Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SET A

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2023

Semester : Semester V - 2021
Course Code : PET3011
Course Name : Well Intervention Technologies
Program : B.Tech.

Date : 12-JAN-2024
Time : 9:30AM - 12:30 PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **5 X 2M = 10M**

1. List any four of the essential steps and considerations that should be followed in a hydraulic fracturing design procedure to ensure optimal reservoir stimulation and effective hydrocarbon recovery.
(CO3) [Knowledge]

2. Mention the key factors that contribute to the enhancement of fracture conductivity in hydraulic fracturing operations.
(CO3) [Knowledge]

3. Show the features of internal gravel packing with a diagram.
(CO4) [Knowledge]

4. In context of sand control, what are the viable techniques and strategies available for the effective mitigation of sand production in oil and gas wells without resorting to the use of screens or chemical treatments?
(CO4) [Knowledge]

5. “The presence and movement of water within reservoirs influence sand production in oil and gas wells.”-Comment.
(CO4) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **5 X 10M = 50M**

6. What intricate web of consequences does sand production weave within the oil and gas industry, encompassing challenges such as compromised well integrity, increased maintenance costs, and potential environmental repercussions? How can thoughtful exploration of these consequences inspire innovative solutions that not only address immediate operational hurdles but also pave the way for a more sustainable and resilient future in hydrocarbon extraction?

(CO4) [Comprehension]

7. Reflecting on the intricate interplay of reservoir geology, wellbore dynamics, and production fluid characteristics, how can the oil and gas industry harness advancements in each of these three main components to not only manage but also leverage sand production as a potential asset rather than a challenge in the pursuit of sustainable and efficient hydrocarbon extraction?

(CO4) [Comprehension]

8. As a completion engineer responsible for implementing hydrofracturing techniques in an unconventional reservoir, outline a comprehensive application plan for well stimulation. Consider the reservoir's geological and geomechanical properties, the selection of fracturing fluids, and the design of fracturing stages. How would you optimize the fracture network for increased hydrocarbon recovery while minimizing environmental impact? Discuss the integration of real-time monitoring technologies and collaborative efforts with geoscientists to ensure the success of the hydrofracturing process.

(CO3) [Comprehension]

9. Answer the following: [3+4+3]

1. “TAML 3 and TAML 4 are two complicated type of well completion”-Write any three difference between these two.
2. “While the large diameter conduit for fluids flowing to the surface has the advantage of lower pressure losses, it has the disadvantage of lower velocity for the same volumetric rate”-Discuss.
3. “Tubing less completion is a completion design in which the reservoir fluids are produced through small-diameter casing”- Mention any three disadvantage of Tubing less cased hole completion.

(CO1) [Comprehension]

10. The working principle behind all stimulation techniques available till today for the improvement of flow rated is based on the modified Darcy’s equation given below. Relate the equation and state how we can manipulate the parameters from the right hand side and enhanced productivity.

$$Q_o = \frac{K_o\, h\, (P_e - P_{wf})}{141.2\mu B_o\{\text{In}(r_e/r_w)+S\}}$$

(CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS **2 X 20M = 40M**

11. A 60-ft thick, 50-md sandstone pay zone at a depth of 9,500 ft is to be acidized with an acid solution having a specific gravity of 1.07 and a viscosity of 1.5 cP down a 2-in. inside diameter (ID) coil tubing. The formation fracture gradient is 0.7 psi/ft. The wellbore radius is 0.328 ft. Assuming a reservoir pressure of 4,000 Psia, drainage area radius of 1,000 ft, and a skin factor of 15,
Calculate
(a) the maximum acid injection rate using safety margin 300 psi.
(b) the maximum expected surface injection pressure at the maximum injection rate

$$\Delta p_f = \frac{518\rho^{0.79}q^{1.79}\mu^{0.207}}{1{,}000D^{4.79}}L,$$

where
- ρ = density of fluid, g/cm^3
- q = injection rate, bbl/min
- μ = fluid viscosity, cp
- D = tubing diameter, in.
- L = tubing length, ft.

$$q_{i,\max} = \frac{4.917 \times 10^{-6} kh\left(p_{bd} - \overline{p} - \Delta p_{sf}\right)}{\mu_a\left(\ln\frac{0.472r_e}{r_w} + S\right)},$$

where
- q_i = maximum injection rate, bbl/min
- k = permeability of undamaged formation, md
- h = thickness of pay zone to be treated, ft
- p_{bd} = formation breakdown pressure, psia
- $\overline{p}$ = reservoir pressure, psia
- Δp_{sf} = safety margin, 200 to 500 psi
- μ_a = viscosity of acid solution, cp
- r_e = drainage radius, ft
- r_w = wellbore radius, ft
- S = skin factor, ft.

(CO3) [Application]

12. In a subsurface formation at a depth of 8,500 ft, a sandstone exhibits a Poison's ratio of 0.28 and a poro-elastic constant of 0.65. The overburden formation has an average density of 180 pcf. The pore pressure gradient within the sandstone is measured at 0.42 psi/ft. Considering a tectonic stress of 2,500 psi and a tensile strength of the sandstone measured at 1,200 psi, estimate the breakdown pressure for this specific sandstone scenario.

(CO3) [Application]