UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2018

Program:B.TECH APE UP   Semester – IV
Subject (Course): DRILLING HYDRAULICS   Max. Marks   : 100
Course Code   : PTEG 212   Duration   : 3 Hrs
No. of page/s:04

SECTION A: Answer All the Questions.   **(5*4=20Marks).**

1. To control/increase the density of the mud, barite is used. Explain the cause and the negative effects barite might have during drilling of inclined wells.

2. Describe the main factors which influence the pressure loss when circulating fluid through the drill string and annulus when drilling?

3. Draw and annotate the shear stress vs. shear rate diagram for a: Power law and; Bingham Plastic Drilling Fluid?

4. Explain the effects of different parameters on "Mud Carrying Capacity"?

5. Explain in detail about the importance of types of formation, mud properties and type of bits on bit hydraulics?

SECTION B: Answer All the Questions.   **(5*8=40Marks).**

1.

a) The total system pressure losses in a well's circulating system is the sum of all the pressure losses in each segment of the well system and is reflected in the pump circulating pressure. Write a simple equation to describe this relationship.   **(4 Marks)**

b) Calculate the surge pressure in a 7.875 in. hole below a 12,000 ft drill string composed of 11,400 ft of 5-in. drillpipe (4.3 in. ID), 600ft of 6.25 in. drill collars (2.75 in. ID) and a bit containing three 1232 in. nozzles. The drill string is being lowered through a 14 lbm/gal drilling fluid having a flow behavior index of 250 eq cp at a maximum rate of 3.5 ft/sec.   **(4 Marks)**

2.

   a. A water based mud is being circulated in a well at a pump rate of 620 gal/min, with a surface pump pressure of 3000 psi. The density of the mud is 10 lbm/gal. If the bit was dressed with two each 15/32 inch nozzles and one each 16/32 inch nozzle, calculate the total pressure loss in the well's circulating system. **(5 Marks)**

   b. Describe the way in which the pressure losses in the system change as the hole section is deepened and how this effects the optimization of the hydraulics of the system? **(3 Marks)**

3. After setting a casing string at 10,000 ft, it is necessary to increase the density of 900 bbls of mud in the surface pits from 16 ppg to 17.5 ppg. The volume fraction of low density solids must also be reduced from 5.0 % to 3.0 %, by dilution with fresh water. A final volume of 900 bbls is required.

   a. What volume of mud should be discarded? **(3 marks)**

   b. How much water must be added? **(3 marks)**

   c. How many sacks of barite are required? **(2 marks)**

   (Assume density of barite is 35 lb/gal, density of water is 8.33 lb/gal, and one sack of barite is 94 lbs.).

4.

A bit currently in use has three $\frac{12}{32}$ $in.$nozzles. The driller has recorded that when the 10 lbm/gal mud is pumped at a rate of 500$\frac{gal}{min}$. , a pump pressure of 3,000 psig is observed, and when the pump is slowed to a rate of 250 $\frac{gal}{min}$, a pump pressure of 800 psi is observed. The pump is rated at 1,000 hp and has an overall efficiency of 0.9.The minimum flow rate to lift the cuttings is 240 $\frac{gal}{min}$. The maximum allowable surface pressure is 3,000 psi. **(8 Marks)**

   a. Determine the proper pump operating conditions and bit nozzle sizes for maximum bit horsepower for the next bit run.

   b. What bit horsepower will be obtained at the conditions selected?

   c. What impact force will be obtained at the conditions selected?

   d. What nozzle velocity will be obtained at the conditions selected?

5. Derive the flow rate equation for a fluid flow through a drill string using Power Law Model? **(8 Marks).**

SECTION C: Answer All the Questions.   **(2*20=40Marks).**

1)
    a) Using the below data, determine the annular velocity, cuttings slip velocity, and cuttings net rise velocity: **(12 Marks)**

       DATA: Mud Weight = 11.0 ppg.

               Plastic Viscosity = 13.0 cps.

               Yield Point = 10 lb/100 $sq\ ft$.

               Diameter of Particle = 0.25 in.

               Density of the Particle = 22.0 ppg.

               Hole Diameter = 12.25 in.

               Drill Pipe OD = 5.0 in.

               Circulation Rate = 520 gpm.

    b) Explain the role of surface pressures and maximum bit hydraulic horse power on optimization of bit hydraulics?   **(8 Marks)**

2)
    a) While drilling in the 8 ½"section, at a depth of 1 500 m TVD / 6 000 m MD, in overbalance, the ECD will fluctuate and at times be high in this long well. Previous experience from that area indicates that instable, swellable shale will be penetrated. Your task now is the following:

       i. Define what wellbore stability-related processes may take place in the shale while drilling through it with WBM.

       ii. Which type of inhibitive mud will you suggest in order to maximize wellbore stability? Explain how this mud type will affect the wellbore.

       iii. Does fluctuating ECD have any implications for the stability of the wellbore?

                                             (12 Marks)

    b) Define Swab and Surge Pressure. Also determine both the surge and swab pressure for the data listed below: **(8 Marks)**

       Data: Mud weight = 15.0 ppg , Plastic viscosity = 60 cP

       Yield point = 20 lb/l00 sq ft,   Hole diameter = 7-7/8 in.

       Drill pipe OD = 4-1/2 in.,   Drill pipe length = 14,300 ft

Drill collar OD = 6-1/4 in.,   Drill collar length = 700 ft

Pipe running speed = 270 ft/min