

PHYS 3142 Spring 2021
Computational Methods in Physics
Assignment 8
Due: 11:59 p.m. 25th Apr. 2021

Before you submit your assignment, do remember:

1. the due day
2. submit a report which contains your figures and results along with your code
3. make sure your code can run
4. do not forget to write comments in your codes.
5. label your figures and describe your results

The basic scoring rubric is :

1. **If you submit the assignment after the deadline or do not submit the report, you can only get up to 80% of grade**
2. **If there is any kind of plagiarism, all of the student involving will get zero mark! (except that the one can really prove the code is written by himself or herself and others copied it without telling him or her)**

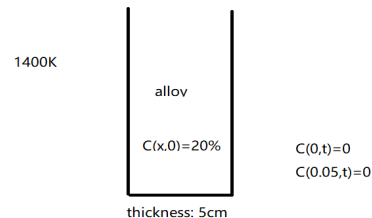
1. Decarburization

Consider we have an iron-carbon alloy with thickness 5cm initially containing 20% carbon, and now put it exposed to an oxygen-rich and virtually carbon-free atmosphere at 1400K (1127°C). Under these circumstances, the carbon diffuses from the alloy, and reacts with the oxygen at the surface in the atmosphere; that is, the carbon concentration is remained at 0% at the surface. This process of carbon depletion is called decarburization. This process of diffusion could be described by the equation:

$$D \frac{d^2 C(x, t)}{dx^2} = \frac{dC(x, t)}{dt}$$

C is the concentration of atoms. The value of D is $6.9 \times 10^{-11} m^2/s$.

1. What will be the carbon concentration after 20h, 40h and 60h? Please plot the concentration of carbon versus thickness of the alloy under different temperatures use the FTCS method.
2. if we hope the concentration of C is lower than 5% everywhere in the alloy, how many hours treatment must be employed?(hint: is your plot obtained in question 1 symmetric?)



You can take the time step as 10s.