North South University

Department of Electrical and Computer Engineering

Course Title: CSE417

Section: 02

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```matlab
function assignment2_1 = assignment2_1 (h)
  x = 0:h:6;
  n = numel(x) - 2;

  A=zeros(n,n);
  A(1,1) = ((50*h*h)-2);
  A(1,2) = (1+h);
  A(n,n-1) = (1-h);
  A(n,n) = ((50*h*h)-2);
  for i=2:(n-1)
  A(i,i) = ((50*h*h)-2);
  A(i,i-1) = (1-h);
  A(i,i+1) = (1+h);
  end

  fTop = (50*h*h);
  fBottom = ((50*h*h)-1-h);

  f = linspace(0,0,n)';
  f(1) = fTop;
  f(n) = fBottom;
  f(2:(n-1)) = (50*h*h);

  y = A\f;

  yNew = linspace(0,0,numel(x))';
  yNew(1) = 0;
  yNew(numel(x)) = 1;
  j = 1;
  for i=2:(numel(x)-1)
  yNew(i) = y(j);
  j = j+1;
  end

  figure;plot(x,yNew);
  title('ODE solution (full matrix)');
  xlabel('x'); ylabel('y');
```
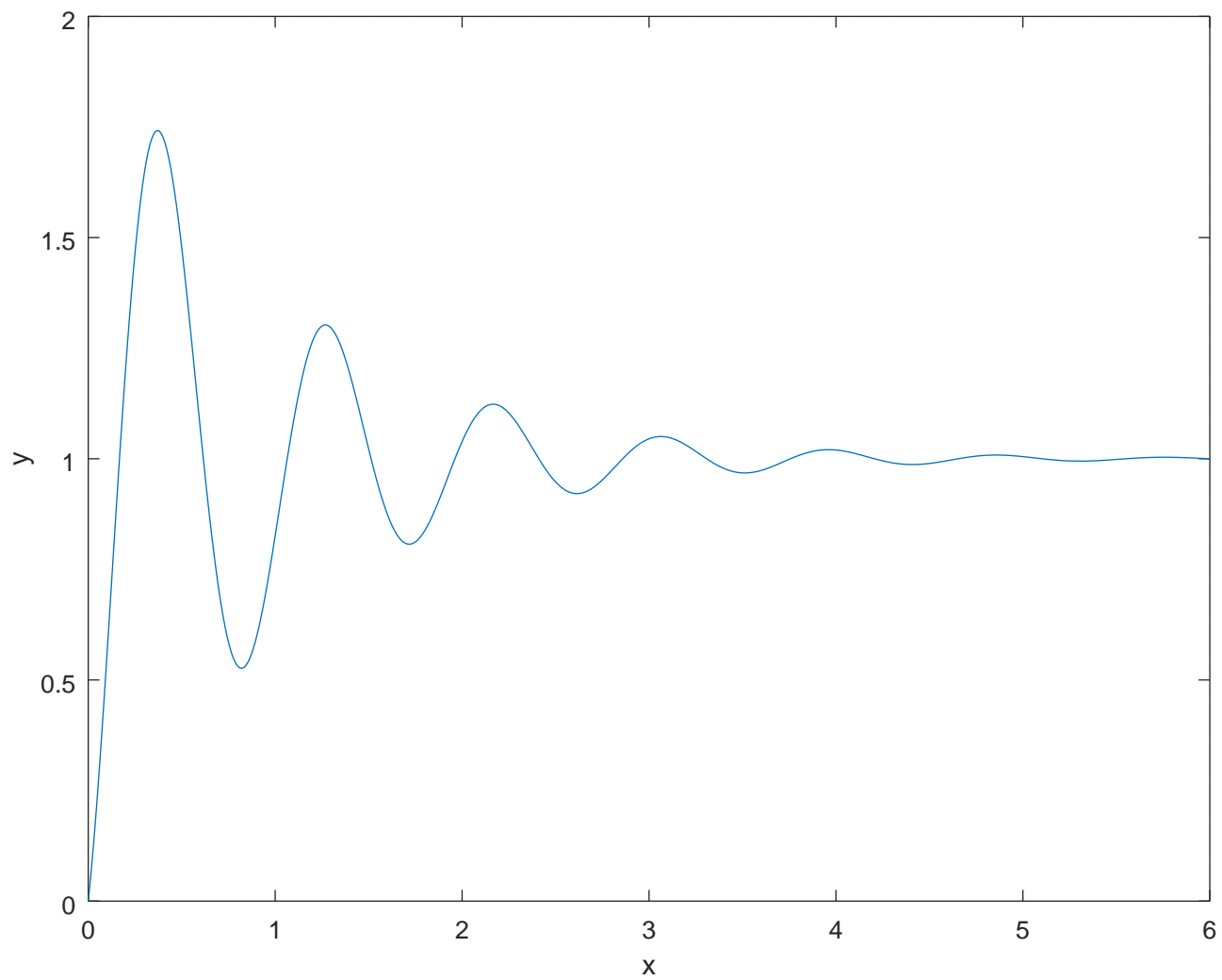
ODE solution (full matrix) for h = 0.25
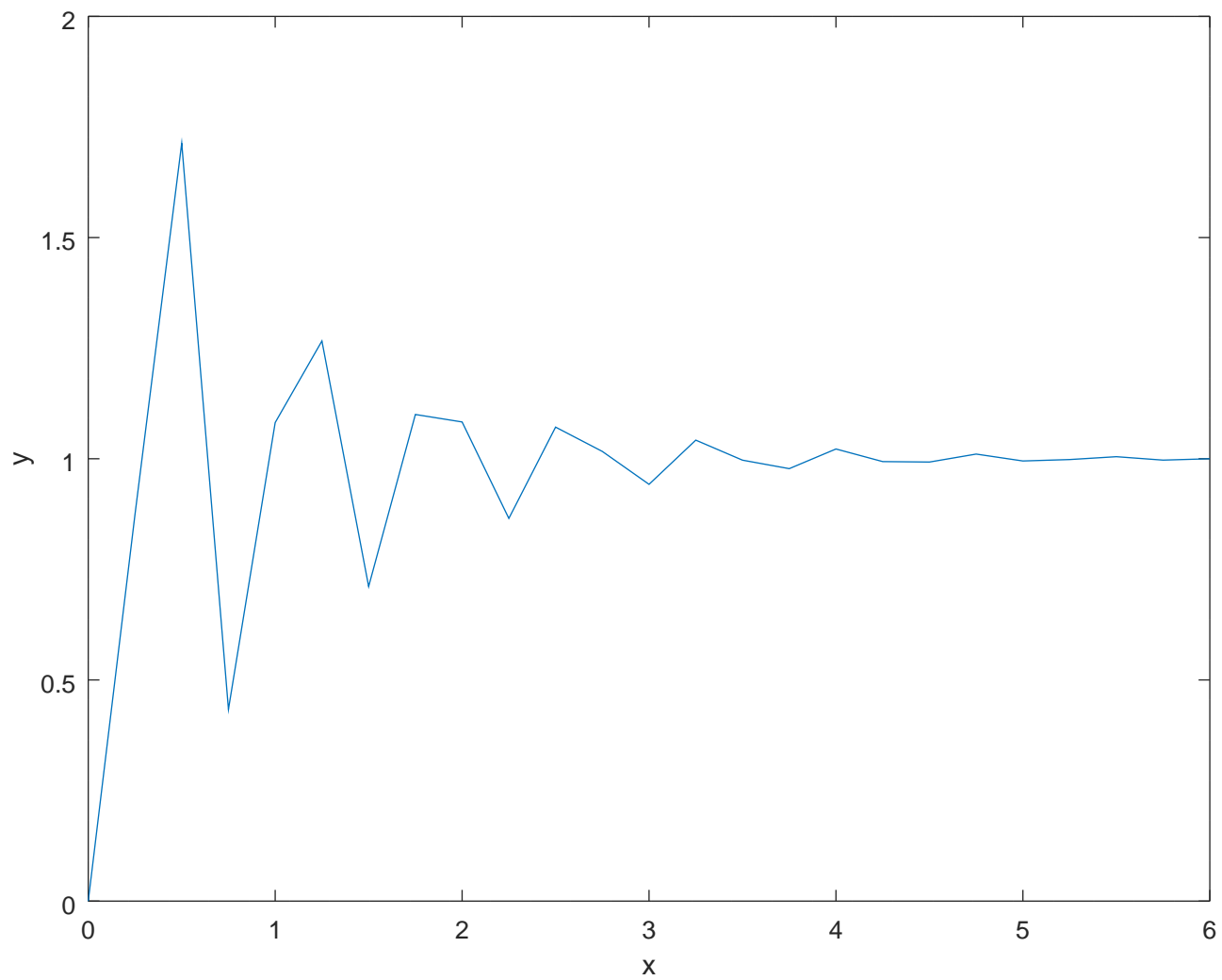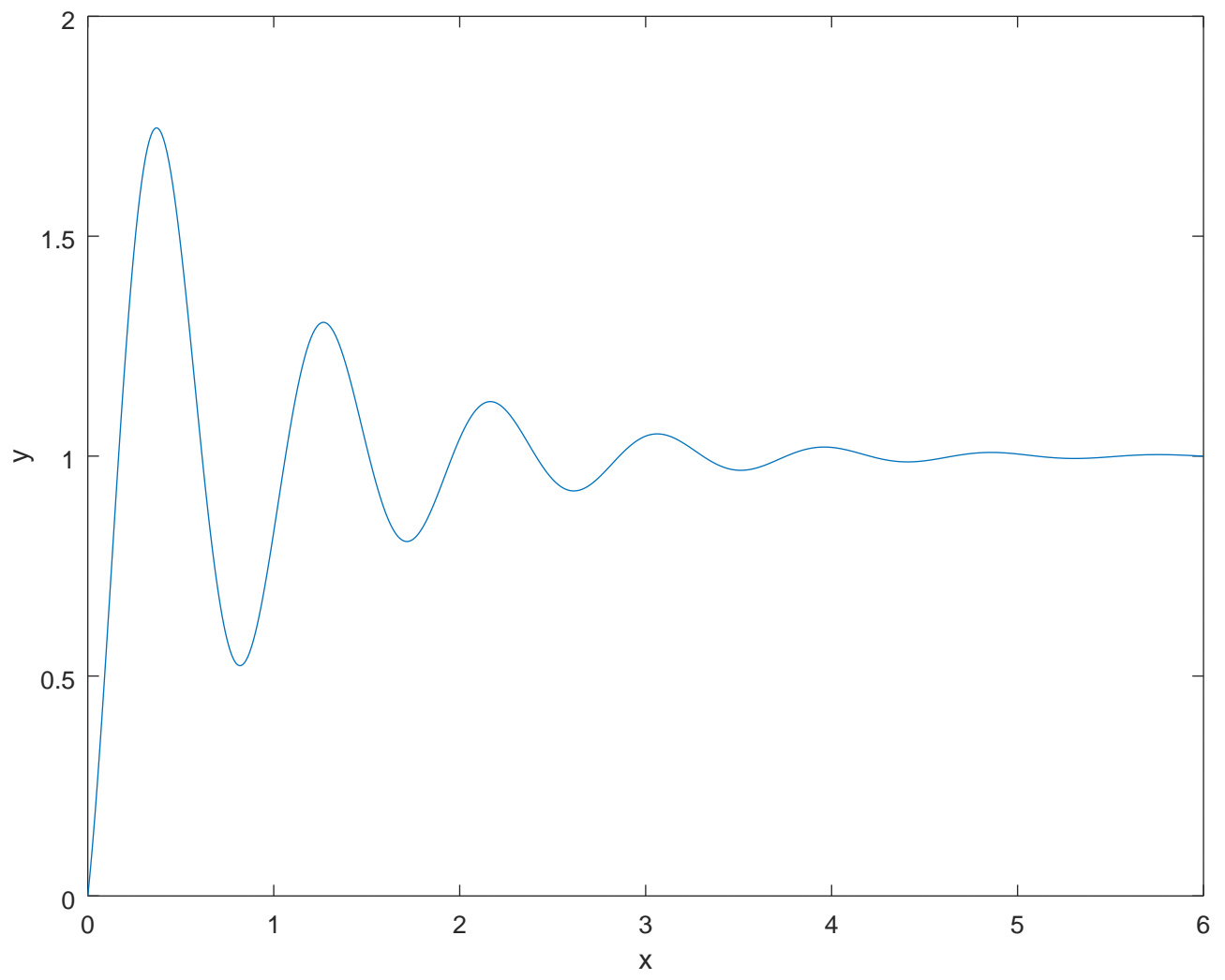
ODE solution (full matrix) for h = 0.1
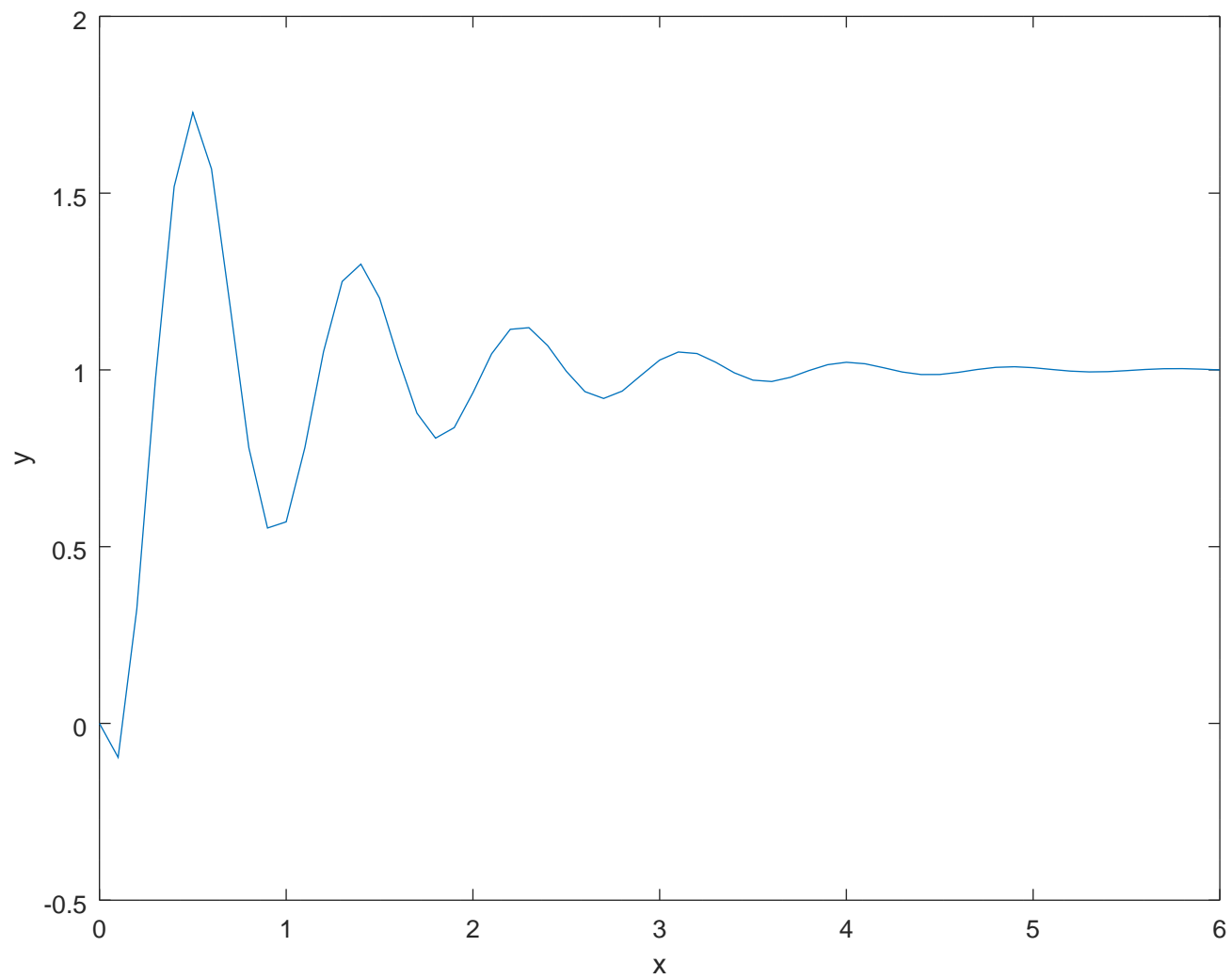
ODE solution (full matrix) for h = 0.01

ODE solution (full matrix) for h = 0.001

```
1    function assignment2_2 = assignment2_2 (n)
2
3      h = 1/n;
4
5      x = 0:h:1;
6      y = 0:h:1;
7      newN = n - 1;
8
9      newNSqr = newN * newN;
10
11     A=zeros(newNSqr,newNSqr);
12     count1 = 1;
13     count2 = 1;
14
15     for i=1:(newNSqr)
16       A(i,i) = -4;
17
18       if i <= (newNSqr - newN)
19         A(i, (i+newN)) = 1;
20       end
21       if i >= n
22         A(i, (i-newN)) = 1;
23       end
24
25       if count1 != newN && i <= newNSqr - 1
26         A(i,i+1) = 1;
27         count1 += 1;
28       elseif count1 == newN
29         count1 = 1;
30       end
31
32       if count2 != newN && i >= 2
33         A(i,i-1) = 1;
34         count2 += 1;
35       elseif count2 == newN
36         count2 = 1;
37       end
38     end
39
40     b = linspace(0,0,newNSqr)';
41
42     tempN = (n+1);
43     P = zeros(tempN, tempN);
44
45     numb = 1;
46     temp1 = 2;
47
48     P(1,1) = 1.0;
49
50     for i=2:tempN - 1
51       P(i,1) = 1 - (numb * h);
52       P(1,temp1) = 1 - (numb * h);
53       if i == 2
54         P(i,i) = -P(i-1,i) - P(i,i-1);
55       end
56       if i == (tempN - 1)
57         P(i,i) = -P(i,i+1) - P(i+1,i);
58       end
59       numb += 1;
60       temp1 += 1;
61     end
62
63     P(2, tempN-1) = -P(1,tempN-1) - P(2,tempN);
64     P(tempN-1, 2) = -P(tempN-1, 1) - P(tempN, 2);
65
66     for i=3:tempN - 2
67       P(2,i) = -P(1,i);
68       P(i,2) = -P(i,1);
69       P(tempN-1,i) = -P(tempN,i);
```

```matlab
70          P(i,tempN-1) = -P(i, tempN);
71      end
72
73      k = 1;
74
75      for i = (tempN-1):-1:2
76        for j=2:tempN-1
77          b(k) = P(i,j);
78          k += 1;
79        end
80      end
81
82      for i = 1: newNSqr
83        if b(i) == -(0.0)
84          b(i) = max(b(i),0);
85        end
86      end
87
88      u = A\b;
89
90      %uNew = reshape(u,[newN,newN]);
91
92      B=zeros(tempN,tempN);
93
94      numb = 1;
95      temp1 = 2;
96
97      B(tempN,1) = 1.0;
98
99      for i=2:tempN - 1
100        B(i,1) = (numb * h);
101        B(tempN,temp1) = 1 - (numb * h);
102        numb += 1;
103        temp1 += 1;
104      end
105
106      k = 1;
107
108      for i = 2:tempN-1
109        for j=2:tempN - 1
110          B(i,j) = u(k);
111          k++;
112        end
113      end
114
115      [X,Y] = meshgrid(x,y);
116      surf(X,Y,B);
117      xlabel('x'); ylabel('y'); zlabel('u');
```
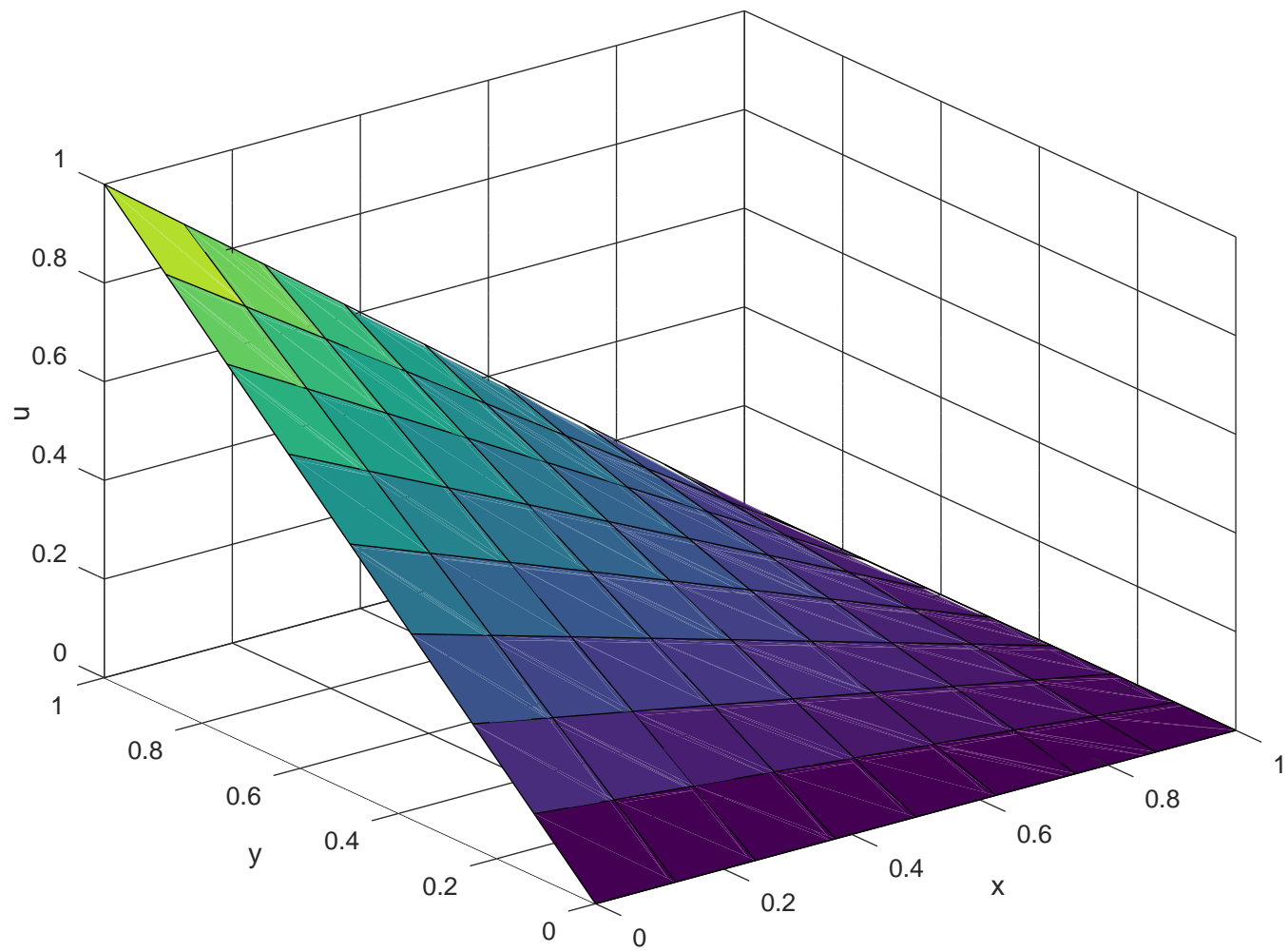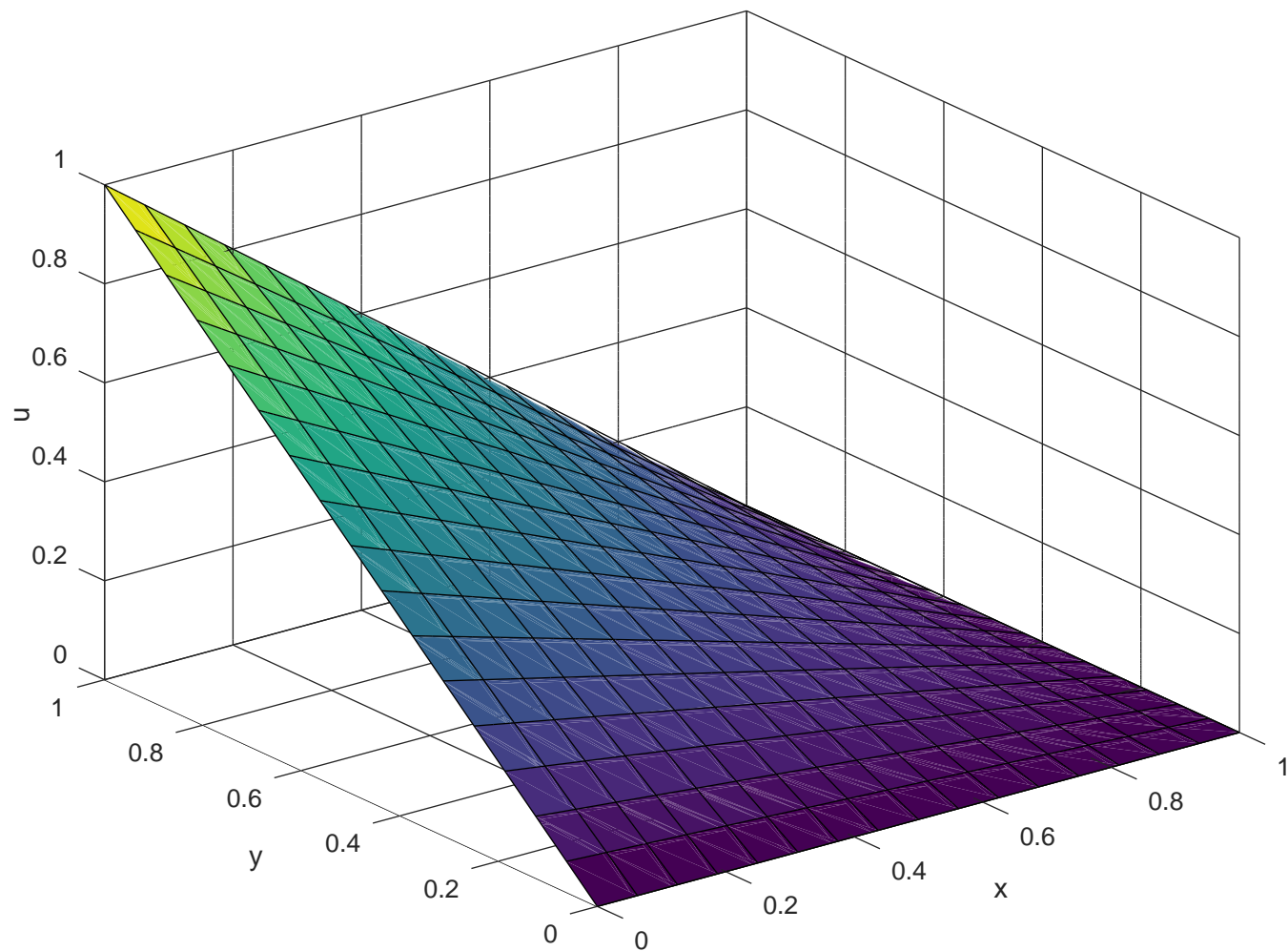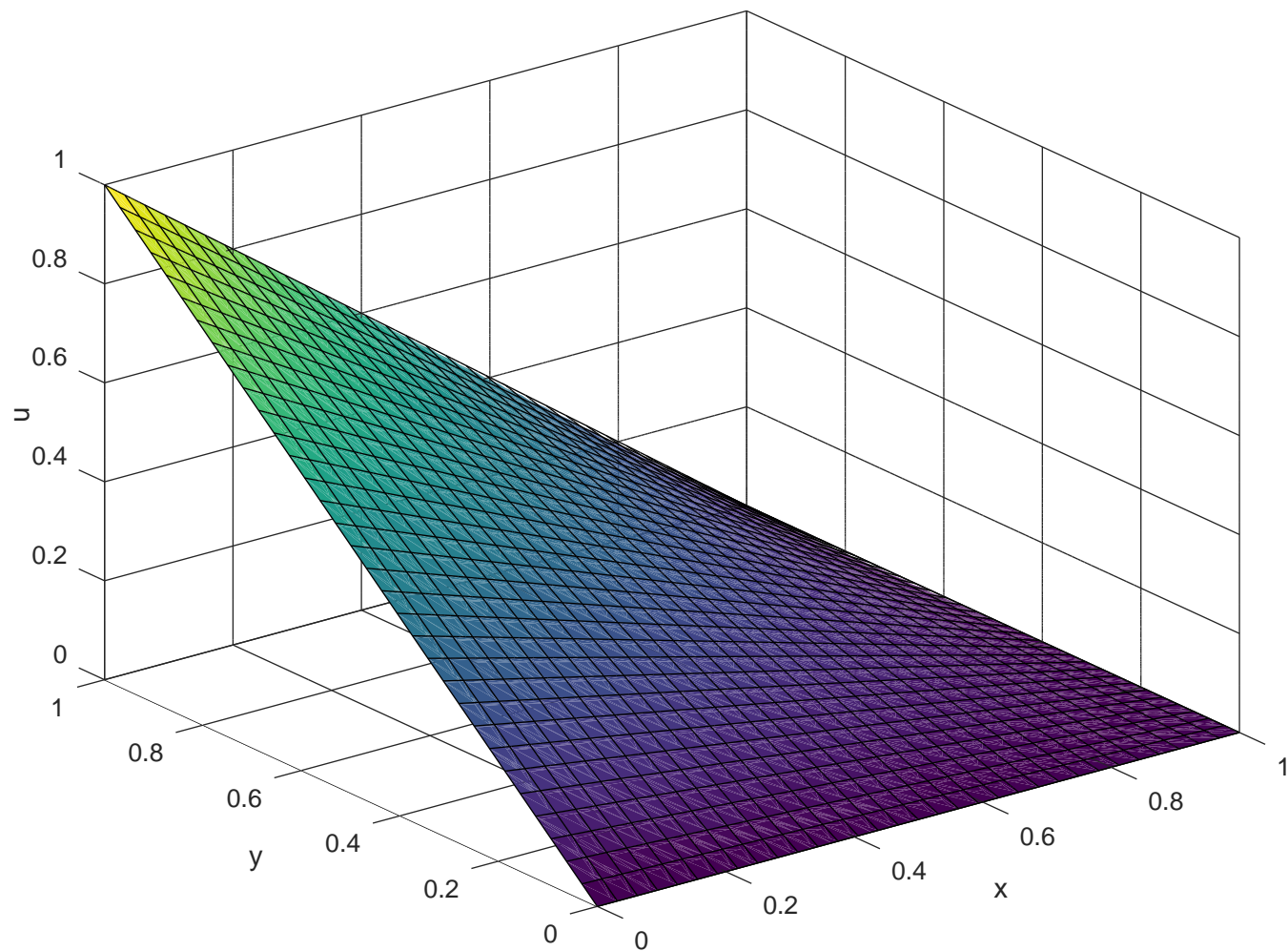
Laplace solution (full matrix) for N = 4
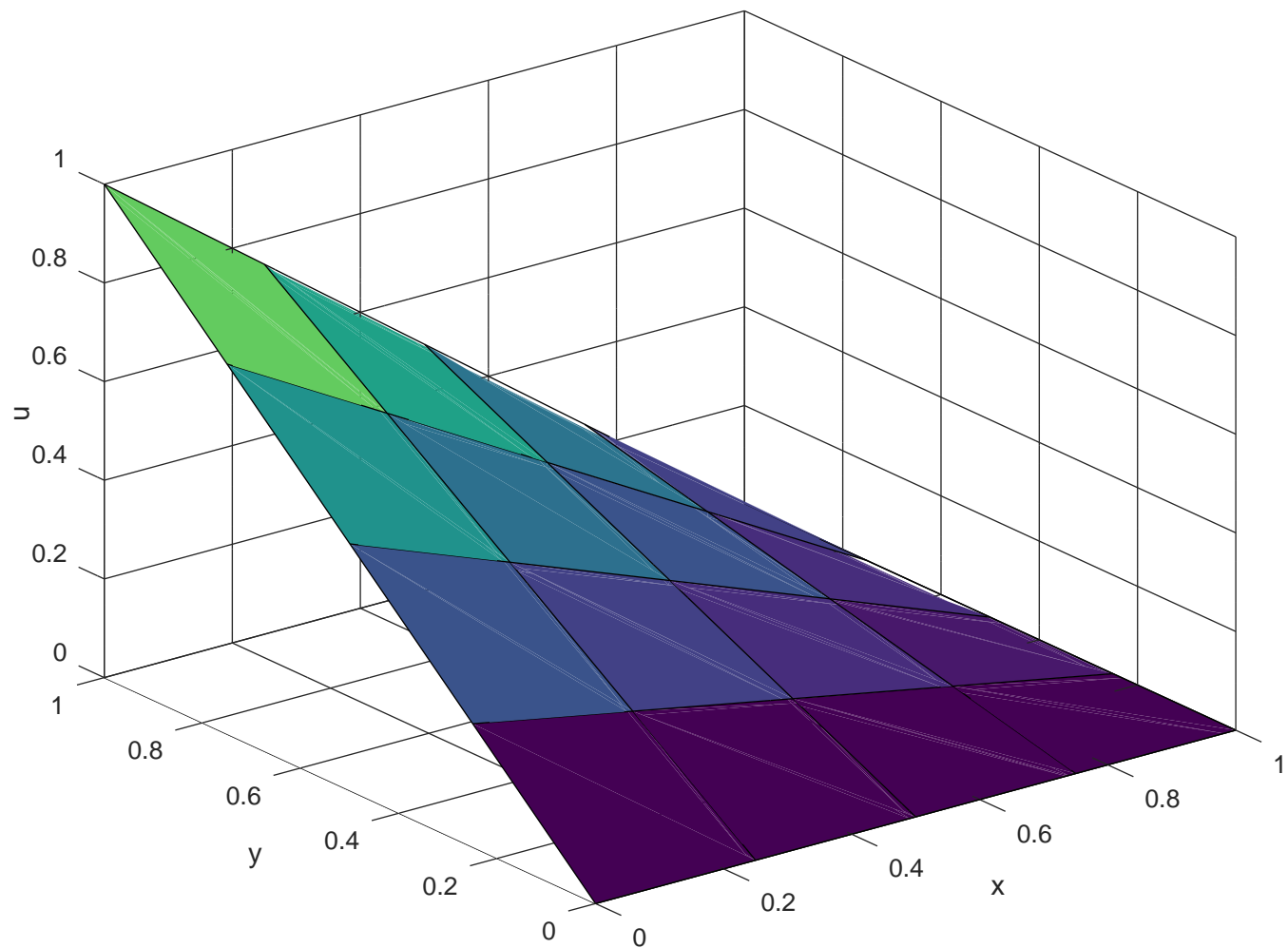
Laplace solution (full matrix) for N = 8

Laplace solution (full matrix) for N = 16
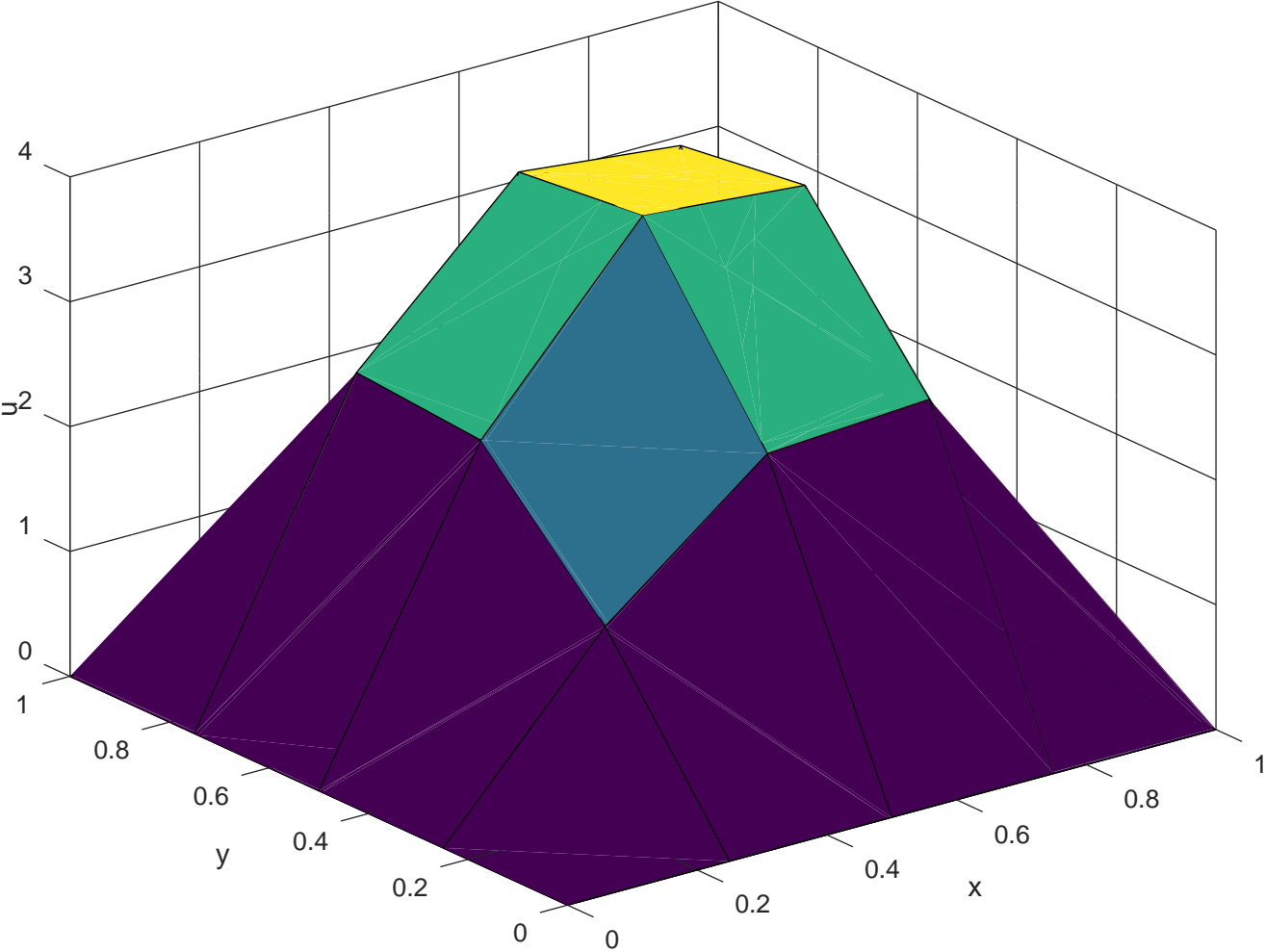
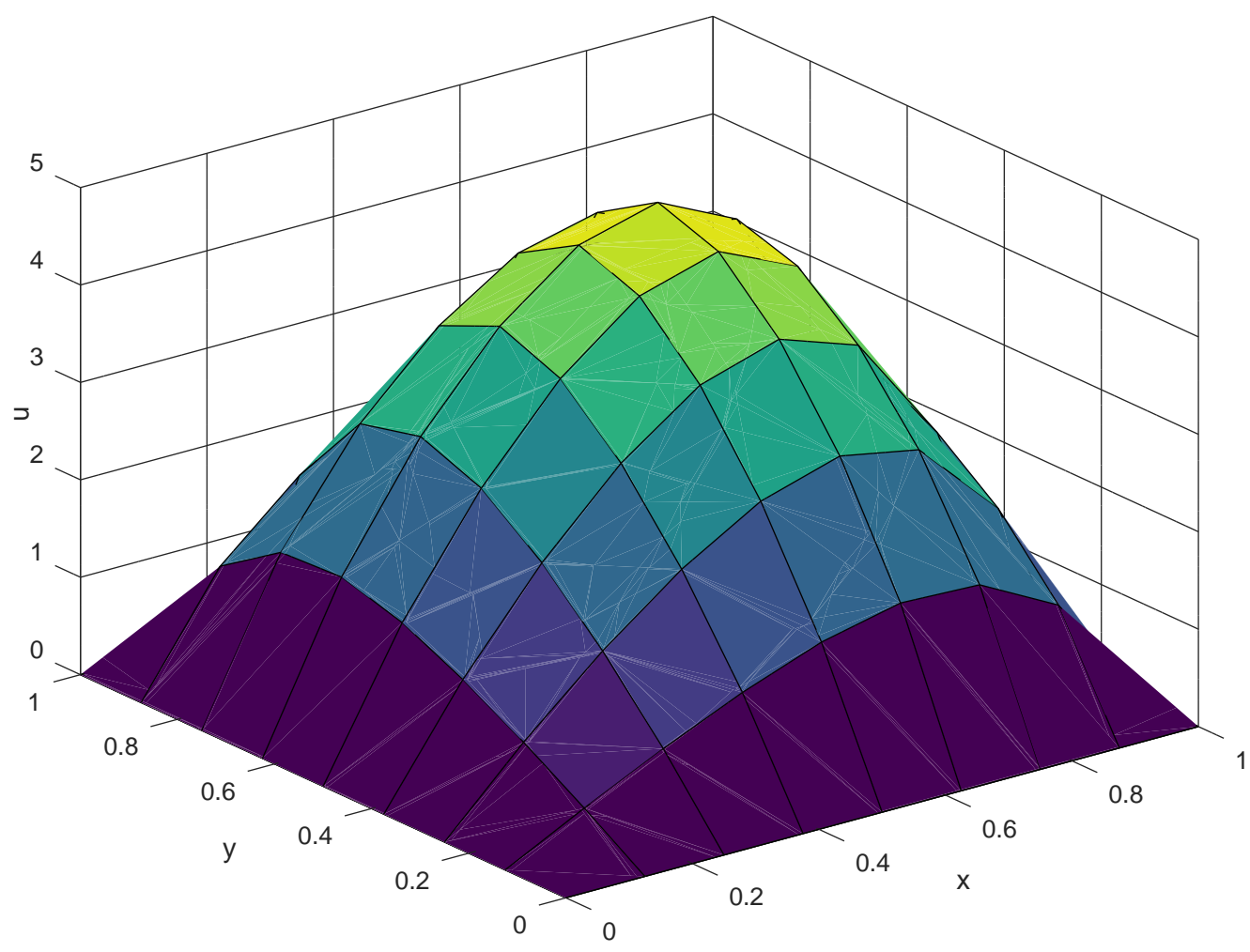Laplace solution (full matrix) for N = 32

```matlab
function assignment2_3 = assignment2_3 (n)

    h = 1/n;

    x = 0:h:1;
    y = 0:h:1;
    newN = n - 1;

    newNSqr = newN * newN;

    A=zeros(newNSqr,newNSqr);
    count1 = 1;
    count2 = 1;

    for i=1:(newNSqr)
      A(i,i) = -4;

      if i <= (newNSqr - newN)
        A(i, (i+newN)) = 1;
      end
      if i >= n
        A(i, (i-newN)) = 1;
      end

      if count1 != newN && i <= newNSqr - 1
        A(i,i+1) = 1;
        count1 += 1;
      elseif count1 == newN
        count1 = 1;
      end

      if count2 != newN && i >= 2
        A(i,i-1) = 1;
        count2 += 1;
      elseif count2 == newN
        count2 = 1;
      end
    end

    b = linspace(0,0,newNSqr)';

    tempN = (n+1);

    k = 1;

    for i = 1:tempN-2
      for j=1:tempN-2
        b(k) = -(100*h*h*(((i*h)*(i*h))+((j*h)*(j*h))));
        k += 1;
      end
    end

    u = A\b;

    B=zeros(tempN,tempN);

    k = 1;

    for i = 2:tempN-1
      for j=2:tempN - 1
        B(i,j) = u(k);
        k++;
      end
    end

    [X,Y] = meshgrid(x,y);
    surf(X,Y,B);
    xlabel('x'); ylabel('y'); zlabel('u');
```
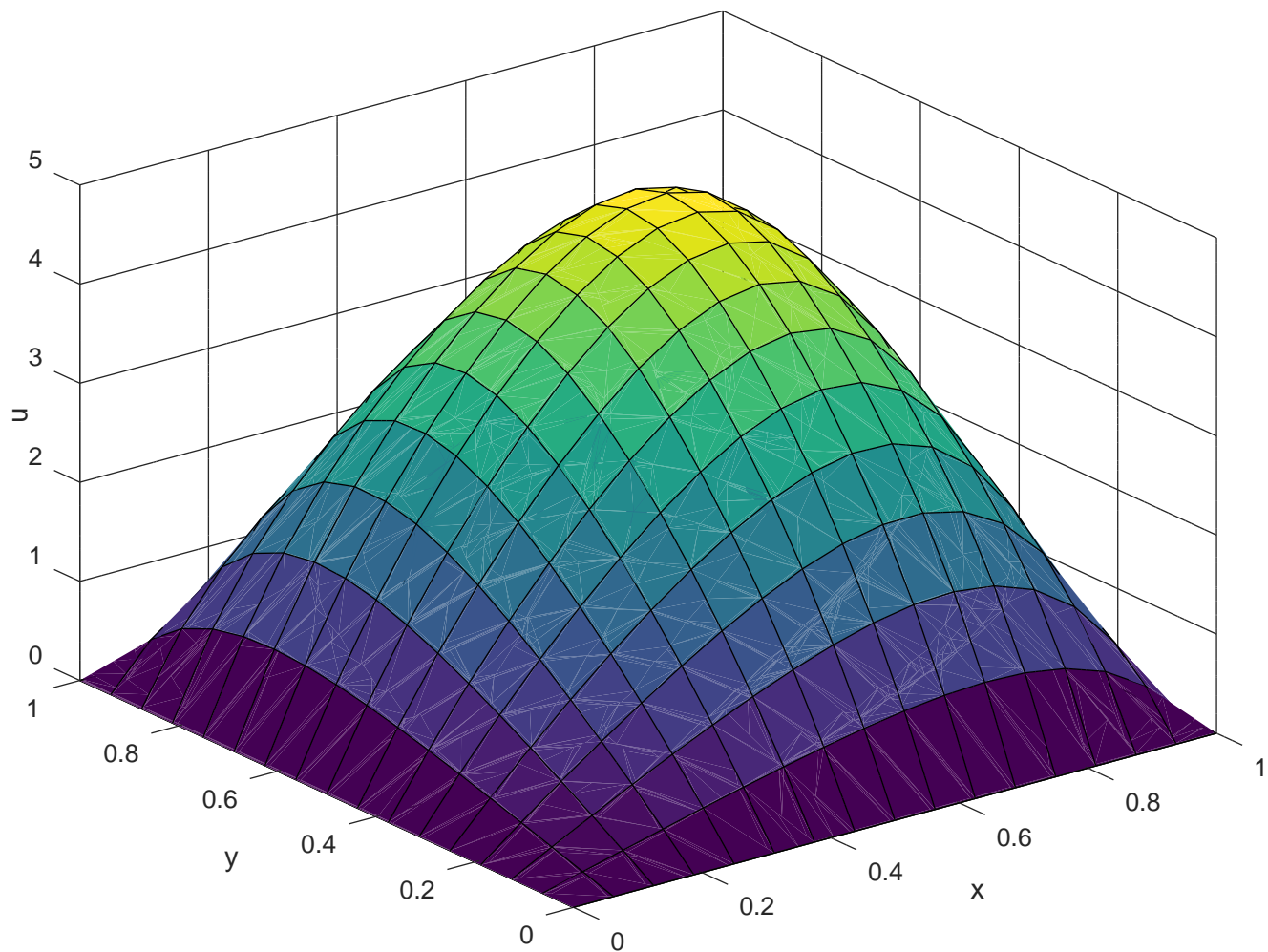
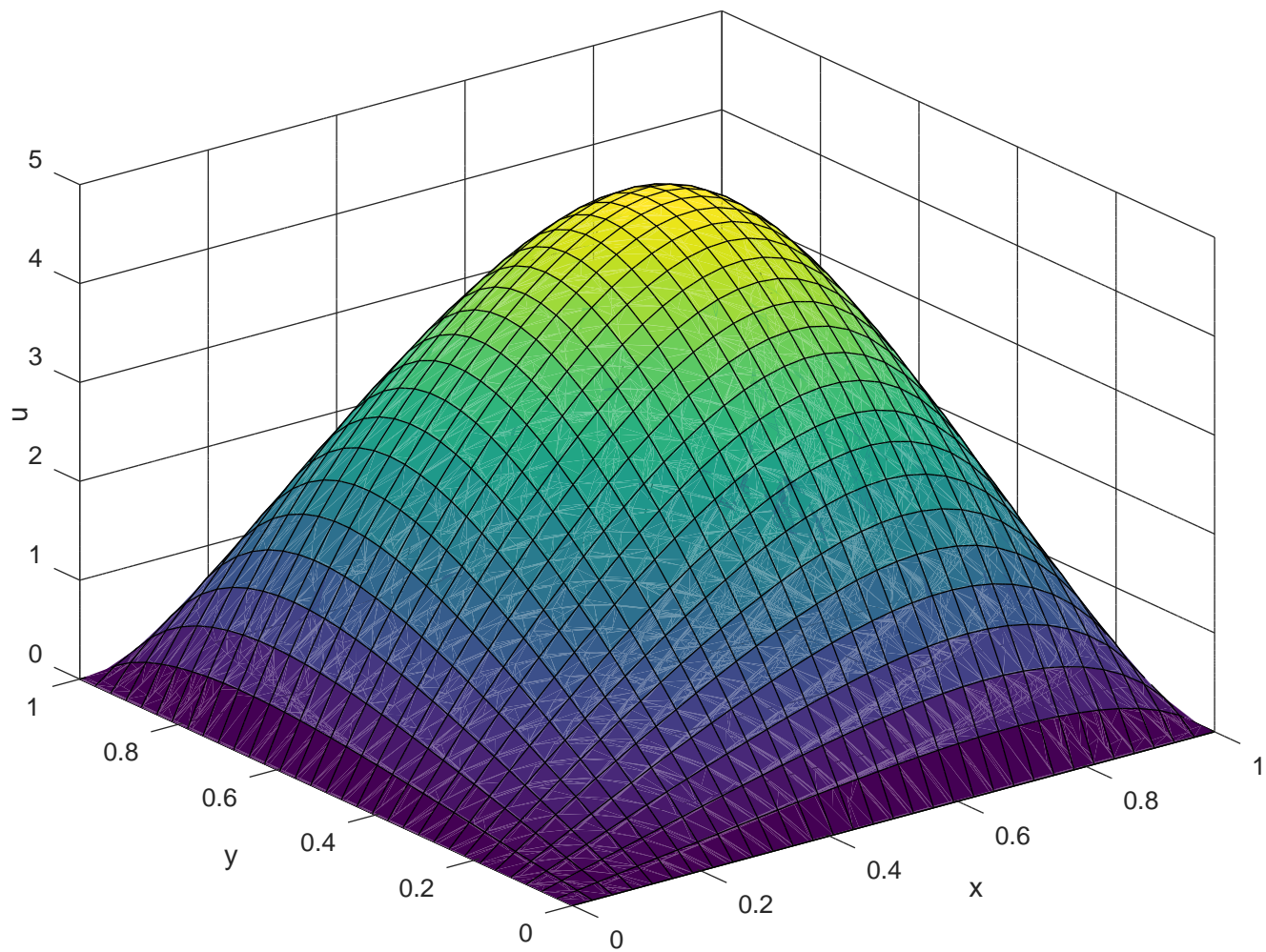Poisson solution (full matrix) for N = 4

Poisson solution (full matrix) for N = 8

Poisson solution (full matrix) for N = 16

Poisson solution (full matrix) for N = 32

```matlab
function assignment2_4 = assignment2_4 (n)

  h = 1/n;

  x = 0:h:1;
  y = 0:h:1;
  newN = n - 1;

  newNSqr = newN * newN;

  A=zeros(newNSqr,newNSqr);
  count1 = 1;
  count2 = 1;

  for i=1:(newNSqr)
    A(i,i) = -4;

    if i <= (newNSqr - newN)
      A(i, (i+newN)) = 1;
    end
    if i >= n
      A(i, (i-newN)) = 1;
    end

    if count1 != newN && i <= newNSqr - 1
      A(i,i+1) = 1;
      count1 += 1;
    elseif count1 == newN
      count1 = 1;
    end

    if count2 != newN && i >= 2
      A(i,i-1) = 1;
      count2 += 1;
    elseif count2 == newN
      count2 = 1;
    end
  end

  b = linspace(0,0,newNSqr)';

  tempN = (n+1);
  P = zeros(tempN, tempN);

  numb = 1;
  temp1 = 2;

  P(1,1) = sin(pi*(tempN-1)*h);
  P(1,tempN) = 0.5*(((tempN-1)*h)**2);

  for i=2:tempN - 1
    P(i,1) = sin(pi*(tempN-1-numb)*h);
    P(1,temp1) = 0.5*((numb*h)**2);
    P(i,tempN) = (exp(pi) * sin(pi*(tempN-1-numb)*h)) + (0.5*(((tempN-1-numb)*h)**2));
    if i == 2
      P(i,i) = -P(i-1,i) - P(i,i-1) + ((((((i-1)*h)**2)+(((tempN-2)*h)**2))*h*h);
    end
    if i == (tempN - 1)
      P(i,i) = -P(i,i+1) - P(i+1,i) + ((((((tempN-2)*h)**2)+(((i-1)*h)**2))*h*h);
    end
    numb += 1;
    temp1 += 1;
  end

  P(2, tempN-1) = -P(1,tempN-1) - P(2,tempN) +
((((((tempN-2)*h)**2)+(((tempN-2)*h)**2))*h*h);
  P(tempN-1, 2) = -P(tempN-1, 1) - P(tempN, 2) + (((((i-1)*h)**2)+(((i-1)*h)**2))*h*h);

  numb = 3;
```

```matlab
69
70    for i=3:tempN - 2
71      P(2,i) = -P(1,i) + ((((( i-1)*h)**2)+(((tempN-2)*h)**2))*h*h);
72      P(i,2) = -P(i,1) + ((((1*h)**2)+(((tempN - numb)*h)**2))*h*h);
73      P(tempN-1,i) = -P(tempN,i) + ((((((i-1)*h)**2)+((1*h)**2))*h*h);
74      P(i,tempN-1) = -P(i, tempN) + ((((((tempN-2)*h)**2)+(((tempN - numb)*h)**2))*h*h);
75      numb += 1;
76    end
77
78    k = 1;
79
80    for i = (tempN-1):-1:2
81      for j=2:tempN-1
82        b(k) = P(i,j);
83        k += 1;
84      end
85    end
86
87    for i = 1: newNSqr
88      if b(i) == -(0.0)
89        b(i) = max(b(i),0);
90      end
91    end
92
93    u = A\b;
94
95    B=zeros(tempN,tempN);
96
97    numb = 1;
98    temp1 = 2;
99
100   B(tempN,1) = sin(pi*(tempN-1)*h);
101   B(tempN,tempN) = 0.5*(((tempN-1)*h)**2);
102
103   for i=2:tempN - 1
104     B(i,1) = sin(pi*(numb)*h);
105     B(tempN,temp1) = 0.5*((numb*h)**2);
106     B(temp1,tempN) = (exp(pi) * sin(pi*(numb)*h))+ (0.5*((numb*h)**2));
107     numb += 1;
108     temp1 += 1;
109   end
110
111   k = 1;
112
113   for i = 2:tempN-1
114     for j=2:tempN - 1
115       B(i,j) = u(k);
116       k++;
117     end
118   end
119
120   [X,Y] = meshgrid(x,y);
121   surf(X,Y,B);
122   xlabel('x'); ylabel('y'); zlabel('u');
```
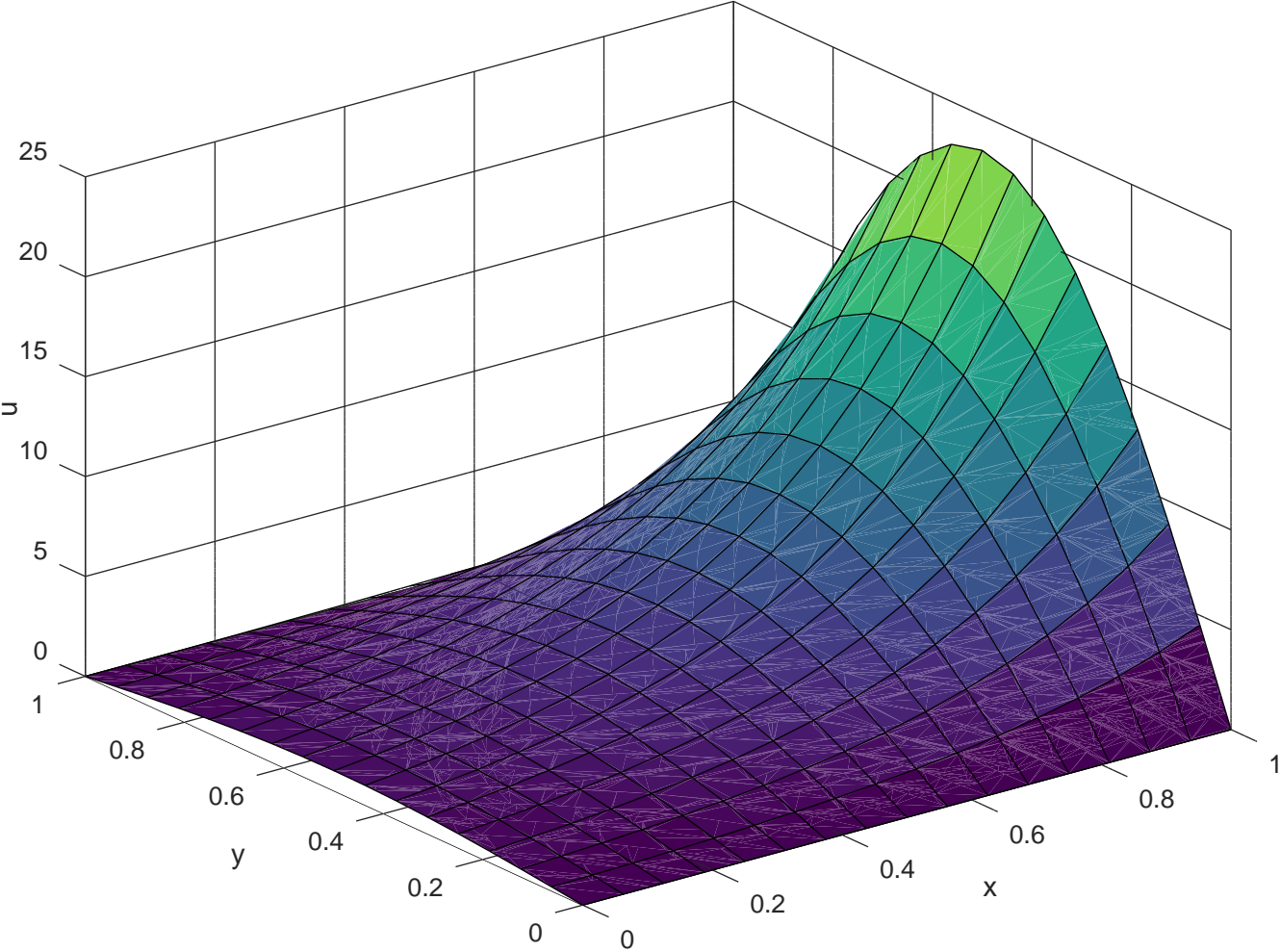
Poisson (Bonus problem) solution (full matrix) for N = 4
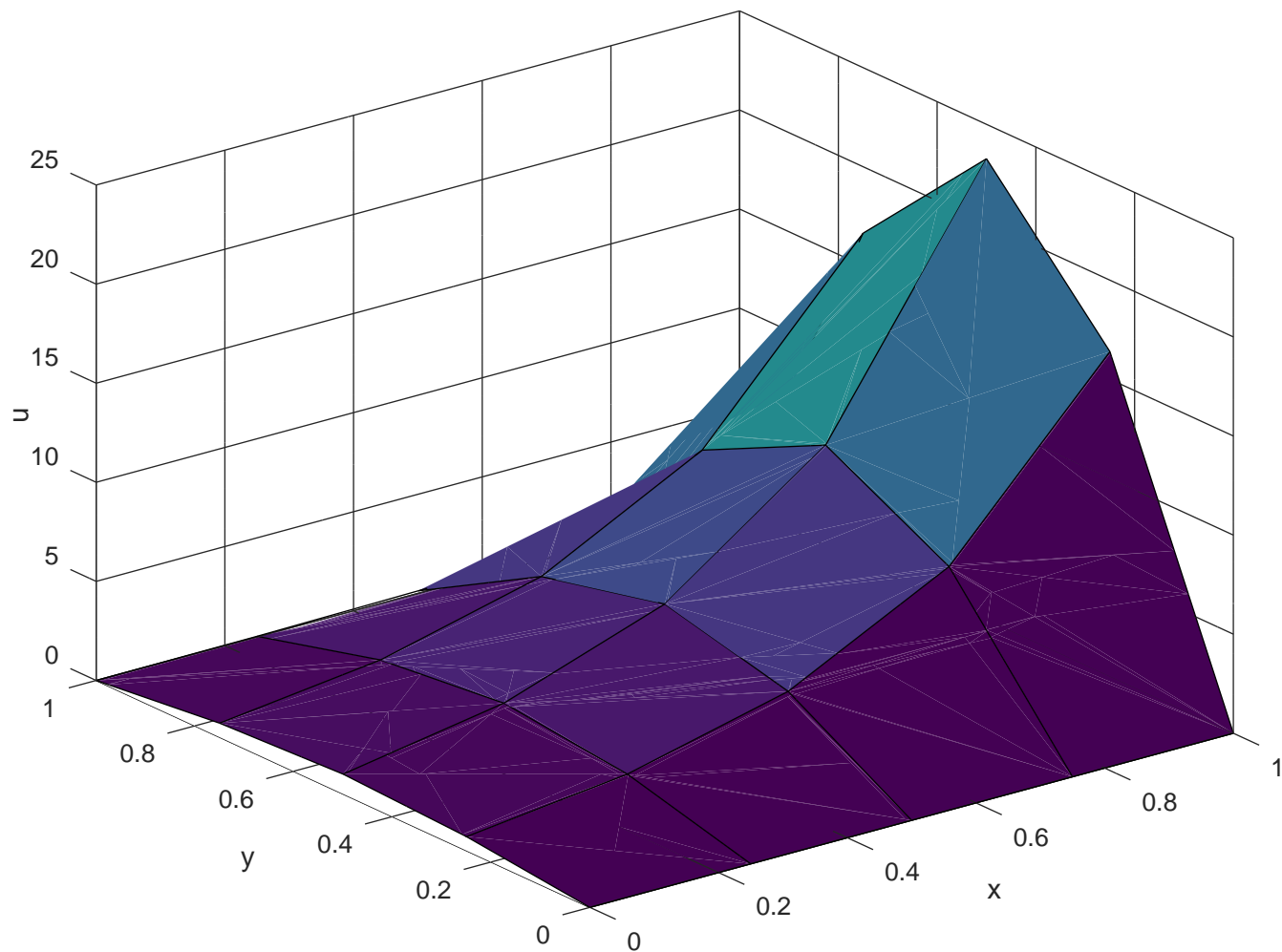
Poisson (Bonus problem) solution (full matrix) for N = 8
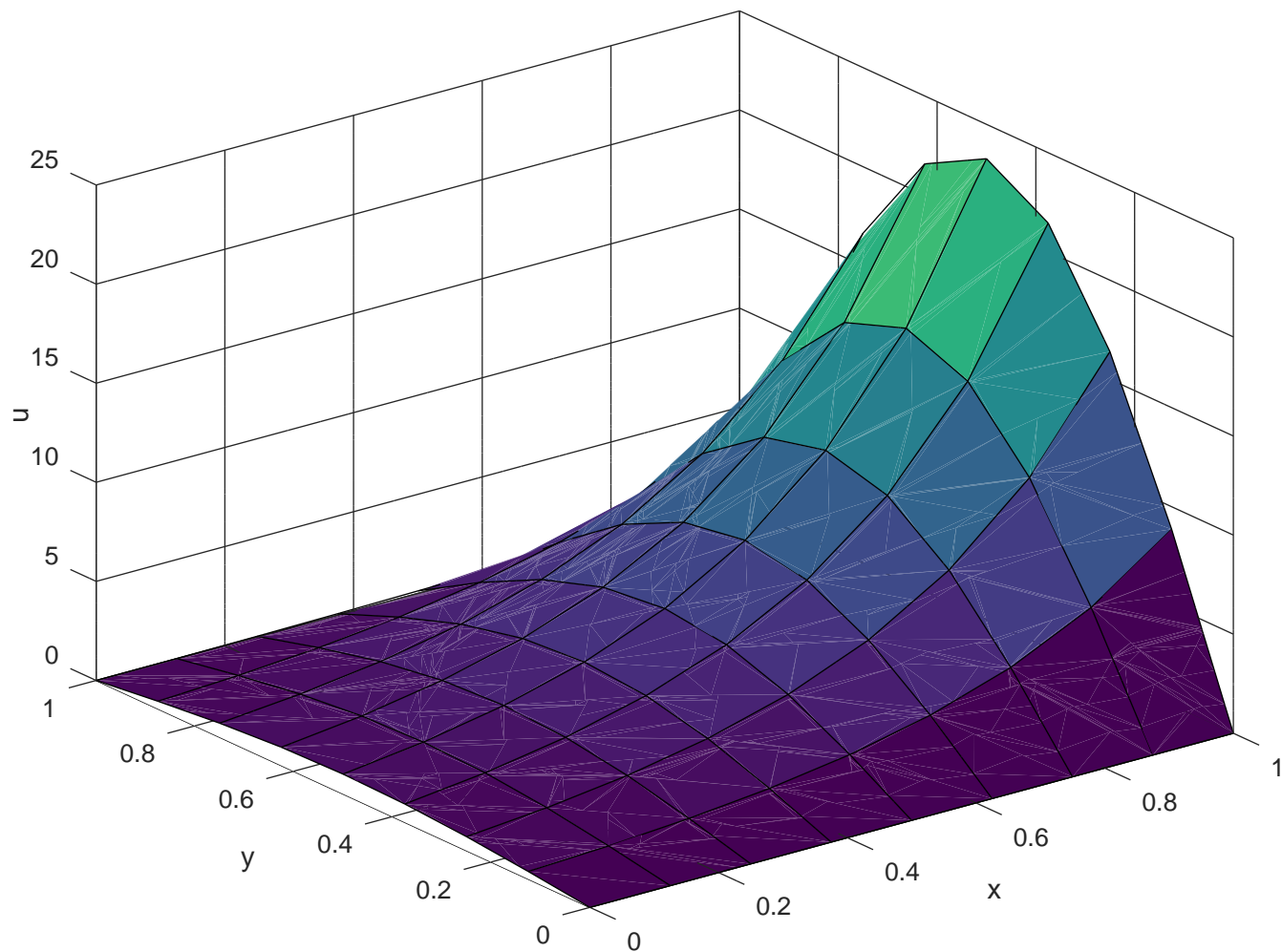
Poisson (Bonus problem) solution (full matrix) for N = 16

Poisson (Bonus problem) solution (full matrix) for N = 32