
Rei. Date. 31 - 31 - 21
Lab 04 Hand Calculations
bee 1=0 21=3 8,0=2 du2 (d)
$\frac{dy}{dt} = -\frac{\tan^2\theta}{y^{1.5}} \frac{d^2}{4} \sqrt{29}$
for solution up to order error term of h3
x+ = 20++ h (b,+26,+26,+b,) = 6,(+,+)
$y(t+h) = y(t) + hy'(t) + \frac{h^2}{h^2}y''(t) + O(h^3)$
2!
finding the derivatives
AT y.5 4
$y'' = \frac{d}{dt} \left(\frac{dy}{dt} \right) = -\tan^2 \theta \cdot \frac{d^2}{4} \sqrt{2g} \cdot -1.5 y^{-2.5}$
$= \frac{1.5 + an^2 \theta}{y^{2.5}} \frac{d^2 \sqrt{29}}{4}$
y ^{2.5} 4
Hence
y (+ + h) = y
$y_{i+1} = y_i + h \left(-\frac{\tan^2 \theta}{y_i} \right) + \frac{h^2}{2!} \left(\frac{1.5 \tan^2 \theta}{y^{2.5}} \right) + O(1)$
*
027273.6 2780.0
$m d^2x + c dx + kx = 0$
(dt + dt
De- 21 / Leterson-1 - 21 20 = 2
Reducing to system of 1st order ODEs
180FP2.g = 7. 883F80'0 - 2
$dz = v \rightarrow 0$
(dt + w + de + x + de +) it = it (det + w + de +) it = it
$\frac{dv}{dt} = -kx - \frac{c}{t}v \longrightarrow 2$
11
dt mero mare 1807730.0- s

(p)	Sub k=0.5, c=1.5, m=1	200	
		PE 2 9	had you (NUT)
	$\frac{d^2x}{dt^2} + 1.5 \frac{dx}{dt} + 0.5x = 0$		$x(0) = x_0 = 1.5$
	dt2 dt		v(0) = 0
5	The past some taken of		Δ+=0.1 S (4)
	$x_{i+1} = x_i + h(k_1 + 2k_2 + 2k_3 + k_4) = f_i(t_i, z_i)$		+=0s -> +=0.1 s
		the tried + the	
-		7.5	
	* Vit = V; + h (9, + 292	+ 293 + 94) = f2(+,x	v)
10	* Vi+1 = Vi + h (g, + 2g2	(1-2-1-yla-1-2-1-y	
10	$f_2(t,x,v) = -kx - \frac{1}{2}$		
-	m	m	
	ve. = 0-0.5x - 1.5	5 V	
000000000000000000000000000000000000000		Hal the	
15	for i= 0 4 8 male		
	k, = f, (+o, *o)	g, = f2 (to, xo, vo)	
	= 0	= - k x, - < (0) = -0.75
		m m	(dety-
V)O. L	$k_2 = f_1 \left(f_0 + \frac{h}{2}, v_0 + \frac{9, h}{2} \right)$	$g_2 = f_2 \left(+ \frac{h}{2} \right) x_3 +$	+ hk, , vo + g,h)
20	= 0 + (-0.75) 0.1	= -0.5 (1.5+0) -	1.5 0 - 0.75×0.1
	2.		2
	= -0.0375	= -0.693750	
			4 × 6 10 . 2
	$k_3 = f_1(t_0 + \frac{h}{2}, v_0 + \frac{g_2h}{2})$ $g_3 = f_2(t_0 + \frac{h}{2}, x_0 + \frac{k_2h}{2}, v_0 + \frac{g_2h}{2})$		+ k2h , Vo + 92h)
25	= 0 _ 0.69375 ×0.1	2 - 0.5 1.5 + (-0.0375)0.1 - 1.5 -0.69	
	2.	2 300 valing & formal	2 2
	= -0.0346 88	120599.0- =	
		0 4	- v = xb
	ka = f, (to+h, vo+gsh)	J4 = f2 (to+ h , 20+	+ k3h , Vo + 93h)
30	= 0 + (-0.697031)0.)	= -0.5 (1.5+ (-0.0	34688)0.1)
	= -0.0697031	-0 1.5 (-0.6970	031)0.1
		= ~0.643711	

-	Substituting -> Vit, and oxi+1	7 ×)-G
			Ze .
	x, = 1.5 + 0.1 (0 + 2(-0.0375 - 0.034688		
		nevy nottoups	mind
5	= 1.496432		
,	gu , 16		
***************************************	Z, = 0 + 0.1 (-0.75 + 2 (-0.69375 - 0.6	97031) - 0.643	HII)
A CONTRACTOR OF THE CONTRACTOR	6		
-	= -0.06958 788 -		
10	. Description of the second	. 39 A	5 -
10	*	,42	
Q5	$\frac{dy}{dt} = -3y + 6e^{-t} \qquad yc$	0) = 1.0	3
***************************************	dt	0 > A2	
(a)	yi+1 = y; + h (-3y) + h (6e-t)	0 < 3.	
15	y; = y; + 2		E
and a second a second and a second a second and a second	$y_{i+1}^{e} = y_{i}^{(e)} (1-3h)^{i} \longrightarrow (1-3h)^{i} (y_{i+1}^{e})^{i}$	(c) 1 2 \	
***************************************	(168h) V	+ (1-3h) E.	- X (d)
***************************************		E+	_
-	for $E_+ \rightarrow 0$ $i \rightarrow \infty$	Et	
20		77	
-	11-3h < 1 -1 < 1-3h \$ < 1	(33-1)	1917
-	$\frac{-1 < 1 - 3h}{-2} < -3h < 0$		

***************************************	$\frac{2}{3}$ $\frac{2}{3}$ $\frac{1}{3}$	o < h < 3	3
			7 - 1 / 1
25			
25	Alternative Method: Lfrom lecture slides)		
25	Alternative Method: (from lecture slides) $\frac{dy}{dt} = f(t,y) \iff \frac{dy}{dt} = Ky$	1 > 1 3	1-
25	$\frac{dy}{dt} = f(t,y) \iff \frac{dy}{dt} = Ky$	1 > 1 3 XA-1	
	$\frac{dy}{dt} = f(t,y) \iff \frac{dy}{dt} = Ky$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} \right) \left(\frac{1}{2} + \frac{1}{2} \right) \left(\frac{1}{2} + \frac{1}{2} \right)$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right)$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right)$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac$		3 418
25	$\frac{dy}{dt} = f(t,y) \iff \frac{dy}{dt} = Ky$ $\frac{dy}{dt} = \frac{f(t,y)}{dt} \implies \frac{dy}{dt} = Ky$ $\frac{dy}{dt} = \frac{f(t,y)}{dt} = \frac{Ky}{dt}$ $\frac{f(t,y)}{dt} = \frac{Ky}{dt}$ $\frac{f(t,y)}{dt} = \frac{Ky}{dt}$	8	
	$\frac{dy}{dt} = f(t,y) \iff \frac{dy}{dt} = Ky$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} \right) \left(\frac{1}{2} + \frac{1}{2} \right) \left(\frac{1}{2} + \frac{1}{2} \right)$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right)$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right)$ $\frac{dy}{dt} = \frac{1}{2} \left(\frac{1}{2} + \frac$	8	

-	∂f = K	x home into the printing of a	
	27		
	. ((zofpao - (zea+20.0 .	27:00-)5+0) 10 +21 - X	
	from equation given fit, y	at = -3y + 6e-t	
5		dt serepti =	
	əf	= -3	
	(11 2 4 2.0 - (18 0 8 4 3 4 1 2) - 12 4 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2, = 0 + 0.1 [-0.95 + 2 (-0.4	
***************************************	K = -3	3	
000000000000000000000000000000000000000	obte	ained similar to shown in previous pg	
10	- 2 < h 2f < 0	(previous solution)	
10	-z < h af <0		
	-2 < hK <0	1 93 + 48 - 3 46	25
	-2 < -3h <0	16.	
		⇒ 0 < h < 2	(e)
	$\frac{2}{3}$ > h > 0	⇒ 0 < h < 2 3	
000000000000000000000000000000000000000	(18 2 " 12 L (18-1)		
(b)		(Some as previous method)	
(2)	Y:+1 = y: + hf (+:+1, y:+1)	L.	
(10)	= y; + h (Ky;+,) + h (60	e ^{-+(+,})	
20	= y; + h (Ky;+,) + h (60	e ^{-t} i+1)	
	= y; + h (Ky;+,) + h (60		
	= y; + h (Ky;+,) + h (60	E E, 30 1 -3 00	
	$= y_{i} + h(Ky_{i+1}) + h(GG)$ $y_{i+1} = \left(\frac{1}{1-hK}\right)^{i} y_{i} + E_{+}$	12-148-11	
	$= y_{i} + h(Ky_{i+1}) + h(GG)$ $y_{i+1} = \left(\frac{1}{1-hK}\right)^{i} y_{i} + E_{+}$	1 > 1 /2 - 1 > 1 - 1 /2 1 /2 1 /2 1 /2 1 /2	
20	$= y_{i} + h(Ky_{i+1}) + h(GG)$ $y_{i+1} = \left(\frac{1}{1-hK}\right)^{i} y_{i} + E_{+}$	1>1/8-11 1>1/8-11 2/8-25-25-25-25-25-25-25-25-25-25-25-25-25-	
	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$	1 > 1 / 1 / 2 1 / 2 1 / 2 1 / 2 1 / 2 2 2 2 2 2 2 2 2 2	
20	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$ $\left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i \longrightarrow 0$		
20	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$ $\left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i \longrightarrow 0$	1 > 1 / 1 / 2 1 / 2 1 / 2 1 / 2 1 / 2 2 2 2 2 2 2 2 2 2	
20	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$ $\left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i \longrightarrow 0$	15.1.48-11 15.1.48-11 15.1.48-11 2 de -151-2 de	
20	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$ $\left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i \longrightarrow 0$ $-1 < 1 < 1$ $1-hK$	$\frac{1}{1} \cdot \frac{1}{1} \cdot \frac{1}$	
20	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$ $\left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i \longrightarrow 0$ $-1 < 1 < 1$ $1-hK$ Sub $K = -3$	$\Rightarrow \qquad 1 \qquad > -1$ $1-hK$ $-1+hK < 1$ $hK < 2$	
20	= y; + h(Ky; + 1) + h(66) $ y; + =$	$\Rightarrow \qquad 1 \qquad > -1$ $1 - hK$ $-1 + hK < 1$ $hK < 2$	
20	$= y_i + h(Ky_{i+1}) + h(GG$ $y_{i+1} = \left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i y_i + E_+$ $\left(\begin{array}{c} 1 \\ 1-hK \end{array}\right)^i \longrightarrow 0$ $-1 < 1 < 1$ $1-hK$ Sub $K = -3$	$\rightarrow \qquad \qquad$	