```
 1 function [shape_fun,loc_node,loc_inelem] = phi_all(Oder_p,num_elem_N,length_of_domain)
 2
 3
 4 % this function will return the shape functions for all elements
 5
 6 %% function for piecewise function
 7 syms x
 8
 9 %% Preprocessor
10 L=length_of_domain;
11 N=num_elem_N;      % Number of elements
12 h=L/N;             % Uniform Mesh size
13 p=Oder_p;          % order of basis function
14 n=p+1;             % Number of Nodes inside an element
15 n_dom=(N*p)+1;     % Number of nodes in Domain (0,L)
16 n_loc=linspace(0,1,((N*p)+1));  % Locations of nodes inside the domain
17 x_jun=0;
18
19 % storing elementwise location
20 loc_c=2;           % counter of location in domain
21
22 % with the help of below loops we are storing location of each element in a
23 % perticuler row
24
25 for i=1:N           % for element run
26     for j=1:(p+1)   % for nodes inside an element
27         if j==1
28             loc(i,j)=x_jun;
29         else
30         loc(i,j)=n_loc(loc_c);
31         loc_c=loc_c+1;
32         end
33
34     end
35     x_jun=loc(i,(p+1));
36 end
37
38
39 % shape function
40 % up_t=1;     % initialisation of upper term
41 % lw_t=1;     % initialisation of lower term
42 for i1=1:N
43     for k1=1:p+1
44         up_t=1;     % initialisation of upper term
45         lw_t=1;     % initialisation of lower term
46
47         for j1=1:(p+1)
48             if j1~=k1
49                 up_t=up_t*(x-loc(i1,j1)); % upper term of shape function
```

```
50                 lw_t=lw_t*(loc(i1,k1)-loc(i1,j1)); % lower term of shape function
51             end
52         end
53         shape_f(k1,i1)=(up_t)/(lw_t);  % final shape function
54         % Note: Here shape functions are being stored in a coloumn
55         % (shape function,k_th_elem)
56     end
57
58 end
59 % shape_ft=shape_f';
60 % % for storing shape function in a list
61 % c=1;
62 % for i2=1:N
63 %     for j2=1:p
64 %         shape_fl(c)=shape_f(j2,i2);
65 %         c=c+1;
66 %     end
67 % end
68 % shape_fl(c)=shape_f(p+1,N);
69 %
70 %
71 % lshape_fun=shape_fl;
72 shape_fun=shape_f;      %Returning the result
73 loc_node=n_loc;
74 loc_inelem=loc;
75
76
77 %% ploting of shape functions
78 for l=1:N
79     t(:,l)=linspace(((L/N)*(l-1)),((L/N)*l),100);
80 end
81 %%
82
83 for i2=1:N
84     for j2=1:p+1
85         f1=shape_f(j2,i2);
86         val=subs(f1,x,t(:,i2));
87         plot(t(:,i2),val);
88         hold on
89         grid on
90     end
91 end
92 y=zeros(100,1);
93 plot(t,y,'r--');
94 ylim([-0.4,1.5]);
95 Na=strcat("N = ",num2str(N)," p = ",num2str(p));
96 [q,s]=title("Shape function plot for N=",Na);
97
98
```

```
99 end
```