2019S

Modeling and Analysis of Physical and Biological Processes
(EBS 270 – 3 units)
&
Biological Engineering
(EBS 289 C – 1 unit)

Instructor: Shrini K. Upadhyaya, Professor

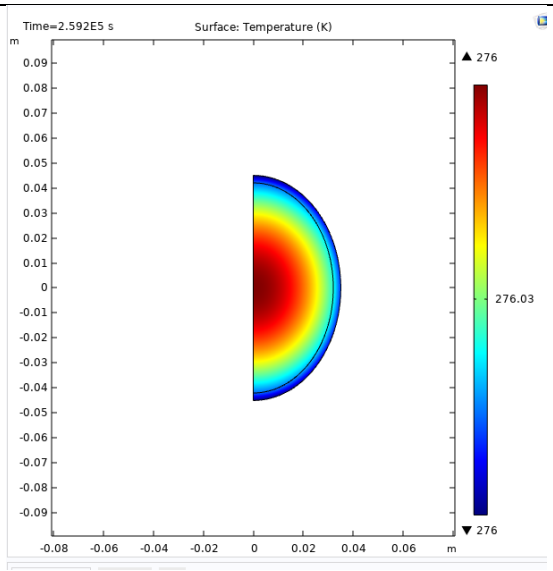
Office: 3036 Bainer Hall
Phone: 2-8770
E-mail: skupadhyaya@ucdavis.edu

Time: Tuesdays and Thursdays 9:00 – 10:20 AM
Room: Physics 140

Office Hours: 2:00 to 4:00 PM on Thursdays or by Appointment

TA: Chang Chen
E-mail: cgchen@ucdavis.edu

Office hours: Fridays from 1:00 to 3:00 PM (Tentative)



Temperature of an orange in cold storage

Topics:

A) Modeling Principles:

1. Modeling biological and physical systems - Types of models, General or vague problem statement, Role of assumptions and simplification, Specific or precise mathematical statement, Model verification, updating, and generalizations.
2. Development of models: Mass, energy, and momentum conservation principles.
3. Example problem(s).

B) Finite Difference (1-D problems):

1. Finite difference approximation for first and second derivatives – Forward, backward, and central difference
2. Types of partial differential equations
3. Derivative boundary conditions and fictitious nodes
4. Transient problems – explicit and implicit methods, stability, Crank-Nicklson Method

C) Finite Elements (2-D and Axisymmetric problems)

1. Review of FEM
2. Triangular elements and Galerkin's formulation
3. Boundary conditions, initial conditions
4. Source and sink terms
5. Solution to partial differential equations using COMSOL

References:

1. Ozisik, M. N. 1994. Finite Difference in Heat Transfer. CRC Press, Ann Harbor.412pp.
2. Segerlind, L. J. 1984. Applied Finite Element Analysis. Second Edition. John Wiley and Sons, NY. 427pp.
3. Class handouts.

Grading:

Homework	25%
Test #1 (Project proposal)	10%
Test #2 (Finite differences,)	25%
Test #3 (Finite elements)	25%
Final Project and presentation (Wednesday, June 12, 1:00 to 3:00 PM)	15%

Project: Your project proposal takes the place of midterm1 and will be a take home midterm. You need to review at least five papers form your field of steady and select a problem that can be modeled using Partial Differential Equations. You will be divided into groups with 2 to 3 students per group.

Homework: There will be four homework sets. They will be due on Fridays. You will have eight (8) free days to use for the whole quarter. You can use them as you wish for homework problems only. Weekends do not count (i.e., You can use one free day and submit your homework on Monday without penalty). *These free days will be lost on the last day of classes, if they are not utilized by then*