Introduction

The intention of this document is to provide some guidelines as to what level of design is expected for each of the stages of the projects, that is, Conceptual Design (CoD), Preliminary Design (PD), Critical Design (CD). These descriptions are by no means comprehensive but give the spirit of the meanings which should be adopted for each phase.

Conceptual Design (CoD)

1. A basic scientific requirements document must be available before or as part of the Conceptual Design stage.
2. The function of the CoD is to demonstrate that it is likely that there is at least one way of producing a system which meets these broad scientific requirements.
3. The design need not be shown to be optimised in terms of cost, scientific performance or other parameters which need detailed investigation. Therefore, although the CoD must demonstrate a design whose functionality meets the scientific requirements, the design details need only be at the level of describing sub-components and their functions, indicating the way in which the sub-components are inter-dependent and would function together to provide the full required system.
4. There may be areas identified (and probably some remaining unidentified!) which have some technical or cost risk. There should be some indication that for any such identified areas there is a reasonable chance of success in overcoming the technical difficulties or excessive high cost.
5. Although the CoD need only demonstrate one possible solution, it may present options for sub-components (or possibly the whole system), especially in areas where one or more options involve extra technical risk or cost.

Preliminary design (PD)

1. A detailed scientific requirements and operational requirements/constraints document must be available before or as part of the Preliminary Design.
2. The prime function of the preliminary design is to describe the way in which the full system is most likely to be built to meet these detailed requirements. Therefore, where appropriate it should describe a full layout meeting the scientific requirements and environmental requirements.

3. The space envelope for all sub-components is described, with preferably a high-level design for each sub-component (examples: mounting shape and size, requirement for accuracy of linear translations and rotations, location of bearings and shafts, range of movement of slides, what is mechanised and what is manual, approximate expected power dissipation, general plan for cabling routes). Full design of components is not required at this stage.
4. The last sentence above notwithstanding, it may be appropriate to have done quite detailed design or other appropriate investigation of components which are still viewed to be of high technical risk, to ensure that there is a good probability of their implementation being feasible at acceptable cost.
5. By this stage there must have been reasonable exploration of cost implications of the proposed design so that the likely cost envelope is known. An awareness of the major cost drivers is essential. Likewise, a good estimate of the timescale and route to completion should exist.
6. The project should be able to show how it has remained open to ideas for alternatives producing the full or sub- system(s) which may prove more cost effective or scientifically advantageous. It is not necessary (or possible) to demonstrate that all possible avenues for improvement have been explored (they won't have been!).
7. Areas with unresolved problems may remain, but there should be high expectation that the problems are tractable within the cost and timescale estimates.
8. Where options existed at the CoD stage, the preferred option should be indicated and justified at the PD stage.
9. Work areas which can be tested significantly before construction, by modelling or simulations, should be indicated and the nature and scope of the modelling described.

Critical Design

1. The prime function of the Critical Design is to describe in full detail how the system will be built and is the final hurdle which needs to be overcome before construction is started. In practice a sub-system may pass a CDR and 'cut metal' before all sub-system CDRs are completed, but this still entails risk and should not be done without good reason.
2. Full designs for individual components shall exist.
3. An updated full costing based on building, testing and commissioning the proposed designs must be available.
4. Where possible and appropriate, models demonstrating the system and sub-components in operation should be made (examples: showing precise calibration

and alignment procedures including the nature and detectability of individual adjustments; dummy software procedures emulating mechanism control, real-time control). Note that this item might not be applicable to your MSE320.

5. Detailed cost and timelines to completion, management plans, intended resource locations must be described.

References:

[1] https://www.ing.iac.es//~docs/wht/naomi/wht-naomi-87/wht-naomi-87.html