



Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

1956 – 2016

60
years of
Engineering
Education

Department of Industrial and Systems Engineering
University of Pretoria

BSS 410 Systems Engineering

Semester Design Project Presentation Guide & Grading Rubric

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*Students are encouraged to monitor
the contents of this design study guide as it
is subject to changes*

A cover page containing the following:

- Module code and title
- Group number
- Names of group members, Student number
- Any other useful detail at your discretion

A new page: Present the summary of the document [An Abstract or Extended Abstract (Executive Summary)]

Systems Design and Development [Phase I] ==65marks==

[Concept Development Stage] 25marks

❖ **Needs Analysis Phase [8/25marks]**

- **Operational Need (Requirement Analysis)** *[The name of the system to be developed and a descriptive representation of the problem to be addressed using letters, figures, charts, photos etc as deemed necessary.]*

Is it a new system from the scratch? Is it a major upgrade of an existing system? Any market opportunities/technological capability in terms of availability and cost? Etc.

- **Operational Objective(s) (Requirement Analysis)** *[what exactly do you want to do in this problem space? Which component(s) of the operational need will you be addressing]*
- **Functional Definition (Functional Definition)**
[What initial functions/processes/capabilities need to come on board to achieve the stated objectives?]
- **Feasibility Definition (Physical Definition)**
Visualisation of the physical elements/hardware/software/technology etc.
- **Need validation (Design Validation)**

❖ **Concept Exploration [8/25marks]**

- **Operational Requirements Analysis (Requirements Analysis)**
 - analysing the stated operational requirements in terms of their objectives

- restating, redefining or amplifying (as required) to provide specificity, independence and consistency among different objectives
- **Performance Requirements Formulation (Functional Definition)**
 - translating operational requirements into subsystem functions and
 - defining a necessary and sufficient set of performance characteristics reflecting the functions essential to meeting the system's operational requirements.
 - formulating the performance parameters required to meet the stated operational requirements.
- **Implementation of Concept Exploration (Physical Definition)**
 - exploring a range of feasible implementation technologies and concepts offering a variety of potentially advantageous options
- **Performance Requirements Validation (Design Validation)**
 - conducting effectiveness analyses to define a set of performance requirements that accommodate the full range of desirable system concepts and
 - validating the conformity of these requirements with the stated operational objectives and refining the requirements if necessary.
- ❖ **Concept Definition [9/25marks]**
 - **Performance Requirement Analysis (Requirement Analysis)**
 - analysing the system performance requirements and relate them with operational objectives
 - refining the requirements as necessary to include unstated constraints and quantifying qualitative requirements where possible.
 - **Functional Analysis and Formulation (Functional Definition)**
 - allocating subsystem functions to the component level in terms of system functional elements and defining element interactions,
 - developing functional architectural products, and
 - formulating preliminary functional requirements corresponding to the assigned functions.

❖ **Concept Selection (Physical Definition)**

- synthesizing alternative technological approaches and component configurations designed to performance requirements;
- developing physical architectural products; and
- conducting trade-off studies among performance, risk, cost, and schedule to select the preferred system concept, defined in terms of components and architectures.

❖ **Concept Validation (Physical Definition)**

- conducting system analyses and simulations to confirm that the selected concept meets requirements and is superior to its competitors and
- refining the concept as may be necessary.

[Engineering Development Stage] 25marks

❖ **Advanced Development Phase** (required more for systems with weak predecessor i.e. outrightly new systems or systems evolving from a weak background. Every group is required to apply this phase for the experience sake [8/25marks])

▪ **Requirements Analysis (Requirement Analysis)**

- analysing the system functional specifications
- with regard to their derivation from operational and performance requirements and the validity of their translation into subsystem functional requirement
- identifying components requiring development

▪ **Functional analysis and Design (Functional Definition)**

- analysing the allocation of functions to components and subcomponents and performing analyses and simulations to resolve outstanding performance issues.

▪ **Prototype Development (Design Validation)**

- identifying issues of physical implementation especially with regards to unproven technology

- determine the level of analysis, development and test required to reduce risks to acceptable values.
- **Development Testing (Design Validation)**
 - creating test plans and criteria
 - conducting tests of critical components
- ❖ **Engineering Design Phase** (Design is for product systems while Procurement is for service/enterprise systems. Detailed motivational information regarding procurement should be provided by service or enterprise systems engineers) [8/25marks]
 - **Requirements Analysis (Requirement Analysis)**
 - analysing the system design requirements for consistency and completeness
 - identifying requirements for all external and internal interactions and interfaces
 - **Functional analysis and Design (Functional Definition)**
 - analysing component interactions and interfaces and identifying design, integration and test issues
 - analysing detailed user interaction modes
 - designing and prototyping user interfaces
 - **Component Design (Physical Definition)**
 - Laying out preliminary designs of all hardware and software components and interfaces
 - Implementing detailed hardware designs and software code after review
 - Building prototype versions of engineered components
 - **Design Validation (Design Validation)**
 - Conducting test and evaluation of engineered components with respect to function, interfaces, reliability and reproducibility
 - Correcting deficiencies
 - Documenting product design
- ❖ **Integration and Evaluation Phase** (Required for all output types) [9/25marks]

- **Test Planning and Preparation (Requirement Analysis)**
 - Reviewing system requirements and defining plans for integration and system testing
 - Defining the test requirements and functional architecture
- **System Integration (Functional Definition)**
 - Integrating the tested components into subsystems and the subsystems into a total operational system
 - Defining and building integration test equipment and facilities needed to support the system integration process
- **Developmental System Testing (Physical Definition)**
 - Performing system-level tests over the entire operating regime and comparing system performance with expectations
 - Developing test scenarios
 - Eliminating all performance deficiencies
- **Operational Test and Evaluation (Design Validation)**
 - Performing tests of system performance in a fully realistic operational environment
 - Measuring degree of compliance with all operational requirements
 - Measuring the system's readiness for full production and operational deployment

[Post Development Stage] 15marks

- ❖ **Production and Deployment Phase (Required for product systems engineering) [7,5/15marks]**
 - **Transitions from Development to Production**
 - Transition in management and participants
 - Problems in the transition process
 - Product preparation
 - **Production Operations**
 - Production planning
 - Component manufacture
 - System Acceptance tests
 - Manufacturing Technology (type/choice)

- Logistics, support and maintenance schedule
- Acquisition of the right knowledge base for specific production systems
- ❖ Operations and Support Phase (Required for all outputs) [7,5/15marks]
 - Installation and test (system integration site, internal and external, disruptive or non-disruptive installation, early system operational difficulties encountered or that could be encountered, operational personnel)
 - Logistics, Support and Maintenance schedule
 - System Upgrades (hard and software upgrade plans)

Phase II

[System Dynamics (SD) Analysis] ==35marks==

Selected elements for (SD) analysis showing a network ==10/35marks==

Reason for selecting these elements in a situation where the new network for SD differs from the main designed network ==5/35marks==

Simulation runs to demonstrate sensitivity analysis, changed system behaviour etc ==20/35marks==

This phase is required to study the behaviour and structure of a system by carrying out sensitivity analysis tests. Only select critical elements or more as deemed fit from the designed system and apply to these to the modelling capability of a chosen software.

Your algorithm/software approach should be such that a change in the value of one element's input can be quantitatively seen in other elements within the network. [Use software such as: Anylogic, Vensim, Stella, Dynamo++ etc]

N.B:

Phase I is tied to your motivations and ability to apply Core9 to the design exercise.

An example of motivation: For example if one of the activities in a particular phase requires that you analyse and refine a set of inputs from a previous phase, if you think there is no need for that, simply state that inputs need no refinement

for x,y,z reasons such as readily available technology, large pool of trained human resources, affordable cost wise etc.

Phase II is tied to your ability to demonstrate **sensitivity analysis, structure and behaviour of a system** resulting from a change in one or more parameters of some system elements.

Due Date October 19th, 2018 @11:59pm

Hand-in Soft Copy of the final document and any other supporting files via ClickUp. Only one submission per group.

Kindly assess the contributory level of your group members by scoring them using the peer assessment sheet on ClickUp.

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