NATIONAL INSTITUE OF TECHNOLOGY KARANATAKA, SURATHKAL

ASSIGNMENT 1

APPLIED COMPUTATIONAL METHODS IN MECHANICAL SCIENCES

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ASSIGNMENT ON GAUSS ELIMINATION METHOD. INCLUDES THE CODE, OUTPUT.

Question:

The upward velocity of a rocket is given at 3 different times: At 5s – 106.8 m/s, 8s – 177.2 m/s and 12 s – 279.2 m/s respectively. Velocity is approximated as a 2nd order polynomial. Find the coefficients of the polynomial. Also find velocity at 6s.

Solution:

2nd order linear polynomial $v(t) = a_1 t^2 + a_2 t + a_3$
So, using the given information

$$\begin{bmatrix} 25 & 5 & 1 \\ 64 & 8 & 1 \\ 144 & 12 & 1 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} 106.8 \\ 117.2 \\ 279.2 \end{bmatrix}$$

Equation is of the form $AX = B$ which can be solved by Gauss Elimination method using the following code.

Program (C++):

```
#include<iostream>
#include<time.h>
using namespace std;
main()
{
    clock_t begin = clock();
    int n=3,i,j,k;
    float rtio,sum,x[n],time_spent,b[n]={106.8,177.2,279.2};
    float a[n][n]={{25,5,1},{64,8,1},{144,12,1}};
    for(k=0;k<n-1;++k)
        for(i=k+1;i<n;++i)
        {
            rtio=a[i][k]/a[k][k];
            for(j=k+1;j<n;++j)
                a[i][j]=a[i][j]-rtio*a[k][j];
            b[i]=b[i]-rtio*b[k];
        }
    x[n-1]=b[n-1]/a[n-1][n-1];
    for(i=n-1;i>=0;--i)
    {
        sum=0;
        for(j=i+1;j<n;++j)
            sum=sum+a[i][j]*x[j];
        x[i]=(b[i]-sum)/a[i][i];
    }
    cout<<"Solution Vector:";
    for(i=0;i<n;++i)
        cout<<"\na"<<i+1<<" = "<<x[i];
    cout<<"\nVelocity at 6s: "<<float(x[0]*36+x[1]*6+x[2])<<" m/s";
```

```
    clock_t end = clock();
    time_spent = (float)(end - begin)/(float)CLOCKS_PER_SEC;
    cout<<"\nCPU time:"<<time_spent<<" seconds";
}
```

Output: