

# Syllabus — History and Science of the Manhattan Project — Not Finalized

Spring 2023, Deep Springs College, Prof. **Brian Hill**

## Overview

The Manhattan project is a chance to look simultaneously at the almost unbelievable scientific and technological developments which came in rapid succession just before, during, and after WWII, and at their historic consequences. The fundamental science begins in the late 1800s with the discovery of natural radioactivity (by Becquerel and the Curies), the development of controlled fission (Fermi's atomic pile), and the possibility of violent fission chain reactions. The history includes the race to make weapons based on fission, the destruction of two cities, and the setting of the stage for the superpower stalemate that has continued with slowly shifting boundaries decade after decade ever since. A study of the Manhattan Project is not just an opportunity to study momentous scientific developments and past events. Its ongoing significance makes it nearly a duty to understand what we have collectively created. By the end of the course, each person will have their own response to the events and the resulting situation.

## Unit Outline

### Term 4 — Fundamental Physics and Atomic Technology

- I. The Atom, and Basic Physics for Nuclear Fission
- II. Discovery of Radioactivity
- III. Physics Background needed for Chapter 2 of Reed Controlled Fission (Enrico Fermi's Atomic Pile)
- IV. Possibility of a Fission Bomb (A-Bomb)
- V. The Race to Develop the Atomic Bomb
- VI. Assembly of the Manhattan Project Scientists
- VII. Creation and Refinement of Fissile Isotopes

### Term 5 — Weapons Design and the Arms Race

- VIII. Gun and Implosion Designs for Criticality
- IX. Technology to Deliver a Bomb
- X. The First Three Atomic Bombs: Trinity, Little Boy, and Fat Man
- XI. The Destruction of Hiroshima and Nagasaki
- XII. The Fusion Bomb (H-Bomb)
- XIII. The Arms Race and The Beginning of the Cold War
- XIV. Mutually Assured Destruction and Arms Control

## Primary Text (required)

- Bruce Cameron Reed: **The History and Science of the Manhattan Project, 2nd Edition, 2019.**

## Other Resources (that we will draw from)

- Robert Serber: The Los Alamos Primer. This is the physics of the atomic bomb as it was presented to scientists as they arrived in Los Alamos in the early 1940s.
- Additional resources forthcoming.

## Grading

- A one-hour exam covering the science toward the end of each term, worth 20% of the grade (x2 for the two terms). Homework problems on the science, 40%. A paper 1500-1800 words on a topic of your choice at the end of the second term, 10%. Consistent preparation for and participation in class discussion, 10%.
- Regarding the two exams: since we will cover a very wide variety of scientific topics, and as a result, it may not be clear what you might be expected to do on an exam, a practice exam will be provided. Problems on the actual exam will cover the same topics at approximately the same difficulty level. However, the actual problems will require you to come at some of the concepts from new directions.
- Regarding the paper: share a draft for peer-editing (post-outlining method). Final draft to be circulated to peers and professor. Read all of the each others' papers as the final reading. During the final week, present paper and respond to questions.

## Miscellaneous Policies

There will be a lot of handouts. Get a three-ring binder to keep all the handouts and problem sets organized. Assignments should be on 8 1/2 x 11 paper (and not torn out from a bound notebook). Multi-page assignments should be stapled. Corrections should be erased (if done in pencil) or recopied (if done in pen).

The College's general policies on absences and late work are applicable. There was an email from the Dean on this September 8, 2022. The policies below are consistent with that email:

Whereas missed coursework affects both your classmates and professors by lowering the thinking and understanding you bring to a given class, and interrupts the course schedule that has been set up and is adjusted on an ongoing basis with substantial care. The same is true for absences — whereas a handful of absences might be “normal” at colleges with large lectures or less serious academics, at Deep Springs we expect students to miss *no classes* save for legitimate health issues or emergencies requiring also missing labor and governance obligations.

For a student wishing to submit a course assignment past its required deadline, the student may request an extension on the assignment directly from the professor 48 hours in advance. Within 48 hours of the due date, the student must request an extension directly from the Dean. Exceptions will be granted by the Dean only if the student faces unforeseen and unforeseeable circumstances. A student who misses the deadline will be penalized a number of points that is roughly equivalent to a whole letter grade for each 24-hour period the assignment is late. Assignments cannot be turned in after solutions and graded assignments have been passed back, which generally happens 1-2 classes after they were turned in.