



The University of Southern Queensland

## Course specification

The current and official versions of the course specifications are available on the web at <http://www.usq.edu.au/coursespecification/current>.  
Please consult the web for updates that may occur during the year.

### Description: Electronic Measurement

Subject	Cat-nbr	Class	Term	Mode	Units	Campus
ELE	3506	90307	2, 2009	ONC	1.00	Toowoomba

<b>Academic group:</b>	FOENS
<b>Academic org:</b>	FOES04
<b>Student contribution band:</b>	2
<b>ASCED code:</b>	031303

### STAFFING

Examiner: Andrew Maxwell  
Moderator: Nigel Hancock

### REQUISITES

Pre-requisite: (ELE1502 and (ELE2101 or ELE2103) and (ELE2503 or ELE2504)) or Students must be enrolled in one of the following Programs: GCEN or GDET or METC or MEPR

### SYNOPSIS

Central to the profession of all electrical engineering professionals is the measurement of electrical quantities, or, more generally, physical quantities whose values have been rendered electrical by a transducer. Such measurements are almost invariably made with the aid of electronics, and increasingly by sophisticated instrumentation which provides multidimensional displays and analytical capabilities. Automation of such measurements is also on the rapid increase. However, in the face of these developments the need to comprehend the physical principles of making accurate, precise and trustworthy measurements, particularly of small quantities (microvolts, microamperes), remains fundamental. It is the task of the engineering professional to be able to specify and evaluate equipment for a given measurements task; this requires an appreciation of electronic measurement systems : at the system level by an awareness of the range, operating principles and limitations of commercial test equipment; and, at the circuit level which includes the effects and minimisation of interference, certain commonly employed circuit and IC configurations such as the Phase Lock Loop and frequency synthesis, and choice of components and construction details. An important aspect of the operating requirements of equipment is the need for them to be electromagnetically compatible. It is also the responsibility of professionals to implement measurement systems with regard to their human and environmental impact, and some introduction to these issues is also provided.

### OBJECTIVES

The course objectives define the student learning outcomes for a course. The assessment item(s) that may be used to assess student achievement of an objective are shown in parenthesis. On completion of this course, students should be able to:

1. discuss the operating principles of common electronic laboratory test equipment (Differential Thermometer, CMA 2 and Timed Assignment);
2. apply the principles of operation of common electronic measuring equipment, and to assess the limitations of that equipment (Differential Thermometer, CMA 2 and Timed Assignment);
3. measure the performance of electronic test equipment and electronic circuits (Differential Thermometer, CMA 1 and Timed Assignment);
4. design appropriate techniques for minimising signal interference (Amplifier Design, CMA 1 and Timed Assignment);
5. select and justify amplifiers appropriate to an application (Amplifier Design and Timed Assignment);
6. design, construct and evaluate electronic circuits for low-signal, high-interference environments (Amplifier Design, Differential Thermometer, CMA 1 and Timed Assignment);
7. analyse the performance of Phase Lock Loops and calculate their parameters (CMA2 and Timed Assignment);
8. discuss the principles of reliability theory as applied to electronic systems, and calculate composite reliability and subsystem redundancy (Differential Thermometer, CMA 2 and Timed Assignment); and
9. discuss human and environmental implications of measurement systems (Amplifier Design and Timed Assignment).

## TOPICS

	Description	Weighting (%)
1.	<b>SIGNAL INTERFERENCE AND CORRUPTION</b> the problem of measurement, input impedance, EMI and RFI, coupling paths, electromagnetic compatibility and techniques to reduce EMC problems.	20.00
2.	<b>ELECTRONIC MEASUREMENT COMPONENTS AND CIRCUITS</b> operational amplifiers and their errors; instrumentation amplifiers; the Phase Lock Loop; frequency synthesis principles.	30.00
3.	<b>ELECTRONIC TEST EQUIPMENT</b> analogue and digital voltmeters, current, power, gain and phase measurement; frequency and period measurement; the oscilloscope and CRT display; signal sources; analogue swept spectrum measurements; the digital oscilloscope and sampled measurement systems; quantisation, aliasing and interpolation problems; test equipment for digital systems; the logic analyser and honest reporting of results.	30.00
4.	<b>AUTOMATIC TEST EQUIPMENT</b> the GPIB, operation, use and programming; internal design of GPIB-based test equipment and ethical considerations.	15.00
5.	<b>ELECTRONIC RELIABILITY</b> component reliability, burn in, wear out and derating; MTBF; composite reliability and system MTBF; subsystem redundancy; high reliability systems; concepts of hybridisation and microelectronics.	5.00

## **TEXT and MATERIALS required to be PURCHASED or ACCESSED**

ALL textbooks and materials are available for purchase from USQ BOOKSHOP (unless otherwise stated). Orders may be placed via secure internet, free fax 1800642453, phone 07 46312742 (within Australia), or mail. Overseas students should fax +61 7 46311743, or phone +61 7 46312742. For costs, further details, and internet ordering, use the 'Textbook Search' facility at <http://bookshop.usq.edu.au> click 'Semester', then enter your 'Course Code' (no spaces).

*ELE3506 Electronic Measurement External Study Package*, USQ Publication,  
Instrumentation Amplifier Kit

Electronic prototyping breadboard minimum 800 holes, digital multimeter, electronic construction tools.

## **REFERENCE MATERIALS**

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

Analog Devices Data Book, Chichester, New York

Bentley, JP 2005, *Principles of measurement systems*, 4th edn, Pearson/Prentice Hall, New York.

Buchla, D & McLachlan, W 1992, *Applied electronic instrumentation and measurement*, Maxwell MacMillan, New York.

Denny, HW 1983, *Grounding for the control of EMI*, Don White Consultants Inc, Gainesville, Va.

Drummer, GHA & Griffin, NB 1966, *Electronics reliability - calculation and design*, Pergamon Press, Oxford, New York.

Fish, PJ 1993, *Electronic noise and low noise design*, McGraw Hill, New York.

Helfrick, AD & Cooper, WD 1990, *Modern electronic instrumentation and measurement techniques*, Prentice Hall, Englewood Cliffs, NJ.

Ibrahim, KF 1988, *Instruments and automatic test equipment*, Longman Scientific and Technical, Harlow, Essex.

Millman, J & Grabel, A 1988, *Microelectronics*, 2nd edn, McGraw Hill, New York.

Morrison, R 1998, *Grounding and shielding techniques*, 4th edn, Wiley, New York.

Ott, HW 1988, *Noise reduction techniques in electronic systems*, 2nd edn, Wiley, New York.

Sheingold, DH (ed) 1980, *Transducer interfacing handbook*, Analog Devices Inc, Norwood, Mass.

Tran Tien, L 1987, *Electronics of measuring systems: practical implementations of analogue and digital techniques*, John Wiley, Chichester.

## STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessments	15.00
Lectures	26.00
Private Study	36.00
Project Work	40.00
Report Writing	12.00
Tutorials	26.00

## ASSESSMENT DETAILS

Description	Marks out of	Wtg (%)	Due date
AMPLIFIER DESIGN	160.00	16.00	17 Aug 2009
CMA 1	50.00	5.00	24 Aug 2009
DIFFERENTIAL THERMOMETER	240.00	24.00	05 Oct 2009
CMA 2	50.00	5.00	12 Oct 2009
TIMED ASSIGNMENT	500.00	50.00	02 Nov 2009 (see note 1)

### NOTES

1. The timed assignment comprises a series of questions requiring either calculations or written answers. The questions are different for each student and will be provided a short time prior to the due date. Full details are provided in the study materials.

## IMPORTANT ASSESSMENT INFORMATION

- 1 Attendance requirements:  
It is the students' responsibility to attend and participate appropriately in all activities (such as lectures, tutorials, laboratories and practical work) scheduled for them, and to study all material provided to them or required to be accessed by them to maximise their chance of meeting the objectives of the course and to be informed of course-related activities and administrations. This course contains a discussion forum where students' participation is formally assessed and successful participation in that discussion group is required to complete the requirements to be awarded a passing grade in the course.
- 2 Requirements for students to complete each assessment item satisfactorily:  
To satisfactorily complete an individual assessment item, a student must achieve at least 50% of the marks or a grade of at least C-.
- 3 Penalties for late submission of required work:  
If students submit assignments after the due date without extenuating circumstances then a penalty of 5% of the assigned mark may apply for each working day late up to a maximum of ten working days at which time a mark of zero can be recorded for that assignment.
- 4 Requirements for student to be awarded a passing grade in the course:  
To be assured of receiving a passing grade in a course a student must obtain at least 50% of the total weighted marks for the course.

- 5 Method used to combine assessment results to attain final grade:  
The final grades for students will be assigned on the basis of the weighted aggregate of the marks (or grades) obtained for each of the summative assessment items in the course.
- 6 Examination information:  
There is no examination in this course.
- 7 Examination period when Deferred/Supplementary examinations will be held:  
There will be no Deferred or Supplementary examinations in this course.
- 8 University Regulations:  
Students should read USQ Regulations 5.1 Definitions, 5.6. Assessment, and 5.10 Academic Misconduct for further information and to avoid actions which might contravene University Regulations. These regulations can be found at the URL <http://www.usq.edu.au/corporateservices/calendar/part5.htm> or in the current USQ Handbook.

## **ASSESSMENT NOTES**

- 1 The due date for an assignment is the date by which a student must despatch the assignment to the USQ. The onus is on the student to provide proof of the despatch date, if requested by the Examiner.
- 2 Students must retain a copy of each item submitted for assessment. This must be despatched to USQ within 24 hours if required by the Examiner.
- 3 In accordance with University's Assignment Extension Policy (Regulation 5.6.1), the examiner of a course may grant an extension of the due date of an assignment in extenuating circumstances.
- 4 The Faculty will normally only accept assessments that have been written, typed or printed on paper-based media.
- 5 The Faculty will NOT accept submission of assignments by facsimile.
- 6 Students who do not have regular access to postal services or who are otherwise disadvantaged by these regulations may be given special consideration. They should contact the examiner of the course to negotiate such special arrangements.
- 7 In the event that a due date for an assignment falls on a local public holiday in their area, such as a Show holiday, the due date for the assignment will be the next day. Students are to note on the assignment cover the date of the public holiday for the Examiner's convenience.
- 8 Students who have undertaken all of the required assessments in a course but who have failed to meet some of the specified objectives of a course within the normally prescribed time may be awarded one of the temporary grades: IM (Incomplete - Make up), IS (Incomplete - Supplementary Examination) or ISM (Incomplete -Supplementary Examination and Make up). A temporary grade will only be awarded when, in the opinion of the examiner, a student will be able to achieve the remaining objectives of the course after a period of non directed personal study.
- 9 Students who, for medical, family/personal, or employment-related reasons, are unable to complete an assignment or to sit for an examination at the scheduled time may apply to defer an assessment in a course. Such a request must be accompanied by appropriate supporting documentation. One of the following temporary grades may be awarded IDS (Incomplete - Deferred Examination; IDM (Incomplete Deferred Make-up); IDB (Incomplete - Both Deferred Examination and Deferred Make-up).

## **OTHER REQUIREMENTS**

- 1 Students will require internet access to UConnect for this course.
  - 2 Students will require access to basic electronic manufacturing equipment for this course. Full details are provided in the study materials.
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