UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY, 2018

COURSE NO: PE 370
COURSE NAME: COMPUTER APPLICATIONS IN PETROLEUM ENG
CLASS: PE III TIME: 3 HRS.

Name: _____ Index Number: _____

Attempt <u>All questions.</u>

Open book, closed neighbour; no cell phones or internet access during the exam.

Save you file as Your_Name_final_exams.xls and copy it unto the flash drive provided. Save a copy for yourself as back up. Save your file before you try to run or debug!

If you do not Indent and Comment your Code you will lose 5 marks.

If a well is produced at a constant bottomhole flowing pressure, its rate declines with time; that is, the initial flowing rate is large, but it gradually decreases with time. The declining rate versus time behaviour can be approximated by the following expression

$$q(t) = \begin{cases} q_i (1 + bD_i t)^{-\frac{1}{b}} & \text{for } 0 < b \leq 1 \\ q_i \exp(-D_i t) & \text{for } b = 0 \end{cases} \quad (1)$$

where q (t) is the rate at a given time in STB/d, q_i is the initial rate (at $t = 0$) in STB/d, D_i is the initial decline rate as a fraction per day, t is time in days and b is a decline parameter that depends on the reservoir and fluid type; for example, for an undersaturated oil solution-gas drive reservoir, $b = 0$, whereas for a saturated solution-gas drive reservoir, b might be 0.2. The cumulative oil produced from a well at time t, N_p (t) STB, is given by

$$N_p(t) = \int_0^t q(t)\, dt; \quad (2)$$

We can approximate this integral by

$$N_p(t) = \left[\frac{q_i + q(t)}{2} + \sum_{j=1}^{n-1} q(t_j) \right] \Delta t \quad (3)$$

Where n is the number of intervals that we want to use to approximate the integral,

$$\Delta t = \frac{t}{n} \quad (4)$$

And $$t_j = j\Delta t \quad (5)$$

For example, if we had a well with an initial rate of 100 STB/d, a decline rate of 0.001 per day and a b value of 0.2, the rate after 300 days would be

$$q(300) = 100(1 + (0.2)(0.001)(300))^{\frac{-1}{0.2}}$$
$$= 74.76 \text{ STB/d}$$

A. Write a function to compute the rate at a given time provided values of t, q_i, D_i and b. If the user provides a b value outside the range $0 < b < 1$, put up an error message. **(20)**

If we wanted to approximate the cumulative production at 200 days from this well using four intervals (i.e., n = 3) we would proceed as follows:

1. Compute $\Delta t = \frac{t}{n} = \frac{300}{3} = 100\ days$
2. Compute the sum, i.e. in this case, there will be two terms; q(100) and q(200).

   $= 100(1 + (0.2)(0.001)(100))^{\frac{-1}{0.2}} + 100(1 + (0.2)(0.001)(200))^{\frac{-1}{0.2}}$ = 172.77 STB/d

3. Compute $N_p(200) = (\frac{100+74.76}{3} + 172.77)\ (100)$ = **23102 STB.**

B. Write a function to compute cumulative production given n, t, q_i, D_i and b. **(35)**

C. Create a user interface with buttons for the flow rate and cumulative production. **(5)**

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(Examiners)