ME2 Computing- Coursework assignment

Learning outcomes:

- Being able to identify a PDE for a physical problem
- Being able to choose an appropriate method to solve numerically the PDE
- Being able to implement and code the numerical method

This CW has to be done in groups of two students, of your choice, presenting both the same single report (with consequent common mark).

Before you start:

In your H drive create a folder *H:\ME2MCP\CW* and work within it

Outcomes:

1. One single Python file (template is on BB).

2. A two pages summary of the work done (template is on BB). Word counting: max 1000 (Maths formulas do not count towards word counting).

Deadline: Mon 25th of March 2024 at 11.59pm (UK time)

Path A

Tasks:

1. Choose a physics described by a PDE (of any type: i.e. elliptic, parabolic, hyperbolic), from any of the ME1/ME2 modules you have encountered till now or from any Physics of your choice (even outside Mech. Eng. domain).

2. Set the PDE, for the chosen physics, with three independent variables, i.e. three spatial *(x,y,z)* or one time and two spatial *(t,x,y).* It does not need to be in Cartesian coordinates. **Note:** the heat equation is **not** accepted, unless you are going to use an implicit numerical method to solve it.

3. Set the boundary/initial values for the event you wish to analyse. Exploit any symmetries, if applicable.

4. Choose a method to solve numerically the PDE.

5. Work out the maths to discretise the PDE, according to the method chosen.

6. Implement your numerical analysis by using Python.

7. Test the numerical code by using a discretised grid.

8. Plot the results by adopting at least three possible types of plotting.

9. Repeat the test with grids ten times and fifty times finer and discuss about any possible problems of convergence.

Path B

Tasks:

1. Choose a physics described by a PDE (of any type: i.e. elliptic, parabolic, hyperbolic), from any of the ME1/ME2 modules you have encountered till now or from any Physics of your choice (even outside Mech. Eng. domain).

2. Set the PDE, for the chosen physics, with two independent variables, i.e. two spatial *(x,y)* or one time and onespatial *(t,x).* It does not need to be in Cartesian coordinates.

3. Set the boundary/initial values for the event you wish to analyse. Exploit any symmetries, if applicable.

4. Choose an explicit **AND** an implicit method to solve numerically the PDE.

5. Work out the maths to discretise the PDE, according to the two methods chosen.

6. Implement your numerical analysis by using Python.

7. Test the numerical code by using a discretised grid.

8. Plot the results by adopting at least three possible types of plotting.

9. Repeat the test with finer or coarser grids and show how the two methods differ about convergence.