**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, May 2022**

Course: Advanced Production Engineering          Semester: 6
Program: M. Tech (PE)                            Time     : 03 hrs.
Course Code: PEAU 7019                           Max. Marks: 100

Instructions: There is internal choice in Q9 & Q11

| | SECTION A (5Qx4M=20Marks) | | |
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| S. No. | | Marks | CO |
| Q 1 | Define the following terms:<br>a) cavitation<br>b) liquid re-entrainment | 4 | CO1 |
| Q 2 | Classify the types of pumps used in oil and gas industry | 4 | CO2 |
| Q 3 | Classify the types of compressors used in oilfield | 4 | CO2 |
| Q 4 | State the retention time (in minutes or hours) of following pressure vessels used in surface production facility: a) FWKO b) Gunbarrel c) vertical heater treater d) electrostatic heater treater | 4 | CO3 |
| Q 5 | State the typical treating temperature (in °F) for loose, moderate, tight, very viscous emulsions operating inside a) Gunbarrel b) heater treater c) electrostatic heater treater | 4 | CO4 |
| | SECTION B (4Qx10M= 40 Marks) | | |
| Q 6 | Name the equipment, draw any one schematic sketch and explain the process in brief, in which oil must be held at a temperature for a specific period of time to enable de-emulsifying the water in-oil emulsion. | 10 | CO3 |
| Q 7 | a) Write four important objectives of stage separation in a surface production facility<br>b) Estimate the free settling velocity (in ft/hr) of a 100 μm brine drop in oil. Following data is given: Specific Gravity of oil = 0.8, viscosity of oil = 10 cP, Specific Gravity of brine = 1.02 | 10 | CO4 |
| Q 8 | a) State the types of storage tank used in oil and gas industry. Explain the operation, design and parts of any one in detail.<br><br>b) Elaborate about corrosion control of storage tank | 10 | CO5 |
| Q 9 | Draw the process diagram for glycol dehydration and explain the design | 10 | CO6 |

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| | considerations.<br>OR<br>Discuss the potential operating problems during operation of a vertical separator | | |

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<tr><td colspan="4" align="center"><strong>SECTION-C</strong><br><strong>(2Qx20M=40 Marks)</strong></td></tr>
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<td>Q 10</td>
<td>a) Discuss in detail about vessel internal parts of a two-phase separator<br><br>b) Size a vertical 2 phase separator to determine diameter & seam to seam length of it. Following data is given:<br><br>    Gas flow rate = 10 mmscfd @ 0.6 specific gravity<br>    Oil flow rate = 2000 bopd @ 40 °API<br>    Operating Pressure of vessel = 1000 psia<br>    Operating Temperature of vessel = 60 °F<br>    diameter of droplet size to be removed = 140 μm<br>    Viscosity = 0.013 cP<br>    Gas compressibility factor = 0.84<br>    Drag coefficient = 0.851</td>
<td align="center"><strong>20</strong></td>
<td align="center"><strong>CO5</strong></td>
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<td>Q 11</td>
<td>a) State the primary and secondary condition for hydrates formation<br>b) State the function of baffles used in shell & tube heat exchanger<br>c) Discuss about estimation of settling velocity of water with the law applicable<br>d) Following data is given:<br><br>Gas flow rate = 25 mmscfd<br>Oil flow rate = 3000 bopd<br>Operating Pressure = 800 psig<br>Operating Temperature = 80 F<br>Flowing gas density = 3.4 lb/ft3 (for 20.3 Molecular Weight gas)<br>Flowing oil density = 51.5 lb/ft3 (40 °API)<br>Two phase separator is used. Calculate the diameter of vessel (in ft) and liquid capacity (in bbl/day). Assume 10 ft shell height of separator which is 30% liquid full. The value of constant, depending upon design and operating conditions, is 0.3<br><br>    e) Define emulsion and emulsifying agents. State and explain the factors on which stability of emulsion depends upon.<br><br><br><br><div align="center"><strong>OR</strong></div></td>
<td align="center"><strong>20</strong></td>
<td align="center"><strong>CO6</strong></td>
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a) Discuss about the type of devices used for measurement of oil and gas flow rate.

b) A liquid hydrocarbon (having density = 788.4 kg/m³ & viscosity = 5.857 * 10⁻⁷ kg/m–sec) flows through a pipe with inner diameter 4 cm and orifice meter installed to measure volumetric flow rate. Discharge coefficient is having the value of 0.61. The 2 pressure taps are connected to Hg U – tube manometer (density of Hg = 13600 kg/m³) and column height difference is 11 cm. The ratio of orifice diameter to pipe diameter is 0.75. Calculate volumetric flowrate of hydrocarbon.

c) Size a horizontal 3 phase separator. Following data is given:
Oil flow rate= 5000 bpd @ 30 °API
Water flow rate = 3000 bpd @ 1.07 specific gravity
Gas flow rate = 5 mmscfd @ 0.6 specific gravity
Operating pressure = 100 psia
Operating temperature = 90 °F
Retention time of oil = retention time of water = 10 min
Viscosity of oil = 10 cP & Viscosity of water = 1 cP
Gas density = 0.3 lb/ ft³ & Liquid density = 54.7 lb/ft³
Drag coefficient = 2.01 & Gas compressibility factor = 0.99
Droplet removal criterion is 100 microns liquids, 500 microns H₂O and 200 microns oil. Vessel is half full of liquid.