Coding Theory 6539
Unit Outline, 2009

Faculty of Information Sciences and Engineering
University of Canberra

Australian Government Higher Education (CRICOS)
Registered Provider number: #00212K

This Unit Outline must be read in conjunction with:

(a) *Studying at the University of Canberra: A Guide to Policies and Procedures* which sets out University-wide policies and procedures, including information on matters such as plagiarism, grade descriptors, moderation, feedback and deferred exams, and is avilable at http://www.canberra.edu.au/student-services

(b) *Guide to Student Services at the University of Canberra* which is available at http://www.canberra.edu.au/student-services

(c) Any additional information specified in Section 6f.

Contents

Section 1: General Information

1a. Unit title: Coding Theory

1b. Unit number: 6539

1c. Semester and year offered: Semester 2, 2009

1d. Credit point value: 3

1e. Unit level: 3

1f. Name of unit convenor and contact details:

Dr Ian Lisle, *Email:* Ian.Lisle@canberra.edu.au
Office: 11 C 9
Phone: 6201 2389
Mailbox: 306 (Level C, Building 11)

Email is the quickest and most reliable way to contact me.

Ian will be rostered in the Student Resource Centre 11A33 for certain hours each week, starting in Week 2. You are welcome to see me in my office at other times – just email me first to make a time.

Unit moderator: Ms. Mary Hewett, *E-mail:* Mary.Hewett@canberra.edu.au
Office: 11 C 10
Phone: 6201 2951

1g. Administrative contact details:

Faculty of ISE office, *E-mail:* ise@canberra.edu.au
Office: 11B14
Phone: 6201 2417, 6201 2619.

Section 2: Academic Content

2a. Unit description and learning outcomes:

Class Contact: Three hours a week.

Syllabus: Coding theory is the area of applied mathematics concerned with the efficient and accurate communication and storage of digital data. Sophisticated mathematical concepts such as finite fields have turned out to be exactly the right tools here. Applications range from mobile phones to deep space communications, computer networks to DVDs. This unit develops the mathematics needed and proceeds to its application in error detection and correction via linear, cyclic and/or convolutional codes. Examples such as Hamming, BCH and/or Reed-Solomon codes will be examined, along with their applications in various fields.

Learning Outcomes: Students will be expected to be able to understand and apply techniques of error detection and correction, to prove the properties of codes studied, and to demonstrate familiarity with issues arising from application of these codes.

2b. Prerequisite: Mathematical Structures or permission of Head of Discipline.

Section 3: Delivery of Unit and Timetable

3a. Delivery mode:

The unit is delivered over the standard UC semester in face-to-face mode at UC Bruce campus.

It is also assumed that students can and will retrieve documents from the unit website, and by email at their UC student account.

3b. Schedule of topics / classes by week

At time of printing, the unit timetable was as follows:

Lecture	Tuesday	14:30–15:30	11C43
Lecture	Friday	09:30–10:30	11B24
Tutorial	Friday	10:30–11:30	6B46

A schedule of lecture and tutorial classes will be handed out separately. Minor variations to the lecture / tutorial sequence may occur. Any such changes that affect the coverage of the tests will be prominently notified in class and via the website.

There is only one tutorial group. *The tutorial **will** meet in Week 1.*
In certain weeks a lecture hour may be used for extra tute time.
We may use a computer lab for the tutorial one week, so that the Maple computer algebra system can be introduced. The tutorial time may be varied with the agreement of the class.

Section 4: Unit Resources

4a. List of required texts:

R. Hill. *A First Course in Coding Theory,* Oxford Univ. Press, 1986. ISBN 0-19-853803-0. This is the only text you need to buy; it covers about 2/3 of the unit in Chapters 1–9, 11, 12, 15. Take lecture notes for the rest – some supplementary materials will also be handed out. Many tutorial exercises will simply be references to questions in the text.

4b. Materials and equipment Apart from the textbook, you'll need access to a computer to browse the unit website. A simple calculator will be useful too.

Additional perspective on the unit content can be had from books in the UC library, which has a couple of dozen books on Coding Theory, mostly under QA268 or TK5102, 5103. Keywords to try are 'coding theory', 'error correcting codes', 'error control codes' and the like. Four good books are:

- P. Garrett, 2003. *The Mathematics of Coding Theory,* Pearson / Prentice Hall. ISBN 0-13-101967-8.

  Undergrad text, pretty good on the maths – more than we do in Coding Theory – but weak on applications.

- Hoffman, et al., 1992. *Coding Theory–The Essentials,* Dekker. ISBN 0-8247-8611-4.

  Similar in coverage and philosophy to Hill. Deals only with binary codes (plus some on binary extension fields), but includes a chapter on convolution codes (not covered by Hill). Many exercises, some with answers.

- R. Wells, 1999. *Applied Coding and Information Theory for Engineers,* Prentice-Hall. ISBN 0-13-961327-7.

  One of the best introductory books on coding and transmission of data. Includes chapter on convolution codes.

- S.B. Wicker, 1995. *Error Control Systems: For digital communication and storage,* Prentice Hall. ISBN 0-13-200809-2.

  Excellent, thorough book on error control codes for graduate students of electronic engineering. A bit harder than our coverage in Coding Theory.

4c. Unit website: Moodle site at `http://learnonline.canberra.edu.au`
Certain handouts and other resources will be placed here as time permits. Most documents will be in Adobe PDF format.

Section 5: Assessment

5a. Assessment overview:

A composite score will be computed based on the following items:

Item	Details	Weight	Due Date
Test 1	45 min. Covers Lectures 1–7.	10%	Tue Week 5
Assignment 1	Various questions.	15%	Tue Week 10
Test 2	60 min. Covers Lectures 8–19.	15%	Fri Week 12
Assignment 2	Various questions.	15%	Fri Week 14
Final Exam	2 1/2 hr. Covers entire semester.	45%	Exam Period

5b. Details of each assessment item:

Tests The two Tests listed have the durations and cover the lectures shown. Permitted materials for the Tests include: calculator (non-alphabetic keyboard) and language dictionary (non-electronic).

Missed test: If you miss a Test for any good reason, you must advise the lecturer-in-charge of these reasons within 3 working days so that alternative arrangements can be made. Documentation will be required.

Assignments The assignments are to be strictly *individual* work. Assessment criteria will include correctness and completeness of answers and working; *clarity* of explanation and working will be highly prized.

Assignment Extensions: may be granted if reasons justify it. Documentation may be required for an individual extension.

Late penalties: may be applied to assignments submitted more than a few days late.

Final Exam There will be a 2 1/2 hr exam in the exam period at the end of semester, date to be advised. Permitted materials for the final exam will include a (non-alphabetic) scientific calculator, a (non-electronic) language dictionary and $2\times$A4 sides of (hand-written original) notes.

For full marks in the tests and final exam, working should be shown.

Raw marks on any of the assessment items may be scaled up (but never down) according to the academic judgement of the Unit Committee.

For final assessment in the unit, the result will be one of the following grades: HD, DI, CR, P, or Fail. The composite mark calculated from your scores, after scaling, will determine your grade.

5c. Special assessment requirements: None.

5d. Supplementary assessment:

For the university policy on supplementary assessments, see *Studying at the University of Canberra: A Guide to Policies and Procedures* at http://www.canberra.edu.au/student-services

5e. Text-matching software: Not applicable.

Section 6: Student Responsibility

6a. Workload:

The amount of time you will need to spend on study in this unit will depend on a number of factors including your prior knowledge, learning skill level and learning style. Nevertheless, in planning your time commitments you should note that for a 3 cp unit the total notional workload over the fifteen week semester is assumed to be 150 hours, or an average of 10 hours per week. These hours include time spent in classes.

6b. Special needs

Students who need assistance in undertaking the unit because of disability or other circumstances should inform their unit convenor or the Disabilities Office as soon as possible so the necessary arrangements can be made.

6c. Attendance requirements:

The primary delivery mode is face-to-face, and it is expected that you attend the lectures and tutorial.

6d. Required IT skills:

It is assumed that all students can access the unit's website, and can read and print the documents there. Most documents will be published in PDF (Adobe Acrobat) format.

It is also assumed that all students will regularly read e-mail received at their UC accounts – at least a couple of times a week.

The Maple computer algebra system may be introduced during semester; if so it is expected that students master a basic toolkit of commands for manipulating matrices and polynomials over finite fields. Maple is available in UC student labs.

6e. Costs:

Apart from normal tuition fees, students will need to purchase a copy of the textbook. Other small costs may be incurred for buying a calculator and for printing out unit materials.

6f. Additional information:

Provision of information to the group:

Announcements made at lectures or circulated by e-mail to your UC student accounts will be deemed to have been communicated to the whole group. I will try also to post important announcements on the website.

Assessment:

If there is any doubt with regard to the requirements of any particular assessment procedure, the onus for clarifying the issue rests with the student who should contact (e-mail!) the lecturer about the matter.

- It is expected that all students make themselves aware of the dates of the Tests and Final Exam.
- It is similarly expected that students ensure they are aware when the assignments are handed out and when they are due.
- Each assignment is to be an individual piece of work.

Section 7: Student Feedback

All students enrolled in this Unit will have an opportunity to provide anonymous feedback on the Unit at the end of semester via the Unit Satisfaction Survey which will be presented to you on OSIS. Your lecturer or tutor may also invite you to provide more detailed feedback through an anonymous questionnaire administered through the University's Teaching and Learning Centre (TLC).

Section 8: Authority of this Unit Outline

Any change to the information contained in Section 2 (Academic content), Section 3 (Delivery of unit and timetable) and Section 5 (Assessment) of this document, will only be made by the Unit Convenor if the written agreement of staff and a majority of students has been obtained; and if advice of the change is then forwarded to each student enrolled in the unit, either by email to their student address or by mail to their registered term address. Any individual student who believes him/herself to be disadvantaged by a change is encouraged to discuss the matter with the Unit Convenor.