ID NO.	

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 40 % Max Marks: 40 Max Time: 02 hrs. 10 May 2018,Thursday

ENDTERM FINAL EXAMINATION MAY 2018

Even Semester 2017-18 Course: **PET 212 Reservoir Engineering II** VI Sem. Petroleum

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Instructions:

(i) Read the question properly and answer accordingly.

(ii) Scientific and Non-programmable calculators are permitted

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Part A

(2 Q x 4 M = 8 Marks)

1. A single-phase oil reservoir, consisting of a horizontal layer, has many vertical production wells. Table - 1 identifies two of these wells and the dimensions, permeability's, and skin factors of their well blocks. Each well is located at the center of the well block and fully penetrates the layer. The oil FVF and viscosity are 1 RB/STB and 2 cp, respectively. Well diameter is 5 inches. Calculate the well block geometric factors for the wells given in below Table-1.

Well ID	**Well Block**					
	Δx (ft)	**Δy (ft)**	**h (ft)**	K_x **(md)**	K_y **(md)**	**s**
W-1	208	832	30	100	225	+1
W-2	208	832	30	150	150	-1

Table-1

2. Write well production rate equations for 1d radial flow in a single block with following well operating conditions
   I. Shut-in well
   II. Specified well production rate
   III. Specified well FBH

Part B

(2 Q x 6 M = 12 Marks)

3. Write the algorithm for obtaining the pressure solution for an incompressible flow problem.

4. The following pressure equations were obtained for the 1D reservoir:

   $9P_1 + P_2 + P_3 = 10$

   $2P_1 + 10P_2 + 3P_3 = 19$

   $3P_1 + 4P_2 + 11P_3 = 0$

   Solve these equations using the point Jacobi iterative method (Iterations are to be done till maximum absolute difference between the successive iterations among all blocks is less than 0.01)

Part C

(2 Q x 10 M = 20 Marks)

5. The following pressure equations were obtained for the 1D reservoir:

   $-3P_1 + P_2 = -8000$

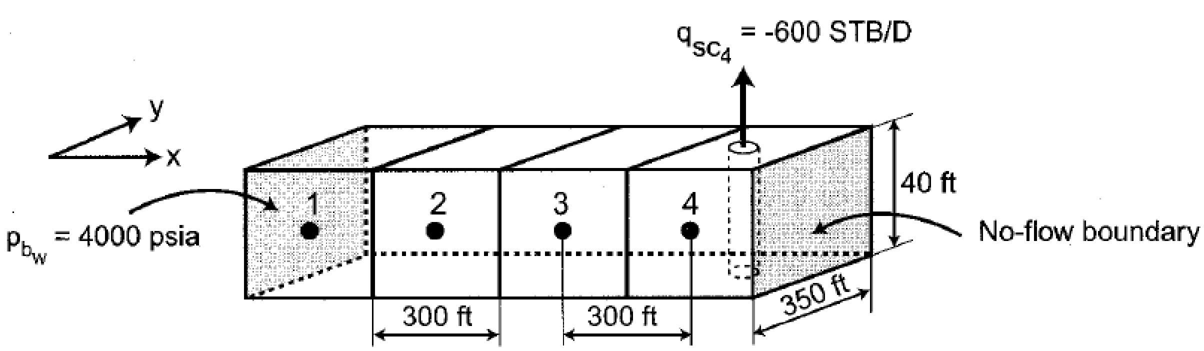
   $P_1 - 2P_2 + P_3 = 0$

   $P_2 - 2P_3 + P_4 = 0$

   $P_3 - P_4 = 21.127$

   Solve these equations using the Thomas' algorithm.

6. A single-phase incompressible fluid reservoir is described by four equal blocks as shown in Figure-1. The reservoir is horizontal and has homogeneous and isotropic rock properties, k = 270 md. The gridblock dimensions are Δx = 300 ft, Δy = 350 ft, and h = 40 ft. The reservoir fluid properties such as density is 50 lb/ft^3 and viscosity is 0.1127 cp. The reservoir left boundary is kept at constant pressure of 4000 psia, and the reservoir right boundary is sealed off to flow. A 6-inch diameter vertical well was drilled at the center of gridblock 4. The well produces 600 STB/D of fluid and has a skin factor of 1.5. Assuming that the reservoir rock and fluid are incompressible, find the pressure distribution in the reservoir and the FBHP of the well.



Figure–1

ID NO:	

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 20%   Max Marks: 20   Max Time: 1 hr.   26 March Monday 2018

TEST – 2   **SET A**

Even Semester 2017-18   Course: **PET 212 Reservoir Engineering II**   VI Sem. Petroleum

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Instruction:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) *Answer all questions.*
(iv) Scientific and Non-programmable calculators are permitted.

Part A

(1 Q x 3 M = 3 Marks)

1. Write three important differences between the block centered grids and the point distributed grids.

Part B

(1 Q x 7 M = 7 Marks)

2. Consider single-phase fluid flow in the 4X3 2D horizontal reservoir in which a well located in gridblock 7 produces at a rate of 4000 STB/D. All gridblocks have Δx = 300 ft, Δy = 250 ft, h = 100 ft, k_x = 220 md, and k_y = 270 md. The FVF and viscosity of the flowing fluid are 1.0 RB/STB and 2 cp, respectively. The reservoir east boundary is maintained at 3000 psia, the reservoir south boundary is sealed off to flow, the reservoir north boundary is kept at a constant pressure gradient of 0.1 psi/ft, and the reservoir loses fluid across its west boundary is at a rate of 500 STB/D. Write the flow equations for boundary gridblocks 2 and 5.

Part C

(1 Q x 10 M = 10 Marks)

3. A 0.5 ft diameter water well is located in 10 acre spacing reservoir. The reservoir thickness, horizontal permeability, vertical permeability and porosity are 20 ft, 200 md, 50 md and 0.23, respectively. The flowing fluid has a density, FVF, and viscosity of 62.4 lb/ft^3, 1 RB/STB, and 0.5 cp, respectively. The reservoir external boundary in the radial direction is a no-flow boundary, and the well is completed in the top 15 ft only and produces at a rate of 1000 STB/D. The reservoir bottom boundary is subject to influx such that the boundary is kept at 5000 psia. The reservoir top boundary is sealed to flow. Assuming the reservoir can be simulated using three equi - spaced gridpoints in the vertical direction and four gridpoints in the radial direction, estimate bulk volume, transmissibilities in radial and vertical directions and write them in a tabular form along with gridpoint locations using the formulae given below.

Direction	Geometric Factor
r	$G_{r_{i-1/2,j,k}} = \dfrac{\beta_c \Delta\theta_j \Delta z_k}{\log_e[\alpha_{lg} \log_e(\alpha_{lg})/(\alpha_{lg}-1)]/k_{r_{i,j,k}} + \log_e[(\alpha_{lg}-1)/\log_e(\alpha_{lg})]/k_{r_{i-1,j,k}}}$
	$G_{r_{i+1/2,j,k}} = \dfrac{\beta_c \Delta\theta_j \Delta z_k}{\log_e[(\alpha_{lg}-1)/\log_e(\alpha_{lg})]/k_{r_{i,j,k}} + \log_e[\alpha_{lg} \log_e(\alpha_{lg})/(\alpha_{lg}-1)]/k_{r_{i+1,j,k}}}$
θ	$G_{\theta_{i,j\mp1/2,k}} = \dfrac{2\beta_c \log_e(\alpha_{lg})\Delta z_k}{\Delta\theta_{j\mp1/2}/k_{\theta_{i,j,k}} + \Delta\theta_{j\mp1/2}/k_{\theta_{i,j\mp1,k}}}$
z	$G_{z_{i,j,k\mp1/2}} = \dfrac{2\beta_c (V_{b_{i,j,k}}/\Delta z_k)}{\Delta z_{k\mp1/2}/k_{z_{i,j,k}} + \Delta z_{k\mp1/2}/k_{z_{i,j,k\mp1}}}$

Geometric Factors in Cylindrical Grids

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 20 % Max Marks: 20 Max Time: 1 hr. 21 Feb Wednesday 2018

TEST – 1

Even Semester 2017-18 Course: **PET 212 Reservoir Engineering II** VI Sem. Petroleum

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Instruction:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
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Part A

(1 Q x 5 M = 5 Marks)

1. Block ordering not only serves to identify blocks in the reservoir but also minimizes matrix computations in obtaining the solution of linear equations. Following figure 1 shows the engineering notation for block identification in a 2D reservoir consisting of 4X5 blocks.

(1,5)	(2,5)	(3,5)	(4,5)
(1,4)	(2,4)	(3,4)	(4,4)
(1,3)	(2,3)	(3,3)	(4,3)
(1,2)	(2,2)	(3,2)	(4,2)
(1,1)	(2,1)	(3,1)	(4,1)

Figure 1 Engineering notation for block identification

Illustrate the above reservoir in 5 different block ordering schemes.

Part B

(1 Q x 5 M = 5 Marks)

2. What is reservoir discretization? Show reservoir discretization in the x direction with focus on block *i* and explain the various terms in it.

Part C

(1 Q x 5 M = 10 Marks)

3. Consider single-phase fluid flow in a 3D horizontal reservoir. The reservoir is discretized using 4x3x3 blocks as shown in below figure 2. A well that is located in block (3,2,2)

produces at a rate of 133.3 STB/D. All grid blocks have Δx = 250 ft, Δy = 30Oft, Δz = 33.333 ft, k_x = 270md, k_y = 220 md, and k_z = 50 md. The FVF, density, and viscosity of the flowing fluid are 1.0 RB/STB, 55 Ibm/ft^3, and 2 cp, respectively.

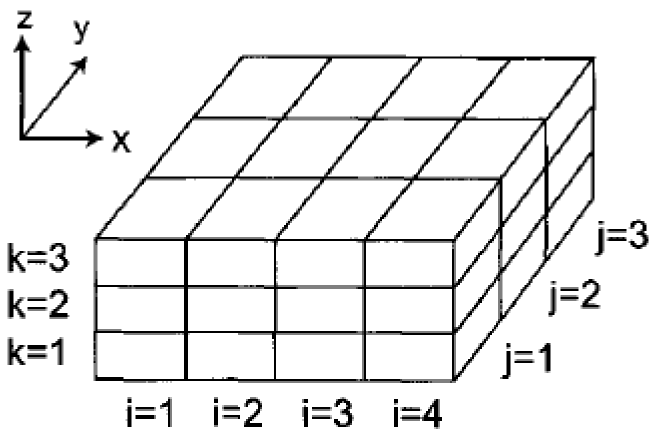

Figure 2 Reservoir representation

I. Identify the interior and boundary blocks in this reservoir.
II. Represent the above reservoir in engineering notations and natural ordering
III. Write the flow equation for the block (3,2,2) using CVFD terminology using natural ordering of blocks.