Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SET A

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024

Semester : Semester III - 2022
Course Code : PET2001
Course Name : Drilling Fluids and Cements
Program : B.Tech.

Date : 04-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. In the context of drilling operations, explain the fundamental principle behind ensuring that the hydrostatic head of the drilling fluid is greater than the formation pressure.
(CO1) [Knowledge]

2. List out the primary limitations and challenges associated with the use of water-based drilling fluids.
(CO1) [Knowledge]

3. Compare the processes of flocculation and aggregation of particle interactions in terms of colloidal chemistry.
(CO1) [Knowledge]

4. Define primary and secondary cementing.
(CO5) [Knowledge]

5. Select Oil well cement class for the following cases

1. Shallow depth; 6000 ft.
2. HPHT/high sulphate resistance; 6000-10000 ft.
3. No additives other than $CaSO_4$ or H_2O; Upto 8000
4. HPHT; 12000-18000 ft.

(CO5) [Knowledge]

PART B

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

6. As a drilling engineer, you are designing a drilling fluid program for an unconventional reservoir with extreme pressure and temperature conditions. The well is expected to encounter high-pressure zones, abrasive formations, and temperatures exceeding 300°F. Develop a drilling fluid program that addresses challenges related to wellbore stability, temperature resistance, and effective cuttings transport. How would your program mitigate risks associated with extreme downhole conditions, and what considerations would you take into account to optimize drilling efficiency in this challenging scenario?

(CO1) [Comprehension]

7. As a drilling engineer managing a deepwater drilling project in a subsalt formation characterized by extreme pressure and temperature conditions, outline an application-based mud circulatory system. The challenging environment demands careful consideration for wellbore stability, hydrate prevention, and efficient cuttings removal. Propose a mud circulatory system that incorporates specialized fluids, advanced pressure control mechanisms, and technologies for hydrate inhibition. How would your mud circulatory system navigate the complexities of deepwater drilling, ensuring safety, stability, and optimal drilling performance in this high-pressure and high-temperature subsalt formation?

(CO4) [Comprehension]

8. How can the deliberate management of mud cake thickness transcend being a routine parameter in drilling fluid control, transforming into an intricate balancing act that not only safeguards wellbore stability but also optimizes drilling efficiency, minimizes formation damage, and contributes to enhanced hydrocarbon recovery in diverse geological environments?

(CO2) [Comprehension]

9. Imagine you are a completion engineer tasked with designing a wellbore completion system for an unconventional reservoir. The goal is to enhance zonal isolation and reservoir performance using various oil well cement accessories. Propose a comprehensive plan that includes the selection and application of cement accessories such as centralizers, scratchers, and casing packers. Consider the downhole conditions, well geometry, and formation characteristics. How would your proposed implementation of these accessories contribute to maximizing production efficiency, minimizing formation damage, and ensuring the long-term integrity of the completion system? Additionally, address any environmental considerations in your plan.

(CO5) [Comprehension]

10. As a cementing engineer assigned to enhance well integrity in a mature oil and gas reservoir with potential casing leaks, design an application-based approach utilizing the Bradenhead method, Packer Squeeze method, and Hesitation Squeeze method for secondary cementing. The goal is to restore zonal isolation in specific intervals, mitigate sustained casing pressure, and extend the productive life of the well. Develop a detailed plan that addresses the specific challenges of the mature reservoir, including wellbore conditions, formation heterogeneity, and the presence of multiple completion zones. How would the integration of these secondary cementing methods contribute to the successful rehabilitation of well integrity and productivity in this mature reservoir setting?

(CO5) [Comprehension]

PART C

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

11. A final volume of 1,750 bbls of drilling mud was planned to be prepared. An existing mud having a mud weight of 10.2 ppg will be used. It is needed to increase its density to 10.5 ppg by adding clay of 2.52 gm/cc density. Calculate the volume of the old mud to be taken and the amount of clay required in sack to get the desired mud weight.

(CO4) [Application]

12. The following data are given. Casing dimensions: OD 20 in (508 mm), ID 18.73 in (475.7mm), 133 lbm/ft (198 kg/m)
Hole size: 26 in
Casing setting depth: 350 ft
Mud weight: 65 pcf
Cement properties: Cement API Class G with 4% bentonite
Slurry weight: 106 pcf
Slurry yield: 1.5ft3/sack
Water requirement: 7.6 gal/sack (Note: Cement data are obtained from cementing companies' handbooks.)
Pumping rate: through drillpipe 100 gal/min
Pumping rate: through casing 300 gal/min
Drillpipe: OD/ID 5 in/4.276 in, 19.5 lb/ft.
Allow 15 min for the release of plugs and assume casing to be cemented to surface.

1. Calculate required quantities of cement and bentonite for a conventional cementing job. A shoe track of 80 ft (24 m) is to be used. Also allow 100% excess cement in the open hole. (Nate: A shoe track is the distance between the casing shoe and the float or landing collar.)
2. Calculate volume of mixing water.
3. Calculate total time for the job, assuming that the mixing rate is 10 sacks/min.

(CO5) [Application]