

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End-Semester Examination, May 2021 (ONLINE MODE)

Course: Transport Phenomena in Geosystems Engineering

Semester: IV

Program: APE(UP)

Time : 3 hrs

Course Code: PEAU2007

Max. Marks: 100

Instructions: The exam is closed book and closed notes. Use of unfair means will be severely dealt with.

SECTION A

S. No.		Marks	CO
1	What is meant by 'Algebra of vectors'?	5	CO1
2	Verify whether the following statements are true or false. a. 'Scalar multiplication of vectors follow the commutative and associative laws' b. 'Vector multiplication of vectors is distributive' c. 'Scalar triple product is zero if and only if the three vectors are co-planer' d. 'Curl of a vector field is distributive.' e. 'A Laplacian can be defined only for a scalar field.'	5	CO1
3	.Explain the terms 'elastic resistance and 'viscous resistance'.	5	CO2
4	What is reduced viscosity? What are its units?	5	CO2
5	State Fick's law of diffusion in your own words.	5	CO2
6	Complete the following statements. a. Darcy's law is a consequence of _____. b. The Buckley-Leverett equation is a consequence of _____.	5	CO3

SECTION B

S. No.		Marks	CO
1	Determine the surface area of the portion of the plane $4x + 6y + 9z = 36$ that lies in the 1 st octant.	10	CO1
2	A pipe is transporting hot water at temperature T_h . The ambient temperature is T_a . The inner radius of the pipe is R and it has a thickness d . Use shell balance to calculate the heat loss per unit length of the pipe at steady state.	10	CO2
3	A spherical balloon made of polymeric material has hydrogen contained within it. The polymeric material has void spaces such that it allows hydrogen to diffuse through just like porous catalysts. Let the concentration of hydrogen inside the polymeric material be C_H and let there be negligible hydrogen concentration in the ambient air. If the effective diffusivity of hydrogen in the polymeric material be D_H , calculate the loss of hydrogen from the balloon at steady state given that the balloon has an inner radius of R and a thickness of t .	10	CO2

4	What is the Klinkenberg effect? Derive Darcy's law for gaseous phases.	10	CO3
5	What are the assumptions made while deriving the Buckley-Leverett equation? What is the primary consequence of these assumptions? Derive the Buckley-Leverett equation using these assumptions.	10	CO3
SECTION C			
1	Use the concepts of mass and momentum balance to derive the 'Black oil' equations for fluid flow in reservoirs.	20	CO4