

Fusion Technology module essay assignment 2017
Lectures - week of January 16, 2017

85% of the Fusion Technology module mark is based upon the following open-book assignment of an essay (15% of the module mark is based on the 5 questions that are assigned over 5 weeks).

The submitted essay shall consist of two parts, which will have a similar format. Both parts are based on one of the series of talks given during week two of the spring term in the “Fusion Technology” week.

You will need to give a detailed response, of ~ maximum length 1800 words for EACH essay (neglecting references, figures and figure captions):

1) Two fusion schemes that are currently being actively researched are indirect-drive Inertial Confinement Fusion (as exemplified by experiments at the National Ignition Facility) and Magnetized Liner Inertial Fusion (as exemplified by experiments on the Z machine). Compare these two schemes. Your discussion should include references to the differences in driver technologies, implosion physics and burning plasmas between the two schemes. You should also comment on the technological advancements that are required in order to develop an inertial fusion power plant for both schemes.

2) There are a number of fusion reactions in nature. At least for now we are focused on the DT reaction for energy generation. Please review at least 5 fusion reactions (DT, DD, D-He³, p-⁶Li, p-¹¹B) and compare them to DT in terms of positives and negatives. Demonstrate that you understand why the current choice is DT.

We would also like you to explore the length of time (years) Fusion could provide the earth's energy needs assuming the every person in the world's energy usage was at the European energy consumption levels of ~ 7000 kW-hrs/year/person for each of the following limiting cases: a) the amount of D available; and separately b) that Li is the limiting factor in making more T. **Note – be clear on your assumptions and how you came to your conclusions and reference sources of information.** Lastly, explore whether there are impacts on the total energy available through the DT reaction from other factors, for example from materials other than the fuels (or perhaps the energy expended in obtaining the materials needed for a reactor). Suggest ways these problems could be overcome.

Grading criteria 1: You must demonstrate that you have gone beyond the information in the lectures and have pursued deeper understanding (research!) in at least one area (which can be related to that requested). That typically means taking at least one aspect of the essay question goals and pursuing it farther. For the first essay we would prefer you pick from suggested topics in Appendix A.

Grading criteria 2: While the lecture slides are a source of material they are to be used as a starting point for your own journal research utilising appropriate peer-reviewed journal articles. The latter, as opposed to web references or talks, should be the majority of your references.

Typesetting information: all submissions for assessment should be on A4 size pages with

all margins at 25mm. Text should be 12 point and double-spaced. Both parts of the submission should be submitted in a single document but with each part beginning on a new page. Submissions not conforming to the word limit (1800 words per response, 3600 words total), or meeting these typesetting criteria will be penalised.

All submitted work must be entirely your own. Avoid working on the questions in collaboration with other students. Severe penalties will be implemented where collusion between students is detected, up to and including removal from the course.

Your work must be submitted through the VLE before **16:00 on Thursday of week 10 of the spring term (the 16th of March)**. The time stamp on the VLE submission will determine your submission date and time. If this is past the deadline then the normal University late penalties apply unless you have mitigation.

You must submit your assignment in PDF format with embedded fonts. Other formats are not acceptable.

Please label your file clearly, with your username (for CDT students) or exam number (MSc), then assignment title.

By submitting your assignment you agree to the University rules on Collusion and Plagiarism.

You may submit more than one version of the assignment, if necessary, but we will only consider the latest (most recent) submission you make. The usual late penalties will apply to that submission.

If there is a technical problem with the VLE at the time you intend to submit and it is close to the deadline then please email your work to phys-emergency-vle-submissions@york.ac.uk.

Please only use this address as a last resort. The time stamp on the email will determine the time of submission.

Feedback

Marking sheets for the essay, including feedback, will be e-mailed to you during week 2 of the summer term.

Appendix A

Z-pinch research areas:

- Comparison of Marx generator vs. Linear Transformer Driver Technologies.
- Explore other applications of Z-pinchs and how these can aid technological advances.
- The density, temperature and magnetic field requirements needed for ignition in Magneto-inertial fusion.
- The means by which different schemes mitigate the growth of Rayleigh-Taylor instabilities.