

**HACETTEPE UNIVERSITY**

**ELECTRICAL AND ELECTRONICS ENGINEERING**

**ELE338 MICROPROCESSOR ARCHITECTURE AND PROGRAMMING LAB.**

**TERM PROJECT**

**ASSIGNMENT GROUP 4**

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**CODE ANALYSIS**

I will explain the important parts of my code one by one.

**LOGIN SCREEN**

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| When we ran the code, I printed these as the login screen. There are 5 different situations for the code to move on to the next step. Pressing A/a, B/b, C/c, D/d or ESC moves to the next step. Pressing A/a, B/b, C/c or D/d moves to the next step to get the input value from you. Pressing Esc ends the code. |

**PRESS DIFFERENT KEY**

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| If we press any key other than A / a, B / b, C / c, D / d or ESC. It writes 'invalid input' on the screen and puts the code first. It asks for input from us again to make a selection. |

**TO DRAW INTERNAL AND EXTERNAL LAYER**

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| To draw the external layer, I first examined the INT 10h commands one by one.  **Mov AX,03h**  **Int 10h**  The command system allows us to use an 80x25 emulator screen. In this command system, we use DH and DL Registers as rows and columns. We enter the start command of the shape we will draw at the beginning of the procedure.  **Mov AH,02h**  **Int 10h**  **Mov AL,32d ; AL = Charachter**  **Mov BH,0 ; BH = Page Number**  **Mov BL,0E0h ; BL = Color (0E0h= Yellow , 0A0h= Green)**  **Mov CX,1 ; CX = Number of times to print character**  I used this command system to print the shape we want on the screen.  I designed the shape in my head and drew it with these commands. At the end of the figure, I printed the input and output values to the screen together with its units. |

**IF OUR CHOICE IS A/a**

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| If we choose A/a. Maximum current will be calculated in internal layer. To calculate the maximum current in the internal layer, we need to enter the width(mils) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished. |

**TAYLOR SERIES ACCORDING TO THE INPUT VALUE**

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| If the input value (width) entered is 20 or less than 20, ıt does the operations in First\_Taylor\_CI.  If the input value (width) is between 70 and 21, ıt does the operations in Second\_Taylor1\_CI.  If the input value (width) is greater than 70, ıt does the operations in Third\_Taylor1\_CI. |

**Input Value : 1 ≤ Width ≤ 20 (First\_Taylor\_CI)**

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| Area = (Current/(k\*Temp\_Rise^b))^(1/c)  Width = Area/(Thickness\*1.378)  IN INTERNAL LAYERS:  Temp\_Rise = 10 C , Thickness = 1 oz  b = 0.44 , c = 0.725 , k = 0.024  Current = Area^c (k\*10^b)  Current = (Width^0.725)/12  Current = (1+0.725(Width-1))/12  Current = (10+7(Width-1))/120  Finally  Current = (3+7\*Width)/120  If the input value is between 1 and 20, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **(3 + 7\*Width)/120**.  My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 7 times. Then I added 3 to my AX value. To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 120 to my BX Register. My output value has been found. |

**Input Value : 21 ≤ Width ≤ 70 (Second\_Taylor1\_CI)**

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| Current = (Width^0.725)/12  (Width^0.725) = Center^0.725 + (Center^-0.275)(0.725)(Width-Center)  (Width^0.725) = 9 + 3(Width-21)/10  If the input value is between 21 and 70, I took the center of the taylor series as 21. After putting the constants in place, the resulting equation is **(9 + 3(Width-21)/10)/12**    My input value is registered in the CX Register, I subtracted 21 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 3 times. I divided my AX Register by BL = 10. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+10, otherwise I add it as AL+9. I multiply the CX by 10 for the last time. And I put the value in AX Register.  To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 120 to my BX Register. My output value has been found. |

**Input Value : Width ≥ 71 (Third\_Taylor1\_CI)**

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| Current = (Width^0.725)/12  (Width^0.725) = Center^0.725 + (Center^-0.275)(0.725)(Width-Center)  (Width^0.725) = 22 + 1(Width-71)/4  If the input value is greater than 70, I took the center of the taylor series as 71. After putting the constants in place, the resulting equation is **(22 + 1(Width-71)/4)/12**    My input value is registered in the CX Register, I subtracted 71 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 1 times. I divided my AX Register by BL = 4. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+23, otherwise I add it as AL+22. I multiply the CX by 10 for the last time. And I put the value in AX Register.  To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 120 to my BX Register. My output value has been found. |

**RESULTS**

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| **Input: Width = 4(mils)** |
| **Input: Width = 24(mils)** |
| **Input: Width = 74(mils)** |

**IF OUR CHOICE IS B/b**

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| If we choose B/b. Maximum current will be calculated in external layer. To calculate the maximum current in the external layer, we need to enter the width(mils) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished. |

**TAYLOR SERIES ACCORDING TO THE INPUT VALUE**

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| If the input value (width) entered is 19 or less than 19, ıt does the operations in First\_Taylor\_CE.  If the input value (width) is between 71 and 20, ıt does the operations in Second\_Taylor1\_CE.  If the input value (width) is greater than 71, ıt does the operations in Third\_Taylor1\_CE. |

**Input Value : 1 ≤ Width ≤ 19 (First\_Taylor\_CE)**

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| Area = (Current/(k\*Temp\_Rise^b))^(1/c)  Width = Area/(Thickness\*1.378)  IN EXTERNAL LAYERS:  Temp\_Rise = 10 C , Thickness = 1 oz  b = 0.44 , c = 0.7 , k = 0.048  Current = Area^c (k\*10^b)  Current = (Width^0.7)/6  Current = (1+0.7(Width-1))/6  Current = (10+7(Width-1))/60  Finally  Current = (3+7\*Width)/60  If the input value is between 1 and 19, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **(3 + 7 \* Width) / 60**.  My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 7 times. Then I added 3 to my AX value. To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 60 to my BX Register. My output value has been found. |

**Input Value : 20 ≤ Width ≤ 71 (Second\_Taylor1\_CE)**

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| Current = (Width^0.7)/6  (Width^0.7) = Center^0.7 + (Center^-0.3)(0.7)(Width-Center)  (Width^0.7) = 8 + 3(Width-20)/10  If the input value is between 20 and 71, I took the center of the taylor series as 20. After putting the constants in place, the resulting equation is **(8 + 3(Width-20)/10)/6**    My input value is registered in the CX Register, I subtracted 20 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 3 times. I divided my AX Register by BL = 10. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+9, otherwise I add it as AL+8. I multiply the CX by 10 for the last time. And I put the value in AX Register.  To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 60 to my BX Register. My output value has been found. |

**Input Value : Width ≥ 72 (Third\_Taylor1\_CI)**

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| Current = (Width^0.7)/6  (Width^0.7) = Center^0.7 + (Center^-0.3)(0.7)(Width-Center)  (Width^0.7) = 20 + 1(Width-72)/5  If the input value is greater than 71, I took the center of the taylor series as 72. After putting the constants in place, the resulting equation is **(20 + 1(Width-72)/5)/6**    My input value is registered in the CX Register, I subtracted 72 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 1 times. I divided my AX Register by BL = 5. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+21, otherwise I add it as AL+20. I multiply the CX by 10 for the last time. And I put the value in AX Register.  To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 60 to my BX Register. My output value has been found. |

**RESULTS**

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| **Input: Width = 3(mils)** |
| **Input: Width = 23(mils)** |
| **Input: Width = 73(mils)** |

**IF OUR CHOICE IS C/c**

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| If we choose B/b. Minimum trace width will be calculated in internal layer. To calculate the Minimum trace width in the internal layer, we need to enter the current(A) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished. |

**TAYLOR SERIES ACCORDING TO THE INPUT VALUE**

|  |
| --- |
| If the input value (current) entered is 20 or less than 20, ıt does the operations in First\_Taylor\_WI.  If the input value (current) is between 70 and 21, ıt does the operations in Second\_Taylor1\_WI.  If the input value (current) is greater than 70, ıt does the operations in Third\_Taylor1\_WI. |

**Input Value : 1 ≤ Current ≤ 20 (First\_Taylor\_WI)**

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| --- |
| Area = (Current/(k\*Temp\_Rise^b))^(1/c)  Width = Area/(Thickness\*1.378)  IN INTERNAL LAYERS:  Temp\_Rise = 10 C , Thickness = 1 oz  b = 0.44 , c = 0.725 , k = 0.024  Width = (Current^(1/c))/(k^(1/c)\*10^(0.44/c)\*1.378)  Width = 31\*(Current^(1.38))  Width = 31\*(1+1.38(Current-1))  Width = 31+43(Current-1)  Finally  Width = 43\*Current-12  If the input value is between 1 and 19, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **43\*Current – 12**.  My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 43 times. Then I subtract 12 to my AX value. My output value has been found. |

**Input Value : 21 ≤ Current ≤ 70 (Second\_Taylor1\_WI)**

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| Width = 31\*(Current^(1.38))  (Current^1.38) = Center^1.38 + (Center^0.38)(1.38)(Width-Center)  (Current ^1.38) = 67 + 9(Width-21)/2  If the input value is between 20 and 70, I took the center of the taylor series as 21. After putting the constants in place, the resulting equation is **31\*(67 + 9(Width-21)/2)**    My input value is registered in the CX Register, I subtracted 21 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 9 times. I divided my AX Register by BL = 2. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+68, otherwise I add it as AL+67. I multiply the CX by 31 for the last time. And I put the value in AX Register. My output value has been found. |

**Input Value : Current ≥ 71 (Third\_Taylor1\_WI)**

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| Width = 31\*(Current^(1.38))  (Current^1.38) = Center^1.38 + (Center^0.38)(1.38)(Width-Center)  (Current^1.38) = 359 + 7(Width-71)  If the input value is greater than 70, I took the center of the taylor series as 71. After putting the constants in place, the resulting equation is **31\*(359 + 7(Width-71))**    My input value is registered in the CX Register, I subtracted 71 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 7 times. I added 359 to AX. Then, I multiply the AX by 10 for the last time. My output value has been found. |

**RESULTS**

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| **Input: Current = 2(A)** |
| **Input: Current = 22(A)** |
| **Input: Current = 72(A)** |

**IF OUR CHOICE IS D/d**

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| If we choose B/b. Minimum trace width will be calculated in internal layer. To calculate the Minimum trace width in the internal layer, we need to enter the current(A) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished. |

**TAYLOR SERIES ACCORDING TO THE INPUT VALUE**

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| --- |
| If the input value (current) entered is 20 or less than 20, ıt does the operations in First\_Taylor\_WE.  If the input value (current) is between 70 and 21, ıt does the operations in Second\_Taylor1\_WE.  If the input value (current) is greater than 70, ıt does the operations in Third\_Taylor1\_WE. |

**Input Value : 1 ≤ Current ≤ 21 (First\_Taylor\_WE)**

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| --- |
| Area = (Current/(k\*Temp\_Rise^b))^(1/c)  Width = Area/(Thickness\*1.378)    IN EXTERNAL LAYERS:  Temp\_Rise = 10 C , Thickness = 1 oz  b = 0.44 , c = 0.7 , k = 0.048    Width = (Current^(1/c))/(k^(1/c)\*10^(0.44/c)\*1.378)  Width = 13\*(Current^(1.43))  Width = 13\*(1+1.43(Current-1)) (From Taylor Series)  Width = 13+19(Current-1)    Finally  Width = 19\*Current-6  If the input value is between 1 and 19, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **19\*Current – 6**.  My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 19 times. Then I subtract 6 to my AX value. My output value has been found. |

**Input Value : 22 ≤ Current ≤ 70 (Second\_Taylor1\_WE)**

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| Width = 13\*(Current^(1.43))  (Current^1.43) = Center^1.43 + (Center^0.43)(1.43)(Width-Center)  (Current^1.43) = 83 + 11(Width-22)/2  If the input value is between 21 and 70, I took the center of the taylor series as 22. After putting the constants in place, the resulting equation is **13\*(83 + 11(Width-22)/2)**    My input value is registered in the CX Register, I subtracted 22 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 11 times. I divided my AX Register by BL = 2. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+83, otherwise I add it as AL+84. I multiply the CX by 13 for the last time. And I put the value in AX Register. My output value has been found. |

**Input Value : Current ≥ 71 (Third\_Taylor1\_WE)**

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| Width = 13\*(Current^(1.38))  (Current^1.38) = Center^1.38 + (Center^-0.38)(1.38)(Width-Center)  (Current^0.7) = 444 + 9(Width-71)  If the input value is greater than 70, I took the center of the taylor series as 71. After putting the constants in place, the resulting equation is **13\*(444 + 9(Width-71))**    My input value is registered in the CX Register, I subtracted 71 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 9 times. I added 444 to AX. Then, I multiply the AX by 13 for the last time. My output value has been found. |

**RESULTS**

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| **Input: Current = 1(A)** |
| **Input: Current = 22(A)** |
| **Input: Current = 71(A)** |