02623 Finite Element Method for Differential Equations

Week 2 Exercise Solutions

EXERCISE 2.1
CASE 1:
==========

```
x =         0
         0
         0
         0
    0.2500
    0.2500
    0.2500
    0.2500
    0.5000
    0.5000
    0.5000
    0.5000
    0.7500
    0.7500
    0.7500
    0.7500
    1.0000
    1.0000
    1.0000
    1.0000

y =    1.0000
    0.6667
    0.3333
         0
    1.0000
    0.6667
    0.3333
         0
    1.0000
    0.6667
    0.3333
         0
    1.0000
    0.6667
    0.3333
         0
    1.0000
    0.6667
    0.3333
         0
```

```
elmtab =     1     6     5
     2     6     1
     2     7     6
     3     7     2
     3     8     7
     4     8     3
     5    10     9
     6    10     5
     6    11    10
     7    11     6
     7    12    11
     8    12     7
     9    14    13
    10    14     9
    10    15    14
    11    15    10
    11    16    15
    12    16    11
    13    18    17
    14    18    13
    14    19    18
    15    19    14
    15    20    19
    16    20    15

CASE 2:
========================================
x =   -2.5000
   -2.5000
   -2.5000
   -2.5000
   -0.6000
   -0.6000
   -0.6000
   -0.6000
    1.3000
    1.3000
    1.3000
    1.3000
    3.2000
    3.2000
    3.2000
    3.2000
    5.1000
    5.1000
    5.1000
    5.1000

y =    1.1000
   -0.8667
   -2.8333
   -4.8000
```

```
   1.1000
  -0.8667
  -2.8333
  -4.8000
   1.1000
  -0.8667
  -2.8333
  -4.8000
   1.1000
  -0.8667
  -2.8333
  -4.8000
   1.1000
  -0.8667
  -2.8333
  -4.8000
```

EXERCISE 2.2

CASE 2.2a:

```
==========================================
delta =    1.8683abc =   -6.5633   -1.9667   -1.9000
    4.9167    1.9667         0
    5.3833         0    1.9000
```

CASE 2.2b:

```
======
Face 1
n1 =     0
n2 =    -1
======
Face 2
n1 =    0.7192
n2 =    0.6948
======
Face 3
n1 =    -1
n2 =     0
```

EXERCISE 2.3

CASE 1:

```
==========================================
B =   -0.6667   -0.3750    1.0417         0         0
  -1.3333   -0.3750    2.0833   -0.3750         0
  -1.3333   -0.3750    2.0833   -0.3750         0
  -0.6667         0    1.0417   -0.3750         0
  -0.6667   -0.7500    2.0833         0   -0.6667
  -1.3333   -0.7500    4.1667   -0.7500   -1.3333
  -1.3333   -0.7500    4.1667   -0.7500   -1.3333
  -0.6667         0    2.0833   -0.7500   -0.6667
  -0.6667   -0.7500    2.0833         0   -0.6667
  -1.3333   -0.7500    4.1667   -0.7500   -1.3333
```

```
   -1.3333   -0.7500    4.1667   -0.7500   -1.3333
   -0.6667         0    2.0833   -0.7500   -0.6667
   -0.6667   -0.7500    2.0833         0   -0.6667
   -1.3333   -0.7500    4.1667   -0.7500   -1.3333
   -1.3333   -0.7500    4.1667   -0.7500   -1.3333
   -0.6667         0    2.0833   -0.7500   -0.6667
         0   -0.3750    1.0417         0   -0.6667
         0   -0.3750    2.0833   -0.3750   -1.3333
         0   -0.3750    2.0833   -0.3750   -1.3333
         0         0    1.0417   -0.3750   -0.6667

d =    -4
    -1
     0
     1
     4

CASE 2:
==========================================
B =   -0.5175   -0.4831    1.0006         0         0
   -1.0351   -0.4831    2.0012   -0.4831         0
   -1.0351   -0.4831    2.0012   -0.4831         0
   -0.5175         0    1.0006   -0.4831         0
   -0.5175   -0.9661    2.0012         0   -0.5175
   -1.0351   -0.9661    4.0024   -0.9661   -1.0351
   -1.0351   -0.9661    4.0024   -0.9661   -1.0351
   -0.5175         0    2.0012   -0.9661   -0.5175
   -0.5175   -0.9661    2.0012         0   -0.5175
   -1.0351   -0.9661    4.0024   -0.9661   -1.0351
   -1.0351   -0.9661    4.0024   -0.9661   -1.0351
   -0.5175         0    2.0012   -0.9661   -0.5175
   -0.5175   -0.9661    2.0012         0   -0.5175
   -1.0351   -0.9661    4.0024   -0.9661   -1.0351
   -1.0351   -0.9661    4.0024   -0.9661   -1.0351
   -0.5175         0    2.0012   -0.9661   -0.5175
         0   -0.4831    1.0006         0   -0.5175
         0   -0.4831    2.0012   -0.4831   -1.0351
         0   -0.4831    2.0012   -0.4831   -1.0351
         0         0    1.0006   -0.4831   -0.5175

d =    -4
    -1
     0
     1
     4
```

```
b =    9.3832
   9.9506
   2.6018
   0.5674
  -0.8996
  -0.4982
 -15.1958
  -6.9474
 -22.1986
 -43.0962
 -57.7938
 -28.2464
 -43.4976
 -85.6942
-100.3918
 -49.5454
 -17.3824
 -53.0468
 -60.3956
 -43.0132
```

EXERCISE 2.4
CASE 1:

```
==========================================
B =         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
   -1.3333   -0.7500    4.1667         0         0
   -1.3333         0    4.1667   -0.7500         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
   -1.3333   -0.7500    4.1667         0   -1.3333
   -1.3333         0    4.1667   -0.7500   -1.3333
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0   -0.7500    4.1667         0   -1.3333
         0         0    4.1667   -0.7500   -1.3333
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
```

```
d =   -4
   -1
    0
    1
    4
```

```
b =    1.0000
   1.0000
   1.0000
   1.0000
   1.0000
   2.0833
   2.0833
   1.0000
   1.0000
   0.7500
   0.7500
   1.0000
   1.0000
   2.0833
   2.0833
   1.0000
   1.0000
   1.0000
   1.0000
   1.0000
```

CASE 2:

==========

```
B =         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
   -1.0351   -0.9661    4.0024         0         0
   -1.0351         0    4.0024   -0.9661         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
   -1.0351   -0.9661    4.0024         0   -1.0351
   -1.0351         0    4.0024   -0.9661   -1.0351
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0   -0.9661    4.0024         0   -1.0351
         0         0    4.0024   -0.9661   -1.0351
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0
         0         0    1.0000         0         0

d =    -4
    -1
     0
     1
     4
```