```
function [DU_s,a_s,K_s,m] = scr(Nel,order_P_c,DUfem,DU_exact,Length_of_domain)

% function for Super-convergence rate

              % order of lagrangian basis function
n=Nel;          % number of element
p_c=order_P_c;        % order of curve_fit
L=Length_of_domain;
p_m=p_c+1;
x0=0;
xl=L;
Ea=1;
syms x
x1=linspace(x0,xl,n+1);

for l=1:n
    m_bound(l,:)=[x1(l),x1(l+1)];         % upper and lower limits for each mesh element [lw,up]
    m(l,:)=g_int(p_c,x1(l),x1(l+1));      % Gauss_quad points for given order of curve fit

end

% initialisation for K_tilda and F_tilda matrices
K_s=zeros((p_m),(p_m));
F_s=zeros((p_m),1);
a_s=zeros((p_m),1);
DU=DUfem;
DU_e=DU_exact;

%% Gauss integration points in each element
for k=1:n
    a=m_bound(k,1);
    b=m_bound(k,2);
    g_pnt(k,:)=g_int(p_c,a,b);
end

%%
for k=1:n
    if k==n
            l=k;          % for first boundary elements
             for i=1:p_m
                 f_s1=(DU*x^(i-1));
                 od=5;
                 F_s(i,1)=gauss_quad(f_s1,od,m_bound(l,1),m_bound(l,2))+gauss_quad(f_s1,od,m_bound((l-1),1),m_bound((l-1),2));
                 for j=1:p_m
                     od2=6;
                     k_s=(x^(i-1))*(x^(j-1));
```

```
 47                      K_s(i,j)=gauss_quad(k_s,od,m_bound(l,1),m_bound(l,2))+gauss_quad↙
(k_s,od,m_bound((l-1),1),m_bound((l-1),2));
 48                  end
 49              end
 50              a_s(:,l)=K_s\F_s;
 51
 52      elseif k==1
 53              l=k;              % for first boundary element
 54                 for i=1:p_m
 55                     f_s1=DU*x^(i-1);       % gauss_quad functions for element-(L)
 56                     od=5;
 57                     F_s(i,1)=gauss_quad(f_s1,od,m_bound(l,1),m_bound(l,2))+gauss_quad↙
(f_s1,od,m_bound((l+1),1),m_bound((l+1),2));
 58                  for j=1:p_m
 59                     od2=6;
 60                     k_s=(x^(i-1))*(x^(j-1));
 61                      K_s(i,j)=gauss_quad(k_s,od,m_bound(l,1),m_bound(l,2))↙
+gauss_quad(k_s,od,m_bound((l+1),1),m_bound((l+1),2));
 62                  end
 63                end
 64                a_s(:,l)=K_s\F_s;
 65      else
 66          for l=2:(n-1)              % for inner elements
 67              for i=1:p_m
 68                  f_s1=DU*x^(i-1);
 69                  od=5;
 70                  F_s(i,1)=gauss_quad(f_s1,od,m_bound(l,1),m_bound(l,2))+gauss_quad↙
(f_s1,od,m_bound((l-1),1),m_bound((l-1),2))+gauss_quad(f_s1,od,m_bound((l+1),1),m_bound↙
((l+1),2));
 71                  for j=1:p_m
 72                      od=6;
 73                      k_s=(x^(i-1))*(x^(j-1));
 74                      K_s(i,j)=gauss_quad(k_s,od,m_bound(l,1),m_bound(l,2))+gauss_quad↙
(k_s,od,m_bound((l-1),1),m_bound((l-1),2))+gauss_quad(k_s,od,m_bound((l+1),1),m_bound↙
((l+1),2));
 75                  end
 76              end
 77              a_s(:,l)=K_s\F_s;
 78          end
 79      end
 80 end
 81 %%
 82 DU_s=0;
 83 for l=1:n
 84      for i=1:p_m
 85          DU_sml(l,i)=a_s(i,l)*x^(i-1);
 86      end
 87      DU_sm(l,1)=sum(DU_sml(l,:));
 88      DU_s=piecewise((x>=m_bound(l,1))&(x< m_bound(l,2)),DU_sm(l),DU_s);
```

SCR_function


```
 89
 90 end
 91 %%
 92
 93 t=linspace(0,1,100);
 94 val_s=subs(DU_s,t);
 95 val=subs(DU,t);
 96 val_e=subs(DU_e,t);
 97 hold on
 98 plot(t,val_s,'g-')
 99 plot(t,val,'r-')
100 plot(t,val_e,'--',LineWidth=1.5);
101 hold off
102
103 %%
104 legend('SCR','FEM','Exact');
105
106
107 end
```