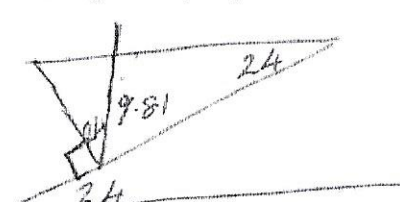
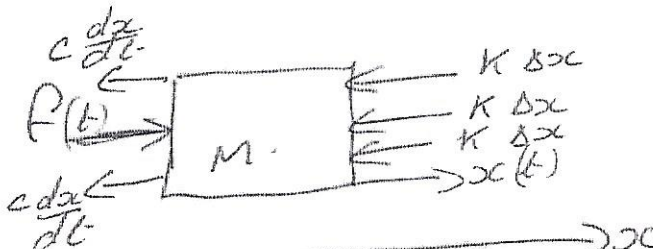
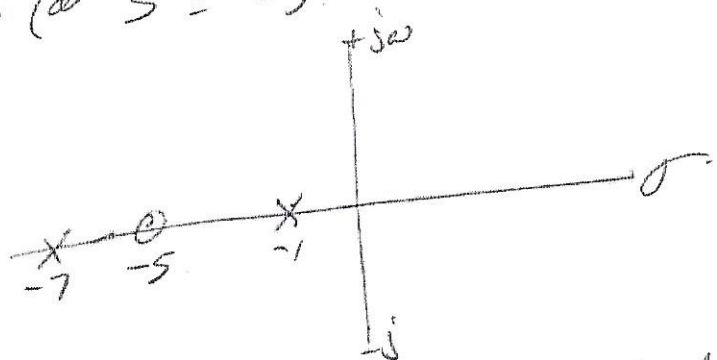


Question		marks																								
Q1.	Using SUVAT Equations. <table border="1"> <thead> <tr> <th></th> <th>⊥ TO PLANE</th> <th>HORIZONTAL</th> <th>ALONG PLANE</th> </tr> </thead> <tbody> <tr> <td>S</td> <td>0</td> <td></td> <td></td> </tr> <tr> <td>U</td> <td>$80 \sin(40) \text{ m/s}$</td> <td>$80 \cos(64)$</td> <td>$80 \cos(40)$</td> </tr> <tr> <td>V</td> <td></td> <td>$80 \cos(64)$</td> <td></td> </tr> <tr> <td>a</td> <td>$-9.81 \cos(24) \text{ m/s}^2$</td> <td>0</td> <td></td> </tr> <tr> <td>t</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> acc ⊥ to Plane  Consider ⊥ to Plane. $S = ut + \frac{1}{2}at^2$ $0 = 80 \sin(40)t - 4.9 \cos(24)t^2$ $0 = t(80 \sin(40) - 4.9 \cos(24)t)$ $S = 0$ @ $t = 0$ = INITIAL CONDITION. $S = 0 @ 80 \sin(40) - 4.9 \cos(24)t = 0$ $t = \frac{80 \sin(40)}{4.9 \cos(24)} = 11.49 \text{ Sec.}$		⊥ TO PLANE	HORIZONTAL	ALONG PLANE	S	0			U	$80 \sin(40) \text{ m/s}$	$80 \cos(64)$	$80 \cos(40)$	V		$80 \cos(64)$		a	$-9.81 \cos(24) \text{ m/s}^2$	0		t				① ① ① ① ①
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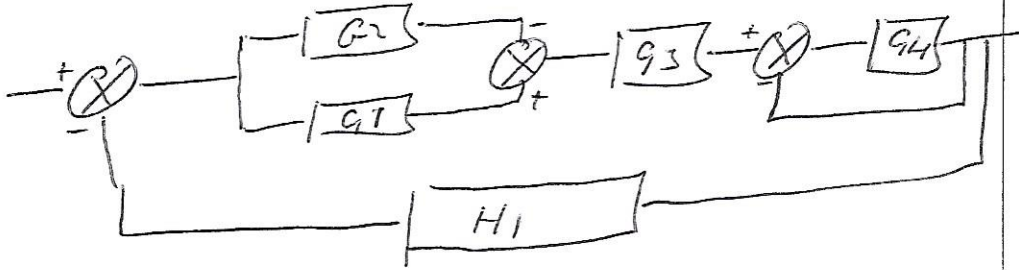
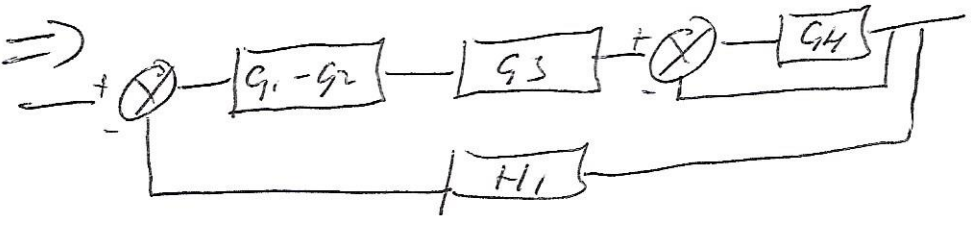
Question		marks
Q1(b)	To find Distance, in HORIZONTAL DIRECTION $S = \frac{u + v}{2} \times t$ $= \frac{80 \cos(64) + 80 \cos(64) \times 11.49}{2}$ $= 402.95$ DISTANCE IN INCLINED PLANE A-B $= \frac{402.95}{\cos(24.1)} = 440 \text{ m}$	① ① ① ①
Q2(a)	$S = 24t^2 + 18t - 17 \quad \text{①}$ $S = 14t^2 + 5t + 25 \quad \text{②}$ $V_{EL} \text{ (A)} = \frac{dS}{dt} = 48t + 18 \text{ m/s}$ $V_{EL} \text{ (B)} = \frac{dS}{dt} = 28t + 5 \text{ m/s}$ $V \text{ (A)} = 3 \times V \text{ (B)}$ $48t + 18 = 3(28t + 5)$ $48t - 84t = 15 - 18$ $36t = 3$ $t = \frac{1}{12} \text{ s}$ $Acc. \text{ (B)} = \frac{dV_B}{dt} = 28 \text{ m/s}^2$ Acc. (A)	① ① ① ① ① ①

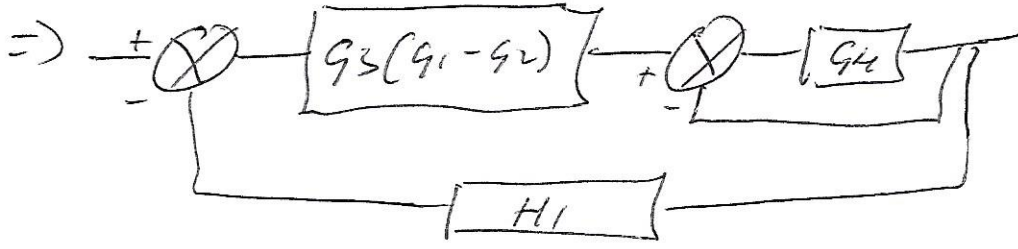
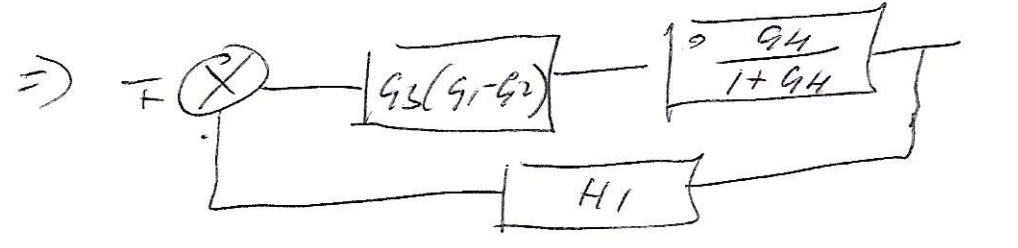
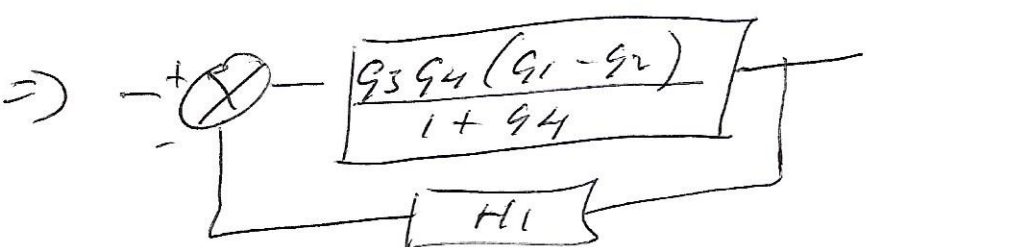
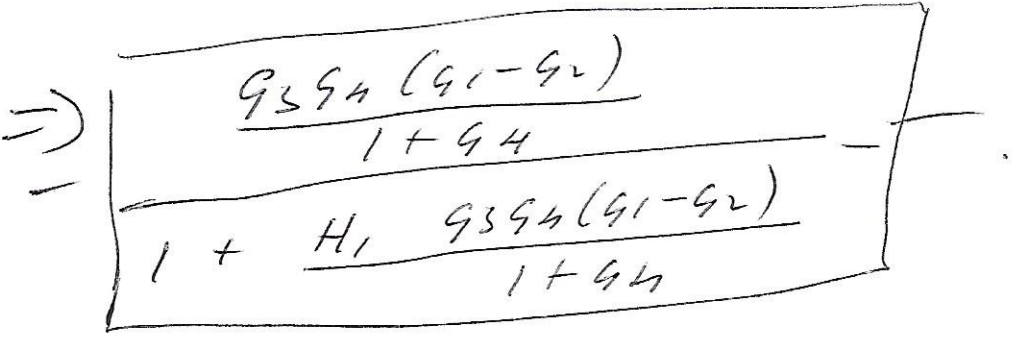
Question	marks
Q2(b) @ $t=0$ @ $t=4$. A. $S = -17$. $S = 24 \times 16 + 18 \times 4 - 17$ $S = 439$. DISTANCE = $439 - -17 = \underline{456 \text{ m.}}$ @ $t=0$ @ $t=4$. B. $S = +25$ $S = 14 \times 16 + 5 \times 4 + 25$ $= 269$ Distance = $269 - 25 = \underline{244 \text{ m.}}$	② ②
Q2(c) $A_{(1)} = 48 \text{ m/s}^2$ NOT DEPENDENT ON t.	①
Q3(a).  $F(t) = Ma$ TOTAL FORCE $= F(t) - 2c \frac{dx}{dt} - 3K(x) = M \frac{d^2x}{dt^2}$ Laplace Transform $F(s) = Ms^2X(s) + 2c sX(s) + 3KX(s)$ $\frac{X(s)}{F(s)} = \frac{1}{Ms^2 + 2cs + 3K} = \text{TF.}$	① ② ②

Question		marks
Q3(b)	$TF = \frac{1}{6s^2 + 6s + 24}$ IN STANDARD FORM $\frac{\frac{1}{6}}{s^2 + s + 4} = \frac{K\omega_n}{s^2 + 2\zeta\omega_n + \omega_n^2}$ $\therefore \omega_n^2 = 4$ $\omega_n = 2 \text{ Rad/sec}$ $f = \frac{\omega_n}{2\pi} \text{ Hz}$	① ① ① ①
Q3(c)	$2\zeta\omega_n s = s$ $4\zeta = 1$ $\zeta = \frac{1}{4} = 0.25$	① ①
Q3(d)	System is under damped ($\zeta < 1$)	①

Question		marks
Q4.	$G(s) = \frac{s+5}{s^2+8s+7}$ $= \frac{(s+5)}{(s+7)(s+1)}$ Poles @ $s = -7, s = -1$ Zero @ $s = -5$  Poles in <u>LM Plane</u> : <u>Stable</u>	① ① ① ①
Q4(b)	D.C. Response Put $s = 0$ $= \frac{5}{(0+7)(0+1)} = \frac{5}{7}$	② ①

Question		marks
Q4(c)	$\frac{(s+5)}{(s+7)(s+1)} \text{ APPLY STEP } = \frac{1}{s} \frac{s+5}{(s+7)(s+1)}$ $\frac{(s+5)}{s(s+7)(s+1)} = \frac{A}{s} + \frac{B}{(s+7)} + \frac{C}{(s+1)}$ $(s+5) = A(s+7)(s+1) + Bs(s+1) + Cs(s+7)$ Put $s=0$ (ALREADY FOUND), $A = \frac{5}{7}$ Put $s=-7$. $-7+5 = B(-7)(-6)$ $-2 = 42B \quad B = -\frac{1}{21}$ Put $s=-1$ $-1+5 = C(-1)(6)$ $4 = -6C \quad C = -\frac{2}{3}$ $\therefore \frac{5}{7s} + \frac{1}{21(s+7)} - \frac{2}{3(s+1)}$ $\mathcal{L}^{-1} = \frac{5}{7} + \frac{1}{21} e^{-7st} - \frac{2}{3} e^{-t}$ @ $t=2$. $= \frac{5}{7} + \frac{1}{21} e^{-14} - \frac{2}{3} e^{-2}$ $= 0.624$ $\times 3 = 1.872$ FOR STEP=3.	① ① ① ① ① ① ① ①

Question		marks
Q5	$2s^5 + 3s^4 + 2s^3 + s^2 - s + 4$ $\begin{array}{r rrrrrr} s^5 & 2 & 2 & -1 & 0 & 0 & 2 \\ s^4 & 3 & 1 & 4 & 0 & 0 & 0 \\ s^3 & \frac{4}{3} & -\frac{11}{3} & 0 & 0 & 0 & 0 \\ s^2 & \frac{37}{4} & 4 & 0 & 0 & 0 & 0 \\ s^1 & -\frac{157}{37} & 0 & 0 & 0 & 0 & 0 \\ s^0 & 4 & 0 & 0 & 0 & 0 & 0 \end{array}$ ↑ 2 CHANGE OF SIGN = 2 POLE IN RH PLANE = UNSTABLE	(2) (1) (1) (1)
Q6	 ⇒ 	(1)

Question		marks
Q6 CONT	$\Rightarrow$  $\Rightarrow$  $\Rightarrow$  $\Rightarrow$  $\Rightarrow$ $\frac{G_3 G_4 (G_1 - G_2)}{(1 + G_4) + H_1 G_3 G_4 (G_1 - G_2)}$	(1) (1) (1) (1)

Question		marks
Q6 (b).	$Q_1: 5 \text{ mV/Pa} \quad \Rightarrow \quad \frac{200^\circ}{1000 \text{ mV}} \quad \Rightarrow \quad Q_0$ $1 + \frac{200^\circ \times 0.4 \text{ mV}}{1000 \text{ mV}}$ $= 5 \text{ mV} \times \frac{200^\circ}{1000 \text{ mV}} \times \frac{1}{1 + \frac{80^\circ}{1000}}$ $= \frac{1000}{1080}^\circ / \text{Pa}$ $= 1000 \times \frac{1000}{1080} = 925.925^\circ$	④ ① ① ①