Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Well Stimulation (PTEG315) **Semester:** 6th
Program: B. Tech (APE upstream) **Max. Marks: 100**
Time: 03 hrs. **No. of Pages: 3**

Instructions:
1. Attempt the question paper in serial wise as it is framed.
2. Neat diagrams must be drawn wherever necessary.
3. Assume suitable data, if necessary.

SECTION A

S. No.		Marks	CO
Q 1	State the type of clays and their formation damage mechanism.	**4**	**CO1**
Q 2	Explain the procedure of step rate (up) test performed during hydraulic fracturing job.	**4**	**CO6**
Q 3	A gas reservoir has a permeability of 1 mD. A vertical well of 0.328 ft radius draws the reservoir from the centre of an area of 160 acres. If the well is hydraulically fractured to create half-length of 2,000-ft; 0.24 inch wide fracture of 100,000 mD permeability around the centre of the drainage area, what is the fracture conductivity of the aperture	**4**	**CO5**
Q 4	Explain the mechanism of failure of a coiled tubing with help of stress-strain curve: -	**4**	**CO4**
Q 5	A producing well has a shut-in tubing pressure of 1000 psig for crude oil of specific gravity 0.69. [1 g/cm3 = 8.33 ppg]. What is the kill fluid density (ppg) for a workover job at 10,000 ft (TVD)?	**4**	**CO2**

SECTION B

Q 6	a) The pore pressure and fracture gradient of petroleum formation at a depth of 4000 ft are 9 ppg and 0.75 psi/ft respectively. The overburden pressure gradient is 0.9 psi/ft. If the pore pressure declines to 8 ppg after a few years of production, what is the reduced fracture pressure of the formation? b) Explain "slickline", "braided line" and "electric line" well intervention	**4+4=8**	**CO5** **CO3**

	methods.		
Q 7	Explain in detail the 3 different stages involved in hydraulic fracturing job.	**8**	**CO5**
Q 8	a) Explain the term "Water block". b) Discuss the function of well control equipment's used in coiled tubing operation.	2+6 =8	**CO2**
Q 9	Draw and explain surface read out of pressure variation during hydraulic fracturing job on a pressure vs time plot	**8**	**CO6**
Q 10	a) Explain the mechanics of hydraulic fracturing with the help of Mohr stress diagram. b) A fracture's area evolves according to a Power Law model with exponent 2/3 (KGD model; opening time distribution factor is = 1.478). The leakoff coefficient is 0.001 ft/min$^{0.5}$ and the pumping time is 40 min. Calculate the width lost because of leakoff. OR a) State the primary and secondary barriers during drilling, production and well intervention operations. b) Explain any four formation properties that are known to influence a fracture's growth pattern	**4+4 =8**	**CO6** **CO4**
	SECTION-C		
Q 11	a) A sandstone formation at a depth of 11,000 ft has a Poison's ratio of 0.25 and a poro-elastic constant of 0.71. The average density of the overburden formation is 165 lb/ft3. The pore pressure gradient in the sandstone is 0.38 psi/ft. Assuming a tectonic stress of 2,000 psi and a tensile strength of the sandstone of 1,000 psi, predict the breakdown pressure for the formation. b) Explain the rheology of hydraulic fracturing fluid. c) Define scale. Discuss the mechanism of scale formation and their detection and removal techniques.	**5+5+10 =20**	**CO5+CO6 +CO2**
Q 12	a) It has been decided that a low-permeability formation, consisting of three separate producing zones, will have to be fractured to produce at economic rates. Before perforating, reasonable injection rates for fracturing (4 m^3/min) and large pressure drops across each perforation (3.5 MPa) have been		

selected as being suitable. Calculate the **surface pressure** and the **number of perforations** required in each zone such that the proportion of fracture fluid entering each of the zones is proportional to the height of the zones

Well data:

Zone	Depth (m)	Net pay thickness
A	2,130	9
B	2,225	7.5
C	2,255	14

Additional data:

Fracture gradient = 15.8 kPa/m of depth
6.5 lb/ft tubing used
Perforation ID = 0.76 cm
Fracturing fluid density = 1042 kg/cm^3
Water based fracturing fluid is used
Friction pressure losses = 8.2 kPa / m of depth
Perforation orifice coefficient = 0.9
Calculate fracturing fluid surface injection pressure in kPa (10 marks)

(b) A sandstone with a porosity of 25 % containing 12 vol.% calcite ($CaCO_3$) is to be acidized with HF/HCl mixture solution. A preflush of 15 wt.% HCl solution is to be injected ahead of the mixture to dissolve the carbonate minerals and establish a low pH environment. If the HCl preflush is to remove all carbonates in a region within 1 ft beyond a 0.328-ft radius wellbore before the HF/HCl stage enters the formation, what minimum preflush volume is required in terms of gallon per foot of pay zone?
Following data is given:
Molecular weight of calcite = 100.1 lb/mol
Molecular weight of HCl = 36.5 lb/mol
Density of calcite = 169 lb/ft^3
Specific gravity of HCl = 1.07 (10 marks)

OR

a) Explain various additives used during matrix acidization of a formation. (5 marks)
b) Explain various acid diversion techniques during matrix acidization process. (5 marks)
c) Explain the "workover planning" to be performed on a sick well. (10 marks

20

CO5 or CO5

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SECTION A

S. No.		Marks	CO
Q 1	State the type of clays and their formation damage mechanism.	**4**	**CO1**
Q 2	A well in a very large reservoir has a wellbore radius of 10 cm. The sandstone, with a porosity of 0.25 and 12% (by grain volume) calcite (CaCO3), is to be acidized with a preflush (HCl solution) to dissolve all the calcite up to a distance of 1 m from the wellbore. 1 m^3 of preflush can dissolve 0.082 m^3 CaCO3. Assume that the reaction between HCl and $CaCO_3$ is instantaneous. What is the minimum preflush volume (in m^3) required per meter of the formation thickness. (rounded-off to two decimal places)	**4**	**CO3**
Q 3	A gas reservoir has a permeability of 1 mD. A vertical well of 0.328 ft radius draws the reservoir from the centre of an area of 160 acres. If the well is hydraulically fractured to create half-length of 2,000-ft; 0.24 inch wide fracture of 100,000 mD permeability around the centre of the drainage area, what is the fracture conductivity of the aperture	**4**	**CO5**
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SECTION B

Q 6	a) The pore pressure and fracture gradient of petroleum formation at a depth of 4000 ft are 9 ppg and 0.75 psi/ft respectively. The overburden pressure gradient is 0.9 psi/ft. If the pore pressure declines to 8 ppg after a few years of production, what is the reduced fracture pressure of the formation? b) Explain "slickline", "braided line" and "electric line" well intervention methods.	**4+4=8**	**CO5** **CO3**
Q 7	Explain in detail the 3 different stages involved in hydraulic fracturing job.	**8**	**CO5**
Q 8	a. Explain the term "Water block". b. Discuss the function of well control equipment's used in coiled tubing operation.	2+6 =8	**CO2**
Q 9	Draw and explain in detail surface read out of pressure variation during hydraulic fracturing job on a pressure Vs time plot	**8**	**CO6**
Q 10	I. State the primary and secondary barriers during drilling, production and well intervention operations. II. A fracture's area evolves according to a Power Law model with exponent 2/3 (KGD model; opening time distribution factor is = 1.478). The leakoff coefficient is 0.001 ft/min$^{0.5}$ and the pumping time is 40 min. Calculate the width lost because of leakoff. OR a) State the primary and secondary barriers during drilling, production and well intervention operations. b) Explain any four formation properties that are known to influence a fracture's growth pattern	**4+4 =8**	**CO4** **CO6**

SECTION-C

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