Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2019

Programme Name: BTECH APE-Spz-Gs
Semester : V
Course Name : RESERVOIR ENGINEERING **Time : 03 hrs**
Course Code : PEAU 3009 **Max. Marks: 100**
Nos. of page(s) : 3

Instructions: All questions are compulsory. There is no overall choice. However, internal choice has been provided. You have to attempt only one of the alternatives in all such questions

SECTION A

S. No.		Marks	CO
1	Illustrate the relationship between liquid volume and pressure of multicomponent system having $T_i < T_c$ with the help of a graph.	**4**	**CO3**
2	Describe the process of capillary hysteresis with the help of a graph.	**4**	**CO4**
3	Derive from Darcy's law, formula to calculate permeability of a combination of beds in series, in radial flow.	**4**	**CO4**
4	Elaborate the different categories of reserve. Explain in brief about proven reservoir.	**4**	**CO5**
5	Illustrate the difference between a saturated and undersaturated reservoir. State differences in Rs, Bt, Bo and Bg in the two cases.	**4**	**CO2**

SECTION B

6	Calculate Initial Oil in Place for a four layered oil reservoir which exists at the bubble point pressure of 3000Psia and temperature of 160°F. The oil has an API gravity of 42° and GOR of 600 scf/stb. The specific gravity is 0.65 and oil formation volume factor is 1.3bbl/stb. The following additional data is also available Reservoir area = 640acres. Connate water saturation =0.25 Considering porosity as a discreet function of pay-zone thickness: $f\,(H) = \phi\ ;\ H = \sqrt{0.4}\ \sin\,(h)\ ;\ \ h\ (0,30)$ The thickness of the layers are: 1ft, 1.5ft, 1ft, 2ft, 2.1ft and 1.1ft respectively.	**10**	**CO1**
7	During a PVT experiment a crude oil sample was placed in a variable volume PVT cell at reservoir pressure and temperature and its bubble point pressure was determined. The pressure in the PVT cell was then decreased in steps and the volume of liquid and gas phases were recorded. After recording the volume at each pressure, the gas was purged out of the cell retaining the liquid volume in the cell. At the end of experiment, the liquid volume collected at atmospheric condition was 54.128 ml.	**10**	**CO2**

Pressure psig	Liquid volume at reservoir condition (mL)	Liberated Gas volume at STP (mL)
4000	80.36	
3000	78.17	1146
2000	71.58	2882
1000	68.04	2000
Atm	60.23	3012

i. Calculate oil formation volume factor (Bo) at 4000, 3000psig
ii. Calculate the solution GOR at 2000, 1000 psig

8 Diagrammatically represent the process of flash and differential liberation tests.

10 **CO3**

9 A volumetric gas reservoir has the following production history.

Time (years)	Reservoir pressure(psi)	Z	Cumulative production G_P (MMMSCF)
0	1798	0.869	0
0.5	1680	0.870	0.96
1	1540	0.880	2.12
1.5	1428	0.890	3.21
2	1335	0.900	3.92

The following data is also available:
porosity = 13%
Swi = 0.52
A = 1060 acres
h = 54 ft.
T = 164°F

Calculate the gas initially in place volumetrically and from the MBE.

OR

“The decline-curve analysis technique is based on the assumption that past production trends and their controlling factors will continue in the future and, therefore, can be extrapolated and described by a mathematical expression.”

Elaborate the conditions which must be considered in production decline curve analysis. Also illustrate the types of rate decline behavior.

10 **CO5**

SECTION-C

<table>
<tr>
<td>10</td>
<td>A gas reservoir has the following characteristics:
A = 3000 acres
h = 30ft f = 0.15
Swi = 20%
T = 150°F
pi = 2600 psi
<table>
<tr><th>Pressure(Psia)</th><th>z</th></tr>
<tr><td>2600</td><td>0.82</td></tr>
<tr><td>1000</td><td>0.88</td></tr>
<tr><td>400</td><td>0.92</td></tr>
</table>
Calculate cumulative gas production and recovery factor at 1000 and 400 psi.</td>
<td>20</td>
<td>CO6</td>
</tr>
<tr>
<td>11</td>
<td>Treating the reservoir pore as an idealized container derive the volumetric balance expression which occurs naturally during the productive life of a reservoir. Determine the relative magnitude of each of the driving mechanisms and its contribution to the production in a combination drive mechanism.</td>
<td>20</td>
<td>CO5</td>
</tr>
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<td></td>
<td>OR</td>
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<tr>
<td>11</td>
<td>A combination-drive reservoir contains 10 MMSTB of oil initially in place. The ratio of the original gas-cap volume to the original oil volume, i.e., m, is estimated as 0.25. The initial reservoir pressure is 3000 psia at 150°F. The reservoir produced 1 MMSTB of oil, 1100 MMscf of 0.8 specific gravity gas, and 50,000 STB of water by the time the reservoir pressure dropped to 2800 psi. The following PVT is available:
<table>
<tr><th></th><th>3000 psi</th><th>2800 psi</th></tr>
<tr><td>Bo, bbl/STB</td><td>1.58</td><td>1.48</td></tr>
<tr><td>Rs, scf/STB</td><td>1040</td><td>850</td></tr>
<tr><td>Bg, bbl/scf</td><td>0.0008</td><td>0.00092</td></tr>
<tr><td>Bt, bbl/STB</td><td>1.58</td><td>1.655</td></tr>
<tr><td>Bw, bbl/STB</td><td>1</td><td>1</td></tr>
</table>
The following data are also available:
Swi =0.20 cw =1.5x10−6 psi^{-1} cf =$1x10^{-6}$ psi^{-1}
Calculate:
a. Cumulative water influx
b. Net water influx
c. Primary driving indexes at 2800 psi</td>
<td>20</td>
<td>CO5</td>
</tr>
</table>