```
clear all
clc

T04=857+273                % Turbine inlet temperature
m=48                        % inlet mass rate
T06A=927+273               % max afterburner temperature
afterburner=1 ;             % 0 if afterburner not used, 1 if used
T_inf=220                  % ambient temperature
P_inf=0.25*101325          % ambient pressure
M_inf=0.85                 % flight mach number
gamma=1.4    ;             % ratio of specific heats
R=287  ;                    % gas constant
u=M_inf*sqrt(gamma*R*T_inf)     %  inlet velocity

Cp=gamma*R/(gamma-1) ;              % specific heat
prc=linspace(14, 14,1)            %  compressor pressure ratio

% isentropic efficiencies
e_diff=0.97 ;                   % inlet/diffuser
e_n_hot=0.98;                   % hot stream nozzle
e_comp=0.835;                   % compressor
e_turb=0.865;                   % turbine
e_burner=0.95;                  % burner/combustor
e_ab=0.5;                       % afterburner
del_p1=0.0;                     % burner pressure loss in %
del_p2=0;                      % afterburner pressure loss in %
Q=45000000 ;                    % fuel heat content


prc_critical= 1/(1-(gamma-1)/(e_n_hot*(gamma+1)))^(gamma/(gamma-1))   % to check if nozzle chokes or not

% diffuser stage
T02=T_inf*(1+(gamma-1)*0.5*M_inf^2)
P02=P_inf*(1+(T02/T_inf-1)*e_diff)^(gamma/(gamma-1))



for i=1:length(prc)

    f_ab(i)=0;                          % initializing the afterburner fuel fraction
    %  compressor stage
    P03(i)=(P02*prc(i))
    T03(i)=T02*(1+(prc(i)^((gamma-1)/gamma)-1)/e_comp)

    % burner fuel air ratio
    f(i)=(T04-T03(i))/(e_burner*Q/(Cp)-T04)

    % turbine inlet pressure
    P04(i)=(P03(i))*(1-del_p1)  % # given pressure loss is zero


    %  compressor turbine power balance
    T05(i)=T04-(T03(i)-T02)/0.99 %-B*(T08-T02);
    P05(i)=(P04(i)*(1-(1-T05(i)/T04)/e_turb)^(gamma/(gamma-1)))
    T06(i)=(T05(i))
    P06(i)=(P05(i))

    if afterburner==0                                   % if the afterburner is disabled
        if P_inf/P06(i) > 1/prc_critical                 % loops if nozzle doesn't choke
        v7(i)=(sqrt(2*e_n_hot*Cp*T06(i)*(1-(P_inf/P06(i))^((gamma-1)/gamma))))   % exit velocity, complete expansion to P_inf
           t(i)=(1+f(i))*v7(i)-u                        % unchoked thrust without afterburner
           s=(f(i))/t(i)                % TSFC
           sprintf('no afterburner, nozzle does not choke ')
        else                                        % runs if nozzle chokes

        T7(i)=2*T05(i)/(gamma+1)               % critical temperature
        v7(i)=(gamma*R*T7(i))^0.5              % exit choked velocity
        p7(i)=P06(i)/prc_critical              % critical pressure
        rho7(i)=P06(i)/(R*T7(i))               % critical density at exit
        t(i)=(1+f(i))*v7(i)-u + (p7(i)-P_inf)/(rho7(i)*v7(i))   % choked thrust without afterburner

       s=(f(i))/t(i)    %TSFC
```

```
        sprintf('no afterburner, nozzle chokes, nozzle diameter -')
        d=2*sqrt(m/(rho7(i)*v7(i)*3.14))
         end


    else

        P_06(i)=P05(i)*(1-del_p2)        % loss in afterburner
        f_ab(i)=((1+f(i))*(T06A-T05(i)))/(e_ab*Q/Cp-T06A)    % fuel fraction in afterburner

        if P_inf/P06(i) >1/prc_critical                % nozzle unchoked with afterburner

            v7(i)=(sqrt(2*e_n_hot*Cp*T06A*(1-(P_inf/P06(i))^((gamma-1)/gamma))))   % exit velocity, complete expansion to atmosphere
            t(i)=(1+f(i)+f_ab(i))*v7(i)-u                 % unchoked thrust with afterburner
            s=(f(i)+f_ab(i))/t(i)         %TSFC
            sprintf(' afterburner on, nozzle does not choke ')

        else                                    % nozzle choked with afterburner

        T7(i)=2*T06A/(gamma+1)                % critical temperature
        p7(i)=P06(i)/prc_critical             % critical pressure
        v7(i)=(gamma*R*T7(i))^0.5             % critical choked velocity at exit
        rho7(i)=p7(i)/(R*T7(i))               % critical denstiy

        t(i)=(1+f(i)+f_ab(i))*v7(i)-u + (p7(i)-P_inf)/(rho7(i)*v7(i))    % choked thrust with afterburner
        s=(f(i)+f_ab(i))/t(i)               % TSFC
         sprintf(' afterburner on, nozzle chokes ')
          d=2*sqrt(m/(rho7(i)*v7(i)*3.14))
        end

    end
    e_prop(i)=2*t(i)*u/(t(i)*u*2+(1+f(i)+f_ab(i))*(v7(i)-u)^2)   % propulsive efficiency
    e_therm(i)=(t(i)*u*2+(1+f(i)+f_ab(i))*(v7(i)-u)^2)/(2*(f(i)+f_ab(i))*Q) %thermal efficiency

end

e_overall=e_prop.*e_therm
%hold on
  thrust=t*m
 %    plot(prc,t)
 %    title('Variation of specific thrust with afteburner disabled')
 %    xlabel('Compressor pressure ratio \pi_C')
 %    ylabel('t N/kg.s')
 %   plot(prc,e_prop,'o')
 %   plot(prc,e_therm,'*' )
 %   plot(prc,e_prop.*e_therm,'+' )
 %   title('T_{04}=1630 K & B=0')
 %   xlabel('  Compressor pressure ratio \pi_C')
 %   ylabel('\eta')
```

```
T04 =

        1130


m =

    48


T06A =

        1200


T_inf =

   220


P_inf =

   2.5331e+04
```

```
M_inf =

    0.8500


u =

  252.7175


prc =

    14


prc_critical =

    1.9202


T02 =

  251.7900


P02 =

   4.0091e+04


P03 =

   5.6127e+05


T03 =

  591.1848


f =

    0.0130


P04 =

   5.6127e+05


T05 =

  787.1770


P05 =

   1.2378e+05


T06 =

  787.1770


P06 =

   1.2378e+05


P_06 =
```

```
    1.2378e+05
```

```
f_ab =
```

```
    0.0197
```

```
T7 =
```

```
        1000
```

```
p7 =
```

```
   6.4462e+04
```

```
v7 =
```

```
  633.8770
```

```
rho7 =
```

```
    0.2246
```

```
t =
```

```
  676.7555
```

```
s =
```

```
   4.8367e-05
```

```
ans =
```

```
 afterburner on, nozzle chokes
```

```
d =
```

```
    0.6553
```

```
e_prop =
```

```
    0.6951
```

```
e_therm =
```

```
    0.1670
```

```
e_overall =
```

```
    0.1161
```

```
thrust =
```

```
   3.2484e+04
```

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