MOOSE Part 2 Grading

Anthony Cowan

Good intro. Good outlining of the methods. Good material definitions. Properly cited. Typo in your report for the LHR(z) function, but used the correct one in your file. Was the way I envisioned doing the BCs. Results from part 1 all look good. Temperature profiles all look reasonable. Centerline T is reasonable. Well written report. Code converges. Outputs match results. All looks good to me.

Grade: 99

CeCe

Very well written report. Properly defining materials and references. Would prefer you to type equations instead of copy/paste into the text as an image. BC defined in the expected way. All looks good. Data from previous parts looks good. Good context on the differences in this problem and a real reactor core size. Also have the higher power generation closer to Z0. Good context. Results all look reasonable. Code converges well. Could have used a conclusion to wrap up the report, felt like it ended in the middle of a section.

Grade: 99

Gwen

Writing tips, best not to use possessive phrasing, ‘my gap’. Hyphenate temperature-dependent. Justification for ny=100? Seems arbitrary. The fact that your results diverge with increasing mesh refinement seems odd. It should only converge and become more accurate. Were there code convergence problems? You didn’t include the LHR to VHR conversion in the report in eq 3, but it is included in the code. For eq4, you put the conversion inside the cosine, which is wrong. But again, its right in the code. For your BC, you had it set up properly, but used a fixed value of z, instead of letting it be a function of z. Thus, your BC is a constant value, instead of a function, as it should be. I made this edit and the code ran fine. Your constant k and variable k in fig 4 cant be right. There should be a larger difference here, with variable k(T) producing lower centerline temps. Because you enforced the constant value BC, your fuel centerline temp peaks at the center, when it should be shifted up in z/y. Your analysis of this result is a bit off, doesn’t quite make sense. Well written report, some issues, but basically got there except for fixing the z in your BC.

Grade: 93

Hongsup:

Should have included results from Part 1 as well in the writeup. Good theory writeup. Didn’t need to go through all of this development of the hc, but it is good to see. Could have used the values reported in class, which was 2.6 W/cm2-K. But yes, this is the thorough way to do it. Good definition and citing of kth in different materials. Your equation is different from the one developed in class for LHR(z). Where is this from? Gives the same profile, but with slightly different extrapolation lengths. Did some math wrong in your T\_inf equation compared to your input file. Not sure how much that will affect it. But should be 0.64, instead of 2.1322. Could you have done AD of the kth to skip the step of defining the derivatives? You can define it as an ADHeatConductionMaterial with a function. Should have seen a shift in z of the centerline temperature peak, but only slightly. I assume the math error causes this discrepancy. Other error is forgetting to scale your LHR to a VHR, which gives you much lower peak centerline temperatures. But everything looks good. Code runs, good convergence study. All look solid.

Grade: 96

Joy

Since you are using the adjustment to a theoretically dense UO2, your kth values are a bit higher, and thus your temperatures are a bit lower. This is fine, as you showed your work on this. Typically, using the 95% value is accepted, as this is the ballpark density of actual UO2 fuel. You saw in your convergence that using too many elements can lead to divergence, probably because of the elongated nature of the elements and the small gradients between them. Should have had the purple label in fig 5 be k(T), not just kth. Glad that you went back and fixed the first part. This all looks very good. I would recommend outputting your csv files more fine, such that you don’t get what appear to be discrepancies around your gap. I think that is just a plotting/csv artifact, but it makes the transition look off. Would have been good to show how you were handling the LHR(z) and the T\_cool for your system in the report. I had to look to your files to verify what you were doing. But your BC is handled appropriately. Peak should be shifted just north of 0.5 Z0, as you saw, but its because the coolant is getting hotter with Z, so your BC changes, shifting the peak centerline T. Good convergence behavior. Code runs. Everything looks good!

Grade: 96

Lexi:

Well written report. Thorough background, problem definition, material definition, etc. Good description of mesh convergence studies. To open and close quotes in latex, you do ``the text”. However, you are overusing quotations. Instead of “t”, you can use *t* in italics. That is preferred. Some kind of typo below equation 6. Same typo below equation 9. Not sure what you were doing. Its almost like that is a caption? Would have liked to have seen you describe how you were handling the BC, as that is the only ‘tricky’ part here. Good description of prior results. Aka isn’t a scientific term, use i.e. I didn’t quite follow your justification for the temperature profiles, it seems lacking, or potentially incorrect. The main contributor to the T profile is the power profile. Secondary are the axially varying BC and the temperature-dependent kth. You seem to say fig 9 comes from somewhere else, but you don’t cite it: you need to. Overall, looks good. Computationally everything seems correct. Code runs, converges well. Results seem to match the reported results.

Grade: 96

Cole:

Code runs. Good code convergence. Good background and intro. I like how you walk through each MOOSE block. I get that the petsc options were taken from examples, but there should be a reason you include them. The default is to have no petsc options. If you include them and they improve convergence, then that is a reason to keep them. But don’t need to have them just because an example had them online. That’s a bad reason. How did you decide on the mesh size? You just say that it is reasonable, but that doesn’t really mean anything. Did you do a convergence study, showing that you do not need a more fine mesh? Good working through of all the Part 1 results. Should have reported peak centerline T values and their location. I cannot tell if your cladding T profile is flat or curved based on your plotting. You should have discussed these results more, you show one plot, but don’t really say anything about it. You set the Tco as the Tcool. You needed to add on the heat transfer from the outer cladding to the coolant. LHR/(2\*pi\*Rf)/h\_cool. Otherwise, everything looks good. Code is in good shape.

Grade: 93

Vaughn

Good intro paragraph. You restate yourself in 2.1. I prefer table titles above the table and figure captions below. But this is personal preference. Better practice to cite where each value comes from, than saying citations 1-7. Very good mesh refinement study. I would say a tolerance of 1 K is probably sufficient, but you went well beyond that. Temperature profiles all look good. Good use of convective heat flux BC. Could have just set Function Dirichlet BC using the Tco-Tcool relationship in class combined with your Tcool. But this works too. Yours is probably more robust, as we presented an assumption in class. Code converges well. Very good analysis of the transient behavior in the axial system. Very well written. All runs as it is supposed to. Great job.

Grade: 99

Tim:

Code runs. Good code convergence. Could have written it as a ‘clean report’, basically presenting all of the information as if new, in a revised format. Would have liked to have seen results from part 1 also included. The derivation you did for the Toc wasn’t necessary, because we developed that relationship in class. Yours is similar, but you miss the z dependence on the LHR. Thus, your BC is a linear function of z, which is not correct. Our ‘core’ here is only a piece of the core, so, I was expecting a much lower delta T over the problem pin that in a real reactor. You realized this and made adjustments so that it was more appropriate to compare to an actual reactor case. While I understand, it makes you end up using things like a flow velocity which are not reasonable. But, I get it. References should typically be numbered, not lettered. It doesn’t look like you include a z component on the LHR, which is why your temperature profiles are wrong. Fuel centerline should peak near the axial midpoint. I think its clever how you went about defining the BCs from a fundamental perspective, but you missed the entire LHR(z) component, which messed up all your BCs and temperature profiles. You set everything up correctly, but missed a key concept.

Grade: 90

Anthony: PCT=1752K, z=50.58

CeCe: PCT=1754K, z=50.75

Gwen: PCT=1721K, z=49.95

Hongsup: PCT=1125K, z=49.9

Joy: PCT=1333K, z=51.01

Lexi: PCT=1766K, z=50.5

Tim: PCT= 1989K, z=1

Vaughn: PCT=1592K, z=52

Cole: PCT= didn’t report