# Dominik Ciesiołkiewicz 44289 – Sprawozdanie Lab 7

## Kodowanie transmisyjne

**Kod:**

```
#include <iostream>
#include <fstream>
#include <complex>

using namespace std;

double pi = 3.14159265359;

int lengthOfString(string str)
{
    return str.length();
}

string S2BS(string in, bool choice)  //String To Binary Stream
{
    string out = "";

    int n = in.length();
    string bity = "";

    if (choice == 1)//LittleEndian
    {
        for (int i = 0; i < n; i++)
        {
            int wartosc = int(in[i]);
            bity = "";

            while (wartosc > 0)
            {
                if (wartosc % 2)
                {
                    bity += '1';
                }
                else
                {
                    bity += '0';
                }
                wartosc = wartosc / 2;
            }
            out += bity;
        }
        reverse(out.begin(), out.end());
        //cout << out << endl;
        return out;
    }
    else {//BigEndian
        for (int i = 0; i < n; i++)
        {
            int wartosc = int(in[i]);
            bity = "";

            while (wartosc > 0)
```

```
            {
                if (wartosc % 2)
                {
                    bity += '1';
                }
                else
                {
                    bity += '0';
                }
                wartosc = wartosc / 2;
            }
            reverse(bity.begin(), bity.end());
            out += bity;
        }
        //cout << out << endl;
        return out;
    }
}

int* Mgenerator(string tab, int size, double Tb, double fs)
{
    ofstream saveM("M.txt");
    int probki = fs * Tb;
    int* m = new int[size * probki * 8];
    int index = 0;
    for (int i = 0; i < size; i++)
    {
        if (tab[i] == '1')
        {
            for (int j = 0; j < 8 * probki; j++)
            {
                m[index] = 1;
                saveM << m[index] << endl;
                index++;
            }
        }
        else
        {
            for (int j = 0; j < 8 * probki; j++)
            {
                m[index] = 0;
                saveM << m[index] << endl;
                index++;
            }
        }
    }

    saveM.close();
    return m;
}

int* clock(double f, int size, double Tb, double fs)
{
    ofstream saveClock("Clock.txt");
    int probki = fs * Tb;
    int* clock = new int[size * probki * 8];

    double phase = 0;
    for (int i = 0; i < size * probki * 8; i++) {

        if (phase < 0.5)
        {
```

```
            clock[i] = 1;
        }
        else
        {
            clock[i] = 0;
        }

        phase += f / (probki*8);

        if (phase >= 1)
        {
            phase -= 1;
        }
        saveClock << clock[i] << endl;
    }
    saveClock.close();
    return clock;
}

double* timeSpan(double f, int size, double Tb, double fs)
{
    ofstream saveTimeSpan("Time.txt");
    int probki = fs * Tb;
    double* time = new double[size * probki * 8];

    double timeStamp = 0;

    for (int i = 0; i < size * probki * 8; i++) {
        //timeStamp = double(double(i) / double(fs));
        time[i] = timeStamp;
        saveTimeSpan << time[i] << endl;
        timeStamp += double(1 / (double(probki)*8));
    }

    saveTimeSpan.close();
    return time;
}

double* TTLCoder(int size, double Tb, double fs, int* m, int* clock)
{
    ofstream saveTTL("TTL.txt");
    int probki = fs * Tb;
    double* TTL = new double[size * probki * 8];
    TTL[0] = m[0];
    saveTTL << TTL[0] << endl;
    for (int i = 1; i < size * probki * 8; i++)
    {
        if (clock[i] == 1 && clock[i] != clock[i - 1])
        {
            if (m[i] == 1)
            {
                TTL[i] = 1;
            }
            else
            {
                TTL[i] = 0;
            }
        }
        else
        {
            TTL[i] = TTL[i - 1];
        }
```

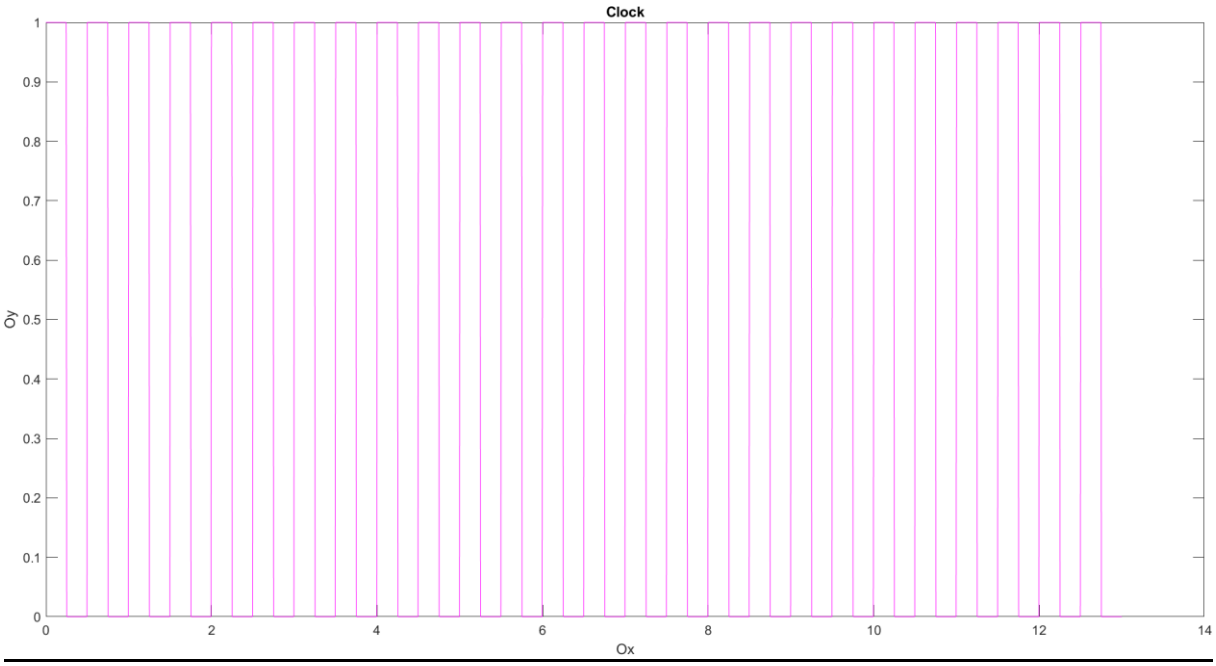
```
        saveTTL << TTL[i] << endl;
    }

    saveTTL.close();
    return TTL;
}

double* ManchesterCoder(int size, double Tb, double fs, int* m, int* clock)
{
    ofstream saveManc("Manchester.txt");
    int probki = fs * Tb;
    double* Manc = new double[size * probki * 8];
    Manc[0] = m[0];
    saveManc << Manc[0] << endl;
    int prevclock = 0;
    for (int i = 1; i < size * probki * 8; i++)
    {
        if (clock[i] == 0 && clock[i] != clock[i - 1])
        {
            if (m[i] == 1)
                Manc[i] = -1;
            else
                Manc[i] = 1;
        }
        else if ((clock[i] == 1 && clock[i] != clock[i - 1]) && (m[i - 1] == m[i]))
        {
            Manc[i] = -Manc[i-1];
        }
        else
        {
            Manc[i] = Manc[i - 1];
        }

        saveManc << Manc[i] << endl;
    }

    saveManc.close();
    return Manc;
}

double* NRZICoder(int size, double Tb, double fs, int* m, int* clock)
{
    ofstream saveNRZI("NRZI.txt");
    int probki = fs * Tb;
    double* NRZI = new double[size * probki * 8];
    NRZI[0] = 1;
    saveNRZI << NRZI[0] << endl;
    int counter = 0;
    double NRZISignal = 1;

    cout << size * probki * 8 << endl;
    for (int i = 1; i < size * probki * 8; i++)
    {
        if (clock[i]==0 && clock[i] != clock[i - 1])
        {
            if (m[i] == 0 )
            {
                NRZI[i] = NRZI[i - 1];
            }
            else
            {
                NRZI[i] = -NRZI[i - 1];
```

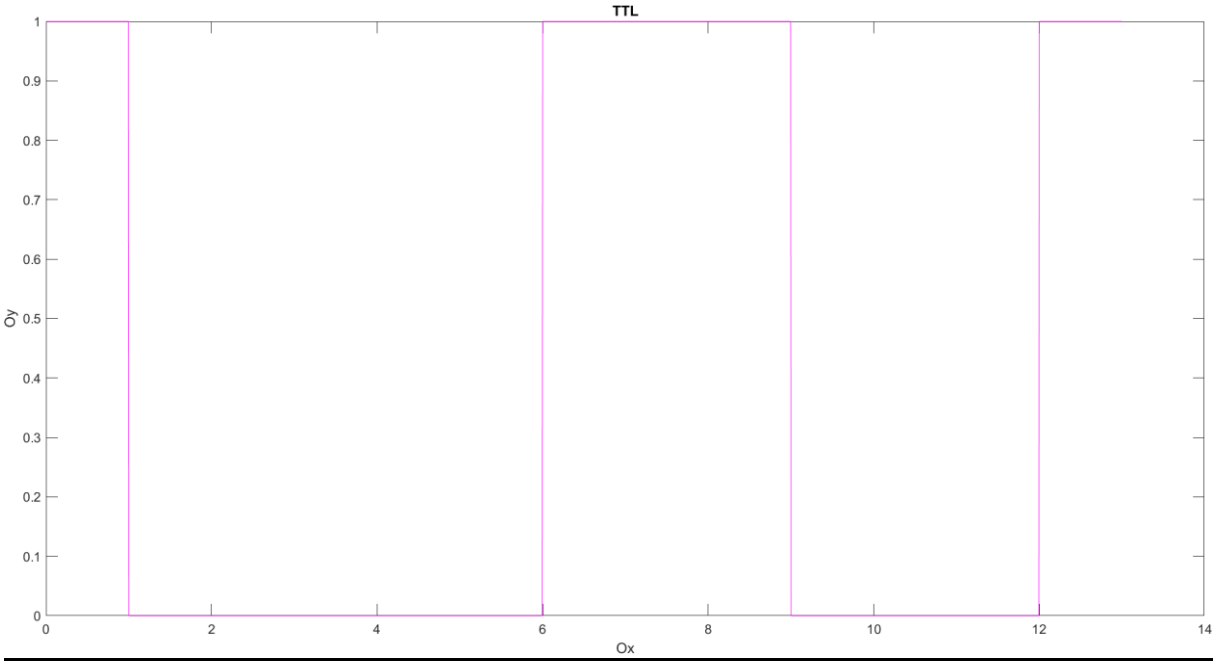
```
            }
            //counter++;
        }
        else
        {
            NRZI[i] = NRZI[i-1];
        }
        saveNRZI << NRZI[i] << endl;
    }

    saveNRZI.close();
    return NRZI;
}

double* BAMICoder(int size, double Tb, double fs, int* m)
{
    ofstream saveBAMI("BAMI.txt");
    int probki = fs * Tb;
    double* BAMI = new double[size * probki * 8];

    int counter = 0;
    int value = 1;

    for (int i = 0; i < size * probki * 8; i++) {
        if (m[i] == 0)
        {
            BAMI[i] = 0;
            counter = probki*8;
        }
        else
        {
            if (counter == probki * 8)
            {
                counter = 0;
                value = -value;
            }
            BAMI[i] = value;
            counter++;
        }
        saveBAMI << BAMI[i] << endl;
    }

    saveBAMI.close();
    return BAMI;
}

int* TTLDecoder(int size, double Tb, double fs, double* m, int* clock)
{
    ofstream saveDecTTL("DecTTL.txt");
    int probki = fs * Tb;
    int* decoded = new int[size * probki * 8];
    decoded[0] = 1;
    saveDecTTL << decoded[0] << endl;
    for (int i = 1; i < size * probki * 8; i++)
    {
        if (clock[i] == 0 && clock[i] != clock[i - 1])
        {
            decoded[i] = m[i];
        }
        else
        {
            decoded[i] = decoded[i - 1];
```

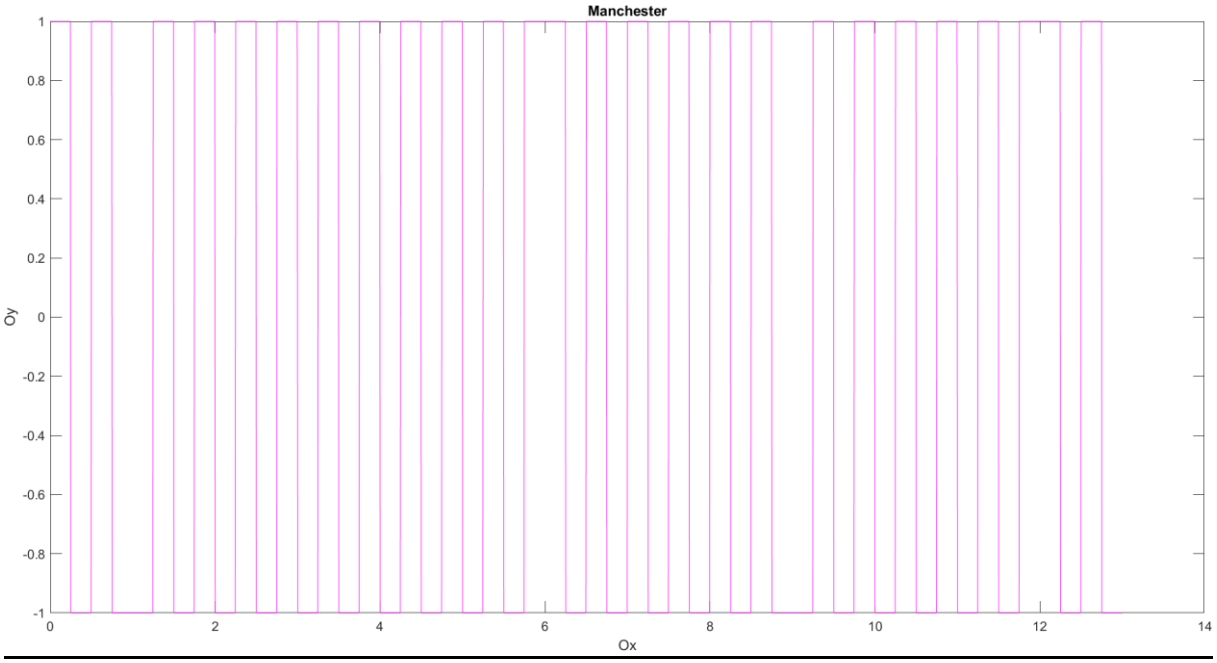
```
        }
        saveDecTTL << decoded[i] << endl;
    }

    saveDecTTL.close();
    return decoded;
}

int* ManchesterDecoder(int size, double Tb, double fs, double* Man, int* clock)
{
    ofstream saveDecManc("DecManchester.txt");
    int probki = fs * Tb;
    int* decoded = new int[size * probki * 8];
    decoded[0] = 1;
    saveDecManc << decoded[0] << endl;

    for (int i = 1; i < size * probki * 8; i++) {
        if (clock[i] == 0 && clock[i] != clock[i - 1]) {
            if (Man[i] > 0)
                decoded[i] = 0;
            else
                decoded[i] = 1;
        }
        else
        {
            decoded[i] = decoded[i - 1];
        }
        saveDecManc << decoded[i] << endl;
    }

    saveDecManc.close();
    return decoded;
}

int* NRZIDecoder(int size, double Tb, double fs, double* NRZI, int* clock)
{
    ofstream saveDecNRZI("DecNRZI.txt");
    int probki = fs * Tb;
    int* decoded = new int[size * probki * 8];
    decoded[0] = 1;
    int prevclock = 0;
    saveDecNRZI << decoded[0] << endl;
    for (int i = 1; i < size * probki * 8; i++) {
        if (clock[i] == 0 && clock[i] != clock[i - 1]) {

            if (NRZI[prevclock] != NRZI[i])
                decoded[i] = 1;
            else
                decoded[i] = 0;
        }
        else
        {
            decoded[i] = decoded[i - 1];
        }
        saveDecNRZI << decoded[i] << endl;
        prevclock = i;
    }
    saveDecNRZI.close();
    return decoded;
}

int* BAMIDecoder(int size, double Tb, double fs, double* BAMI)
```

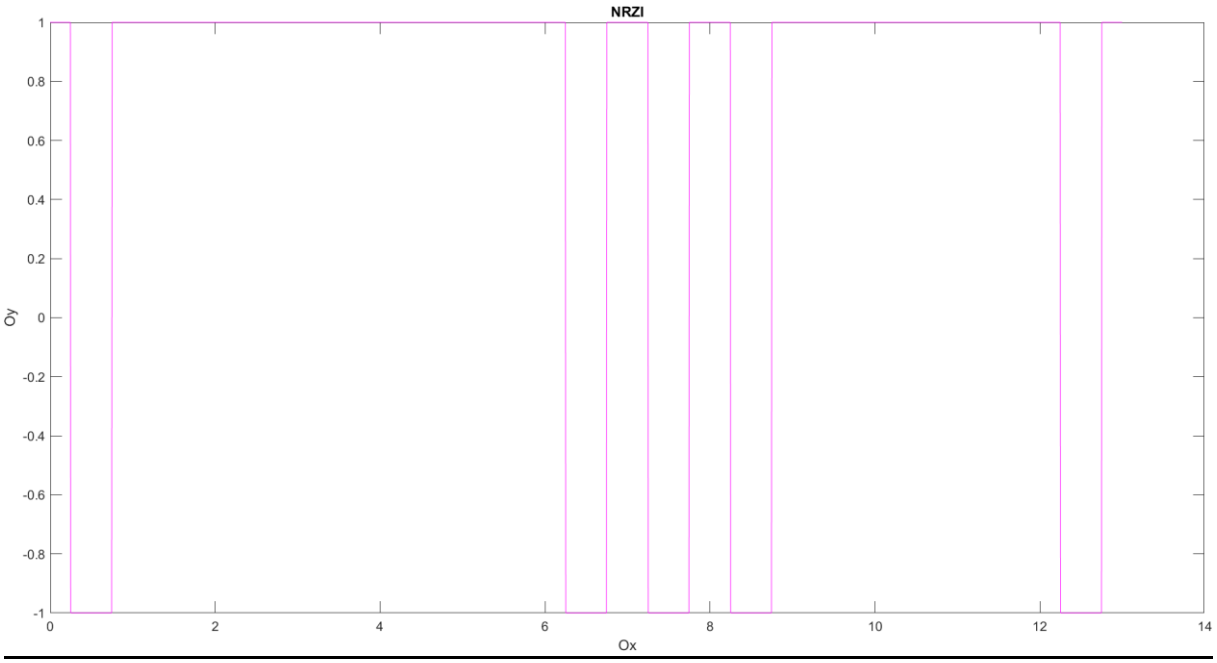
```
{
    ofstream saveDecBAMI("DecBAMI.txt");
    int probki = fs * Tb;
    int* decoded = new int[size * probki * 8];

    int counter = 0;
    int value = 1;

    for (int i = 0; i < size * probki * 8; i++) {
        if (BAMI[i] == 0)
        {
            decoded[i] = 0;
        }
        else
        {
            decoded[i] = 1;
        }
        saveDecBAMI << decoded[i] << endl;
    }

    saveDecBAMI.close();
    return decoded;
}

int main()
{
    //Zad 1 i 2:
    string str = S2BS("1A", 1);
    int n = lengthOfString(str);
    cout << n << endl;
    int fs = 250;
    double Tb = 0.1;//sekundy

    double* time = timeSpan(2, n, Tb, fs);
    int* m = Mgenerator(str, n, Tb, fs);
    int* clockSig = clock(2, n, Tb, fs);

    //Zad 3:

    double* BAMI = BAMICoder(n, Tb, fs, m);
    double* NRZI = NRZICoder(n, Tb, fs, m, clockSig);
    double* Manchester = ManchesterCoder(n, Tb, fs, m, clockSig);
    double* TTL = TTLCoder(n, Tb, fs, m, clockSig);

    //Zad 4:
    BAMIDecoder(n, Tb, fs, BAMI);
    NRZIDecoder(n, Tb, fs, NRZI, clockSig);
    ManchesterDecoder(n, Tb, fs, Manchester, clockSig);
    TTLDecoder(n, Tb, fs, TTL, clockSig);
       return 1;
}
```

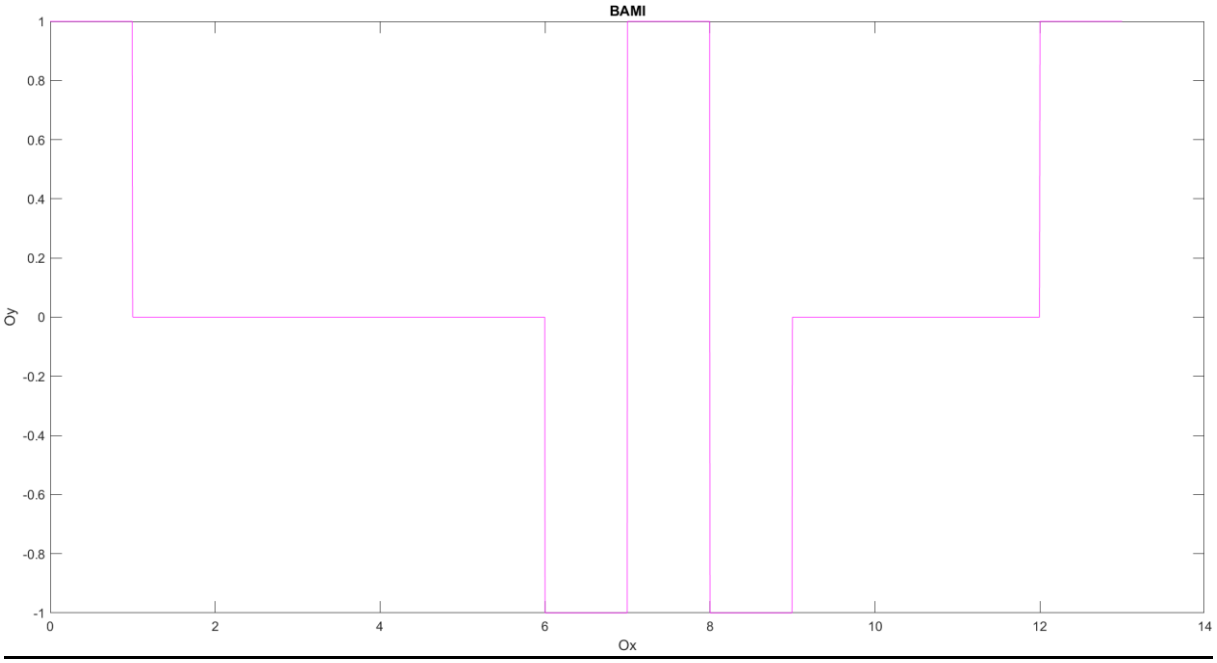
**Wykresy:**


Clock
Oy
Ox
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2
4
6
8
10
12
14


TTL
Oy
Ox
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
2
4
6
8
10
12
14


Manchester
Oy
Ox
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
2
4
6
8
10
12
14


NRZI
Oy
Ox
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
2
4
6
8
10
12
14


BAMI
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Oy
0
2
4
6
8
10
12
14
Ox