**Name:**

**Enrolment No:**

# End Semester Examination, December 2023

**Program Name: B. Tech. APE UP** **Semester: V**

**Course Name: Reservoir Engineering I** **Time: 3 hrs.**

**Course Code: PEAU 3002** **Max. Marks: 100**

**Instructions: All questions are compulsory. Internal choices are mentioned in Section B and C.**

a. Answers must carry supporting material such as equations and diagrams.
b. Abbreviations used in the questions are standard and have their usual meaning.
c. Make appropriate assumptions where data is not supplied.

## Section A
## (5Qx4M=20Marks)

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Differentiate total porosity and effective porosity with suitable figures and formulas. Write down the applications of porosity. | **4** | **CO1** |
| Q 2 | Define permeability and write down the units of permeability in both SI system and practical system. List out the various factors affecting permeability. | **4** | **CO1** |
| Q 3 | Illustrate P-T diagram of black oil, condensate, wet gas and retrograde condensate reservoir with neat sketch. | **4** | **CO2** |
| Q 4 | Define bubble point pressure and specific gravity. Calculate the API gravity of water at $60^{O}$ F and 14.6 psi. | **4** | **CO2** |
| Q 5 | Explain different types of capillary pressure and relative permeability with suitable equation. | **4** | **CO3** |
| | **Section B**<br>**(4Qx10M=40Marks)** | | |
| Q 6 | (a) Discuss the grain density & porosity of a core sample. Determine the porosity & grain density of the core. Diameter=3.8cm, length=10.0cm, dry weight of core=275gm weight of 100% brine-saturated core=295gm, brine density=1.05g/$cm^3$.<br><br>(b) Calculate the permeability of an oil zone with a connate-water saturation and average porosity of 45% and 32%, respectively by using Timur and Morris and Biggs equations. | **10**<br>**(5+5)** | **CO1** |
| Q 7 | (a) Derive Darcy's law and illustrate the assumptions made with suitable equations and figures.<br><br>(b) Calculate the permeability of the core. The available data are- air flow rate=30$cm^3$/sec, inlet pressure=1psig, outlet pressure=1atm, air viscosity at elevated temperature=0.0198cp; length=20inch, diameter=2.4inch. | **10**<br>**(5+5)** | **CO2** |

<table>
<tr><td>Q 8</td><td>(a) Discuss fluid Compressibility and calculate the porosity at 4500 psi.<br><br>Data Given:<br>$c_f = 10 X10^{-6}$<br>original pressure = 5000 psi<br>original porosity = 18%<br>current pressure = 4500 psi<br><br>(b) Compare oil formation volume factor and gas formation volume factor varies with reservoir pressure. Explain with neat diagram.</td><td>10<br>(5+5)</td><td>CO3</td></tr>
<tr><td>Q 9</td><td>Discuss fluid saturation and explain critical saturations (Oil, Water and Gas) and average saturations with suitable equations. Illustrate the factors affecting fluid saturations.<br>OR<br><br>Calculate average oil and connate water saturation from the following measurements:<br><br><table><tr><th>Sample</th><th>$h_i$, ft</th><th>$\phi$, %</th><th>$S_O$, %</th><th>$S_{WC}$, %</th></tr><tr><td>1</td><td>1.0</td><td>10</td><td>75</td><td>25</td></tr><tr><td>2</td><td>1.5</td><td>12</td><td>77</td><td>23</td></tr><tr><td>3</td><td>1.0</td><td>11</td><td>79</td><td>21</td></tr><tr><td>4</td><td>2.0</td><td>13</td><td>74</td><td>26</td></tr><tr><td>5</td><td>2.1</td><td>14</td><td>78</td><td>22</td></tr><tr><td>6</td><td>1.1</td><td>10</td><td>75</td><td>25</td></tr></table></td><td>10</td><td>CO4</td></tr>
<tr><td colspan="4">SECTION-C<br>(2Qx20M=40 Marks)</td></tr>
<tr><td>Q 10</td><td>(a) Discuss importance and classification of drive mechanism in a reservoir. Explain each drive mechanism with suitable figures.<br><br>(b) Explain exponential decline curve and calculate the amount of oil produced after one year if a well has decline from 100 BOPD to 95 BOPD during a one-month period. Then predict the rate after 11 more months & after 22.5 months</td><td>20<br>(10+10)</td><td>CO5</td></tr>
<tr><td>Q 11</td><td>(a) Discuss assumptions and limitations of MBE. Describe sources of data use in MBE.<br><br>(b) Cumulative oil production for our example reservoir was $14.73 \times 10^6$ STB at the time when reservoir pressure was 900 psig. At the same time cumulative production of solution gas was $4.05 \times 10^9$ SCF. Calculate the reservoir volume occupied by released gas.<br><br>Data Given:<br><br>N = 90.46 ×106 [STB]</td><td>20<br>(10+10)</td><td>CO6</td></tr>
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|---|---|---|---|
| | Rsi at 1225 psig = 230 [SCF/STB]<br>Rs at 900 psig = 169 [SCF/STB]<br>Bg at 900 psig = 0.002905 [RB/SCF]<br>**OR**<br>(a) Discuss different oil and gas reserves estimation methods and explain 1P, 2P & 3P Reserves in detail.<br><br>(b) Given the following data of gas field,<br>Area = 160 acres<br>Net productive thickness = 40 ft<br>Initial reservoir pressure = 3250 psia<br>Porosity = 22%<br>Connate water = 23%<br>Initial gas FVF = 0.00533 ft3/SCF<br>Gas FVF at 2500 psia = 0.00667 ft3/SCF<br>Gas FVF at 500 psia = 0.03623 ft3/SCF<br>$S_{gr}$ after water invasion = 34%<br><br>**Calculate**<br>1. Initial gas in place<br>2. Gas in place after volumetric depletion to 2500 psia<br>3. Gas in place after volumetric depletion to 500 psia<br>4. Gas in place after water invasion at 3250 psia<br>5. Gas in place after water invasion at 2500 psia<br>6. Gas in place after water invasion at 500 psia<br>7. Gas reserve by volumetric depletion to 500 psia<br>8. Gas reserve by full water drive, i.e., at 3250 psia<br>9. Gas reserve by partial water drive, i.e., at 2500 psia | | |