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PRESIDENCY UNIVERSITY BENGALURU

 SCHOOL OF ENGINEERING

 SUMMER TERM END TERM EXAMINATION - August 2024

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| **Semester: Summer** | **Date: 06-08-2024** |
| **Course Code: PET3006** | **Time:9:30AM-12:30PM**  |
| **Course Name: Advanced Petroleum Reservoir Engineering**  | **Max Marks: 100** |
| **Program: B. Tech.**  | **Weightage: 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *The question paper consists of 3 parts.*
3. *Scientific and non-programmable calculators are permitted.*
4. *Do not write any information on the question paper besides Roll Number.*
5. *Use Graph Paper wherever needed. Write the Question No. on the graph paper with a pen.*

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| **PART A** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** |
| 1 | Define AOF. State the condition to achieve AOF | (CO 1) | [Knowledge] |
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| 2 | State Schilthuis Steady State Model assumptions and equations | (CO 1) | [Knowledge] |
|  |
| 3 | State the model that can be used to estimate the water influx into a gas or oil reservoir is based on the basic definition of compressibility? Write the equation of the model. | (CO 1) | [Knowledge] |
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| 4 | Explain the behavior of fractional flow of water for strongly water wet reservoirs with variation in oil viscosity. | (CO 2) | [Knowledge] |
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| 5 | Define productivity index. | (CO 3) | [Knowledge] |
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| 6 | State the Vogel’s equation  | (CO 3) | [Knowledge] |
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| 7 | Define Reservoir management. | (CO 4) | [Knowledge] |
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| **PART B** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** |
| 8 | An in-depth understanding and precise identification of the dominant drive mechanisms within a reservoir not only influence production rates and ultimate recovery but also shape the strategic decisions made by operators in maximizing resource extraction efficiency and optimizing field development plans. List all the six drive mechanisms present in natural recovery and briefly explain about them. | (CO1) | Comprehension |
|  |
| 9 | The water influx model that can be used to estimate the water influx rate into an oil reservoir is based on the compressibility concept. Identify the model and predict the cumulative water influx that results from a pressure drop where initial reservoir pressure is 3000 psi and current pressure is 2840 psi at the oil-water contact with an encroachment angle of 70°. The reservoir-aquifer system is characterized by the following properties:

|  |  |  |
| --- | --- | --- |
|  | Reservoir | Aquifer |
| Radius, ft | 6000 | 20,000 |
| Porosity | 0.18 | 0.12 |
| Cf (1/psi) | 4E-06 | 3E-06 |
| Cw (1/psi) | 5E-06 | 4E-06 |
| h, ft | 25 | 20 |

 | (CO1) | Comprehension |
|  |
| 10 | In the dynamic landscape of the oil and gas industry, the accuracy of reservoir performance predictions influences not only the economic success of extraction projects but also their broader impact on environmental sustainability, safety, and the responsible stewardship of finite natural resources. Describe the different phases of predicting the reservoir performance. Explain each phase in brief. | (CO3) | Comprehension |
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| 11 | Water influx rate can be equivalently expressed in terms of material balance equation. Using the same concept to compute the water influx rate (ew) in a reservoir whose pressure is stabilized at 2500 psi. Given: initial reservoir pressure= 3500 psi; dNp/dt= 32,000 STB/day; Bo= 1.4 bbl/STB, GOR= 900 scf/STB, Rs= 700 scf/STB, Bg= 0.00082 bbl/scf, Bw= 1.0 bbl/STB.Also, predict the Schlithuis water influx constant. | (CO1) | Comprehension |
|  |
| 12 | Reservoir management is essential for maximizing hydrocarbon recovery, ensuring economic viability, and maintaining environmental and safety standards in the oil and gas industry. It requires a multidisciplinary approach, incorporating geology, engineering, economics, and environmental science to achieve optimal results throughout the life of a reservoir. Explain the concept of reservoir management. With a neat diagram explain the reservoir life process in connection with reservoir management. | (CO4) | Comprehension |
|  |
| 13 | Prediction of future reservoir performance is essential to determine the economic potential of anoilfield. The material balance equation is often used to provide the estimates of the initial oil in place,size of gas cap and water influx. But to use the material balance equation for performance prediction,it is essential to determine the instantaneous gas-oil ratio (GOR). Thus, understanding ofinstantaneous GOR is highly important. Keeping this in mind, provide your understanding of theGOR curve (given below) of a given hypothetical depletion drive reservoir shown below, where well flowingpressure is plotted against time or cumulative oil. Provide your understanding for the following **points 1**,2,3,4,5 of the curve. | (CO3) | Comprehension |
|  |  |  |  |
| 14 | Reservoir economics is fundamental concept in guiding decision-making, resource allocation, and sustainable development in the oil and gas industry. It provides a framework for understanding and addressing the complex interplay of factors that influence the sector, from market dynamics to environmental considerations and societal impacts.Explain the concept of time value of money, net present worth and internal rate of return. if $500 is to be received five years from now, how much is it worth if the time value of money is defined by 5% interest compounded annually. | (CO4) | Comprehension |
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| **PART C** |
|  **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** |
| 15 | Buckley and Leverett (1942) developed a well-established theory, called the frontal displacement theory. This classic theory consists of two equations:1. Fractional flow equation or formula
2. Frontal advance equation or formula.

Briefly discuss about your understanding of Frontal advance equation. State its applicability, assumptions and equation relating the movement and position of front with saturation on a time scale. | (CO2) | [Application] |
|  |
| 16 | Predicting oil reservoir performance is a multifaceted task with far-reaching implications for economic, environmental, and operational aspects of oil and gas extraction. It is a cornerstone of responsible reservoir management and plays a central role in the long-term success and sustainability of the oil and gas industry. In view of that, explain the steps of TRACY method of estimating the oil reservoir performance. explain the steps in brief. | (CO3) | [Application] |
|  |
| 17 | A reservoir- aquifer model system has the following boundary pressure history:

|  |  |
| --- | --- |
| Time (days) | Boundary Pressure (psi) |
| 0 | 3000 |
| 30 | 2956 |
| 60 | 2917 |
| 90 | 2877 |
| 120 | 2844 |

Given the following data: h = 200 ft ; φ= 10%; µw= 0.395 cp; Cf = 5 X 10-6 psi-1; Cw = 3 X 10-6 psi-1 ; Fk = 0.04, T=140 ºF; ra = infinite; re = 2000 ft. k= 80mdIdentify the water drive model for the above situation and compute the cumulative water influx. Use the chart below. Assume data appropriately, if missing.

|  |  |
| --- | --- |
| Dimensionless time | Fluid influx |
| 12 | 7.104 |
| 24 | 11.996 |
| 36 | 34.360 |
| 48 | 43.520 |

 | (CO1) | [Application] |
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