ASSIGNMENT 3

Computational Fluid Dynamics (ME-543)

Submitted to — Prof. Anoop K.Dass

Submitted by – [redacted]

Roll No. — [redacted]

1D WAVE EQUATION APPROXIMATION SCHEMES

A) C-Code

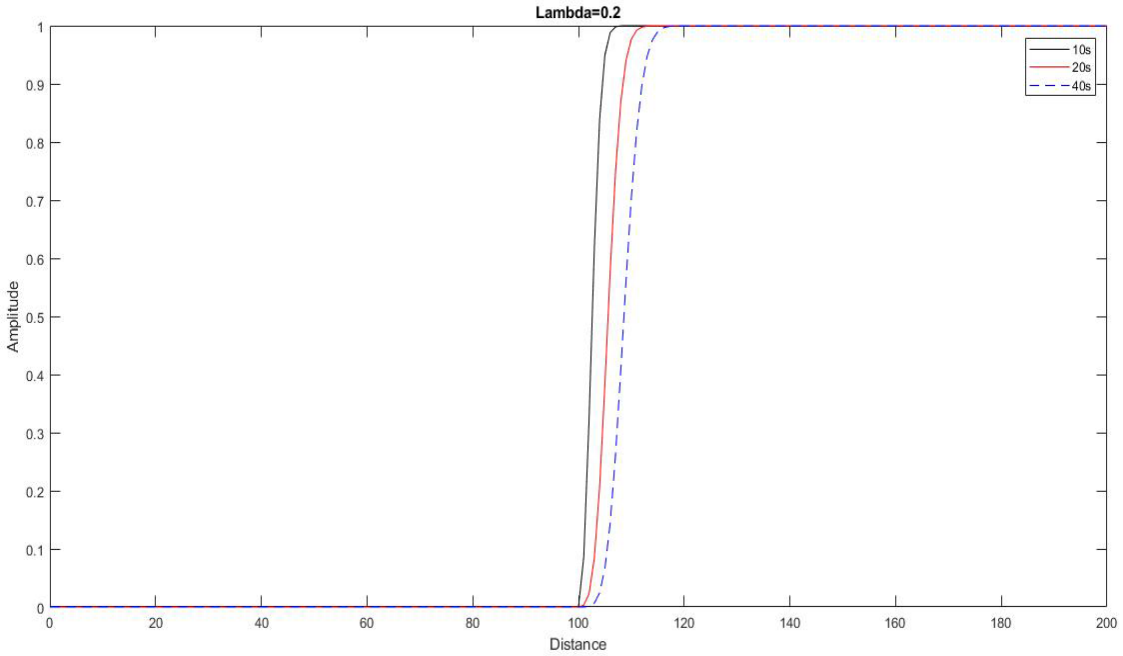
```
#include<stdio.h>
#include<math.h>
#include<stdlib.h>
#include<string.h>
double u[201];
void upwind(float lambda, int N, char filename[])
{
int j=0,n=0;
float temp[201];
for(j=0;j<201;j++)
{
        if(j<=100)
        u[j]=0.0;
        else
        u[j]=1.0;
}
while(n<=N)
{
        for(j=0;j<201;j++)
                temp[j]=u[j];
        for(j=0;j<200;j++)
        {
                u[j]=temp[j]-lambda*(temp[j]-temp[j-1]);
        }
        n++;
}
FILE *fptr=fopen(filename,"a");
```

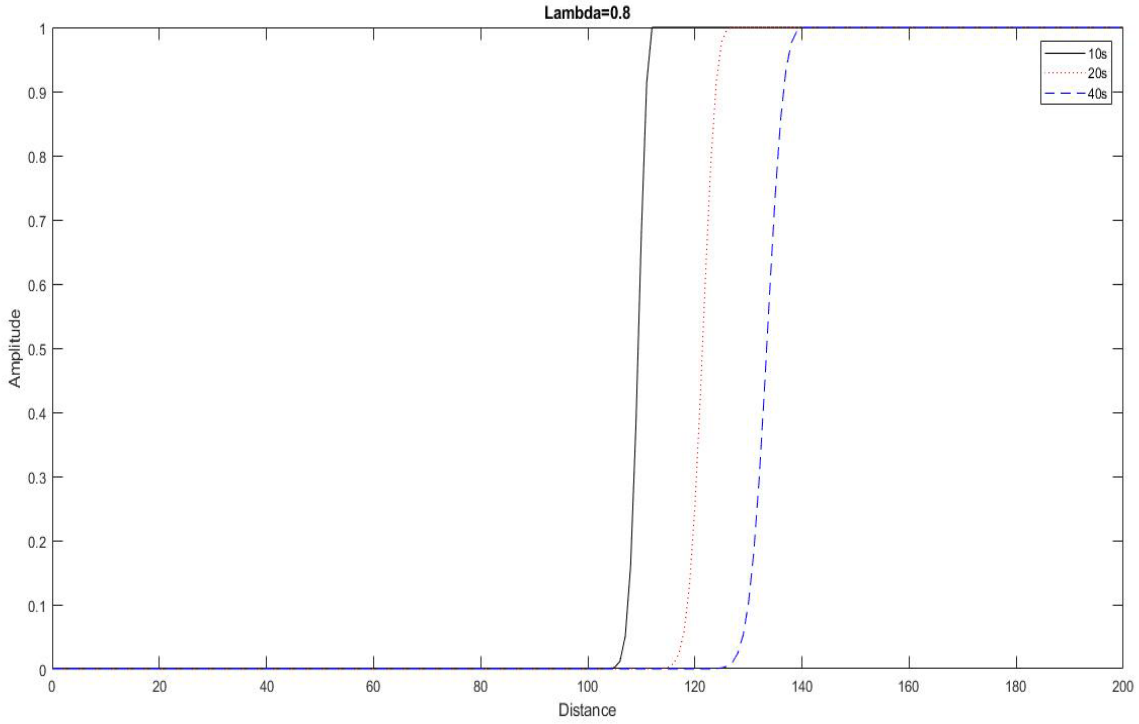
```
for(j=0;j<201;j++)
{
	fprintf(fptr,"%0.4lf\t",u[j]);
}
fprintf(fptr,"\n");
fclose(fptr);

}

void laxwen(float lambda, int N, char filename[])
{
int j=0,n=0;
float temp[201];
for(j=0;j<201;j++)
{
	if(j<=100)
	u[j]=0.0;
	else
	u[j]=1.0;
}
while(n<=N)
{
	for(j=0;j<201;j++)
		temp[j]=u[j];
	for(j=0;j<200;j++)
	{
		u[j]=temp[j]-0.5*lambda*(temp[j+1]-temp[j-1])+0.5*pow(lambda,2)*(temp[j+1]-
2*temp[j]+temp[j-1]);
	}
	n++;
}
FILE *fptr=fopen(filename,"a");
for(j=0;j<201;j++)
{
```

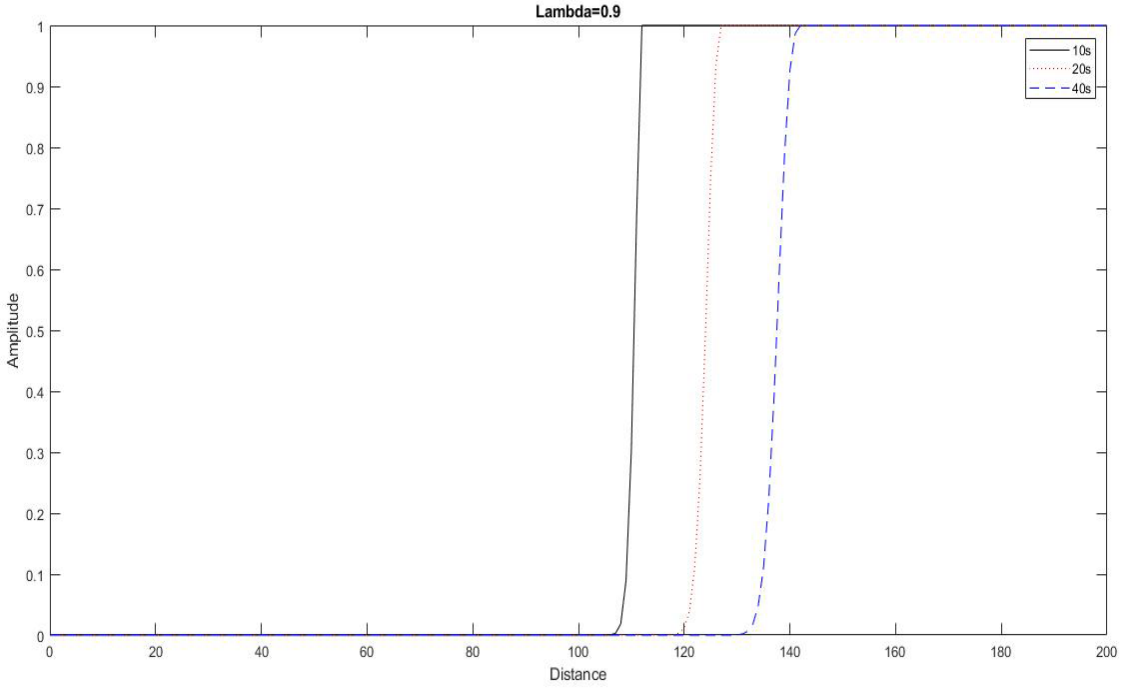
```
        fprintf(fptr,"%0.4lf\t",u[j]);
}
fprintf(fptr,"\n");
fclose(fptr);
}

void main()
{
int ch,j=0,k=0;
double lambda[]={0.2,0.8,0.9,1.0,1.1};
int n[]={10,25,40};
printf("Press 1 for upwind scheme.\nPress 2 for lax wendroff scheme.\n");
scanf("%d",&ch);
if(ch==1)
{
        printf("You have chosen option 1\n");
        for(k=0;k<=4;k++)
        {
                char filename[]="fwd_data";
                char str1[10];
                sprintf(str1,"%d",k);
                char str2[]=".dat";
                strcat(filename,str1);
                strcat(filename,str2);
                FILE *fptr1=fopen(filename,"w");
                for(j=0;j<201;j++)
                        fprintf(fptr1,"%d\t",j);
                fprintf(fptr1,"\n");
                fclose(fptr1);
                for(j=0;j<3;j++)
                {
                        upwind(lambda[k],n[j],filename);
                }
        }
```

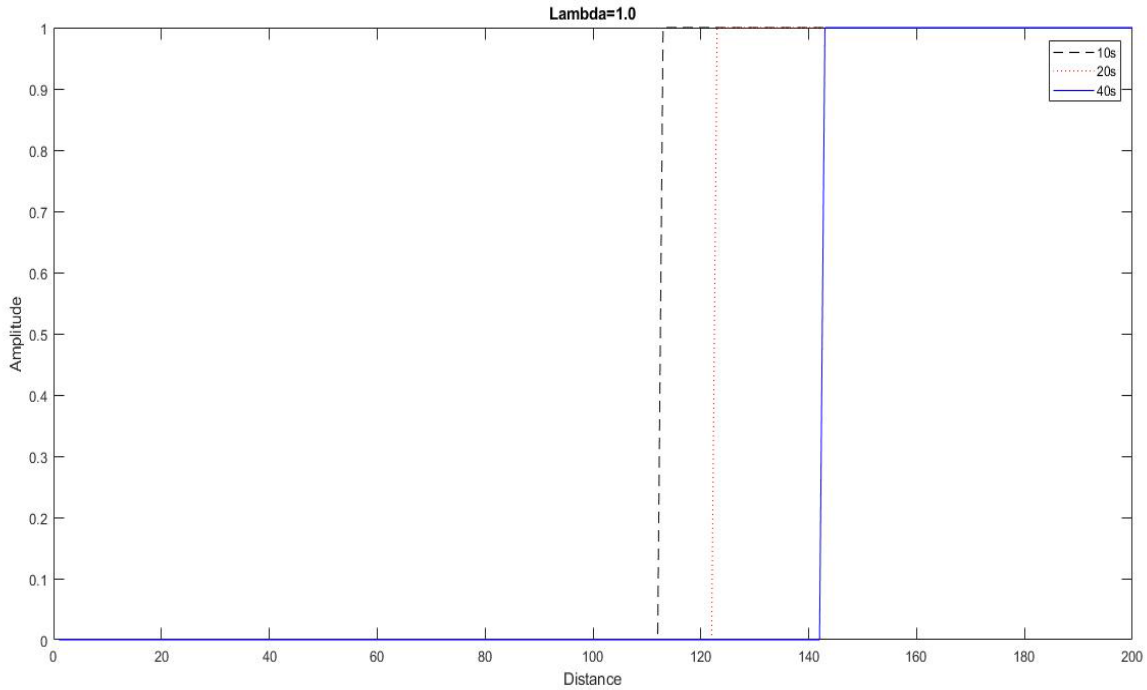
```
}

else if(ch==2)
{
	printf("You have chosen option 2\n");
	for(k=0;k<=4;k++)
	{
		char filename[]="laxwen_data";
		char str1[10];
		sprintf(str1,"%d",k);
		char str2[]=".dat";
		strcat(filename,str1);
		strcat(filename,str2);
		FILE *fptr1;
		fptr1=fopen(filename,"w");
		for(j=0;j<201;j++)
		{
			fprintf(fptr1,"%d\t",j);
		}
		fprintf(fptr1,"\n");
		fclose(fptr1);
		for(j=0;j<3;j++)
		{
			laxwen(lambda[k],n[j],filename);
		}
	}
}

else
	exit(0);
}
```

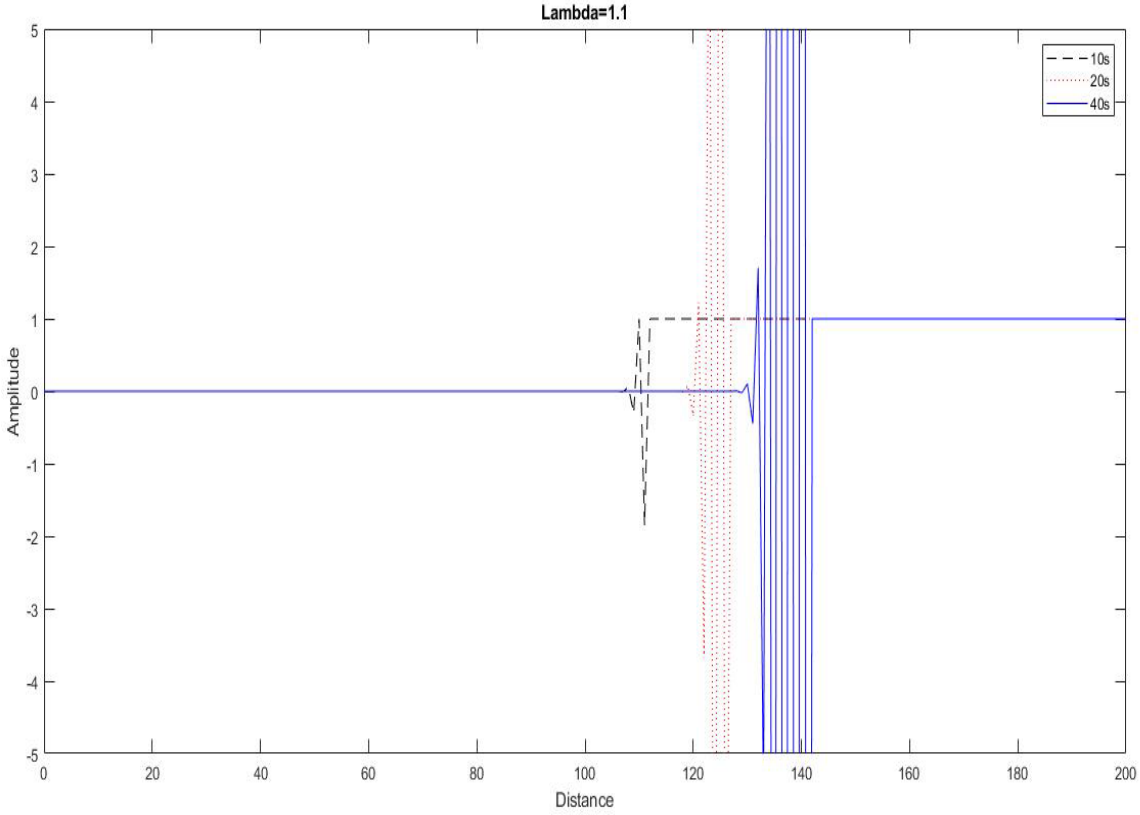
PLOTS FOR UPWIND SCHEME



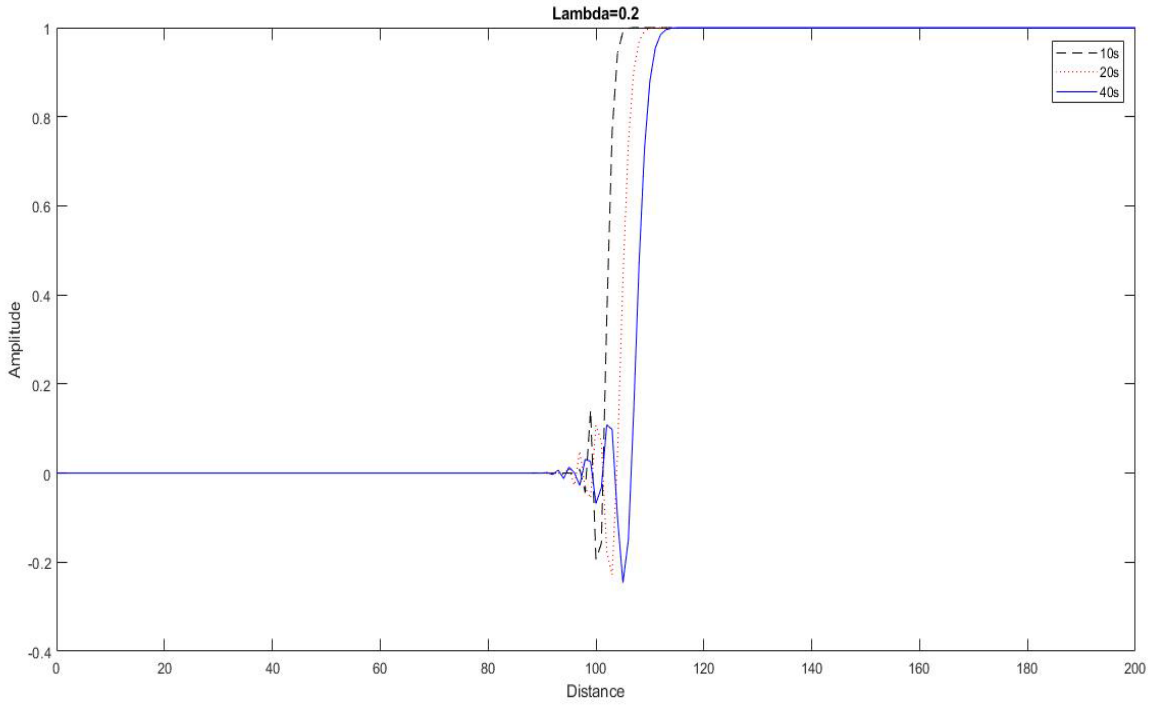


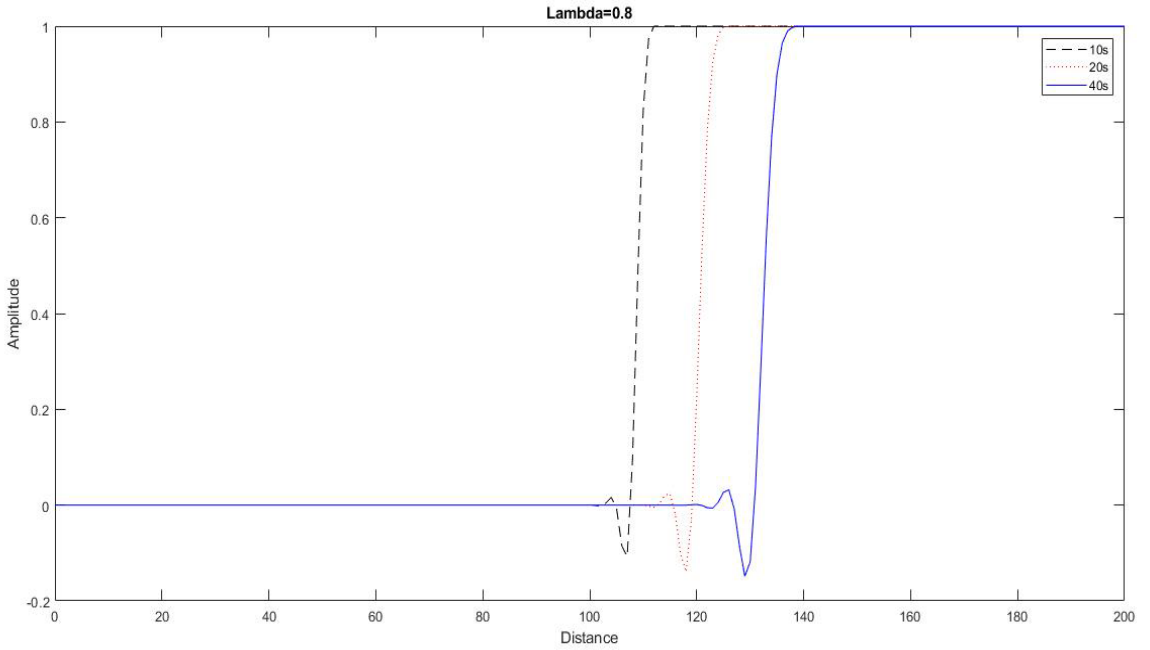

Lambda=0.9
10s
20s
40s
Amplitude
Distance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140
160
180
200

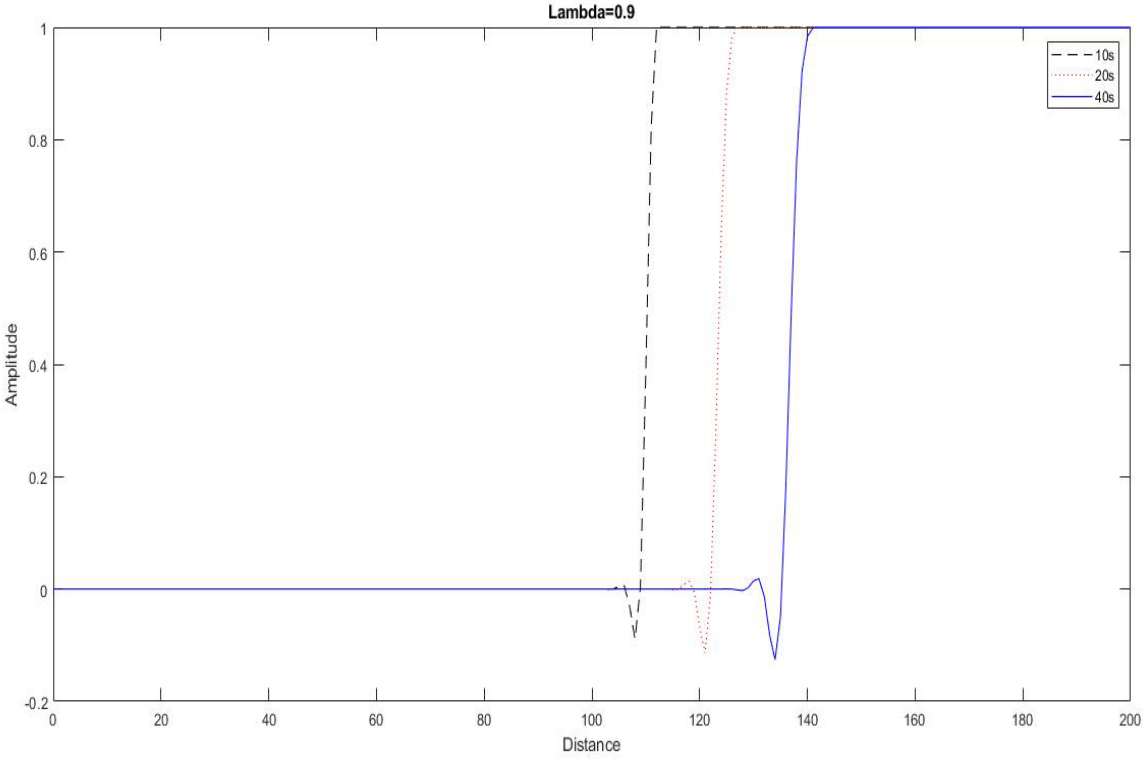

Lambda=1.0
10s
20s
40s
Amplitude
Distance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140
160
180
200

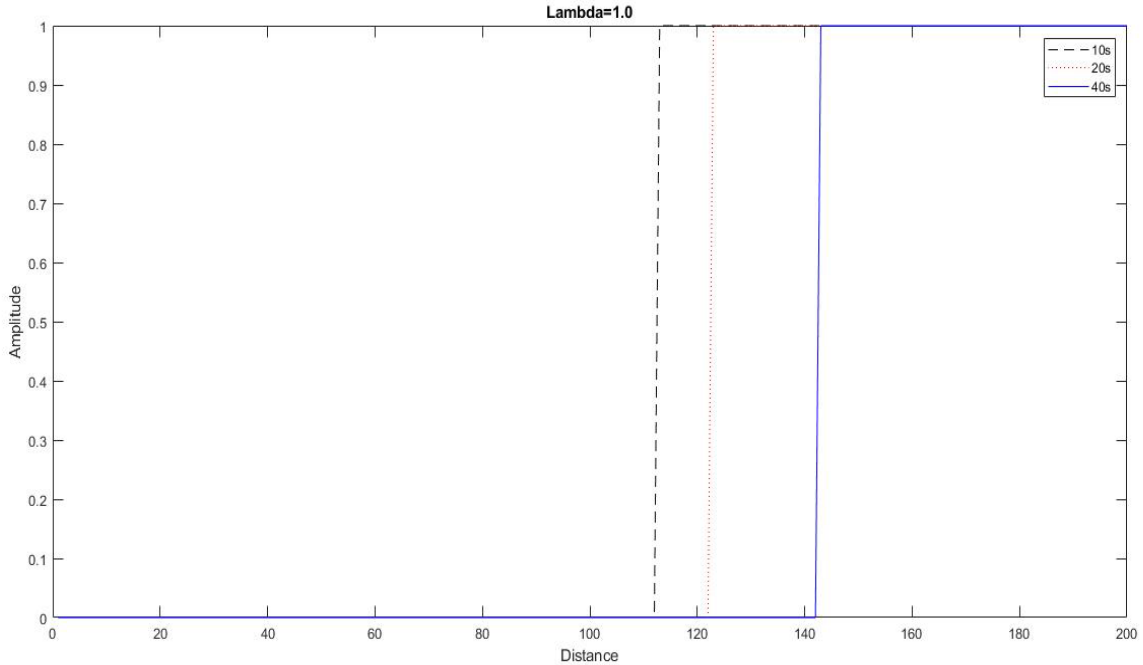

Lambda=1.1
10s
20s
40s
Amplitude
Distance
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
20
40
60
80
100
120
140
160
180
200

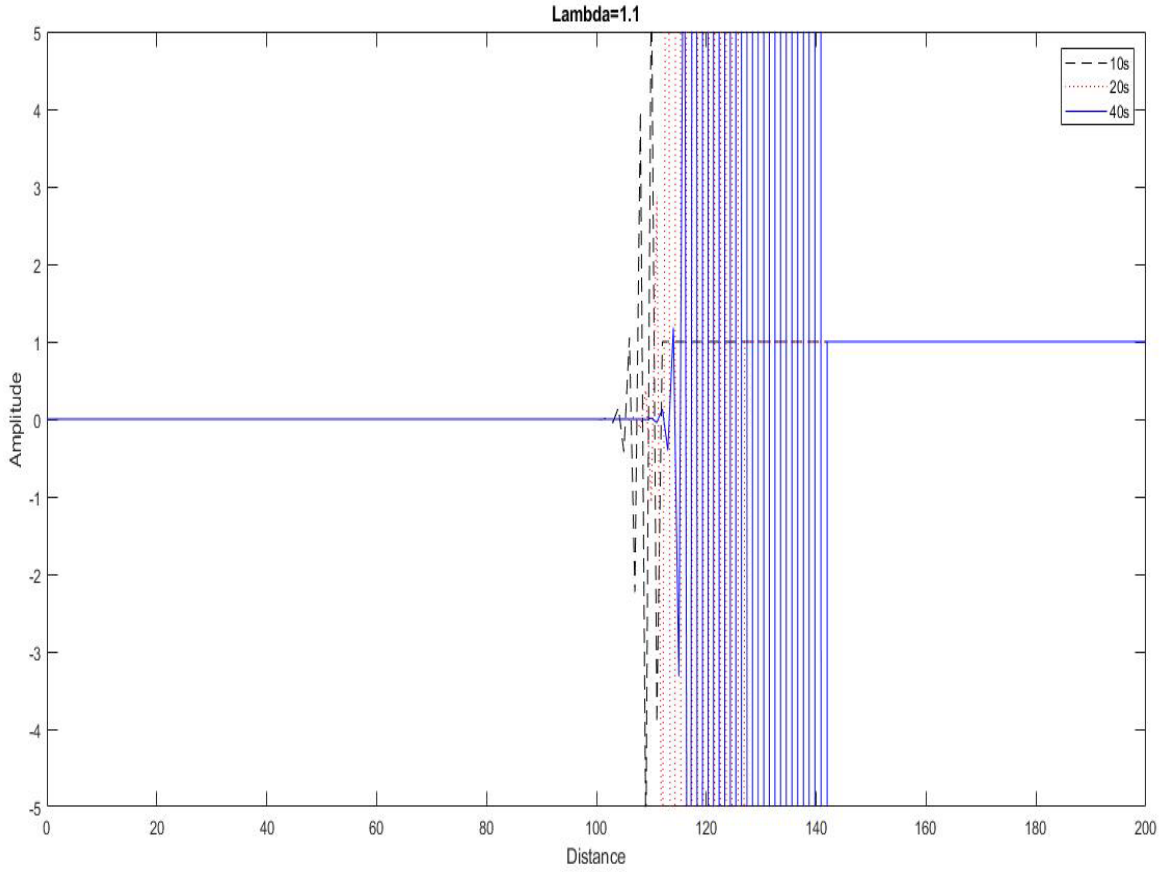
PLOTS FOR LAX-WENDROFF SCHEME






Lambda=0.9
10s
20s
40s
Amplitude
Distance
1
0.8
0.6
0.4
0.2
0
-0.2
0
20
40
60
80
100
120
140
160
180
200


Lambda=1.0
10s
20s
40s
Amplitude
Distance
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
100
120
140
160
180
200


Lambda=1.1
10s
20s
40s
Amplitude
Distance
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
20
40
60
80
100
120
140
160
180
200