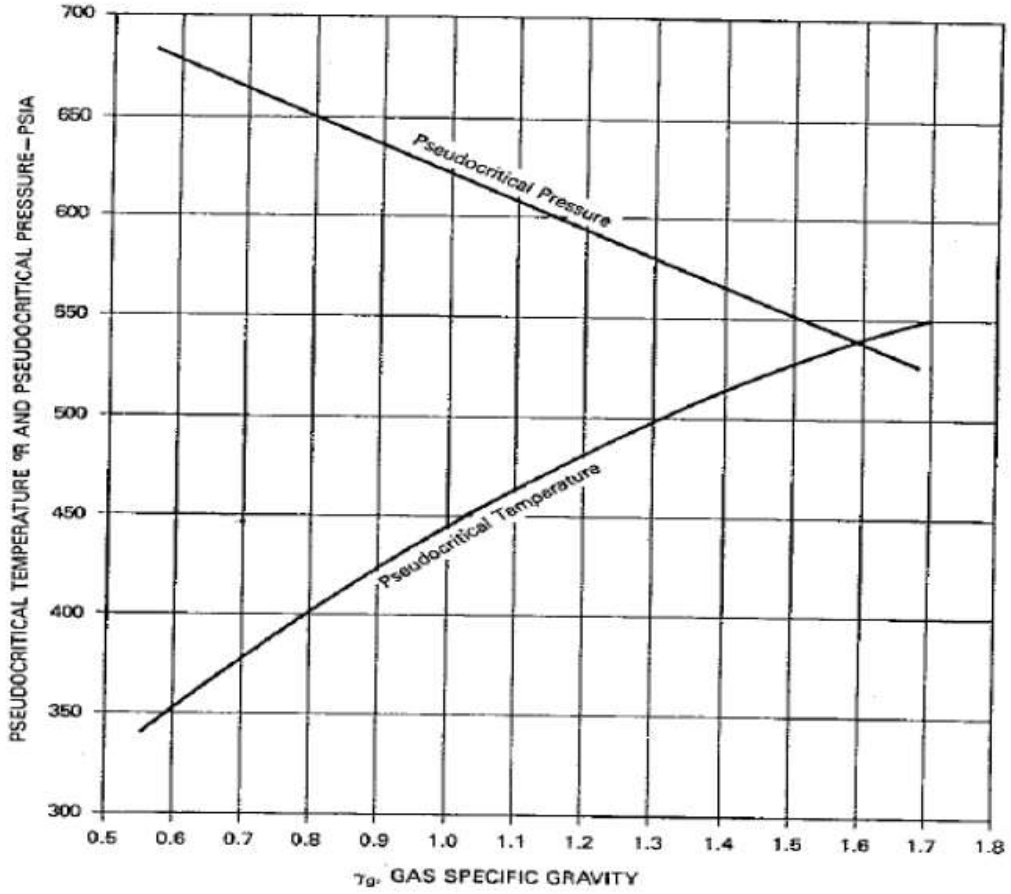
| **Property** | **Reservoir** | **Aquifer** |
|---|---|---|
| Radius, ft | 2600 | 10000 |
| Porosity | 0.18 | 0.12 |
| $c_f$, $psi^{-1}$ | $4 * 10^{-6}$ | $3 * 10^{-6}$ |
| $c_w$, $psi^{-1}$ | $5 * 10^{-6}$ | $4*10^{-6}$ |
| h, ft | 20 | 25 |

| | | | |
|---|---|---|---|
| Q 2 | a) The PVT data from volumetric depletion of an under-saturated reservoir is as follows:<br>At Initial reservoir pressure of 3500 psi, the gas-oil ratio is 1100 SCF/STB and oil- formation volume factor is 1.572 RB/STB.<br>At the depleted pressure and temperature of 2800 psi and 90°F respectively, the gas-oil ratio is 900 SCF/STB, Z is 0.87, oil formation | **5 M+ 5 M** | **CO3** |

| | | | |
|---|---|---|---|
| | volume factor is 1.520 RB/STB and the cumulative production is 1.486 MM STB with a gas oil ratio of 3300 SCF/STB.<br>Calculate the initial stock tank oil in place and the recovery factor at 2800 psi. **(5 Marks)**<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)** | | |
| Q 3 | A gas field extended over 1500 acres with an average payzone thickness of 40 ft. The average porosity and connate water saturation of the pay zone are respectively 22% and 23%. The formation volume factor of gas at the initial reservoir pressure of 3250 psi was calculated to be 0.00533 cu. ft/SCF. Calculate the<br>i. Initial gas in the reservoir.<br>ii. Recovery factor of the volumetric reservoir at an abandonment pressure of 500 psi if the corresponding formation volume factor is 0.03623 cu.ft/SCF.<br>iii. Recovery factor of the reservoir if it is produced under water drive such that the pressure stabilizes at 1500 psia, where the residual gas saturation and the gas formation volume factor were respectively 24% and 0.01122 cu. ft/SCF.<br>iv. Recovery factor of the reservoir if it is produced under very active water drive with no decline in reservoir pressure resulting in a residual gas saturation of 24%. | **10M** | **CO3** |
| Q 4 | A vertical well is drilled in an oil reservoir that is overlaid by a gas cap and under laid by bottom water. Figure shows an illustration of the Simultaneous gas and water coning.<br>  <br><br>The following data are available:<br>oil density, $r_o$ = 47.5 lb/ft3<br>water density, $r_w$ = 63.76 lb/ft3 | **5 M+ 5 M** | **CO4** |

| | | | |
|---|---|---|---|
| | gas density, $r_g$ = 5.1 lb/ft3<br>oil viscosity, $\mu_o$ = 0.73 cp<br>oil FVF, $B_o$ = 1.1 bbl/STB<br>oil column thickness, h = 65 ft<br>depth from GOC to top of perforations, Dt = 25 ft<br>well perforated interval, $h_p$ = 15 ft<br>wellbore radius, $r_w$ = 0.25 ft<br>drainage radius, $r_e$ = 660 ft<br>oil effective permeability, $k_o$ = 93.5 md<br>horizontal and vertical permeability, i.e., $k_h$, $k_v$ = 110 md<br>oil relative permeability $k_{ro}$ = 0.85<br>a) Calculate the maximum permissible oil rate that can be imposed to avoid cones breakthrough, i.e., water and gas coning (5 Marks)<br>b) Calculate the optimum distance for the placement of the 15-foot perforations. (5 Marks) | | |
| **SECTION-C<br>(2Qx20M=40 Marks)** | | | |
| Q 1 | a) A well producing from a particularly tight reservoir produces 6292 bbls during its first month of production. By the end of its twenty-seventh month of production, the rate has dropped to 730 bbls/month, and cumulative production is 55,900 bbls. Calculate for n and the percentage decline per month. (10 Marks)<br>b) Given that, a well has declined from 100 stb/day to 96 stb/day during a one-month period. Use the exponential decline model to perform the following tests:<br>1. Predict the production rate performance after 11 months.<br>2. Calculate the amount of oil produced during the first year.<br>3. Project the yearly production from the well for the next 5 years (10 Marks) | **10 M + 10 M** | **CO3** |
| Q 2 | Calculate the initial oil and gas in place per acre – foot for a gas condensate reservoir.<br>Given:<br>Initial Pressure = 2740 psia<br>Reservoir Temperature = 215°F<br>Average Porosity = 25%<br>Average Connate Water Saturation = 30%<br>Daily tank oil = 242 STB<br>Oil Gravity, 60°F = 48.0° API<br>Daily Separator Gas = 3100 MCF.<br>Separator gas gravity = 0.650<br>Daily tank gas = 120 MCF<br>Tank gas gravity = 1.20 | **20 M** | **CO4** |

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



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