Course Raison D'etre

Most of the other courses that you have done to date (including high school) comprise formal lectures where you are given appropriate formulae and facts, followed by well-defined exercises based on these lectures, and then you are given the answers to the exercises. Everything will have been presented to you as black/white or right/wrong, and you more than likely got upset if there was more than one answer to an exercise, or you weren't given the answer.

When you graduate and become engineers, you will find that life is not like that. The exercises and their answers are not at the back of each chapter. And there can be multiple solutions to a problem, some better than others.

In most of real engineering, you first have to establish what the problem is (and this can be very challenging), and then you have to go about getting a solution. In most cases engineering texts will help you, but only as guides.

This course will try to bridge the gap between how you have been spoonfed in the past and the way engineers work. Hopefully this will make you better engineers. And the tools that are covered in the course should help you throughout your professional career.
Course Structure

There will be no formal lectures. You will be given several engineering problem solving situations, which more than likely you will never have seen before, and you will be asked to deal with these just like a practising engineer would be expected to do.

Each week we'll address these problems. You will be guided in your thinking towards solutions, but you will never be told the solution. This is seen as a necessary transition step to becoming an independently thinking engineer, and leaving behind the high school spoon-feeding mentality of question-answer style thinking. If you don't like thinking for yourself, but rather prefer to regurgitate what others have said, then this is not an appropriate course for you, and if you maintain such a view long term, your engineering career will be very constrained.

Course Textbook

The textbook, on which the course will be based, is:


There should be second-hand copies available on campus.

If you look at the Table of Contents, you will see mention of the following topics:

1. Systems Methodology
2. Models and Modelling
3. Some Common System Models
4. Fundamental Configurations Relating to Systems
5. The Synthesis Configuration
6. The Investigation Configuration
7. Systematic General Problem Solving
8. Creativity
9. General Problem Solving with Groups
10. Decision Making with Multiple Objectives
11. Optimization
12. Decision Approaches and Tools

You'll have need for most of these in your problem solving.
Overview

Problem solving (implying decision making) is carried out every day by everyone. However, few people stop and think of the processes involved and whether they could improve their problem solving or decision making skills.

This course argues that the most rational way to develop a framework for problem solving is via a systems studies viewpoint.

Accordingly, the course firstly outlines systems methodology, modelling and the various systems configurations of analysis, synthesis and investigation. A systematic process is then outlined for problem solving. Problem solving and decision making are shown to lie within a systems synthesis configuration. Various forms of decision making are explored.

What is a problem and what is a solution?

In broad terms, a problem might be described as:

\[
\text{being in a state different to that desired}
\]

An alternative state to that existing is sought or wished for. A difference exists between what could or should happen, and what is actually happening.

In broad terms, a solution might be described as:

\[
\text{that which transfers the existing state to some other state.}
\]

There are degrees of goodness of solutions. Later, mention is given as to how solutions might be ranked. Later, mention is also given on constraints, which restrict the choice of solutions.

In broad terms, a state is:

\[
\text{an indicator of behaviour or performance}
\]

Examples include the balance of a bank account, the health of a person, and the position and velocity of an aircraft.

The above definitions of a problem and solution are satisfactory for introductory or lay purposes but need tightening up for engineering purposes, and are refined later in the course. More correctly, the state should be thought of and expressed as a variable that can take different values. Then a problem exists when:

\[
\text{the current values of the state variables are different to that desired}
\]
and the solution:

changes the values of the state variables

The state variables remain the same from problem definition till after a solution is implemented. The only thing that changes is the values taken by these state variables.

Some examples might help clarify the intent of the meanings of problem, solution and state.

Example 1. Problem: Bank account balance (state) is low, or a higher balance (state) is desired. Possible solutions: Invest the money at a higher interest rate; deposit more money; etc.

Example 2. Problem: A person is unwell (state), or a better health (state) is desired. Possible solutions: Take medicine; undertake exercise and a special diet; move to a sunnier climate; etc.

Example 3. Problem: Person at location A (state), or desires to be at location B (state). Possible solutions: Drive vehicle; catch public transport; walk; etc.

Example 4. Problem: Person is hungry (state), or desires not to be hungry (state). Solution: Anything that removes the hunger, or transfers the person from being hungry to not being hungry.

These views on a problem and a solution are quite different to the majority of the literature and peoples' beliefs. Hopefully by the end of this course, you will be persuaded to this style of thinking. The meaning of the term 'state' is central to understanding. Pay particular notice of it.

The approach presented in this course has developed out of existing systems engineering, systems studies and systems theory thinking.

Dictionary definitions and lay usages of the term 'problem' are rejected here as being unsuitable for developing a systematic framework for problem solving. You will also need to reject such definitions and usages. Typically, dictionaries talk of problems as 'being something difficult, doubtful or hard to understand, there being degrees of severity of problems, and a problem being a matter requiring a solution'.

Consistent with this, you will also need to banish from your thoughts the use of the term 'problem' as encountered in textbooks and classrooms, meaning a contrived (for learning or entertainment purposes) 'exercise', 'question' or 'puzzle', where a 'solution' is sought by the text author or class teacher.
**Aim.** The intent of the course is to present a rational and systematic approach to problem solving and decision making. The approach is intended to be non-discipline specific.

The aims of the course are to understand problem solving and to contribute to thinking on problem solving. The level of thinking that goes into problem solving in much of the literature is very superficial and cookbook in nature. To counter this, the course adopts a systems view to provide a rigorous framework. Rigor in the usage of terminology is also stressed. For technical terms, dictionary definitions and lay usage are rejected.

In many situations, there is frequently no right or wrong answer. In many cases people are satisfied with a satisfactory outcome. The idea of an optimum solution may not exist. People from technical backgrounds may initially have difficulty in accepting that there is no right/wrong, black/white, on/off, yes/no answer.

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**Course Communications**

All communications on the course are to be through the Moodle discussion tool, or during the nominated lecture time slots. Using the Moodle discussion tool allows all students to see replies to any questions asked, and allows all students to join the discussions. Also use the Moodle discussion tool to create discussion topics with others in the class.
Assessment for the course comprises 4 components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Max. Mark</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Assignment (Familiarisation)</td>
<td>10</td>
<td>Submit whenever you like, but <strong>late penalties</strong> apply after 5pm August 28*</td>
</tr>
<tr>
<td>A2. Assignment (More experienced)</td>
<td>20</td>
<td>Submit whenever you like, but <strong>late penalties</strong> apply after 5pm September 18*</td>
</tr>
<tr>
<td>A3. Assignment (Ready or not)</td>
<td>30</td>
<td>Submit whenever you like, but <strong>late penalties</strong> apply after 5pm October 16*</td>
</tr>
<tr>
<td>B. Final examination</td>
<td>40</td>
<td>Multiple choice</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>Multiple choice</strong></td>
</tr>
</tbody>
</table>

* Late submission penalty: 20% deduction for each calendar day or part calendar day late. Submit as early as possible because you don't know what might happen to you near these dates. After submitting, always check what you have submitted.

A maximum total mark of 50% for the course may be given should an unsatisfactory grade be obtained in any of the assessment components (irrespective of grades obtained in other assessment components). Satisfactory in an assessment component here refers to the given mark minus any late penalty being more than 50% for that component.

The course convenor reserves the right to adjust by scaling the final marks, for example where a student has performed very well in all assessment components (but with a maximum mark of 100%), or has performed in a minimalist way in all assessment components (though no mark already above 50% will be taken below 50%). The intent is that the final marks will truly reflect student performance in the course.

**Groupwork**

Assignments A1, A2 and A3 can be done in groups of up to 3 students. You do not have to work in a group if you do not wish to. If you do wish to work in a group, you select the group members, and you are responsible for getting the group to function. The group stays the same for all 3 assignments.

Please note that, even though you might work as a group, you will be individually quizzed on the content of any group submissions. So, make sure that you are across the
whole of any submissions, and not just the bits that you might have been 'delegated'. It is strongly suggested that you don't delegate tasks, but rather have the whole group involved in all tasks.

**Grading of submitted written assessment**

Grading of all written assessment will be based on the following criteria (where relevant):

(i) **Go/no go criteria.** These must be satisfied before any submission can get a mark.

1. **Instructions**
   (Have the submission instructions been followed?)

2. **Content**
   (How comprehensive is the coverage of the topic – in depth, superficial or otherwise? Is it engineer level? How well does the work address the topic – Fully? Not at all? Skirts the topic? Misses the point? Gets sidetracked? Goes off on a tangent?)

3. **Presentation**
   (How professionally or amateurishly presented is the work?)

4. **Accuracy**
   (Is something said that is incorrect or contentious?)

5. **Objectivity**
   (Has the work been objective in its presentation. Does it recognize the difference between rigorous objectivity and subjective opinion?)

6. **Referencing**
   (Does the work include appropriate citations within the body of the work. Is the Reference list at the end complete in all details, such that any reader would be able to go directly to any reference?)

7. **English Expression, Grammar and Spelling**
   (English expression, grammar and spelling (Aus) – correctly used? Does the work show that it has been proofread for English?)

8. **Writing Style**
   (Is the work concise and to the point? Or is it verbose and uses unnecessary padding?)

9. **Level of Material**
   (Is the level of presentation that which you would expect at engineer level? Or is it too simplistic?)

(ii) **Marking criteria.** Provided the above criteria are satisfied, then assignments will be marked according to:

A. How well the assignment takes on board the ideas in the course text.

B. How well the student understands what s/he is doing.
Assessment Details

Assessment Components A1, A2, A3

Regularly look for any announcements in Moodle regarding the administration of the report.

Your report

a. Title your submission files SurnameSurnameSurname_A1.doc, SurnameSurnameSurname_A2.doc and SurnameSurnameSurname_A3.doc (as appropriate) where 'Surname' as it appears in Moodle. Nothing else will be accepted. For example, SmithJonesBlack_A1.doc, SmithJonesBlack_A2.doc and SmithJonesBlack_A3.doc. DON'T USE docx or pdf.

b. Submit as an attachment to Moodle, not a cut and paste to Moodle, not as an email attachment. After submitting, check that you have submitted the correct file.

c. Use sensible margins.

d. Use 12 point Times, single line spacing.

e. Length – maximum 5 pages (including necessary figures and tables), plus appendices.

f. Do not repeat the wording of the assignment. Do not give a table of contents.

g. No cover page. Nothing in headers or footers. Use the first few lines of your submission for: Course name, report topic, your names (as they appear in Moodle), and your student numbers (all 12 point type).

h. Proofread for spelling and grammar.

i. Use third person (not first or second person).

j. Citations within the report are as Author (year) or (Author, year). (Not square brackets with numbers; not superscripted numbers.) An alphabetical list of References at the end is complete with all authors, authors' initials, year, title, and (for a journal) journal name, volume, issue, pages; (for a book or report) publisher and place of publication; (for the internet) full web address. A Bibliography is a list of works that are related to the topic and ones you looked at, but didn't cite directly. So both a list of References and a Bibliography could be expected.

k. Material (text, figures, tables) copied from elsewhere, and not acknowledged, is referred to as plagiarism and represents academic misconduct for which students can fail a course and can have their enrolment cancelled. Any text from another source needs inverted commas around it, together with a citation of Author (year) and the page number of the quote. Any figure or table from another source needs a citation in the figure/table caption. Then give full referencing under 'References' at the end.
1. Use subheadings and give a structured flow. Bullet points are acceptable within the report, but not as the total report.
m. Do not extract or paraphrase material from the text or lecture notes. Just reference the material's location in the text or lecture notes.
n. Make your contribution terse, concise and to the point. Don't pad or be verbose. Don't pad with pretty pictures or university logo.
o. Focus your contribution directly on the topic and exclude peripheral information.
p. Do not use footnotes.

**Assignments A1, A2, A3**

Write your report as an MSWord.doc document right from the first word. Do not write as docx and then later convert to doc, because any equations and symbols will be lost.

See Moodle.

**Assessment Component B**

**Final Examination**

- The final examination is CLOSED BOOK.

- NO COMPUTERS, OR DEVICES FOR STORING INFORMATION, are to be taken into the examination room.

- Non-programmable calculators are permitted.

- Time allowed: 2 hours duration plus 10 minutes reading time.

- The examination format will involve multiple choice questions. Further details will be uploaded to Moodle.