	MA	13006 Sem 1 19/20	Date No.
((a)(i)	Vix=12cos 30°	V2x = -1260830° 0	11 01 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	Vig=-12sin30°	V2y = -12 sin30° 0	1. 200 . 10
	V 1711V		A PART TARREST
	m=pAV=1000π(0.0	004)²(12)= 0.6032kg/s	
1000	SE 5512 (11) 5	ni () ()	
	EFX-EM (VOH) = EI	$(V_{in})_{\infty}$	ave ave
	Fx=0-0.6032(1	$(2\cos 30^\circ) = -6.268N$	0.00
	ZFg=Zm(Vou)y-	CONTRACTOR STORY	410101018-49
			01/3
\oplus		-12sin30°)=3.619N	O. J. M. The
	F= JFx+Fx2=7.2	4 N	
1(a)(;	V24=#12 & V34=-1	$V_{2x} = V_{3x} = 0$	
	V2y=# 2 & V3y=- 1 Fx=-6.268N		
	2Fy= m2V2y+m	Var- m V	$\dot{m}_{1} = \dot{m}_{2} + \dot{m}_{3}$
		o d	$\dot{m}_{3} = \dot{m}_{1} - \dot{m}_{2}$
	ty=12m2-12m3-	- 0.6032(-12sin30°) m2)-0.6032(-12sin30°)	1113-1111112
	0 = 12m2-12(m,-1	m_2) - 0.6032(-128in30°)	6032 1/2
	FR= 6.27 N	1 10 (022 (120:020)	- 242 - 15-ol-/
-	24M2-12(0.6032	L) +0·6032(12sin30°) : s	= () =) 2 = () · 5 (8 Kg / S
	M3=0.4226	12	-tunita O'n l mat II - 1
(a)(iii	rolative spen 1-170	0530°+3=13.39m/5~	always find relative speed
(W)(m)	- 41// 10-01/	(TX (0.004)2 X13.39 =	-0.673kg/s
			ma =mv) get the idea
	=(0.612)(2.20)	V / A /// - -	0.673 x 13.39 = 9.015N
	-105/1	W=F	
	-100 //		7.015 X3 = 27.05 W
			L -1-112 F 1 OO VV
	Sangara and a sangara		
A	towards=)(+) & away	-)(-)	
9 D	The state of the s		

MA3006 Sem 19/20 (b) Q1= Q2= 2X10-3 m3/s $V_1 = \frac{Q_1}{A_1} = \frac{0.002}{\pi (0.015)^2} = 2.829 \text{ m/s}$ $V_2 = \frac{Q_2}{A_2} = \frac{0.002}{\pi (0.03)^2} = 0.7074 \text{ m/s}$ $\frac{P_{1} + V_{1}^{2}}{P_{0}} + \frac{V_{1}^{2}}{29} + \frac{P_{2}}{29} + \frac{V_{2}^{2}}{29} + \frac{V_$

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 $\Delta P = \frac{m\alpha}{\text{area}} = kg(\frac{m}{s^2})(\frac{1}{m^2})$ $= \frac{kg}{m^2 S^2}$

Qactual = AV NOT Qideal!

A STATE OF THE STA	Clactual = AV NOT Clideal!	- N C2
	o right soll atback!	Date No.
2(0)	$\beta = \frac{56}{80} = 0.7$ & Re = $\frac{PVd}{M} = \frac{1000 \times 1.8 \times 0.08}{1.002 \times 10^{-3}}$	=1-437×10° Qactual = AIV1
	Frm fig 3, Co= 056#5 0.613	
	$Q_{\text{actual}} = C_0 A_2 \sqrt{\frac{2\Delta p}{p(1-\beta^4)}} & Q_{\text{ideal}}$	= Co
Qactua	Qidea = $\pi (0.04)^2 \times 1.8 = 9.0478 \times 10^{-3} \text{ m}^3/\text{s}$	2 (2/IP
	Qideal = A2 P(1-134) => 9.0478X10-3= T1(0	
2(b)	$\Delta P = \mathcal{E}(\omega, D, Q) P, M$ Kneed to Sind ΔP $\mathcal{H}_1 = Q(p)^{\alpha}(\omega)^{b}(D)^{c}$ $= \left(\frac{m^3}{S}\right) \left(\frac{kq}{m^3}\right)^{\alpha} \left(\frac{1}{S}\right)^{b} (m)^{c}$	also $P = \frac{kg}{m^3}$ $Q = \frac{m^3}{s}$
0	$\pi = Q(p)^{\alpha}(\omega)^{b}(D)^{c}$ (31) terms!)	$M = \frac{Ns}{m^2} = \left(kg\frac{m}{s^2}\right)\left(\frac{s}{m^2}\right) = \frac{kg}{ms}$
	$= \left(\frac{m^3}{S}\right) \left(\frac{kq}{m^3}\right)^{\alpha} \left(\frac{1}{S}\right)^{b} \left(m\right)^{c}$	T 00 (0)9 (0)16 (0) C
	kg: 0=0 s:-1-b=0 => b=-1	11, -21 ()) (2)
	$m: 3-3a+c=0 \Rightarrow c=-3$	$-\frac{(kq)}{m^2s^2}\left(\frac{kq}{m^3}\right)^a\left(\frac{1}{s}\right)^b\left(m\right)^c$
	$ \Pi_1 = \frac{Q}{\omega D^3} $	kg: +a=0=)a=- m:-1-3a+c=0=)c=4-7-
3		S: -2-b=0=>b=-2
713	$\pi_2 = M(p)^q (\omega)^b (D)^c$	$T_1 = \frac{\Delta P}{P \omega^2 D^2}$
(A)	$= \left(\frac{kq}{ms}\right) \left(\frac{kq}{m^3}\right)^{\alpha} \left(\frac{1}{s}\right)^{b} (m)^{c}$,
	kg: +a=0=)a=- S:-1-b=0=)b=-1	got 6 terms let (0,D,P be Variables
	m:-1-3atc=0=)-1+3+c=0=)c=-2	
	$T_3 = \frac{7^{-1}}{p\omega D^2}$	
	AD-O/Q MIV/ AP O/	Qu
		ωD^3 , $\beta \omega D^2$
	Power = PgQAh=) APQ Power (C) C-P	
	coefficient (P). CP-pw3D5	

Q=VA) Model & prototype have diff areas

	have diff areas
2 Qis not div	weres the same for model a prototypei
$\frac{Q(C)}{(\omega D^3)_m} = \frac{Q(Q)}{(\omega D^3)_p}$	need use fought
	There was something
$\frac{15}{(0.64)^3} = \frac{15}{500(0.8)^3} = 0 = 1$	$\frac{500(0.8)^2}{100}$ - 977 rbm
$(0.64)^3$ 500(0.8)3	(0.64)3 - 1111111
10	Marchad _ no wo 1/(1-194)
(fr) - (fr) 2/90°	Circal - IT (0.04) XIX = 9.0478 XIO
(PWD2) P LPWD2/M	Early SAF - Carroy 63
$ \frac{(\mathcal{A}^{r})_{p} - (\mathcal{A}^{r})_{p}}{(\mathcal{P} \otimes \mathcal{D}^{2})_{m}} = (\mathcal{P} \otimes \mathcal{D}^{2})_{m} $ $ \otimes_{m} \mathcal{D}_{m}^{2} = (\mathcal{P} \otimes \mathcal{D}^{2})_{m} $	Wideal Fre Titlet of Torio
(1) - (1) (Dp.)2 - 50	$O\left(\frac{0.8}{0.64}\right)^2 = 781.25 \text{ rpm}$
m p Dm / - 80	0.64) - 101.23 Political = 91 (d)s
2(1)	Laure IS - STEELS
$2(0)$ $2 \arctan = A_1 V_1 = 71 (0.04)^2 \times 1.8$	$3 = 9.0478 \times 10^{-3} \text{ m}^3/\text{s}$
2(a) Qactual = $A_1V_1 = \pi (0.04)^2 \times 1.8$ Qactual = $C_0 A_2 \int_{\pi (1-\beta^4)}^{2\Delta P} = 9.04$	$178 \times 10^{-3} \text{m/s}$
$0.613 \times \pi (0.028)^2 / 2\Delta P =$	9.0478 X10-3 => AP=13644 Pa
J[000(1-0. 1)	1 110 10 9 4] - 1309414
4.0000000000000000000000000000000000000	6-40 (= 0 = 0 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0
$\Re Q_{actual} = C_0 A_2 \sqrt{\frac{2\Delta P}{P(1-\beta^4)}}$	$= A_1 V_1$ $A_1: pipe's area$ $A_2: orifice area$
Δ - Δ [2ΔΡ]	
Qideal = 1/2 [P(1-134)	Vi: velocity flow @ pipe
Qideal = $A_2 \int \frac{2\Delta P}{P(1-P^4)}$	VI. VEIOCITY FLOW (1) PIPE
Qideal = $A_2 \int_{P(1-\beta^4)}$	VI. VEIOCITY Flow @ Pipe
Qideal = 1/2 JP(1-184)	VI. Velocity +1000 (a) Pipe
Qideal = $\Lambda_2 \int_{P(1-\beta^4)}$	1. velocity +1000 (0) pipe
Qideal = $A_2 \int_{P(1-\beta^4)}$	1-26 0-2-1-12
Qideal = 1/2 Jp(1-184)	1-20G O = 1-1-10 1-20G O = 1-1-10 1-20G O = 1-1-10 1-20G O = 1-1-10
Qideal = 1/2 [p(1-184)]	15 25 = 15 (2) (2) (2) (3) (4) (4) (5) (4) (5) (4) (6) (6) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
Qideal = $A_2 \int_{P(1-\beta^4)}$	10G O = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 = 0 =
Qideal = 1/2 Jp(1-184)	15 25 = 15 (2) (2) (2) (3) (4) (4) (5) (4) (5) (4) (6) (6) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
Qideal = 1/2 Jp(1-184)	15 25 = 15 (2) (2) (2) (3) (4) (4) (5) (4) (5) (4) (6) (6) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
Qideal = 1/2 Jp(1-184)	15 25 = 15 (2) (2) (2) (3) (4) (4) (5) (4) (5) (4) (6) (6) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
Qideal = $\Lambda_2 \int P(1-\beta^4)$	15 25 = 15 (2) (2) (2) (3) (4) (4) (5) (4) (5) (4) (6) (6) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
$Qideal = \Lambda_2 \int_{P(1-\beta^4)}$	15 25 = 15 (2) (2) (2) (3) (4) (4) (5) (4) (5) (4) (6) (6) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7

2(0)	Aggunda and I had a laminar & one 2 had a kind	Date No.
(v)¢	Assume pipe 1 to be laminar & pipe 2 to be turb $d_1=d_2=0.1m$ $Q_1=Q_2=0.01m^3/s$	SOLUTION SOLUTION CONTRACTOR
	01-82-0-111	1 Van for both
	$V_1 = \frac{Q_1}{A_1} = \frac{0.01}{\pi (0.05)^2} = 1.273 \text{ m/s}$ $V_2 = 1.273 \text{ m/s}$	0:00 1 8 7
	7 1 11(0 0 -)	V PIPE I & Z
417	Pipe 1	PAY YAR
FORIS	Pipe I Re = $\frac{PVd}{M} = \frac{800(1.273)(0+1)}{91} = 1020 \text{ (laminar)}$ Value 0: 1 = $\frac{2V_{\text{out}}}{M} = \frac{1}{2} = \frac{2(1.273)}{2.546} = \frac{1}{2} = \frac{2(1.273)}{2.546} = \frac{1}{2} = \frac{2(1.273)}{2.546} = \frac{1}{2} = \frac{2(1.273)}{2.546} = \frac{1}{2} = \frac{1}{$	laminar
TE PO	Re-M- 1020 (Idiminut)	$Vavg = \frac{1}{2}Vc$
	Vc @ pipe 1 = 2 Vavg @ pipe 1 = 2(1.273) = 2.546m/s	PE 18 TO T
o' on Ca		Part - con - an
0	Pipe 2	5.0 -41
	$Re = \frac{PVd}{M} = \frac{7(1.273)(0.1)}{0.00001} = 89110 (turbulent)$	turbulen4 2
	MO M 0.00001	$\frac{turbulent}{V_{avg} = 2V_c \frac{n^2}{(n+1)(2n+1)}}$
	Frm fig 5, n=7	· · · · · · · · · · · · · · · · · · ·
- Land 12 1	$0.01 = 2\pi (0.05)^2 V_c @ Pipe 2 \frac{7^2}{8x15}$	
	Vc @ Pipe 2=1.559m/s	15130-01
11/2/15	VE () PIPE Z 1 30 1 1 1 1 3	1. 3.1.0.0.0.
	V. @ pipe 2 - 2.546 1.559 - 0 (12	4.0 -61
	Vc@pipe 2 - 2.546 - 1.559 - 0.612 Vc@pipe 7559 - 2.546 = 0.612	1000-001-
	With the second	P30000-00, 1
. 0	- 101 x 500 - 101 x 500 -	N 10 1 ma
	-1-02 (1:62	50 1910 - 4 OLL
	5 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	11 0000
	7941 4.0 %.	76 62. 5011
	72700 - 1 - Grown 1 V - 200 - 1	PHP 3: 63 d3 7

	Date No.
3(b)	Consider ONLY 2 cases: OA>C&OB>C A>B/B>AX
	V@reservoir =V=O=)Va=Ve=Vc=O
	$Q_1 = Q_2 = 0.2 \text{ m}^3/\text{s}$ $Q_3 = 0.4 \text{ m}^3/\text{s}$
	VI A. 710.05)2-11-1011/2 12-11-11-11-11-11-11-11-11-11-11-11-11-1
	$A \rightarrow C$ 40
	10 + Vot +7/2 - h = Pc/ +Vot +7/2 - Q3 - Q4 / 4
	79 /2 7 11 pg / 12 V3 - A3 - 43 Td32)
	$40 = \frac{1}{3} \frac{1}{1} \frac{\sqrt{1}}{1} + \frac{1}{3} \frac{1}{3} \frac{\sqrt{3}}{1} = 0.5093 \left(\frac{1}{3}\right)^{2}$
	$\frac{PA}{Pg} + \frac{VA^{2}}{ZQ} + \frac{7}{A} - h_{L} = \frac{Pc}{Pg} + \frac{VA^{2}}{ZQ} + \frac{7}{A} - h_{L} = \frac{Pc}{Pg} + \frac{VA^{2}}{ZQ} + \frac{7}{A} - \frac{Q_{3}}{A_{3}} = \frac{O\cdot 4}{A_{3}} + \frac{4}{\pi d_{3}^{2}}$ $40 = \frac{0.02(1000)}{0.5} \times \frac{1.019^{2}}{19.62} + \frac{0.02(500)}{d_{3}} \times \frac{1}{19.62} \times \left[0.5093(\frac{1}{d_{3}^{2}})\right]^{2} \times \frac{O\cdot 2}{\pi (0.25)^{2}} = 1.019 \text{m/s}$
n²	$37.883 = 0.1322 \frac{1}{d_3^5} \Rightarrow d_3 = 0.322m$
JKE (m	Fens Fig. 5 He T
	B>C 1502
	$45 = \frac{1}{5} \frac{1}{10} \frac{V_{2}^{2}}{10} + \frac{1}{5} \frac{1}{10} \frac{V_{3}^{2}}{10} + \frac{1}{5} \frac{1}{10} \frac{V_{3}^{2}}{10} + \frac{1}{5} \frac{1}{10} \frac{V_{3}^{2}}{10} + \frac{1}{5} \frac{1}{10} \frac{V_{3}^{2}}{10} + \frac{1}{5} \frac{1}{10} \frac{1}{10} \frac{V_{3}^{2}}{10} + \frac{1}{5} \frac{1}{10} \frac{1}{1$
	$45 = 0.02 l_2 \times 1.592^2 + 0.02(500) \times 1 \times 10.5093 (-1.592)^2$
	$7.103 = 0.00646 l_2 = l_2 = 1100 m$
	Pipe 1: $\frac{1}{5_1} \frac{V_1^2}{d_1} = \frac{0.02}{29} = \frac{1.019^2}{0.5} = 0.00212$ Pipe 2: $\frac{1}{5_2} \frac{V_2^2}{d_2} = \frac{0.02}{0.4} \times \frac{1.592^2}{19.62} = 0.00646$ Pipe 3: $\frac{1}{5_3} \frac{V_3^2}{d_3} = \frac{0.02}{0.3225} \times \frac{1}{19.62} \times 0.5093 \times \frac{1}{0.3225} = 0.0758$
	Pipe 2: & 1 V22 - 0.02 x 1.5922 - 0.00646
	Pipe 3: 53 da 20 = 0.02 X 1 X 0.50932 1 = 0.0758
	0.3225
	:. Pipe 3 has the largest frictional head loss per unit length
	7 0
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Always Start w 8.E Date No.
4(i) Pa=200x103 / if find Q1
$\frac{PA}{Pg} + \frac{V_{0}^{2}}{2g} + \frac{7}{4} - h_{L} + H_{p} = \frac{Pc}{pg} + \frac{V_{0}^{2}}{2g} + \frac{7}{2g} $
$\frac{P_{A}}{h_{b}} = \left[\frac{1}{2} \left(\frac{l_{1} + l_{2} + l_{3}}{0.25} \right) + (0 + 4 + 2) \right] \frac{Q^{2}}{2qA^{2}} = 43.604 + Q^{2} + 43.604 + Q^{2}$
$\frac{200\times10^{3}}{9810} = -50 = 43.60946^{2} - 100 + 4000^{2} =)443.6090^{2} = 70.387$
$Q = 0.234 \text{m}^3/\text{s}$
4(ii) $H_p = 100 - 400(0.0546) = 78.14m$ ($w = 2000 \times \frac{2\pi}{60} = 209.44 \text{ rad/s}$
4(ii) $H_{p}=100-400(0.0546)=78.14m$ ($w=2000\times\frac{2\pi}{60}=209.44 \text{ rad/s}$ $N_{s}=\frac{\omega\sqrt{a}}{(9H_{p})^{6.75}}=\frac{209.44\sqrt{0.2337}}{(9.81\chi78.14)^{6.75}}=0.694$ (centrifugal pump)
4(iii) V= Q = 0.234 - 17(0.125)2 = 4.761m/s & Z8=70m 20 0 34
PA + VA + ZA - h_+ Hp = PB + VB + ZQ + ZB & h [S(1+l2) + 2k, + 2k] 4.7612 29 + ZQ + ZA - h_+ + Hp = PB + VB + ZQ + ZB & h [S(1+l2) + 2k, + 2k] 4.7612
4(iii) $V = \frac{Q}{A} = \frac{0.234}{\pi(0.025)^2} = 4.761 \text{m/s}$ & $Z_8 = 70 \text{m}$ $\frac{PA}{PQ} + \frac{VA^2}{AQ} + \frac{1}{Z_A} - h_L + H_p = \frac{PB}{PQ} + \frac{VB^2}{ZQ} + \frac{1}{Z_B} = \frac{1}{Z_B} + \frac{1}{Z_$
TBYPY = 2110 CAVITATION (FOCAS ON MAGNITUDE ONLY)
4(iv) PA + VA ² + ZA - h _L - PS + Vs ² 100 (TS) NPSHA
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
$\frac{20\times10^{3}-2340}{9810} = \frac{0.18^{2}}{19.62} \left(\frac{1}{1720.125}\right)^{4} \left(0.8+2\right) + 2 = NPSH_{A}$
NPSHA=3.25M
NPSH _R = $3+100(0.18)^2=6.24$