MODULE STANDARDS

The modular development is a means of providing elements from which a semester or a quarter course is constructed or revised. Experts in an area, either from academia or from industry, develop the modules for that area, so as to provide the best treatment of a given subject, and a review system ensures the quality of the material. A web site provides easy access to the modules enabling efficient expertise sharing among colleagues. We thus have the equivalent of a series of best possible "textbook chapters," which can be combined as desired and/or revised in parts as the need arises.

1.0 What is the motivation?

The motivation for creating educational modules is to provide a means of responding to diverse and fast changing learning objectives in engineering education as they create the need for continuous revision of instructional course materials.

Engineering learning objectives vary from institution to institution, and any one institution's objectives vary through time.

- *Institutional variation*: Variations between institutions arise naturally out of the differences in interests and expertise of the faculty. This variation prevents the creation of courseware (typically, the textbook) that satisfies the learning objectives of all institutions.
- *Temporal variation*: Variations through time are driven by the need to follow advancements in technology, and, related, the dynamics of accreditation, university, college, and departmental curricular bodies as the perspective of one or more of these bodies change from year to year. This variation prevents the creation of courseware that satisfies the learning objectives of any one institution for very long.

This institutional and temporal variation creates significant pressure to continuously revise courseware. In doing so, one can (1) adopt entirely new courseware, (2) keep the current courseware and utilize supplementary material, or (3) self-develop new courseware. Yet, all of these options have drawbacks, ranging from an inability to match courseware to the desired learning objectives (options 1 and 2), disorganization and loss of courseware fluidity and connectedness (option 2), and excessive investment of time (option 3). The modular approach to courseware development allows each of these options without incurring their drawbacks.

2.0 What is a module?

*A **course module** is an organized, high-quality, textbook-like treatment of a topic, possibly, but not necessarily including other elements, which, when completed successfully, will advance the knowledge of a student by building upon well-defined pre-requisites. The outcome of a module is also well defined, so that other modules can draw upon this module as a pre-requisite.*

The basic and essential element of a module is the *student text*. This is a textbook-like treatment of the material that has the appearance of a textbook chapter, existing as a Microsoft Word file. It includes specification of the prerequisite knowledge and module learning objectives, an introduction, the treatment in terms of pedagogical description and explanation of the material with examples, summary, homework problems, and bibliography. Other elements such as software, video-clips, animations, digital photographs, related textual material (theses, papers, etc), and PowerPoint slides, although not essential, may also be included.

A module is not a complete course. Rather, it is dedicated to a topic, an idea, or a procedure, which is relevant to the overall education of an engineering student. Thus, the scope of a module is limited, as is its duration measured in contact hours.

How long should a module be? In a normal class we often dedicate one or two contact hours to a single topic. Yet broader topics – perhaps corresponding to a chapter in a text - sometimes span two weeks. We allow both ends of this spectrum. Therefore, module coverage is expected to require between one and six 50-minute class periods. Exceptions are allowed. However, for shorter modules, it may be difficult to adequately capture the relevance of an engineering topic in less than one class meeting. At the other end, longer modules limit the flexibility in constructing a modular course. Thus, careful consideration should be given to construction of a module that would lie outside of the one-to-six class meeting criteria.

3.0 Who develops modules?

Modules are developed by academic faculty or by industry engineers, and there is no geographical restriction on who can contribute. Thus, a powerful feature to modular courseware development is that it facilitates worldwide expertise sharing in the creation of instructional courseware, enabling faculty at one university to utilize the expertise of faculty at another university or within industry. The fact that module duration is limited provides that contributions be made without the excessive time investment required of traditional textbook development. It is likely that a module would have its beginnings in a set of lecture notes or overheads initially used in instructional delivery of a particular topic within an academic course or a short-course.

Modules developed by one author may be revised by another author. The original author and any revising authors, along with corresponding dates, are identified on the module title page.

4.0 How are modules used?

A course module is intended for use in courseware construction. Ideally, an instructor first identifies the learning objectives of a course. Then the instructor downloads the modules, which exist simply as Word files, corresponding to the identified learning objectives and appends them in a desirable order. The result of this effort, completed in just hours, is a first draft of the instructional material for the course. If necessary, and if

time permits, the instructor can then modify or supplement the contents of any of the modules, or a set of notes that are not yet modules can be added.

5.0 How are modules identified?

Each module has a unique identifier designated by

discipline.area.depth.topic topicnum

The different parts of this name are identified as:

- *discipline* identifies the engineering discipline under which the module falls, e.g., EE, CE, ME, etc.
- *area* identifies the area of the discipline under which the module falls; for example, EE could have areas of power engineering, communications, controls, electromagnetics, signal processing, etc.
- *depth* identifies the level of treatment of the material according to: 0 (pre-college), 1, 2, 3, 4 (first-fourth year college), 5 (first year graduate level), and 6 (second year graduate level or beyond).
- *topic* identifies the specific topic addressed by the module; for example, power engineering topics might include synchronous generators, transmission lines, induction motors, distribution systems, etc.
- *topicnum* identifies the module number for the identified topic; it allows that different modules may exist for different topics.

An example of a module identified would be EE.PE2.E3, which is an electrical engineering (EE) power engineering (PE) module developed at a level appropriate for sophomores (2) on economics (E), third in the set (3).

In addition, each module has a name that indicates the content of the module. For example, module EE.PE2.E3 could be named “System Control Overview and Economic Dispatch Calculation.”

6.0 How are modules linked?

Modules are linked through identification within each module of module prerequisites and module learning objectives.

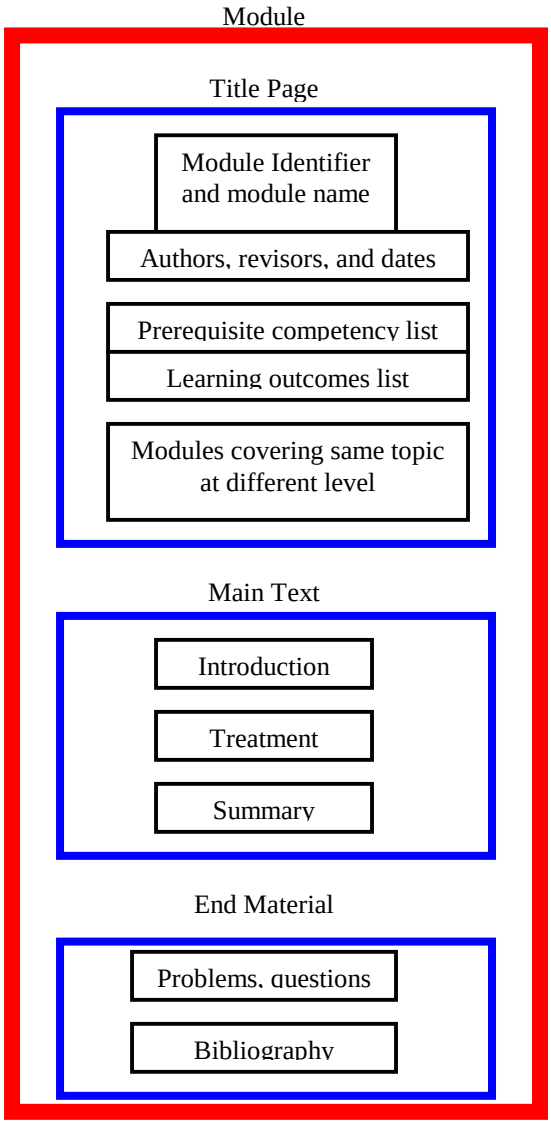
Module prerequisites are defined at two levels. The first level simply identifies the names of the other modules that address the prerequisite material. The second level describes the ideas covered by the modules in the prerequisite list in terms of competencies. These competencies are drawn from the learning outcomes of the prerequisite modules. Both levels are captured in a *prerequisite competency list* located on the module title page.

Module learning objectives are described by short sentences or phrases identifying what students should be able to do following completion of the module rather than in terms of what the instructor does to bring them about. The module learning objectives are captured in an *outcome competency list* located on the module title page.

7.0 Overview of Module Contents and Structure

The single essential element required for a set of material to exist as a module is the student text, having the following elements:

- The title page:
  - The module identifier in the form *discipline.area.depth.topic topicnum*
  - The module name
  - Module author, any revision authors, with e-mail addresses, and corresponding dates of authorship or revision
  - A prerequisite competency list with corresponding modules
  - A learning outcomes list
  - Related course modules covering the same material at a different level.
- The main text:
  - Introduction
  - Treatment (pedagogical description & explanation of material with examples)
  - Summary
- End material:
  - Problems/questions
  - Bibliography



NOMENCLATURE AND FORMATING REQUIREMENTS FOR STUDENT TEXT

The student text, being the element that forms the basis for each module, must conform to some level of consistency in terms of its use of nomenclature and formats. The student text for each module is done in Microsoft Word.

1.0 Nomenclature Requirements

All modules must adhere to a published list of common symbols, units, and terminology. This should follow standard American usage as specified by the IEEE (see IEEE Standard 260.1-1990).

2.0 Formating Requirements

The following format requirements apply to the student text. A template is attached below that illustrates these formatting requirements. Times New Roman, 12 pt font is to be used for all text unless otherwise specified.

- *Title page*:
  - Module identifier: 30 pt font, bold
  - Module name: 14 pt font, italics
- *Section and subsection headings*: The numbering should be given using the topic and topic number as a prefix with the section or subsection number as suffix. For example, module EE.PE2.E3 would have its introduction numbered as E3.1 and its first subsection in its second section as E3.2.1. Each section and subsection heading should be given using Arial, size 14 pt fonts.
- *Tables*: Captions are to be centered above the table using Arial, size 12 pt fonts.
- *Figures*: Captions are to be centered below the table using Arial, size 12 pt fonts.
- *Equations*: Numbered equations should use the format (*topic topicnum.eqnum)*, where *eqnum* is the equation number. For example, the fourth numbered equation in module EE.PE2.E3 would be numbered (E3.4). The equation number should be placed flush with column right margin.
- *Examples*: Examples should be delineated from the main text using 2.25 pt size lines drawn horizontally across the page above and below the example. The example header should appear directly beneath the upper line, using the format "Example *topic topicnum.exnum*" where *exnum* is the example number. For example, the second example in module EE.PE2.E3 would be headed "Example E3.2."
- *References*: References should be headed with the word "References" in Arial, size 14 font. They should be numbered consecutively in the order they appear in the text using square brackets.
- *Problems*: Problems should appear at the end of the student text delineated from the main text using a 2.25 pt size line drawn horizontally across the page. The word "PROBLEMS" in Arial, 12 pt size fonts, should appear just below this line. Each problem should be delineated using 1.5 pt size lines above and below the problem. The first line should be followed by the phrase "Problem *pnum*" where *pnum* is the problem number.

Module EE.PE.**topic topicnum.depth**

Module name

Primary Author: John Doe, Rock State University
Email Address: johndoe@rstate.edu
Co-author: James Doe, Island State University
Email Address: jamesdoe@istate.edu

Last Update: 8/1/99
Prerequisite Competencies: Identify units of current, voltage, and resistance (Module EE.PE.B1.1).
Learning outcomes:
1. Compute currents from voltage and resistance in a circuit.
2. Manipulate Ohm's law to obtain voltage as a function of current.

topic topicnum.1 Introduction

The topic of this module is ….Note that the topic and topic number are used in the section heading

topic topicnum.2 Section Title

This section….

topic topicnum.2.1 Subsection Title

This subsection….

topic topicnum.3 Section Title

This section….

topic topicnum.4 Section Title

This section ….

E3.4.1 Subsection Title

This subsection… From Table topic topicnum.1, we observe….

Table topic topicnum.1

Fuel Type	*$/MBTU*
Coal	*1.50*
Oil	*3.00*
Uranium	*0.65*

Natural Gas	*2.35*

From Figure topic topicnum.1, one can see that ….

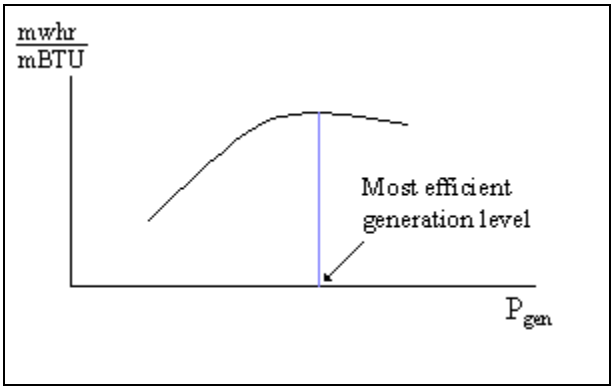


Figure topic topicnum.1 Plot of MWhr/MBTU vs. Generation (Pg)

Example topic topicnum.1

A 100 volt source is applied across a 20 ohm resistance. Find the current.

Solution

I=V/R=100/20=5 amps

topic topicnum.5 Summary

T*his module addressed….*

References

1. L. Cooper and D. Steinberg, Introduction to Methods of Optimization, W. B. Saunders Company, Philadelphia, Pennsylvania, 1970.
2. L. Cooper and D. Steinberg, Methods and Applications of Linear Programming, W. B. Saunders Company, Philadelphia, 1974.

P R O B L E M S

Problem 1
A 200 volt source is applied across a 40 ohm resistor. Find the current.

Problem 2
A 400 volt source is applied across an 80 ohm resistor. Find the current

Problem 3

Problem 4

Problem 5

Problem 6

Problem 7

Problem 8

FORMATTING REQUIREMENTS FOR IMAGES INCLUDED WITHIN STUDENT TEXT

1.0 Digital photographs

2.0 Diagrams

3.0 Animations

4.0 Video

5.0 Software