Subject: **NATURAL GAS ENGINEERING**

Instructions: (i) ANY MISSING DATA MAY BE ASSUMED AND STATED
(ii) A total no. of six pages containing Graphs/Tables to be provided

Time: 3 hrs. **Max. Marks: 100**

Q.No.	Section-A Answer any two questions	Marks
1.	(a) Calculate the initial oil and gas in place per acre-foot for a gas condensate reservoir. *Given:* Initial pressure 3650 psia; Reservoir temperature 230°F; Average porosity 30%; Average connate water 25% Daily tank oil 250bbl; Oil gravity, 60°F 50°API; Daily separator gas 3200MCF; Separator gas gravity 0.68 Daily tank gas 130MCF; Tank gas gravity 1.21. (b) From the above data, calculate the total daily gas-condensate production in SCF and the total daily reservoir voidage. (c) Define and explain reservoir types with the help of phase diagram. (d) Explain retrograde condensation phenomena with molecular theories.	7+3+5+5 =20
2.	(a) A sour gas at 1000psia has the following analysis: N_2 = 8.5%, H_2S = 5.4%, CO_2 = 0.5%, C_1 = 77.6%, C_2 = 5.8%, C_3 = 1.9%, n–C_4 = 0.1%, i–C_4 = 0.1% and i–C_5 = 0.1%. What is the water content of this gas at 120°F? Use at least two methods. (b) What are gas hydrates? With a neat phase diagram explain gas hydrate formation phenomena. (c) List three methods for preventing gas hydrate formation at well sites. Compare and contrast these three methods.	10+ 4+ 6 =20
3.	(a) A natural gas pipe line of original length (L_A+L_C) has a new looping of length L_B parallel to L_A. Develop an expression for the rates of flow (q_{new}/q_{old}) in terms of lengths, diameters (d_A, d_B, d_C) and friction factors (f_A, f_B, f_C) of the three segments. What fraction of the original length must be looped to increase the flow rate by 50%? (b) Calculate the minimum throughput of a 21.25 in ID, 22.0 in OD, 80 mile long gas pipeline using Weymouth equation. Fix upstream pressure from design consideration and zero psia minimum pressure. Data given: C = 0.05,Y = 0.40, S = 35,000 psia, T_{AV} = 100°F.	10+10 = 20
4.	A gas field delivers 13.4MMscf/d of a 0.68 gravity gas and 300bbl/d oil with a 50% water cut. For an operating pressure of 1000 psig and temperature of 80°F, (i) Determine the ID of the spherical separater required to accommodate the liquid and gas, assuming a retention time of 5 minutes. (ii) How much more gas can be flowed through the separator without worrying about gas capacity?	10
5	From the basic mechanical energy balance equation, derive the general equation for steady state isothermal flow of a gas through a horizontal pipe.	10
6.	MEA, DEA and MDEA are used during the desulfurization of sour natural gas. List three most important properties in favour and against each of these solvents.	10
7.	Derive from primary system energy change concept, an equation in consistent units, for calculating flowing well bore pressure at the bottom of a vertical well.	10
8.	Using analytic approach, explain the design procedure of a multistage compressor for the determination of ideal horsepower required per MMscfd for a gas production field for the compression of the produced gas.	10
9.	Derive from primary system energy change concept, an equation in consistent units, for calculating flowing well bore pressure at the bottom of a vertical well.	10

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