Roll No.											

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 11 – 12- 2025 **Time:** 09:30am – 12:30pm

School: SOE	**Program:** B.Tech. (PET)	
Course Code: PET2105	**Course Name:** Fundamentals of Oil and Gas Well Drilling Technology	
Semester: III	**Max Marks:** 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**10**	**4**	**34**	**26**	**26**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Choose the correct option. Which grade of drill pipe is the strongest? A. E B. X95 C. G105 D. S135	**2 Marks**	**L1**	**CO2**
2.	Select the correct option. Drill pipe Class TWO has a minimum wall thickness of: A. 95% B. 80% C. 65% D. 55%	**2 Marks**	**L1**	**CO2**
3.	Choose the correct option	**2 Marks**	**L1**	**CO3**

	Which of the following casing strings is typically set at 2,000–4,000 ft below the mudline? A. Drive Pipe B. Conductor Casing C. Surface Casing D. Production Liner			
4.	Select the correct option Which API collapse regime applies to thin-walled casing that fails due to elastic instability before yielding? A. Plastic Collapse B. Yield Collapse C. Elastic Collapse D. Transitional Collapse	**2 Marks**	**L1**	**CO3**
5.	Identify the rock-cutting mechanism used by a PDC bit. A. Crushing B. Scraping C. Grinding D. Impacting	**2 Marks**	**L1**	**CO4**
6.	Define the term *journal angle*. A. Angle between bit face and gauge B. Angle between journal axis and bit axis C. Angle of tooth penetration D. Cone offset angle	**2 Marks**	**L1**	**CO4**
7.	Recognize which bit is most suitable for drilling soft formations. A. Diamond bit B. TSP bit C. Milled-tooth roller cone bit D. PDC bit	**2 Marks**	**L1**	**CO4**
8.	Select the correct formula for Plastic Viscosity (PV). A. PV = $\theta_{600} + \theta_{300}$ B. PV = $\theta_{600} - \theta_{300}$ C. PV = $\theta_{300} - \theta_{600}$ D. PV = $\theta_{600} \times \theta_{300}$	**2 Marks**	**L1**	**CO5**
9.	Tabulate which of the following variables increase bit pressure loss: A. Increase in Q and decrease in A_T B. Increase in Q and increase in A_T C. Decrease in Q and increase in A_T D. Decrease in Q and decrease in A_T	**2 Marks**	**L1**	**CO5**

10.	Repeat which condition leads to turbulent flow A. $V_a<V_c$ B. $V_a=V_c$ C. $V_a>V_c$ D. $V_a=0$	**2 Marks**	**L1**	**CO2**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Distinguish the operating principles of the desander, desilter, and shale shaker within the solids-control system.	**10 Marks**	**L2**	**CO1**
	b.	Describe a graph for casing depth selection that includes the pore pressure gradient, mud density curve, fracture gradient, kick tolerance margin, and points a, b, c, and d. Explain how these elements guide the placement of surface, intermediate, and production casing strings.	**10 Marks**	**L2**	**CO3**
		Or			
12.	**a.**	Describe the role of the rotary table, kelly, and top drive in the rotating system of a drilling rig.	**10 Marks**	**L2**	**CO1**
	b.	Design a casing string for a well with a pore pressure gradient of 0.50 psi/ft and a planned casing depth of 10,500 ft. 1. Compute the required burst pressure. 2. A casing option has D = 9.625 in, wall thickness t = 0.435 in, and yield strength σ_y = 55,000 psi. Estimate its burst capacity. 3. Compare the required burst to the burst capacity and determine whether the casing is acceptable.	**10 Marks**	**L2**	**CO3**

13.	**a.**	A section of casing has the following properties: • Grade: P-110 • Outside diameter (OD): 8.625 in • Wall thickness (t): 0.400 in • Minimum yield strength (Y): 110,000 psi a) Calculate the D/t ratio (dimensionless). b) Determine whether this D/t falls inside the plastic-collapse D/t range for grade P-110 (use the D/t range shown for P-110 in the table).	**20 Marks**	**L3**	**CO 3**

c) Using the appropriate A, B, C values from the table compute the plastic-collapse pressure Pp and report the answer in psi.

TABLE 10.2 Formula factors and *D/t* ranges for plastic collapse. (Courtesy of API[2])

1	2	3	4	5
Grade†	*Formula factor*			*D/t range*
	A	*B*	*C*	
H-40	2.950	0.0463	755	16.44–26.62
-50*	2.976	0.0515	1056	15.24–25.63
J-K-55 & D	2.990	0.0541	1205	14.80–24.99
-60*	3.005	0.0566	1356	14.44–24.42
-70*	3.037	0.0617	1656	13.85–23.38
C-75 & E	3.060	0.0642	1805	13.67–23.09
L-80 & N-80	3.070	0.0667	1955	13.38–22.46
-90*	3.106	0.0718	2254	13.01–21.69
C-95	3.125	0.0745	2405	12.83–21.21
-100*	3.143	0.0768	2553	12.70–21.00
P-105	3.162	0.0795	2700	12.56–20.66
P-110	3.180	0.0820	2855	12.42–20.29
-120*	3.219	0.0870	3151	12.21–19.88
-125	3.240	0.0895	3300	12.12–19.65
-130*	3.258	0.0920	3451	12.02–19.40
-135	3.280	0.0945	3600	11.90–19.14
-140	3.295	0.0970	3750	11.83–18.95
-150	3.335	0.1020	4055	11.67–18.57
-155*	3.356	0.1047	4204	11.59–18.37
-160*	3.375	0.1072	4356	11.52–18.19
-170	3.413	0.1123	4660	11.37–18.45
-180*	3.449	0.1173	4966	11.23–17.47

† Grades indicated without letter designation are not API grades but are grades in use or grades being considered for use and are shown for information purposes.

Using the API collapse table, extract the D/T value for 5½-in, 14.00 lb/ft casing. Then:

a. Calculate the wall thickness.
b. Determine the internal diameter
c. Calculate the cross-sectional metal area.
d. Examine your calculated area with the tabulated area.

MINIMUM COLLAPSE RESISTANCE OF CASING
UNDER AXIAL LOAD
GRADES J-55 AND K-55

D IN	WT/FT LB/FT	D/T	AREA SQ. IN.	-10000	-5000	0	5000	10000	15000	20000	25000	30000	35000	40000	45000	50000
						AXIAL STRESS – PSI / COLLAPSE PRESSURE—PSI										
4.5	9.5	21.95	2.766	3440	3390	3310	3230	3120	3000	2850	2680	2470	2220	1930	1420	—
	10.5	20.09	3.009	4200	4110	4010	3880	3740	3570	3380	3150	2890	2570	2150	1540	—
	11.6	18	3.338	5220	5100	4960	4790	4590	4360	4100	3800	3450	2980	2380	1710	—
5	11.5	22.73	3.304	3170	3120	3060	2980	2890	2790	2660	2500	2320	2090	1820	1370	—
	13	19.76	3.773	4340	4250	4140	4010	3860	3690	3480	3240	2970	2640	2180	1570	—
	15	16.89	4.374	5880	5730	5560	5360	5120	4860	4550	4210	3730	3160	2530	1820	—
5.5	14	22.54	4.029	3230	3180	3120	3040	2950	2840	2700	2550	2350	2130	1850	1380	—
	15.5	20	4.514	4230	4150	4040	3920	3770	3600	3410	3180	2910	2590	2160	1550	—
	17	18.09	4.962	5180	5060	4910	4740	4550	4320	4060	3770	3430	2970	2370	1700	—
6.625	20	23	5.734	3070	3030	2970	2900	2820	2720	2590	2450	2270	2050	1790	1360	—
	24	18.82	6.937	4790	4690	4560	4410	4230	4030	3800	3530	3220	2850	2290	1640	—
7	20	25.74	5.749	2370	2320	2270	2210	2140	2090	2020	1930	1810	1670	1480	1220	—
	23	22.08	6.656	3400	3340	3270	3180	3080	2960	2820	2650	2450	2200	1910	1410	—
	26	19.34	7.549	4540	4440	4320	4190	4020	3840	3620	3370	3080	2730	2230	1600	—
7.625	26.4	23.25	7.519	2990	2950	2890	2830	2750	2650	2530	2390	2220	2010	1760	1340	—
8.625	24	32.67	6.934	1400	1390	1370	1350	1320	1290	1250	1200	1140	1070	980	870	—
	32	24.5	9.149	2600	2570	2530	2490	2430	2350	2260	2150	2010	1830	1610:	1280	—
	36	21.56	10.336	3590	3530	3450	3360	3240	3110	2960	2770	2550	2290	1980	1440	—
9.625	36	27.34	10.254	2100	2070	2020	1970	1920	1850	1770	1670	1590	1480	1330	1150	—
	40	24.37	11.454	2640	2610	2570	2520	2460	2380	2290	2170	2030	1850	1630	1280	—
10.75	40.5	30.71	11.435	1630	1610	1580	1550	1520	1470	1420	1360	1280	1190	1090	960	—
	45.5	26.88	13.006	2170	2140	2090	2040	1980	1900	1820	1740	1650	1530	1370	1180	—
	51	23.89	14.561	2780	2750	2700	2650	2580	2500	2390	2260	2110	1920	1680	1310	—
11.75	47	31.33	13.401	1550	1540	1510	1490	1450	1410	1360	1310	1230	1150	1050	930	—
	54	27.01	15.463	2150	2120	2070	2020	1960	1890	1810	1720	1630	1520	1360	1170	—
	60	24.03	17.3	2740	2710	2660	2610	2540	2460	2360	2240	2080	1900	1660	1300	—
13.375	54.5	35.2	15.514	1140	1140	1130	1120	1110	1090	1060	1030	980	930	860	770	—
	61	31.1	17.487	1580	1560	1540	1510	1480	1440	1380	1320	1250	1160	1060	940	—
	68	27.86	19.445	2020	1990	1950	1900	1850	1780	1710	1620	1520	1420	1290	1120	—
16	75	36.53	21.414	1020	1020	1020	1010	1010	990	970	950	910	860	800	720	—
	84	32.32	24.112	1440	1420	1410	1390	1360	1320	1280	1230	1160	1090	1000	890	—
18.625	87.5	42.82	24.858	630	630	630	630	630	630	630	630	620	600	580	530	—
20	94	45.66	26.918	520	520	520	520	520	520	520	520	520	510	490	470	—
	106.5	40	30.631	770	770	770	770	770	770	770	760	740	710	670	610	—
	133	31.5	38.632	1530	1520	1500	1470	1440	1400	1350	1290	1220	1140	1040	920	—

Or

14.	**a.**	Contrast elastic, plastic, transition, and yield collapse regimes and explain how the D/t ratio governs the collapse mechanism in each regime	**20 Marks**	**L3**	**CO 3**

15.	**a.**	(i) Analyze the three-code IADC roller-cone bit classification system. (ii) Relate how each code—series classification, formation hardness, and bearing/bit features—guides the selection of a suitable bit for different formation types.	**20 Marks**	**L4**	**CO 4**

Or

16.	**a.**	(i)Given the bit performance equation for cost per foot, calculate the cost per foot for a bit run where: • Bit cost = $45,000 • Drilling time = 12 hours • Operating cost = $1,800/hr • Section drilled = 1,320 ft Show all steps clearly. (ii) Appraise how variations in rate of penetration (ROP), bit cost, and drilled footage affect the economic optimization of bit runs in real-time drilling decisions.	**20 Marks** **(15+5)**	**L4**	**CO 4**

17.	**a.**	(i) Compare the Newtonian, Bingham Plastic, and Power Law rheological models used in drilling hydraulics. (ii) Describe how each model represents the shear stress–shear rate relationship and distinguish the role of PV, YP, n, and K in predicting frictional pressures during circulation	**20 Marks**	**L2**	**CO5**
		Or			
18.	**a.**	Using the following conditions: • Mud weight = 14.5 lb/gal • Flow rate = 300 gpm • Three jet nozzles, each 12/32 in in diameter • Discharge coefficient Cd = 0.95 Estimate the following: (a) Convert the nozzle diameter (12/32 in) into the total nozzle area A_T. (b) Using the total nozzle area you calculated, determine the nozzle velocity V_N with the field-unit formula. Explain how applying C_d=0.95 changes the calculated nozzle velocity and summarize why this correction is required in real field operations.	**20 Marks**	**L2**	**CO5**