CEE 3804: Computer Applications in Civil Engineering (Assignment 4 solution)

Problem 1

J22

	A	B	C	D	E	F	G	H	I
1	Programmed by Armin Zolfaghari					2/25/2021 15:14			
2									
3	Program to calculate Deflection of Beam an any point along it.								
4									
5									
6	Formula:	Deflection= -((W*(x)^2)/(24*E*I))*((6*(L)^2)-((4*L*x)+(x)^2))							
7									
8	Inputs:	Value:							
9	L	5.5	meter						
10	E	1.80E+11	N/m2						
11	IV	0.0001	m4						
12	W	3000	N						
13	Distance between 2 sucessive x	0.5	meter						
14	Iterations:	12							
15									
16	Beam Station (meter)	Deflection							
17	0	0							
18	0.5	-0.000296441							
19	1	-0.001114583							
20	1.5	-0.002355469							
21	2	-0.003930556							
22	2.5	-0.005761719							
23	3	-0.00778125							
24	3.5	-0.009931858							
25	4	-0.012166667							
26	4.5	-0.014449219							
27	5	-0.016753472							
28	5.5	-0.019063802							
29									
30									
31									
32									
33									
34									
35									
36									
37									

Run

Problem1 | Problem2 | Problem3

(General) routine1

```
Dim ValL As Double
Dim ValE As Double
Dim ValIV As Double
Dim ValW As Double
Dim Valx As Double
Dim Valbeamstation As Double
Dim Valdeflection As Double
Sub routine1()
' Programmed by Armin Zolfaghari
'Date: 02/24/2021
'A program to calculater the deflection along a beam every 50 centimetrs

' Define the spreadsheat we are working on
Sheets("Problem1").Select

'Read necessary inputs from Excel to calculate deflection
Range("B9").Select
L = ActiveCell.Value

Range("B10").Select
E = ActiveCell.Value

Range("B11").Select
IV = ActiveCell.Value

Range("B12").Select
W = ActiveCell.Value

'Distance between two sucessive deflection calculation along beam in meter
Range("B13").Select
x = ActiveCell.Value


'Calculate number of iteration
CellNumber = "B" & (14)
Range(CellNumber).Select
Iterations = Int((L / x) + 1)
ActiveCell.Value = Iterations

' Loop to calculate the deflection along beam every x meter
For i = 1 To Iterations

'Function that calculates the desired posion for deflection calculation every 0.5 meter on beam
CellNumber = "A" & (i + 16)
Range(CellNumber).Select
beamstation = x * (i - 1)
ActiveCell.Value = beamstation

'Function to calculate the deflection
CellNumber = "B" & (i + 16)
Range(CellNumber).Select
deflection = -((W * beamstation ^ 2) / (24 * E * IV)) * (6 * L ^ 2 - 4 * L * beamstation + beamstation ^ 2)
ActiveCell.Value = deflection

Next i
End Sub
```

Can use Option Explicit before Dim statements

Problem 2

	A	B	C	D	E	F	G	H	I	J	K	L
1	Programmed by Armin Zolfaghari											
2												
3	Program to calculate Deflection of Beam an any point along it.											
4												
5												
6	Formula:	Deflection= -((W*(x)^2)/(24*E*I))*((6*(L)^2)-((4*L*x)+(x)^2))										
7								Materials				
8	Inputs:	Value:	Unit:					Structural Steel	2.00E+11			
9	L	5.5	meter					Stainless Steel	1.80E+11			
10	E	Aluminum	N/m2					Titanium	1.20E+11			
11	IV	0.0001	m4					Aluminum	7.00E+10			
12	W	3000	N					High Strength Concrete	3.00E+10			
13	Distance between two sucessive x	0.5	meter									
14	Iterations:	12										
15												
16	Beam Station (meter)	Deflection										
17	0	0										
18	0.5	-0.000762277										
19	1	-0.002866071										
20	1.5	-0.00605692										
21	2	-0.010107143										
22	2.5	-0.014815848										
23	3	-0.020008929										
24	3.5	-0.025539063										
25	4	-0.031285714										
26	4.5	-0.037155134										
27	5	-0.043080357										
28	5.5	-0.049021205										
29												
30												
31												
32												
33												
34												
35												
36												
37												

Run

Problem1 | Problem2 | Problem3

	A	B	C	D	E	F	G	H	I	J	K
1	Programmed by Armin Zolfaghari										
2											
3	Program to calculate Deflection of Beam an any point along it.										
4											
5											
6	Formula:	Deflection= -((W*(x)^2)/(24*E*I))*((6*(L)^2)-((4*L*x)+(x)^2))									
7								Materials			
8	Inputs:	Value:	Unit:					Structural Steel	2.00E+11		
9	L	5.5	meter					Stainless Steel	1.80E+11		
10	E	Structural Steel	N/m2					Titanium	1.20E+11		
11	IV	0.0001	m4					Aluminum	7.00E+10		
12	W	3000	N					High Strength Concrete	3.00E+10		
13	Distance between two sucessive x	0.5	meter								
14	Iterations:	12									
15											
16	Beam Station (meter)	Deflection									
17	0	0									
18	0.5	-0.000266797									
19	1	-0.001003125									
20	1.5	-0.002119922									
21	2	-0.0035375									
22	2.5	-0.005185547									
23	3	-0.007003125									
24	3.5	-0.008938672									
25	4	-0.01095									
26	4.5	-0.013004297									
27	5	-0.015078125									
28	5.5	-0.017157422									
29											
30											
31											
32											
33											
34											
35											
36											
37											

Run

Problem1 | Problem2 | Problem3

(General)

```
Dim ValL As Double
Dim ValE As Double
Dim ValIV As Double
Dim ValW As Double
Dim Valx As Double
Dim Valbeamstation As Double
Dim Valdeflection As Double

Sub routine2()

'Programmed by Armin Zolfaghari
'Date: 02/24/2021
'A program to calculater the deflection along a beam every 50 centimetrs

'Define the spreadsheat we are working on
Sheets("Problem2").Select

'Read necessary inputs from Excel to calculate deflection

Range("B9").Select
L = ActiveCell.Value

Range("B10").Select
material = ActiveCell.Value

'Use conditional statements to assign E to the desired material
If material = "Structural Steel" Then
E = 200000000000#

ElseIf material = "Stainless Steel" Then
E = 180000000000#

ElseIf material = "Titanium" Then
E = 120000000000#

ElseIf material = "Aluminum" Then
E = 70000000000#

ElseIf material = "High Strength Concrete" Then
E = 30000000000#

End If

Range("B11").Select
IV = ActiveCell.Value

Range("B12").Select
W = ActiveCell.Value

'Distance between two sucessive deflection calculation along beam in meter
Range("B13").Select
x = ActiveCell.Value
```

Can use Option Explicit before Dim statements

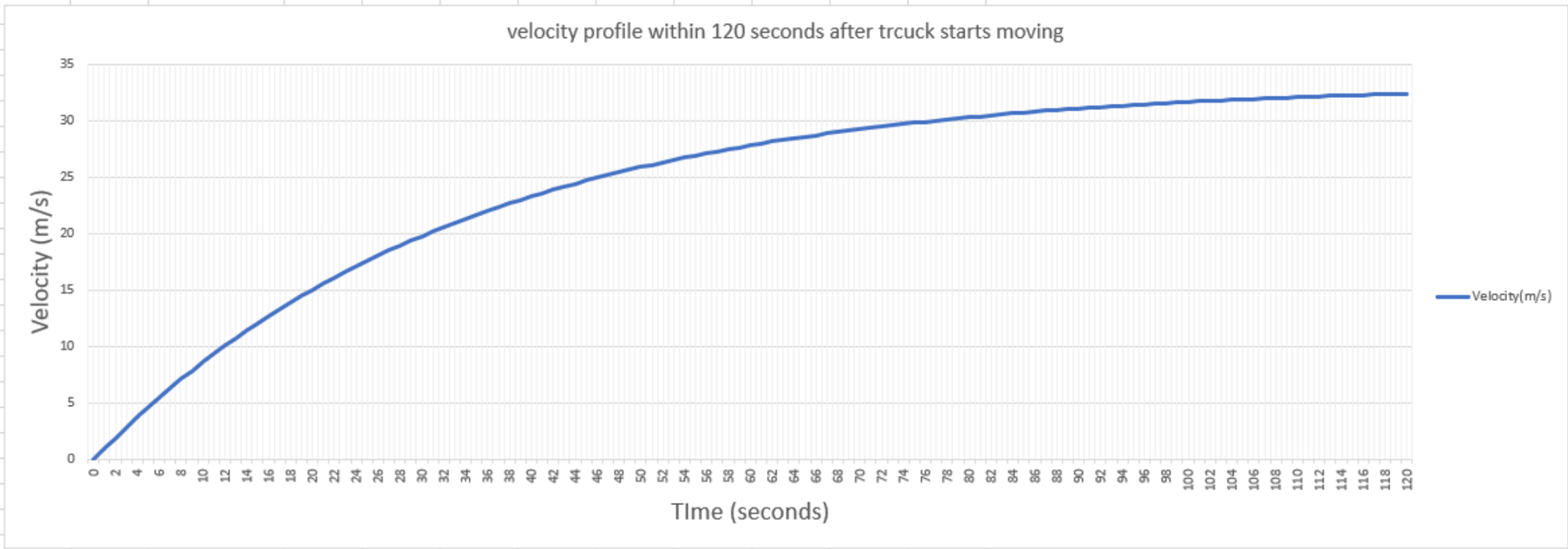
(General) routi

```
Range("B10").Select
material = ActiveCell.Value

'Use conditional statements to assign E to the desired material
If material = "Structural Steel" Then
E = 200000000000#

ElseIf material = "Stainless Steel" Then
E = 180000000000#

ElseIf material = "Titanium" Then
E = 120000000000#

ElseIf material = "Aluminum" Then
E = 70000000000#

ElseIf material = "High Strength Concrete" Then
E = 30000000000#

End If

Range("B11").Select
IV = ActiveCell.Value

Range("B12").Select
W = ActiveCell.Value

'Distance between two sucessive deflection calculation along beam in meter
Range("B13").Select
x = ActiveCell.Value

'Calculate number of iteration
CellNumber = "B" & (14)
Range(CellNumber).Select
Iterations = Int((L / x) + 1)
ActiveCell.Value = Iterations

' Loop to calculate the deflection along beam every 50 centimetrs
For i = 1 To Iterations

'Function that calculates the desired posion for deflection calculation every 0.5 meter on beam
CellNumber = "A" & (i + 16)
Range(CellNumber).Select
beamstation = 0.5 * (i - 1)
ActiveCell.Value = beamstation

'Function to calculate the deflection
CellNumber = "B" & (i + 16)
Range(CellNumber).Select
deflection = -((W * beamstation ^ 2) / (24 * E * IV)) * (6 * L ^ 2 - 4 * L * beamstation + beamstation ^ 2)
ActiveCell.Value = deflection

Next i
End Sub
```

Problem 3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Designing an acceleration ramp for a highway																
2																	
3	Programmed by Armin Zolfaghari					Date:	2/25/2021 15:14		Formula to calculate velocity as a function of time every 1 second								Vt = ((K1 * (1 - (e ^ (-K2 * Time)))) / K2) + (V0 * (e ^ (-K2 * Time)))
4									Formula to calculate travelled distance3 as a function of time every 1 second								Dt = ((K1 / K2) * Time) - ((K1 / (K2 ^ 2)) * (1 - (e ^ (-K2 * Time)))) + ((V0 / K2) * (1 - (e ^ (-K2 * Time))))
5																	
6	Inputs:	Value:	Unit:														
7	V0	0	m/s														
8	K1	1	m/s2														
9	K2	0.03	1/s														
10	t_initial	0	seconds														
11	t_final	120	seconds														
12	iteration	120															
13																	
14	Time	Velocity(m/s)	Distance(meter)														
15	0	0	0														
16	1	0.985148586	0.495047135														
17	2	1.94118164	1.960612006														
18	3	2.868959655	4.368011489														
19	4	3.769317695	7.689410171														
20	5	4.643066141	11.8977953														
21	6	5.490991426	16.96695248														
22	7	6.313856738	22.87144205														
23	8	7.112402713	29.58657623														
24	9	7.887348095	37.08839684														
25	10	8.639390386	45.3536538														
26	11	9.369206475	54.35978415														
27	12	10.07745325	64.0848918														
28	13	10.76476817	74.50772775														
29	14	11.43176987	85.60767102														
30	15	12.0790587	97.36471008														
31	16	12.70721726	109.7594248														
32	17	13.31681093	122.7729691														
33	18	13.90838839	136.3870536														
34	19	14.4824821	150.5839299														
35	20	15.03960878	165.3463738														
36	21	15.58026989	180.6576703														
37	22	16.10495205	196.5015983														
38	23	16.61412752	212.8624162														
39	24	17.10825457	229.7248475														
40	25	17.58777798	247.0740675														
41	26	18.05312932	264.8956892														

Run



Problem1 | Problem2 | Problem3

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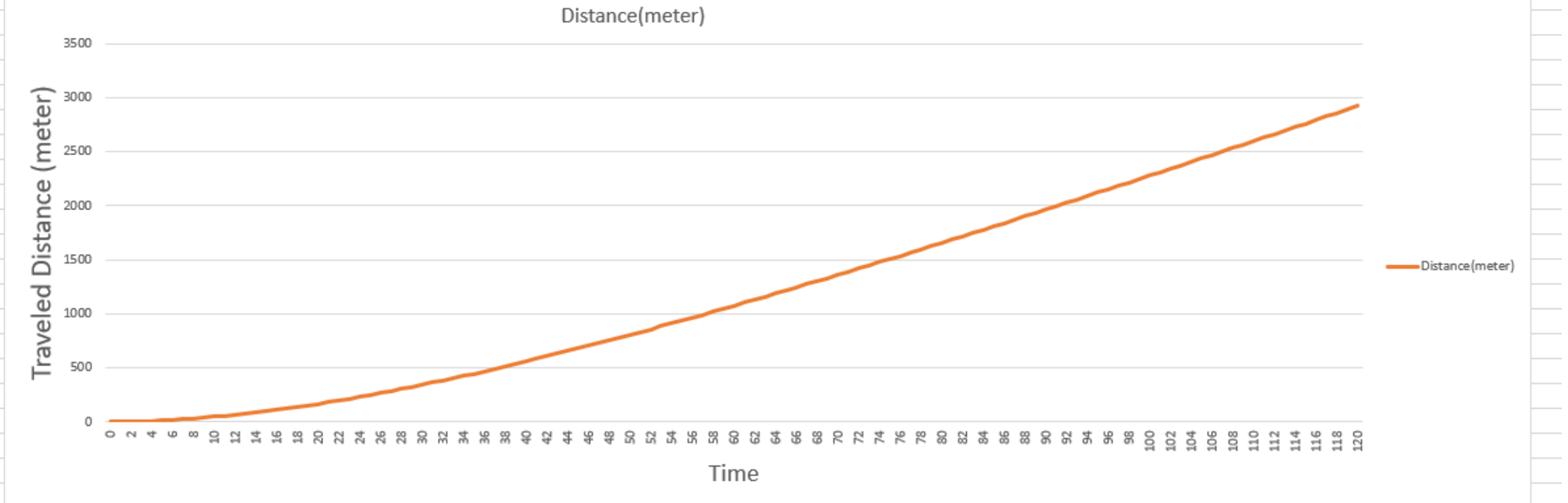
	A	B	C
40	25	17.58777798	247.0740675
41	26	18.05312932	264.8956892
42	27	18.50472747	283.1757512
43	28	18.94297887	301.9007044
44	29	19.36827799	321.0574004
45	30	19.78100762	340.6330792
46	31	20.18153926	360.615358
47	32	20.5702334	380.99222
48	33	20.9474399	401.7520035
49	34	21.31349826	422.8833914
50	35	21.66873796	444.3754012
51	36	22.01347875	466.2173749
52	37	22.34803091	488.3989695
53	38	22.67269557	510.9101477
54	39	22.98776494	533.7411688
55	40	23.2935226	556.8825801
56	41	23.59024376	580.3252081
57	42	23.87819549	604.0601505
58	43	24.15763696	628.0787681
59	44	24.42881969	652.3726771
60	45	24.69198776	676.9337415
61	46	24.94737804	701.7540654
62	47	25.1952204	726.8259867
63	48	25.43573791	752.1420696
64	49	25.66914706	777.695098
65	50	25.89565793	803.4780691
66	51	26.11547439	829.484187
67	52	26.3287943	855.7068568
68	53	26.53580965	882.1396784
69	54	26.73670677	908.7764409
70	55	26.93166649	935.6111169
71	56	27.12086428	962.6378572
72	57	27.30447044	989.8509854
73	58	27.48265021	1017.244993
74	59	27.65556398	1044.814534
75	60	27.82336737	1072.554421
76	61	27.98621143	1100.459619
77	62	28.14424271	1128.525243
78	63	28.29760347	1156.746551
79	64	28.44643174	1185.118942



Problem1 | Problem2 | Problem3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
82	67	28.86704144	1271.098619														
83	68	28.99904028	1300.031991	**Part d answer**													
84	69	29.12713796	1329.095401														
85	70	29.25144978	1358.285007														
86	71	29.37208763	1387.597079														
87	72	29.4891601	1417.027997														
88	73	29.60277256	1446.574248														
89	74	29.71302726	1476.232425														
90	75	29.82002344	1505.999219														
91	76	29.92385741	1535.87142														
92	77	30.02462262	1565.845913														
93	78	30.12240977	1595.919674														
94	79	30.21730687	1626.089771														
95	80	30.30939935	1656.353355														
96	81	30.39877007	1686.707664														
97	82	30.4854995	1717.150017														
98	83	30.56966568	1747.677811														
99	84	30.65134438	1778.288521														
100	85	30.73060911	1808.979696														
101	86	30.80753121	1839.74896														
102	87	30.88217992	1870.594003														
103	88	30.95462243	1901.512586														
104	89	31.02492394	1932.502535														
105	90	31.09314773	1963.561742														
106	91	31.1593552	1994.68816														
107	92	31.22360595	2025.879802														
108	93	31.2859578	2057.13474														
109	94	31.34646687	2088.451104														
110	95	31.40518763	2119.827079														
111	96	31.46217293	2151.260902														
112	97	31.51747406	2182.750865														
113	98	31.5711408	2214.295307														
114	99	31.62322144	2245.892619														
115	100	31.67376287	2277.541238														
116	101	31.72281058	2309.239647														
117	102	31.7704087	2340.986377														
118	103	31.81660009	2372.779997														
119	104	31.86142632	2404.619123														
120	105	31.90492773	2436.502409														
121	106	31.94714349	2468.42855														

Problem1 | Problem2 | **Problem3**

Part (d) – The truck takes 68 seconds to reach 29 m/s and the length of the acceleration ramp would be 1,300 meters.

100	31.67376287	2277.541238
101	31.72281058	2309.239647
102	31.7704087	2340.986377
103	31.81660009	2372.779997
104	31.86142632	2404.619123
105	31.90492773	2436.502409
106	31.94714349	2468.42855
107	31.98811157	2500.396281
108	32.02786887	2532.404371
109	32.06645117	2564.451628
110	32.10389318	2596.536894
111	32.14022862	2628.659046
112	32.17549018	2660.816994
113	32.20970961	2693.00968
114	32.2429177	2725.236077
115	32.27514434	2757.495189
116	32.30641854	2789.786049
117	32.33676845	2822.107718
118	32.36622139	2854.459287
119	32.39480386	2886.839871
120	32.42254159	2919.248614

Problem1 | Problem2 | **Problem3**

(General) Routine3

```
Dim ValV0 As Double
Dim ValK1 As Double
Dim ValK2 As Double
Dim Valt_initial As Double
Dim Valt_final As Double
Dim ValVt As Double
Dim ValDt As Double
Sub Routine3()

'Programmed by Armin Zolfaghari
'Date: 02/24/2021
'This sub routine calculates the velocity of truck and distance taveled as the finctions of time
'Define the spreadsheat we are working on
Sheets("Problem3").Select

'Read necessary inputs from Excel to calculate deflection
Range("B7").Select
V0 = ActiveCell.Value
Range("B8").Select
K1 = ActiveCell.Value
Range("B9").Select
K2 = ActiveCell.Value
Range("B10").Select
t_initial = ActiveCell.Value
Range("B11").Select
t_final = ActiveCell.Value

'Time step in seconds
Range("B12").Select
t_step = ActiveCell.Value
'Calculate number of iteration
CellNumber = "B" & (13)
Range(CellNumber).Select
Iterations = Int(((t_final - t_initial) / t_step))
ActiveCell.Value = Iterations
'Loop to compute velocity of truch as a function of time and traveled distance as a function of time
'Assign value to E
E = 2.718281
For i = 0 To Iterations
'Calculate and assign time steps to the related Excel column
CellNumber = "A" & (i + 15)
Range(CellNumber).Select
ActiveCell.Value = i
'Calculate velocity and assign it to the related Excel column
CellNumber = "B" & (i + 15)
Range(CellNumber).Select
Vt = ((K1 * (1 - (E ^ (-K2 * i)))) / K2) + (V0 * (E ^ (-K2 * i)))
ActiveCell.Value = Vt

'Calculate travelled distance and assign it to the related Excel column
CellNumber = "C" & (i + 15)
Range(CellNumber).Select
Dt = ((K1 / K2) * i) - ((K1 / (K2 ^ 2)) * (1 - (E ^ (-K2 * i)))) + ((V0 / K2) * (1 - (E ^ (-K2 * i))))
ActiveCell.Value = Dt
Next i
End Sub
```

Can use Option Explicit before Dim statements