Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Mechanics of Drilling Engineering **Semester: III**
Program: B.Tech APE UP **Time : 03 hrs.**
Course Code: PEAU 2006 **Max. Marks: 100**

Instructions: All questions are compulsory. However, internal choice has been provided. You have to attempt only one of the alternatives in all such questions.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Why to maintain hydrostatic pressure is greater than formation pressure? Justify	**04**	**CO1**
Q 2	Define Drill collars and HWDP?	**04**	**CO2**
Q 3	Optimizing weight on bit (WOB) is an essential part of drilling to ensure that the well deepens as drilling moves forward. Justify	**04**	**CO2**
Q 4	What is the normal range of pH of a drilling mud? Why a very high pH is undesirable in drilling muds?	**04**	**CO1**
Q 5	Explain the main causes for torque and drag during drilling an oil well. Under which circumstances a wellbore is known to be in poor hole condition.	**04**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	a) Draw the flow diagram of a "Mud Circulation System b) Explain any two properties of a drilling fluid and illustrate their importance	**5+5**	**CO1 + CO2**
Q 7	List and describe the functions of each of the component parts of the hoisting system on a conventional land drilling rig?	**10**	**CO3**

Q 8	Discuss the Selection criteria parameters of drill string along with all loads and selection procedure of drill pipe.	**10**	**CO4**
Q 9	A single-acting triplex pump of an output power of 1,250 hp is used to deliver the required rate at running speed of 110 strokes/min. The liner size and length are 5.5 and 30 inches, respectively. If the displacement efficiency is 90%, calculate the discharge pressure of the pump at that speed. **OR** While drilling, 250 hp was applied to rotate the drillstring and bit where 500 rpm was recorded from the rotary speed machine. In addition, 175 hp was applied to rotate 3,500 ft of drillpipe off 5 in OD with the same speed as drillstring. Assume that C_d = 0.000005. Calculate the required torque for drilling string and the specific gravity of mud.	**10**	**CO4**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	The hoisting system of a rig derrick has a load of 350,000 lbf. The input power of the drawworks for the rig can be a maximum of 530 hp. Eight drilling lines are strung between the crown block and traveling block. Consider there is some loss of power due to friction within the hoisting system. Compute: (1) the static tension in the fast line when upward motion is impending, (2) the mechanical advantage of the block and tackle, (3) the maximum hook horsepower available, (4) the maximum hoisting speed, (5) if a 90 ft stand is required to be pulled, what should be the required time, (6) the actual derrick load, (7) the maximum equivalent derrick load, and (8) the derrick efficiency factor	**20**	**CO5**
Q 11	I. Calculate the Drill collar Dimensions and weights: a. What is the weight in air of 200 ft of 9 1/2" x 2 13/16" drill collar? b. What is the weight of this drill collar when immersed in 11 ppg mud? c. It is not uncommon for 5" 19.5 lb/ft drill pipe to be used in the same string as 8 1/4" x 2 13/16" drill collars. Compare the nominal I.D. of this	**20**	**CO6**

	drill pipe and Drill collar size and note the differences in wall thickness of these tubulars. II. The highest rate of penetration for a particular 12 1/4" bit will be achieved when 25,000lbs weight on bit (Wob) is applied to the bit. Assuming that the bit will be run in 12 ppg mud, calculate the length of drill collars required to provide 25,000 lbs Wob. a) Calculate the weight (in air) of 10000 ft of 5" 19.5 lb/ft Grade G drill pipe with 4 1/2" IF connections. b) Calculate the weight of this string in 14 ppg mud. Calculate the length of 9 1/2" x 2 13/16" drill collars that would be required to provide 25,000 lbs Wob and keep the drill pipe in tension in 12 ppg mud **OR** A drilling string consists of 750 ft of Drill Collar have weight of 90 ppf and Drill Pipes have weight of 25 ppf was used to drill a well to a depth of 16,500 ft using 11.4 ppg drilling mud. If yield strength of drillpipe is 600,000 lbf and steel density is 65 ppg calculate the safety factor at this situation. And if the maximum overpull that can be applied to the drillstring is 75,000 lbf, to what depth can the current drillstring be used to drill this well?	**20**	**CO6**

Tables

CAPACITY AND DISPLACEMENT OF DRILLPIPE

SIZE AND CONN.	NOMINAL WEIGHT LB/FT	GRADE	APPROX WEIGHT LB/FT	CAPACITY L/M	CAPACITY GALL/FT	OPEN END DISPLACEMENT L/M	OPEN END DISPLACEMENT GALL/FT	CLOSED END DISPLACEMENT L/M	CLOSED END DISPLACEMENT GALL/FT
2 3/8		E75	7.00			1.39	0.107	3.01	0.242
2 3/8	6.65	X95	7.08	1.68	0.135	1.34	0.108	3.02	0.243
IF		G105	7.08			1.34	0.108	3.02	0.243
NC26									
2 7/8		E75	10.82			2.05	0.165	4.41	0.355
2 7/8	10.4	X95	10.89	2.36	0.190	2.06	0.166	4.42	0.356
IF		G105	10.89			2.06	0.166	4.42	0.356
NC 31		S135	11.20			2.12	0.171	4.48	0.361
	9.5	E75	10.39	4.54	0.366	1.97	0.159	6.51	0.525
		E75	13.86	3.88	0.312	2.63	0.212	6.51	0.524
3 1/2	13.3	X95	14.32	3.96	0.319	2.71	0.218	6.67	0.537
3 1/2		G105	14.38	3.87	0.312	2.73	0.220	6.60	0.532
IF		E75	16.42			3.11	0.250	6.57	0.529
NC38	15.5	X95	16.54	3.46	0.279	3.14	0.253	6.60	0.532
		G105	16.61			3.15	0.254	6.61	0.533
		E75	20.99			3.98	0.320	13.14	1.058
5		X95	21.09			4.00	0.322	13.16	1.070
	19.5	G105	21.50	9.16	0.738	4.08	0.329	13.24	1.087
4 1/2		S135	22.09			4.19	0.337	13.35	1.075
IF		E75	27.01	8.11	0.653	5.12	0.412	13.23	1.065
NC50	25.6	X95	28.30	8.10	0.652	5.36	0.432	13.46	1.084
		G105	28.11	8.09	0.651	5.33	0.429	13.42	1.080

lbs/ft = 2.67 (OD² - ID²)

DRILL COLLAR WEIGHTS (STEEL) POUNDS PER FOOT

Collar O.D.	BORE OF COLLAR										
	1-1/2	1-3/4	2	2-1/4	2-1/2	2-13/16	3	3-1/4	3-1/2	3-3/4	4
3-3/8	24.4	22.2									
3-1/2	26.7	24.5									
3-3/4	31.5	29.3									
3-7/8	34.0	31.9	29.4	26.5							
4	36.7	34.5	32.0	29.2							
4-1/8	39.4	37.2	34.7	31.9							
4-1/4	42.2	40.0	37.5	34.7							
4-1/2	48.0	45.8	43.3	40.5							
4-3/4	54.2	52.0	49.5	46.7	43.5						
5	60.2	58.5	55.9	53.1	49.9						
5-1/4	67.5	65.3	62.8	59.9	56.8	53.3					
5-1/2	74.7	72.5	69.9	67.2	63.9	60.5	56.7				
5-3/4	82.1	79.9	77.5	74.6	71.5	67.9	64.1				
6	89.9	87.8	85.3	82.5	79.3	75.8	71.9	67.8	63.3		
6-1/4	98.1	95.9	93.5	90.6	87.5	83.9	80.1	75.9	71.5		
6-1/2	106.6	104.5	101.9	99.1	95.9	92.5	88.6	84.5	79.9		
6-3/4	115.5	113.3	110.8	107.9	104.8	101.3	97.5	93.3	88.8		
7	124.6	122.5	119.9	117.1	113.9	110.5	106.6	102.5	97.9	93.1	87.9
7-1/4	134.1	131.9	129.5	126.6	123.5	119.9	116.1	111.9	107.5	102.6	97.5
7-1/2	143.9	141.7	139.3	136.5	133.3	129.8	125.9	121.8	117.3	112.5	107.3
7-3/4	154.1	151.9	149.5	146.6	143.5	139.9	136.1	131.9	127.5	122.6	117.5
8	164.6	162.5	149.9	157.1	153.9	150.5	146.6	142.5	137.9	133.1	127.9
8-1/4	175.4	173.3	170.8	167.9	164.8	161.3	157.5	153.3	148.8	143.9	138.8
8-1/2	186.6	184.4	181.9	179.1	175.9	168.6	172.5	164.5	159.9	155.1	149.9
8-3/4	198.1	195.9	193.9	190.6	187.4	183.9	180.1	175.9	171.4	166.6	161.5
9		207.8	205.3	202.4	199.3	195.8	191.9	187.8	183.3	178.5	173.3
9-1/2		232.4	229.9	227.1	223.9	220.4	216.6	212.4	297.9	203.1	197.9
10			255.9	253.1	249.9	246.4	242.6	238.4	233.9	229.1	223.9
10-1/2			283.3	280.4	277.3	273.8	269.9	265.8	261.3	256.4	251.3
11					305.9	302.4	298.6	294.4	289.9	285.1	279.9

MUD DENSITY, GRADIENT AND BUOYANCY FACTOR

NOTE: Buoyancy factor is for STEEL only

Mud density			Gradient	Buoyancy	Mud density			Gradient	Buoyancy
kg/m³	lb/gall	lb/ft³	psi/ft	Factor	kg/m³	lb/gall	lb/ft³	psi/ft	Factor
1000	8.34	62.4	.433	.873	1800	15.0	112	.779	.771
1010	8.40	62.8	.436	.872	1820	15.2	114	.790	.768
1030	8.50	64.3	.447	.869	1850	15.4	115	.800	.765
1060	8.80	65.8	.457	.866	1870	15.6	117	.810	.762
1080	9.00	67.3	.468	.862	1890	15.8	118	.821	.759
1100	9.20	68.8	.478	.860	1920	16.0	120	.831	.755
1130	9.40	70.3	.488	.856	1940	16.2	121	.842	.753
1150	9.60	71.8	.499	.853	1970	16.4	123	.852	.749
1154	9.625	72.0	.500	.853	1990	16.6	124	.862	.746
1180	9.80	73.3	.509	.850	2010	16.8	126	.873	.743
1200	10.0	74.8	.519	.847	2040	17.0	127	.883	.740
1220	10.2	76.3	.530	.844	2060	17.2	129	.894	.737
1250	10.4	77.8	.540	.841	2090	17.4	130	.904	.734
1270	10.6	79.3	.551	.838	2110	17.6	132	.914	.731
1290	10.8	80.8	.561	.835	2130	17.8	133	.925	.728
1320	11.0	82.3	.571	.832	2160	18.0	135	.935	.725
1340	11.2	83.8	.582	.829	2180	18.2	136	.945	.722
1370	11.4	85.3	.592	.826	2210	18.4	138	.956	.719
1390	11.6	86.8	.603	.823	2230	18.6	139	.966	.716
1410	11.8	88.3	.613	.820	2250	18.8	141	.977	.713
1440	12.0	89.8	.623	.817	2280	19.0	142	.987	.710
1460	12.2	91.3	.634	.814	2300	19.2	144	.997	.707
1490	12.4	92.8	.644	.810	2330	19.4	145	1.01	.704
1510	12.6	94.3	.655	.808	2350	19.6	147	1.02	.701
1530	12.8	95.8	.665	.804	2370	19.8	148	1.03	.698
1560	13.0	97.3	.675	.801	2400	20.0	150	1.04	.694
1580	13.2	98.7	.686	.798	2420	20.2	151	1.05	.692
1610	13.4	100	.696	.795	2450	20.4	153	1.06	.688
1630	13.6	102	.706	.792	2470	20.6	154	1.07	.685
1650	13.8	103	.717	.789	2490	20.8	156	1.08	.682
1680	14.0	105	.727	.786	2520	21.0	157	1.09	.679
1700	14.2	106	.738	.783	2540	21.2	159	1.10	.676
1730	14.4	108	.748	.780	2570	21.4	160	1.11	.673
1750	14.6	109	.758	.777	2590	21.6	162	1.12	.670
1770	14.8	111	.769	.774	2610	21.8	163	1.13	.667