Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, May 2021

Course: Reservoir Engineering II **Semester: VI**
Program: B. Tech. APEUP **Time: 03 hrs.**
Course Code: PEAU 3005 **Max. Marks: 100**

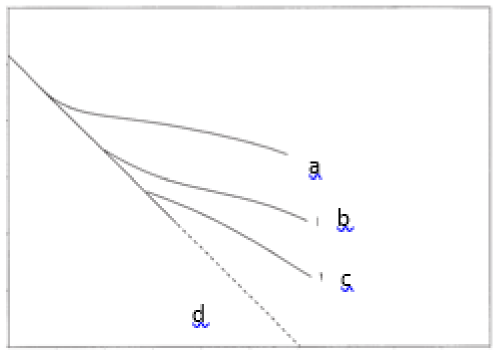
Instructions: All questions are compulsory.

SECTION A

1. Each question will carry 5 marks
2. Instruction: Select the correct answer(s)

Q 1	i. In case of volumetric gas reservoirs, the ultimate gas recovery of the field A. Can be increased by keeping high rate of production B. Can be increased by keeping optimum rate of production C. Is independent of the field production rate. D. None of the above ii. Huff and puff injection method in a gas condensate reservoir is A. Injection of gas through one well and production of gas through another well B. Injection of water through one well and production of gas through another well C. Injection of gas through one well and production of gas through same well simultaneously D. Injection of gas through one well and production of gas through same well alternatively iii. For under-saturated oil reservoirs, the total reservoir compressibility c_t is A. $c_t = S_o c_o + S_w c_w + S_g c_g + c_f$ B. $c_t = S_o c_o + S_w c_w + S_g c_g$ C. $c_t = S_o c_o + S_w c_w$ D. $c_t = S_o c_o + S_w c_w + c_f$ iv. Dew drops is a phenomenon in which A. Liquid drops are formed while doing PVT analysis on a gas condensate sample B. Liquid drops are at separator condition while producing from wet gas reservoir C. Liquid drops are in the reservoir near the well bore D. Dew point pressure measurement is done	CO1

v. For a gas reservoir, when a graph is plotted between p/z vs cumulative gas produced (Gp), we may get four different type of graph depending upon drive mechanism present in the reservoir as shown in the figure below. Write the drive mechanism for the shape of a, b, c and d of the graph.



Q 2 | CO2

i. Select correct statement for the Pot aquifer model used for calculation of water influx,

It is applicable to all type of reservoir

A. The rate of water influx from the aquifer into the reservoir equals the rate of withdrawal

B. Pressure drop in the reservoir is instantaneously transmitted throughout the entire reservoir-aquifer system

C. All of the above

ii. In Schilthuis' Steady-State Model, the water influx constant C in bbl/day/psi is

A. $\frac{0.00708\, kh}{\mu w\, ln(\frac{ra}{re})}\ (p - pi)$

B. $\frac{0.00708\, kh}{\mu w\, ln(\frac{ra}{re})}\ (pi - p)$

C. $\frac{0.00708\, kh}{\mu w\, ln\left(\frac{ra}{re}\right)}$

D. $\frac{0.00708\, kh}{\mu w\, ln(\frac{re}{ra})}$

iii. Select the correct statement from the followings

A. The water influx constant C may be calculated from the reservoir historical production data at different selected time intervals.

B. The influx constant can only be obtained when the reservoir pressure stabilizes.

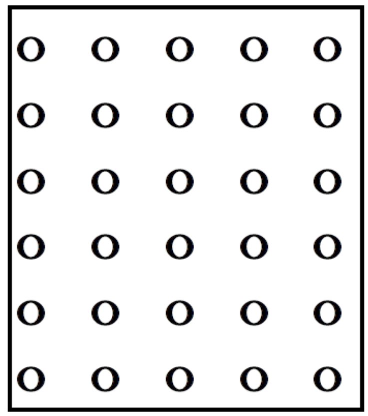
C. Once the influx constant has been found, it may be applied to both stabilized and changing reservoir pressures.

D. All of the above

iv. The name of scientist who proposed that the "apparent" aquifer radius r_a would increase with time is

A. Hurst

	B. Schilthuis C. Fetkovich D. None of the above v. The information required for predicting cumulative hydrocarbon production as a function of declining reservoir pressure A. Actual number of producing wells B. Location of each well C. Production rate of individual wells D. None of the above	
Q 3	i. While predicting cumulative hydrocarbon production using material balance equation which of the following GOR is not required A. Instantaneous GOR B. Liberated GOR C. Solution GOR D. Cumulative GOR ii. In the expression Gp = $\int_0^{Np} (GOR)\, d N_p$, the GOR is A. Instantaneous GOR B. Initial GOR C. Solution GOR at current pressure D. Cumulative GOR iii. Select the main applications of the techniques of material balance (multiple choice) : A. Optimization and planning of the development plan of the reservoir; B. Identification of the geometry of the reservoir C. Estimation of hydrocarbon originally in place D. Assessment of the petro physical characteristics of the overall system iv. Select the data necessary for the application of the techniques of material balance (multiple choice) : A. Geometry of the reservoir B. Petro physical characterization of the reservoir C. Production history D. Definition of wells (location, geometry, type, etc. ...) v. The term ”Φo” used in Tracy’s equation for prediction of hydrocarbon production is A. $\Phi o = \frac{Bo - RsBg}{(Bo-Boi)+(Rsi-Rs)Bg+mBoi\,(\frac{Bg}{Bgi}-1)}$ B. $\Phi o = \frac{Bo - RsBg}{(Bo-Boi)+(Rsi-Rs)Bg}$ C. $\Phi o = \frac{Bo - RsBg}{(Bo-Boi)+mBoi\,(\frac{Bg}{Bgi}-1)}$ D. $\Phi o = \frac{Bo - RsBg}{(Bo-Boi)+(Rsi-Rs)Bg+mBoi\,(\frac{Bg}{Bgi}-1)\Delta p}$	CO2

Q 4	i. The drawing below represents a group of oil wells that are to be subjected to a water flood using a five spot pattern  To achieve this pattern one should: A. Convert alternate horizontal rows of wells to injectors B. Convert alternate diagonal rows of wells to injectors C. Convert alternate vertical rows of wells to injectors D. Convert alternate wells in every diagonal to injectors ii. The mobility ratio.is A. It is the ratio of mobility of the displaced fluid to the mobility of the displacing fluid B. It is the ratio of mobility of the displacing fluid to the mobility of the displaced fluid C. It is the ratio of mobility of the oil to the mobility of the gas D. None of the above iii. The overall recovery factor (efficiency) RF of any secondary or tertiary oil recovery method is dependent on A. Total sweep efficiency B. Volume of oil left after primary recovery C. Volume of water injected D. All of the above. iv. Irregular injection pattern is adopted when A. Availability of water for injection is not regular B. Reservoir is highly heterogeneous C. Cost of drilling of injection well is very high D. All of the above v. Select the most appropriate statement for an ideal displacement in water flooding operation A. Ahead of the interface, oil alone is flowing B. Behind the interface, water alone is flowing C. There is a sharp transition from residual oil saturation (Sor) to maximum oil saturation (1 - Swi) at the oil-water interface. D. All of the above	CO3
Q 5	i. Select the most appropriate statement on the effect of oil viscosity on fractional flow in a water flooding operation.	CO4

	A. High viscosity of water reduces the fractional flow B. High viscosity of oil reduces the fractional flow C. High viscosity of water increase the fractional flow D. High viscosity of water and low viscosity of oil reduces the fractional flow ii. When water is injected in to a reservoir, water break though happened after some time of start of water injection. If continuous water injection is maintained even after break through, the displacement efficiency will A. Continuously increase B. Remain constant C. Continuously decrease D. None of the above ii. In a down dip displacement of oil, the high rate of water injection will A. Deteriorate the displacement efficiency B. Improve the displacement efficiency C. Injection rate has no effect on displacement efficiency D. None of the above v. As per the fractional flow equation relationship, which of the following parameters are in the control of operator A. Viscosity of oil B. Dip angle C. Direction of the flow D. Relative permeability of flooded zone v. Terwilliger and his coauthors termed the reservoir-flooded zone with this range of saturations, the stabilized zone and non-stabilized zone. As per their theory the non-stabilized zone is A. Particular saturation interval between Swc to Swf B. Particular saturation interval between Swf to 1-Sor C. Particular saturation interval between Swc to 1-Sor D. None of the above	
Q 6	i. Tax and Royalty system in License Agreement for exploration and production of a field A. License holder pay a royalty on production to the host government B. License holder sells all production and pay taxes on profits to the host government C. Both A & B above D. None of the above ii. The activity which is not the part of development and planning phase A. Drilling of wells B. Well logging C. Electro-magnetic studies D. All of the above iii. To maximize economic and efficient recovery of hydrocarbons which of the following action is not required. A. Avoid depleting reservoir energy inefficiently, especially during the early stages of reservoir development and production.	CO5

	B. Avoid excessive production of gas from the gas cap of a saturated reservoir C. Avoid high production rates leading to excessive pressure drawdown. D. Avoid drilling of development wells iv. During the field development, engineers feel that the precise picture of the size, shape and productivity of the reservoir is not clear. Under which phase of development this information could have been collected A. Exploration phase B. Appraisal phase C. Development and planning phase D. Production phase v. In the life of a field, the production phase start After completion of exploration, appraisal and development & planning phase A. May be after completion of exploration, appraisal and development & planning phase B. May be after completion of exploration and appraisal phase C. May be after completion of exploration phase D. All of the above	

SECTION B

1. Each question will carry 10 marks

2. Instruction: Write short / brief notes

S No.	Question	CO
Q 7	Describe in details the dewdrops in a gas condensate reservoir and its effect on production from such reservoir. Explain the difference between full gas and partial gas cycling.	CO1
Q 8	If you are assigned to evaluate suitability of oil reservoir for pressure maintenance, please present in details all features of reservoir to be considered for evaluation. Also, describe effect of trapped gas on water flood recovery.	CO3
Q 9	To predict the performance of a solution gas drive reservoir we require both the instantaneous gas-oil ratio equation and an equation to express the average oil saturation. Derive the instantaneous gas-oil ratio equation and reservoir saturation equation for a volumetric oil reservoir with no gas cap, producing below bubble point pressure. Use the instantaneous gas-oil ratio equation to explain briefly the shape of the producing GOR of a depletion type reservoir from a pressure above the bubble point to one significantly below the bubble point pressure.	CO2
Q 10	In an active water drive reservoir the rate of production and reservoir pressure, remain constant. The water influx into the reservoir from aquifer is 6000 bbl/day. The surface oil and water production are 3000 STB/day and 1500 STB /day respectively. The current production gas oil ratio (Rp) is 825 SCF/STB and the formation volume factor at the current pressure for oil, water and gas are 1.375 bbl	CO3

	/ STB, 1.04 bbl/ STB and 0.007 bbl/ STB respectively. Find out the solution GOR at current reservoir pressure	
Q 11	A private player is interested to enter into a hydrocarbon exploration and production business and wants to open an E & P company. Describe in details the various activities associated in this business right from start to bring oil and gas production at commercial scale with further managing the reservoir for maximum oil recovery	CO5

SECTION C

1. Each Question carries 20 Marks.

2. Instruction: Write long answer.

Q 12 — CO4

A water flood is to be conducted in an under saturated oil reservoir which has dimensions that will result in linear flow. The average cross-sectional area is approximately 78,000 square feet. The water saturation at breakthrough is 0.614. Additional data are: The first row of producers is located 1320 ft from injection wells

i_w = 7000 bbl/day B_w = 1.02 RB/STB

S_{wi} = 25% μ_o = 1.39 cp μ_w = 0.50 cp ϕ = 22%

k = 50 md α = 0 B_o = 1.25 $(df_w/dS_w)_{swf}$ = 0.364

S_w	k_{ro}/k_{rw}	S_w	k_{ro}/k_{rw}
0.25	0	0.55	0.612
0.30	11.12	0.60	0.292
0.35	4.84	0.65	0.098
0.45	2.597	0.70	0.017
0.50	1.340	0.72	0.000

A. Calculate the fractional flow for different water saturations
B. Determine the displacement sweep efficiency at the time of water breakthrough.
C. Determine the oil recovery at the time of water breakthrough.
D. How many barrels of cumulative water must be injected to obtain breakthrough
E. Determine the time (days) until water breakthrough.