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PRESIDENCY UNIVERSITY BENGALURU

**SET-B**

SCHOOL OF ENGINEERING

**END TERM EXAMINATION – MAY/JUNE 2024**

**Semester :** Semester II - 2023

**Course Code :** PET2003

**Course Name :** Fundamentals of Oil and Gas Well Drilling Technology

**Program :** B. Tech.

**Date :** Jun 20, 2024

**Time :** 1:00PM – 4:00PM

**Max Marks :** 100

**Weightage :** 50%

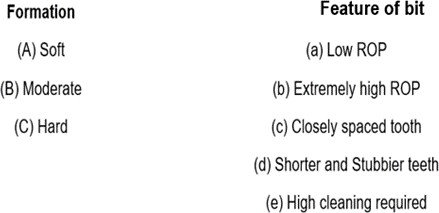
# Instructions:

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

**PART A**

**ANSWER ANY FIVE QUESTIONS 5QX2M=10M**

1. Define buoyancy factor and write its equation.
2. Match the following:



1. List out the different ranges available for drill pipe along with their length.
2. Write any two Key reasons for Kelly failure
3. Mention the valves present in the Xmas tree.

(CO1) [Knowledge]

(CO1) [Knowledge] (CO2) [Knowledge] (CO2) [Knowledge] (CO3) [Knowledge]

1. There is one type of casing which is only used in Offshore E&P activities. Identify that casing and state its function. (CO4) [Knowledge]
2. Mention the steps of “Soft Shut In” of a well. (CO4)[Knowledge]

**PART B**

**ANSWER ANY FIVE QUESTIONS 5QX10M=50M**

1. Given a scenario where a drilling operation encounters unexpectedly hard and abrasive rock formations causing significant vibrations, hole deviation, and instances of stuck pipe, how can the integration and strategic placement of drill string accessories such as reamers, shock subs, stabilizers, drilling jars, and heavy wall drill pipe (HWDP) be optimized to address these challenges?

(CO1) [Comprehension]

1. In the quest for designing casing solutions for oil wells, how can the holistic integration of collapse load, tensile load, and burst load parameters reshape traditional methodologies, enabling engineers to navigate the complexities of downhole environments with precision, while balancing structural integrity, operational performance, and risk mitigation strategies?

(CO2) [Comprehension]

1. In drilling operations, the ability to accurately identify and interpret early warning signs and positive kick indicators is crucial for maintaining well control and preventing potential blowouts. However, current industry practices lack a comprehensive framework for systematically recognizing and responding to these indicators in real-time, leading to delays in response and heightened risks to personnel, equipment, and the environment. List out the early and positive signs of kick.

(CO3) [Comprehension]

1. Explain the various functions of casing in oil and gas wells ensure operational safety and maximize production efficiency.

(CO3) [Comprehension]

1. Explore the nuanced advantages and disadvantages associated with the implementation of liners in drilling operations, considering factors such as wellbore stability, cost-effectiveness, drilling efficiency, reservoir integrity, and environmental impact.

(CO3) [Comprehension]

1. Compare and contrast the following aspects of well control procedures and well killing methods:
   1. Differentiate between the Hard Shut-in and Soft Shut-in procedures employed in oil well control scenarios.
   2. Analyze the distinctions between the Driller's Method and the Weight and Wait Method utilized for well killing operations.

(CO4) [Comprehension]

1. In what ways the blowout preventer (BOP) considered the most critical safety device during drilling operations, and discuss the potential consequences of its failure.

(CO4) [Comprehension]

**PART C**

**ANSWER ANY TWO QUESTIONS 2QX20M=40M**

1. Imagine we're drilling a well in the rugged mountains of Gotham City, home to the legendary Batman and his iconic Batcave. The drilling operation is targeting a depth of 10,000 feet, hoping to uncover hidden secrets buried deep within the earth.Our drill string comprises:

Drill Collars (DC) with nominal weight 56 ppf, a length of 900 feet, and an outer diameter of 5 inches and an inner diameter of 2 inches, because even Batman needs some heavy-duty equipment.

Heavy-Weight Drill Pipe (HWDP) with a length of 500 feet, and nominal weight 70 ppf, designed to withstand the toughest challenges.

Remaining length comprised of Drill Pipe (DP) because Robin needs something to handle too. The mud weight in the well is 10 pounds per gallon, because even the Joker wouldn't mess with heavy mud.

We've set a safety factor for tensile strength at 1.8, because safety is paramount in Gotham City, especially when dealing with villains like Bane.

Now, design the drill string, considering the weight of the drill collars, heavy-weight drill pipe, and drill pipe, given the provided dimensions and densities. Then, determine the tensile load on the drill string components, taking into account the safety factor for tensile strength.

Show your calculations and label your final answer with appropriate units. Happy drilling in the shadowy depths of Gotham City!

(CO2) [Application]

1. Imagine you are part of a drilling team tasked with drilling a well in a coastal area known for its pristine marine ecosystem. The well location is close to a protected marine reserve, making environmental protection a top priority. Additionally, the area has geological challenges such as shallow gas formations and unconsolidated formations near the surface. Your task is to design a casing program that not only ensures well integrity and safety but also minimizes the risk of environmental contamination and operational disruptions. Consider how different types of casing can be strategically employed to address these challenges while adhering to regulatory standards and industry best practices.

Based on this scenario:

1. Describe the specific types of casing you would select and their functions in addressing the following challenges:

Protecting nearby water bodies from contamination Preventing shallow gas kicks

Providing a stable base for mounting a blowout preventer (BOP) Isolating troublesome formations

Sealing off unconsolidated formations at shallow depths

1. Justify your selection of casing types and their placement depths, considering the geological and environmental conditions of the drilling location.
2. Discuss any additional measures or technologies you would implement to enhance environmental protection and mitigate operational risks during drilling operations in this sensitive area. Your response should demonstrate a comprehensive understanding of casing design principles, environmental considerations, and risk management strategies in real-world drilling scenarios.

(CO3) [Application]

1. During drilling of an 8” in hole at 10000 ft, a kick was encountered. The well was shut in and the pressures recorded on both drill pipe and annulus were:DPSIP = 200 psi

Other relevant data include:

Last casing = 9*5/8* in, N80, 43.5 lbm/ft, ID = 8.755in Casing setting depth = 8600 ft

Drill collars = OD/ID: 8 in/3 in, 500 ft Drillpipe = OD/ID: 5 in/4.276, 19.5 lb/ft

Circulation pressure at normal speed = 2000 psi at 60 strokes per minute

Circulation pressure while pumping kill mud at 30 strokes/min = 500 psi [Pump capacity=3 bbl/min] Present mud weight = 75 pcf (10 ppg)

Total annular capacity=479.6 bbl [1bbl=5.615 cf.] Shut in period=60 min

Calculate the following:

1. Capacity of drillpipe and drill collars;
2. Formation pressure;
3. Kill mud weight;
4. Standpipe pressure at start of circulation of heavy mud;
5. Final circulation pressure and standpipe pressure;
6. Time required to replace the contents of the drill string with the kill mud
7. Total time to completely fill the annuals with kill mud
8. Graphically show the variation of drillpipe pressure with time

(CO4) [Application]