```matlab
clc
clear
% close all

%constants
k=1.38e-23;
hbar=1.0546e-34;
m0=9.1e-31;
e=1.6e-19;
eps0=8.85e-12;

X=0.3;
%initial paramets
a=2.8e-9;                  %size of chanel, nm
b=1.8e-9;                  %size of barrier, nm
U0=e*X*0.74;              %height of barrier,  eV
m1=0.067*m0;             %eff. mass in GaAs, kg
m2=(0.067+0.083*X)*m0;  %eff. mass in AlGaAs(x), kg

%solving Schr eq
m=m1; mb=m2;
gm1=@(E)sqrt(2*m*(E))/hbar;
gm2=@(E)sqrt(2*mb*(-E+U0))/hbar;
gm3=@(E)sqrt(2*m*(E))/hbar;
gm4=@(E)sqrt(2*mb*(-E+U0))/hbar;
gm5=@(E)sqrt(2*m*(E))/hbar;
A1=1;

MKoef=@(E)[ 1,                -1,                          -1,
             0,                                  0,
        0,                                  0,
     0;
         -1i*gm1(E)/m,    -gm2(E)/mb,                   gm2(E)/mb,
           0,                                  0,
        0,                                  0,
     0;
         0,                 exp(gm2(E)*b),              exp(-gm2(E)*b),
          -exp(1i*gm3(E)*b),                  -exp(-1i*gm3(E)*b),
        0,                                  0,
     0;
         0,                 gm2(E)/mb.*exp(gm2(E)*b),   -gm2(E)/mb.*exp(-
gm2(E)*b),          -1i*gm3(E)/m.*exp(1i*gm3(E)*b),     1i*gm3(E)/
m.*exp(-1i*gm3(E)*b),     0,                                  0,
                 0;
         0,                 0,                           0,
           exp(1i*gm3(E)*(a+b)),                exp(-1i*gm3(E)*(a+b)),
      -exp(gm4(E)*(a+b)),                  -exp(-gm4(E)*(a+b)),
        0;
         0,                 0,                           0,
                 1i*gm3(E)/m.*exp(1i*gm3(E)*(a+b)), -1i*gm3(E)/
m.*exp(-1i*gm3(E)*(a+b)), -gm4(E)/mb.*exp(gm4(E)*(a+b)),        gm4(E)/
mb.*exp(-gm4(E)*(a+b)),          0;
```

```matlab
           0,                 0,                              0,
             0,                              0,
         exp(gm4(E)*(a+2*b)),                 exp(-gm4(E)*(a+2*b)),
       -exp(1i*gm5(E)*(a+2*b));
           0,                 0,                              0,
             0,                              0,
         gm4(E)/mb.*exp(gm4(E)*(a+2*b)),       -gm4(E)/mb.*exp(-gm4(E)*(a+2*b)),
       -1i*gm5(E)/m.*exp(1i*gm5(E)*(a+2*b))];
MSvob=@(E)[-A1; -A1*1i*gm1(E)/m; 0; 0; 0; 0; 0; 0];
% Koef=@(E)bicgstab(MKoef(E),MSvob(E), 1e-11, 100);
% Koef=@(E)gmres(MKoef(E),MSvob(E),10,1e-12,15);
Koef=@(E)(MKoef(E)\MSvob(E));

f=figure ('Units','normalized','OuterPosition', [0.05 0.05 0.5 0.5]);
subplot(1,2,2)
N=750;
E=linspace(0,1.2*X*e,N);
D=zeros(1,N);
for i=1:N
    T=Koef(E(i));
    D(i)=abs(T(8))^2;
end
plot(D,E/e)
ylabel('E,##')
xlabel('D')
title('########## ##########')

subplot(1,2,1)
E0=0.15*e;
S=zeros(1,100);  k1=gm1(E0); k2=gm2(E0);
Psi1=@(A,B,x)A*exp(1i*k1*x)+B*exp(-1i*k1*x);
Psi2=@(A,B,x)A*exp(k2*x)+B*exp(-k2*x);
x=linspace(-b,a+3*b,N);
T=Koef(E0);
% T=T./sqrt(T.*conj(T));
for i=1:N
    if(x(i)<0)
        S(i)=Psi1(A1,T(1),x(i));
    elseif (x(i)>=0 && x(i)<b)
        S(i)=Psi2(T(2),T(3),x(i));
    elseif (x(i)>=b && x(i)<b+a)
        S(i)=Psi1(T(4),T(5),x(i));
    elseif (x(i)>=b+a && x(i)<2*b+a)
        S(i)=Psi2(T(6),T(7),x(i));
    elseif (x(i)>=2*b+a)
        S(i)=Psi1(T(8),0,x(i));
    end
end
plot(x*1e9,E0/e+real(S)/max(real(S))/30)
xnew=[-b,   0,  0,  b,  b, a+b, a+b,   a+2*b, a+2*b, a+3*b];
Unew=[0     0   U0  U0  0   0   U0     U0      0        0]/e;
hold on
plot(xnew*1e9, Unew)
xlim([x(1) x(end)]*1e9)
```

```
yline(E0/e,'--')
xlabel('x,##')
ylabel('U, ##')
grid on
title('############## ####### ########')

exportgraphics(f,['analyt.jpg'])
```

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Warning: Matrix is close to singular or badly scaled. Results may be
* inaccurate.*
RCOND = 1.450278e-41.
Warning: Matrix is close to singular or badly scaled. Results may be
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RCOND = 1.451882e-41.
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* inaccurate.*
RCOND = 1.453466e-41.
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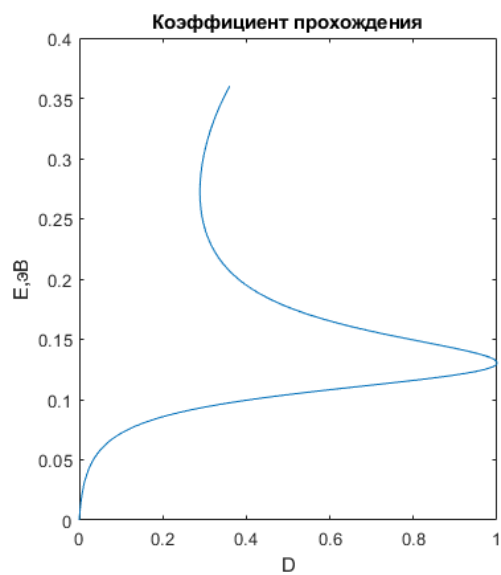 *inaccurate.*
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RCOND = 1.499570e-41.
Warning: Matrix is close to singular or badly scaled. Results may be
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RCOND = 1.500510e-41.
Warning: Matrix is close to singular or badly scaled. Results may be
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RCOND = 1.501436e-41.
Warning: Matrix is close to singular or badly scaled. Results may be
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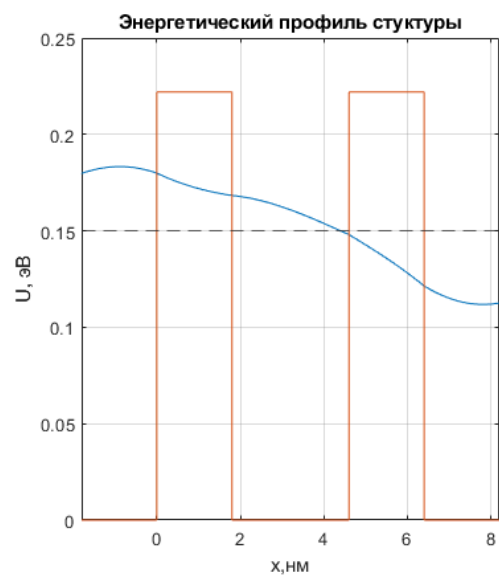*RCOND = 1.502346e-41.*

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RCOND = 1.504124e-41.
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RCOND = 1.505845e-41.
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RCOND = 1.506684e-41.
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RCOND = 1.507509e-41.
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RCOND = 6.430513e-43.

Энергетический профиль стуктуры — **Коэффициент прохождения**

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