1. Federal income tax marginal rates on taxable income for single individuals in the United States are:

<table>
<thead>
<tr>
<th>Taxable income</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1 to $7000</td>
<td>10%</td>
</tr>
<tr>
<td>$7001 to $28,400</td>
<td>15%</td>
</tr>
<tr>
<td>$28,401 to $68,000</td>
<td>25%</td>
</tr>
<tr>
<td>$68,001 to $143,300</td>
<td>28%</td>
</tr>
<tr>
<td>$143,301 to $311,950</td>
<td>33%</td>
</tr>
<tr>
<td>Above $311,950</td>
<td>35%</td>
</tr>
</tbody>
</table>

*Marginal* means the rate applies to the increment in the given range. Thus, for $10,000, the first $7000 would be taxed at 10%, and the remaining $3000 (equal to 10,000 minus 7000) would be taxed at 15%. Thus, the tax on $10,000 would be

\[0.1 \times 7000 + 0.15 \times (10000 - 7000) = 700 + 450 = 1150.\]

Write a program to input taxable income and compute the tax owed. Apply your program to $25,000; $50,000; $75,000; and $175,000.

2. a) Bessel functions can be generated from the following series. Use this series to compute (hand calculate) the value of \( J_2(1.6) \):

\[
J_n(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{2^{n+2k} \Gamma(n + k + 1)} x^{n+2k}
\]

Where \( \Gamma \) is the gamma function and \( \Gamma(m) = (m-1)! \) if \( m \) is an integer, \( \Gamma(1) = 1 \), and \( \Gamma(2) = (2-1)! = 1 \), and \( \Gamma(3) = 2! \), and so on. Also \( 0! = 1 \).

b) Using the above equation, write a VBA program that takes as input the values of \( x \) and \( n \) (the maximum number of terms in the summation sign). Run the code for \( n = 2 \) and \( x = 1.6 \) and verify your hand calculated answer. Also, run the code for \( n = 10 \), \( x = 1.8 \), and \( k \) varying from 0 to 15, and report the final output.

3. Give the output of this code? Show hand calculation (don’t use computer)

```vba
Dim i As Integer, k As Integer, sum As Single, a As Single
a = 2.25
sum = 9#
For i = 1 To 3
    For k = 1 To 2
        sum = sum + a * i * k
    Next k
Next i
Cells(1, 1) = sum
End Sub
```

4. Hand solve the following problem (show steps) and give the output of the code. Run the code and verify your hand calculated results

```vba
Private Sub CommandButton1_Click()
Dim i As Integer, a(3) As Single, b(3) As Single, c(3) As Single
Dim ff As Single, d(3) As Single, x(3) As Single
```
For i = 2 To 3
    ff = a(i) / (b(i - 1) - 1)
    If (ff > 5#) Then
        b(i) = b(i) - (c(i - 1) * ff)
        d(i) = d(i) - (d(i - 1) * ff)
    Else
        b(i) = b(i) - (c(i - 1) / ff)
        d(i) = d(i) - (d(i - 1) / ff)
    End If
Next i
For i = 1 To 3
    x(i) = d(i) / b(i)
Next i
For i = 1 To 3
    Cells(i, 1) = a(i)
    Cells(i, 2) = b(i)
    Cells(i, 3) = c(i)
    Cells(i, 4) = d(i)
    Cells(i, 5) = x(i)
Next i
End Sub

5. Develop a general VB code that can solve the \( Ax = b \) problem for an arbitrary 3 x 3 matrix system using the Cramer's rule. Use a determinant code as a subroutine and call this routine to implement the Cramer's rule to solve the LAE problem given below. Ans: 0.9855, 1.4638, 0.913

Program these Steps: Read matrix A
Copy it three times and make three matrices A1, A2, A3
Replace first column in A1 with b
Replace second column in A2 with b
Replace first column in A3 with b
Call determinant subroutine 4 times and use determinants to evaluate \( x_1, x_2, x_3 \)

sub mydeterminant (Amat() as single, determinantValue as single)
    Term1 = a11*(a22*a33 - a32*a23)
    Term2 = a12*(a21*a33 - a31*a23)
    Term3 = a13*(a21*a32 - a31*a22)
    determinantValue = term1 + term2 + term3
End Sub

Problem: -3y + 7z = 2; \( x + 2y - z = 3; \) \( 5x - 2y = 2 \)