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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Examination, July 2020

Programme: B Tech APE Upstream **Semester 6**
Course Name:Well Log analysis and Well Testing **Max. Marks : 100 Course Code: PEAU 3006** **No. of page/s: 05**

Note:

1. Read the instruction carefully before attempting.
2. This question paper has two section, Section A and Section B.
3. There are total of seven questions in this question paper. **One** in **Section A** and **six** in **Section B**
4. **Section A** consist of multiple choice based questions and has the total weightage of 40-50%.
5. **Section A** will be conducted online on BB Collaborate platform
6. **Section B** consist of long answer based questions and has the total weightage of 50-60%.
7. The maximum time allocated to **Section A** is two Hrs.
8. **Section B** to be submitted within 24 hrs from the scheduled time (*exceptional provision due extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*)**.**
9. No submission of **Section B** shall be entertained after 24 Hrs.
10. **Section B** should be attempted after **Section A**
11. **The section B** should be attempted in blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sapid at the top (as in the format) and signature at the bottom (right hand side bottom corner)
12. Both section A & B should have questions from entire syllabus.
13. The COs mapping, internal choices within a section is same as earlier

1. Multiple Choice: CO1: Which of the following is a mecha...

Points: 1

Question	
	Which of the following is a mechanical log?
Answer	Neutron log
	Gamma ray log
	Caliper log

/

SP log

2. **Multiple Answer: CO1: Which of the following are the uses...**

Points: 2

Question

Which of the following are the uses of SP Log? (Select all that apply)

Answer

- The detection of permeable beds.
- The determination of Rw.
- The indication of the shaliness of a formation.
- Correlation.

3. **Multiple Answer: What are the basic requirement for ...**

Points: 2

Question

What are the basic requirement for SP log? (Select all that apply)

1.

Answer

- A conductive borehole fluid.
- A sandwich of a porous and permeable bed between low porosity and impermeable formations.
- A difference in salinity.
- A non conductive borehole fluid

4. Multiple Answer: The amplitude of the SP deflection ...

Points: 2

Question

The amplitude of the SP deflection depends upon which of the following parameters? (Select all that apply)

1.

Answer

- [x] The resistivity of the mud
- [x] The diameter of the borehole
- [ ] The reservoir area
- [x] The permeability

5. Multiple Choice: The wave of interest in Sonic log i...

Points: 1

Question

The wave of interest in Sonic log is.

Answer

- [x] P wave
- [ ] S wave
- [ ] Stoneley wave
- [ ] Love wave

6. Multiple Choice: What is the advantage of the BHC so...

Points: 1

Question

What is the advantage of the BHC sonic tool over the dual receiver?

Answer

compensates for the misalignment of the tool

Compensates for the pH of the mud

Eliminates the noise

None of the above

7. Multiple Choice: The vertical bed resolution o...

Points: 1

Question

The vertical bed resolution of the sonic tool depends upon

Answer

Transmitter to receiver spacing

Transmitter to transmitter spacing

Receiver to receiver spacing

Wavelength of the elastic wave

8. Multiple Choice: The depth of investigation of the s...

Points: 1

Question

The depth of investigation of the sonic tool depends upon.

Answer

Transmitter to receiver spacing

Transmitter to transmitter spacing

Wavelength of the mud arrivals

Wavelength of the elastic wave

9. Multiple Answer: The synthetic seismogram is obtaine... Points: 2

Question

The synthetic seismogram is obtained using (Select all that apply).

Answer

Sonic log

Density log

Gamma ray log

None of the above

10. Multiple Choice: Evaluate the porosity of sandstone ... Points: 2

Question

Evaluate the porosity of sandstone formation, if the interval transit times of the formation, matrix and fluid are 70 µs, 55 µs and 190 µs respectively?

Answer

15

9

20

23

11. Multiple Choice: The following gamma ray (GR) log da... Points: 2

Question

The following gamma ray (GR) log data are recorded in a borehole:

GR log value against a formation = 30 API units,

Maximum GR log value = 45 API units,

Minimum GR log value = 20 API units.

What is the fraction of shale in the formation?

Answer

- 0.5
- ✓ 0.4
- 0.3
- 0.2

☐ **12. True / False: Well test interpretation is mainly ...** Points: 1

Question

Well test interpretation is mainly carried out using semi-log and log-log techniques.

Answer

- ✓ True
- False

☐ **13. True / False: In wellbore storage, initial flow a...** Points: 1

Question

In wellbore storage, initial flow at surface is due to decompression of fluid in wellbore.

Answer

- ✓ True
- False

☐ **14. True / False: After stimulation, the pressure dro...** Points: 1

Question

After stimulation, the pressure drop near the wellbore may be even less than the ideal one.

Answer	True
	False

15. **True / False: Wellbore storage causes delay hence...** Points: 1

Question	Wellbore storage causes delay hence the reservoir permeability will be affected by the well-bore effects.
Answer	True
	False

16. **True / False: Typically, wellbore storage (C) is ...** Points: 1

Question	Typically, wellbore storage (C) is evaluated from the time match, and the type-curve solution match provides permeability-thickness product (kh).
Answer	True
	False

17. **True / False: When the radius of investigation is...** Points: 1

Question	When the radius of investigation is in the zone of altered permeability, the build-up curve shape will be interpreted accurately.
Answer	True
	False

18. **True / False: The equation of pressure for superp...** Points: 1

Question	The equation of pressure for superposition principle involves skin factor of all the wells flowing in total drainage area.
Answer	True
	False

19. True / False: In fractured well, MTR will not be ... Points: 1

Question	
	In fractured well, MTR will not be developed when boundary effects appear after ETR ended.
Answer	✓ True False

20. Fill in the Blank:_____usually indicates an orga... Points: 2

Question	
	_____usually indicates an organic origin.

Evaluation Method	Answer	Case Sensitivity
Contains	Uranium	

21. Multiple Choice: The following gamma ray (GR) log da... Points: 2

Question	
	The following gamma ray (GR) log data are recorded in a borehole: GR log value against a formation = 30 API units, Maximum GR log value = 45 API units, Minimum GR log value = 20 API units. What is the possible gamma ray value for clean thick sandstone formation?
Answer	✓ 20 API units 45 API units 30 API units 50 API units
Correct Feedback	

22. True / False: The denser the mud used, the greate...

Points: 1

Question

The denser the mud used, the greater the underestimation will be.

Answer

- ✓ True
- False

23. True / False: Archie observed that the bulk resis...

Points: 1

Question

Archie observed that the bulk resistivity of a rock fully saturated with an aqueous fluid of resistivity *Rw* is directly proportional to the resistivity of the fluid.

Answer

- ✓ True
- False

24. Multiple Choice: Calculate the formation water satur...

Points: 2

Question

Calculate the formation water saturation, Sw from the following well log data:

Resistivity of completely saturated formation, Ro = 1.8 Ω-m

True resistivity of formation, Rt = 25 Ω-m.

Answer

- 37%
- ✓ 27%
- 17%
- 7%

25. Multiple Choice: If the saturation exponent in Archi...

Points: 2

Question

If the saturation exponent in Archie's Equation is 2 (n=2) , Then By what factor the bulk resistivity of 50 % water saturated formation increases in comparison to fully water saturated formation ?

Answer

- ✓ 4
- 10
- 40
- 60

26. Multiple Choice: The true resistivity of the formati...

Points: 1

Question

The true resistivity of the formation is given by

Answer

- invaded zone
- ✓ uninvaded zone
- Reservoir boundary
- none of the above

27. Multiple Choice: The constant of proportionality F i...

Points: 1

Question

The constant of proportionality *F in Archie's law* is called the *Formation Factor . It* describes

Answer

The effect of permeability.

the effect of the presence of the rock matrix.

The effect of skin

The effect of invasion.

28. **True / False: The cementation index is the factor...**

Points: 1

Question

The cementation index is the factor that describes the increase in resistivity that results from the insulating mineral grains forcing the current to take tortuous pathways through the conducting fluid.

Answer

True

False

29. **Multiple Choice: The cementation Factor is obtained ...**

Points: 2

Question

The cementation Factor is obtained by determining the gradient of plot

Answer

Water saturation vs resistivity index

Saturation index vs porosity

Formation factor vs porosity

Resistivity index vs water saturation

30. **Multiple Choice: The saturation index is obtained by...** Points: 2

Question

The saturation index is obtained by determining the gradient of plot

Answer

- Water saturation vs resistivity index
- Porosity vs formation factor
- Formation factor vs porosity
- ✓ Resistivity index vs water saturation

31. **Multiple Choice: Resistivity index describes.** Points: 2

Question

R*esistivity index* describes.

Answer

- The effect of partial saturation of a rock
- ✓ The effect of partial desaturation of the rock
- The effect of the tortuous path.
- None of the above

32. **Multiple Choice: If the rock is fully saturated the ...** Points: 2

Question

If the rock is fully saturated the value of resistivity index is.

Answer

0

infinity

✓ 1

cannot be determined

33. Multiple Choice: If the rock is full of dry air the ... Points: 2

Question

If the rock is full of dry air the value of resistivity index is.

Answer

0

1

✓ infinity

cannot be determined

34. Multiple Choice: Which of the following sonde is pre... Points: 1

Question

Which of the following sonde is presses to the borehole wall?

Answer

gamma ray

SP

sonic

✓ density

35. **Multiple Choice: The gas well testing in which the i...** Points: 1

Question	The gas well testing in which the intermediate flow period is constant is
Answer	isochronal
	✓ modified isochronal
	flow after flow
	None of the above

36. **Multiple Answer: Porosity is determined by (Select a...** Points: 2

Question	Porosity is determined by (Select all that apply)
Answer	✓ Sonic log
	✓ Density log
	✓ Neutron log
	Caliper log

37. **Multiple Choice: A pressure build-up test analysis for...** Points: 2

Question	A pressure build-up test analysis for a well with q = 83 STB/D, B = 1.12 RB/STB, □ =3.15 cp, h = 12 ft, r w = 0.265 ft, and p avg - p wf = 265 psia gave k = 155 mD and s = 2.2. Find the pressure drop across the skin.
Answer	29 psi

	39psi
✓	49psi
	59psi

☐ **38. Multiple Choice: A pressure build-up test analysis for...** Points: 2

Question	A pressure build-up test analysis for a well with q = 83 STB/D, B = 1.12 RB/STB, □ =3.15 cp, h = 12 ft, r w = 0.265 ft, and p avg - p wf = 265 psia gave k = 155 mD and s = 2.2. Find the flow efficiency.
Answer	42%
	62%
	72%
✓	82%

☐ **39. Multiple Choice: A pressure build-up test analysis for...** Points: 2

Question	A pressure build-up test analysis for a well with q = 83 STB/D, B = 1.12 RB/STB, □ =3.15 cp, h = 12 ft, r w = 0.265 ft, and p avg - p wf = 265 psia gave k = 155 mD and s = 2.2. Find the damage ratio.
Answer	1
✓	1.22
	2.22
	3.22

☐ **40. Multiple Choice: A pressure build-up test analysis for...** Points: 2

Question	A pressure build-up test analysis for a well with q = 83 STB/D, B = 1.12 RB/STB, □ =3.15 cp, h = 12 ft, r w = 0.265 ft, and p avg - p wf = 265 psia gave k = 155 mD and s = 2.2. Find the apparent wellbore radius.

Answer

0.019ft

✓ 0.029ft

0.29ft

0.0029ft

SECTION B

1. For a well test pressure vs time history, calculate well flowing pressure at 1 minute and 10 hours for infinite acting reservoir and draw the pressure vs time history relationship. Well has produced 135 STB/D of dry oil for 15 days. (5 marks)
   μ = 13.2 cp, k = 90 mD
   Ct = 2.0 x 10-5 psi-I
   Pi = 3265 psia,
   B0 = 1.02 RB/STB,
   h = 47 ft, rw = 0.5 ft, A = 40 acres
   φ = 0.17, s = 0

2. A flowing well is completed in a reservoir that has thefollowing properties. (5 marks)
   μ = 0.44 cp, k = 25 mD
   Ct = 18 x 10-6 psi-I
   Pi = 2500 psia,
   B0 = 1.4 RB/STB,
   h = 43 ft
   φ = 0.16
   What will the pressure drop be in a shut-in well 500 ft from the flowing well when the flowing well has been shut-in for 1 day following a flow period of 5 days at 300 STB/D.

3. A well and reservoir have the following characteristics: The flowing well is producing only oil; it is producing at the constant rate of 200 STB/D. Data describing the well performance are
   μ = 0.62 cp, k = 16 mD
   Ct = 1.0 x 10-5 psi-I
   Pi = 3,200 psia, J = 0.5r STB/psi-D
   B0 = 1.475 RB/STB,
   h = 158 ft
   φ = 0.23
   Calculate the distance of shut-in well from the flowing well when shut-in was performed for a period of 2 days following a flow period of 8 days. (5 marks)

4. Calculate well flowing pressure for the well producing oil from an infinite acting reservoir at 2500 psi undergone a shut-in of 3 days after 5 days of flow period. (5 marks)

   μ = 0.30 cp, k = 20 mD
   Ct = 1.30 x 10-5 psi-1
   Pressure drop due to restriction in a distance of 500 ft from the flowing well = 700 psia,

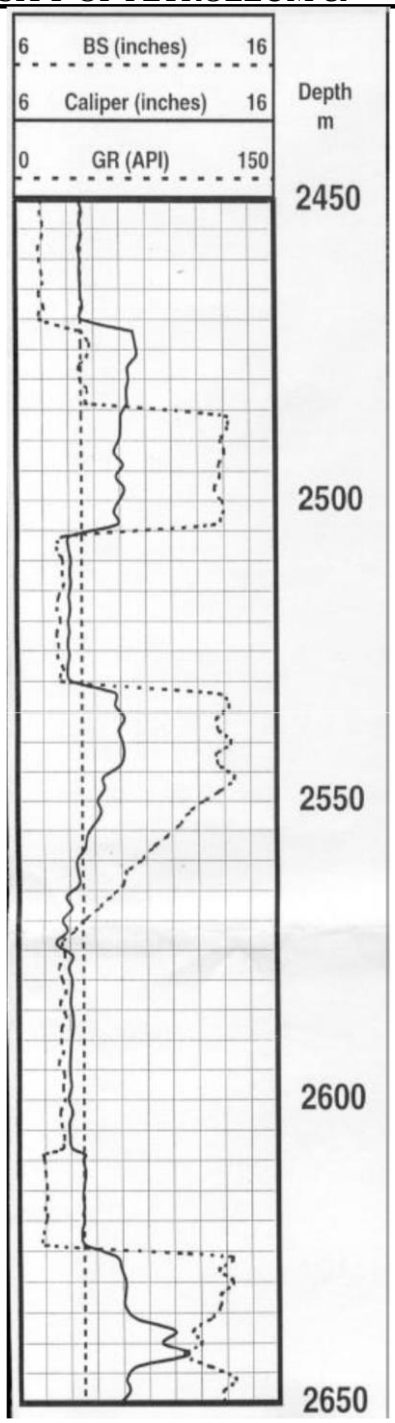
Re = 2050 ft,
Rw = 0.5 ft,
B0 = 1.5 RB/STB,
h = 100 ft
φ = 0.20 and s = 14

5. For the following simulated well-test data, draw both log-log and semi-log type curves. Calculate a) skin
b) Permeability
c) initial reservoir pressure (10 marks)

Δt (hours)	p_{ws} (psi)
0	1,094.897
0.0332947	1,122.317
0.1551056	1,217.656
0.3332977	1,344.633
0.5332947	1,471.678
0.7333069	1,584.464
0.9848022	1,708.728
1.233307	1,814.685
1.533295	1,924.317
1.871201	2,027.047
2.233307	2,117.398
2.633301	2,198.191
2.818207	2,229.975
3.433304	2,315.763
3.830093	2,358.232
4.911301	2,439.504
6.066498	2,491.655
7.300705	2,525.854
8.619293	2,548.988
10.02831	2,565.269
11.53360	2,577.269
13.14200	2,586.563
14.86050	2,594.116
16.69659	2,600.520
18.65829	2,606.144
20.75430	2,611.217
22.99380	2,615.881
25.38651	2,620.230
27.94310	2,624.321
30.67450	2,628.196

□= 0.20 t_p = 150 hrs
r_w = 0.25 ft, p_i = 1154 psia
q_o = 500 STB/D h = 17 ft
B = 1.0 RB/STB □= 1.0 cp
$C_t = 1.0 \times 10^{-6}$ psi^{-1}

6. Answer the following questions marking the logs with construction lines where appropriate and showing full working for numerical questions. (10 marks)
   (a) Identify the main lithology throughout the log.(3)
   (b) Shade the difference between the caliper log and the bit size.(1)
   (c) Comment briefly upon the likely cause of the shape of the gamma ray log in the interval 2635 m and 2645 m.(2)
   (d) Calculate the mud-cake thickness at 2590 m.(2)
   (e) Calculate the shale volume (Vsh) at 2550 m from the gamma ray log.(1)
   (f) What is the approximate borehole volume in the intervals 2500 m to 2550 m in liters?(1)


6
BS (inches)
16
6
Caliper (inches)
16
0
GR (API)
150
Depth
m
2450
2500
2550
2600
2650

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