

THE AUSTRALIAN NATIONAL UNIVERSITY

ENGN2211 Electronic Circuits

[24-02-2009] Course Outline and Assessment Schedule – Semester 1, 2009

[1] COURSE INFORMATION

1.1 Course Coordinator

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Drop-in Session: Wednesday 11:00-12:00

1.2 Lab Supervisor

1. Mr. Ian McRobert (Office: E202) ian.mcrobot@anu.edu.au (Tel: 54885)

1.3 Lab Demonstrators

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|-----------------------|------------------|--|
| 1. Fiona Jean Beck | HLab1 | fiona.beck@anu.edu.au |
| 2. Xiangyun Zhou | CLab1, HLab1 | xiangyun.zhou@anu.edu.au |
| 3. Priscilla Kan John | CLab3 | priscilla.kanjohn@anu.edu.au |
| 4. Sung Han Cha | CLab2 & 4 | sung.cha@anu.edu.au |
| 5. Akramus Salehin | CLab2 & 4, HLab2 | Akramus.Salehin@rsise.anu.edu.au |
| 6. Sandun Kodituwakku | HLab2 & 4 | sandun.kodituwakku@anu.edu.au |
| 7. Lachlan Blackhall | HLab2 | lachlan.blackhall@anu.edu.au |
| 8. Quang Nguyen | HLab3 & 4 | quang.nguyen@anu.edu.au |

1.4 Pre-Requisite

1. ENGN1221 Electromechanical Technologies.

1.5 Text Book

1. Allan R. Hamby, "Electrical Engineering Principles and Applications", 4th edition, Pearson/Prentice Hall, 2008

1.6 Web Site

1. <http://webct.anu.edu.au>
It is your responsibility to regularly check the webpage regularly (**at least twice a week**) for course information and announcements.

1.7 Teaching and Learning Activities

	No.	Day	Time	Location
Lectures: (Weeks 1-13)	Lecture 1:	Tuesday	10:00 AM-11:00 AM	CHEM T1 Lecture Theatre
	Lecture 2:	Wednesday	10:00 AM-11:00 AM	CHEM T1 Lecture Theatre
	Lecture 3:	Thursday	11:00 AM-12:00 AM	CHEM T1 Lecture Theatre
Computer Labs: (Weeks 4,6,10,12)	Group 1:	Monday	2:00 PM-5:00 PM	ENGN G1 Computer Lab
	Group 2:	Tuesday		
	Group 3:	Wednesday		
	Group 4:	Thursday		
	Group 5:	Friday		
Hardware Labs: (Weeks 5,7,11,13)	Group 1:	Monday	2:00 PM-5:00 PM	Ian Ross Room 104
	Group 2:	Tuesday		
	Group 3:	Wednesday		
	Group 4:	Thursday		

Note: CLab Group 6 and HLab Group 5 (showing in timetable page on webct) are additional bookings which will not be used this semester.

[2] COURSE DESCRIPTION

2.1 Course Outline

This course introduces the analysis and design of fundamental analogue electronic and introductory digital electronic circuits. It also provides an understanding of the basic circuit properties and applications of different electronic devices (diodes, bipolar junction transistor, operational amplifier and logic gates). The primary aim is to provide a solid foundation for students in the field of electronic engineering. Specific topics include:

- Electric circuit analysis: first order RC and RL circuits.
- Diodes: Basic diode concepts and diode circuit models, applications (rectifier and wave shaping circuits).
- Bipolar Junction Transistors: Basic BJT concepts and circuit models, BJT Amplifiers (bias circuits, small-signal and large-signal equivalent circuits).
- Introduction to Operational Amplifiers: Ideal op-amp, Basic Op-amp configurations, First order active filters (low-pass and high pass).
- Introduction to Digital Electronics: Number systems, Boolean algebra, Logic gates, Combinational logic circuits, Karnaugh maps.

PSPICE is used extensively in the analysis and simulation.

2.2 Learning Outcomes

Knowledge Base

Having successfully completed this course, students should be able to:-

1. Apply circuit analysis techniques (e.g. Kirchhoff's law's, Thevenin equivalent circuits, Phasors and complex impedances, Transfer functions) to solve electronic circuits.
2. Explain diode and transistor operating modes and analyse the operation of basic diode and transistor circuits (e.g. power supply and amplifier circuits).
3. Identify first order filter circuits and draw Bode Plots to determine the frequency response.
4. Describe differences between analogue and digital signals and design combinational logic circuits using Karnaugh Maps.

Engineering Ability

Having successfully completed this course, students should be able to:-

1. Explain in simple terms the working principles of basic electronic circuits.
2. Model the behaviour of electronic circuit components using mathematical techniques.
3. Read data sheets for specific electronic components and identify values of key operating parameters.

Practical Skills

Having successfully completed this course, students should be able to:-

1. Assemble circuits using breadboard and perform circuit measurements using electrical measurement devices (oscilloscope, function generator, digital multimeter, power supply).
2. Simulate electrical circuits using electronic software packages (e.g. PSPICE and DigitalWorks) with confidence.
3. Calculate results using scientific calculator (complex mode, base-n mode, engineering mode) in a knowledgeable and confident manner.

2.3 Library Reserve

1. Thomas L. Floyd, *Fundamentals of analog circuits*, 2nd ed, Prentice Hall, 2002.
<http://library.anu.edu.au/record=b2202643>
2. Theodore F Bogart, *Electronic devices and circuits*, 2nd ed, Merrill Pub. Co., c1990.
<http://library.anu.edu.au/record=b1763474>
3. Richard C. Dorf & James A. Svoboda, *Introduction to electric circuits*, 7th ed, John Wiley & Sons, 2006. <http://library.anu.edu.au/record=b2274718>
4. *Microelectronic Circuit Design*, 2nd ed, R. Jaeger, and T. Blalock, McGraw-Hill, 2004.
<http://library.anu.edu.au/record=b2202651>
5. J.R.Cogdell, *Foundations of Electrical Engineering*, 2nd Ed., Prentice Hall, 1996.
<http://library.anu.edu.au/record=b2153047>

[3] POLICIES AND PROCEDURES

3.1 Assessment

There are FOUR components to the assessment for this course:

No.	Component	Marks
1.	Computer Labs	10% (4 Computer Labs, each worth 2.5%)
2.	Hardware Labs	20% (4 Hardware Labs, each worth 5%)
3.	Mid Semester Exam	20%
4.	Final Exam	50%

Note:

1. The Mid-semester exam topics include:
 1. Lectures 1-11
 2. Problem Sets 1-7
 3. Text Book Chapters 4,10,13.1-13.6
2. The Mid-semester exam will consist of 4 questions, each worth 10 marks. It will be marked out of 40 and scaled.
3. The Final exam topics include:
 1. Lectures 9-13, 16-28
 2. Problem Sets 7-15
 3. Text Book Chapters 11,13,14,6,7
4. The Final exam will not directly address the topics already covered in Mid-semester exam (except BJTs which is included in BOTH Mid-semester and Final exam). Nevertheless, knowledge and understanding of these topics will be assumed.
5. The Final exam will consist of 5 questions, each worth 15 marks. It will be marked out of 75 and scaled.
6. Past examination papers (2006-2008) are not available from the library. Sample examination questions will be made available via Webct before the mid-semester and final exams. Some exam questions will be taken from Problem Set questions as outlined in Section 3.4.

3.2 Permitted Exam Materials

1. A4 page (one sheet) with hand-written notes on both sides.
2. Calculator (Memory cleared for programmable calculators).

3.3 Lecture Notes

1. The lecture notes will be posted on the course web site after each lecture.

3.4 Problem Sets

1. At the start of each week, Problem Sets covering the course material will be prepared and posted on the course web-site. The solutions to the Problem Sets will be posted at the end of each week.
2. The Problem Sets are assessable as follows:
 - a. ONE question each in the Mid Semester and Final Exams will be taken from the Problem Sets with changes in numerical values. The question wording may be modified as required.
 - b. A further TWO questions in both the Mid Semester and Final Exams will be similar in nature and difficulty to the Problem Set Questions.

3.5 Computer Laboratories

1. There are four computer laboratories (worth 10% of overall marks) that support the hardware laboratories.
 - a. CLabs 1-3 are based on PSPICE.
 - b. CLab 4 is based on PSPICE and DigitalWorks.
2. CLabs 1-3 require formal lab reports while CLab4 will be assessed based on the satisfactory completion of tasks as outlined in the lab manual.
3. [**CLab Groups**] Sign up (via WebCT in WEEK 2) for ONE of the five CLab groups. An upper limit of **24 students per lab group** will apply. Each student will perform the lab individually and attend labs only at those times during designated lab weeks.
4. [**Pre-Lab**] Preliminary preparation for the laboratories is essential. Read the *Pre-Lab* section BEFORE coming to the CLab.
5. [**Lab Time**] Complete the *Lab Procedure* section DURING lab time. The Lab tutor will make a note that all procedure steps and measurements have been completed during lab time.

3.6 Hardware Laboratories

1. There are four hardware laboratories, worth 20% of overall marks.
2. HLabs 1-3 require formal lab reports while HLab4 will be assessed based on the satisfactory completion of tasks as outlined in the lab manual.
3. [**Lab Kit**] Obtain a lab kit from Pam Shakespeare, Student Administrator (in WEEK 4).
4. [**HLab Groups**] Sign up (via WebCT in WEEK 2) for ONE of the four HLab groups. An upper limit of **34 students per lab group** will apply. Each student will attend labs only at those times during designated lab weeks. Experiments are conducted by teams of two persons. *It is expected that the composition of the teams is maintained for the 4 hardware experiments.*
5. [**Pre-Lab**] Preliminary preparation for the laboratories is essential. Read the Pre-Lab Reading and Theory sections BEFORE coming to the HLab.
6. [**Lab Time**] Complete the Procedure section DURING lab time. The Lab tutor will make a note that all procedure steps and measurements have been completed during lab time.

3.7 Lab Reports

1. CLab 1-3 and HLab 1-3 reports will be prepared by every student AFTER completing the lab.
2. [**HLab Reports**] A proper HLab report is expected including:-
 - a. main circuit diagrams
 - b. relevant observations/explanations (where requested in the lab manual),
 - c. theoretical calculations/analysis (where requested in the lab manual)
 - d. measured results,
 - e. answers to Evaluation & Review Questions.
 - f. However, no formal introduction or aims or conclusions are required.
3. [**CLab Reports**] A proper CLab report is expected including:-
 - a. relevant observations/explanations (where requested in the lab manual),
 - b. theoretical calculations/analysis (where requested in the lab manual)
 - c. PSPICE result figures and
 - d. answers to Evaluation & Review Questions.
 - e. However, no formal introduction or aims or conclusions are required.
4. [**Report Lengths**]
 - a. HLab reports should be limited to a maximum of 12 pages (typically 10 pages). Reports in excess of 12 pages will have additional pages removed and the report then marked.
 - b. CLab reports should be limited to a maximum of 8 pages (typically 5 pages), excluding the result printouts. Reports in excess of 8 pages will have additional pages removed and the report then marked.
 - c. For typed lab reports, use 11 point font (Times New Roman or Arial) and all page borders must be at least 1 inch.
 - d. The printout figures must be appropriately labeled and referenced in the report, e.g. Figure for [A1], Figure for [B2] etc.
 - e. The first page must clearly show the Student Name, University ID and Lab number.

5. **[CLab Report Submission]** Reports are due in ENGN2211 submission box at 10am on Thursday in the next week i.e.
 - i. CLab1 due week 5: Thursday 26 March, 10am
 - ii. CLab2 due week 7: Thursday 09 April, 10am
 - iii. CLab3 due week 11: Thursday 21 May, 10am
6. **[HLab Report Submission]** Reports are due in ENGN2211 submission box at 10am on Thursday in the next week i.e.
 - i. HLab1 due week 6: Thursday 02 April, 10am
 - ii. HLab2 due week 8: Thursday 07 May, 10am
 - iii. HLab3 due week 12: Thursday 28 May, 10am

3.8 Lab Report Assessment

1. **[Assessment Criteria]** Each lab report is worth up to 10 marks. All labs will be assessed taking into account the following:-
 - a. discussion of the results and/or measurements,
 - b. theoretical calculations and observations/explanations (where requested in the lab manual at individual lab tasks),
 - c. answers to the evaluation and review questions and
 - d. standard of the lab report as outlined in Section 3.7.
2. **[Regrading]**
 - a. The marked reports will be returned back to the students (details will be announced later).
 - b. There are occasionally small mistakes made in the lab report grading. If a grading mistake is clear (such as incorrect addition of marks) then you can contact the tutor to correct your marks.
3. **[Late Submission Policy]** Late reports (both CLabs and HLabs) will be accepted but will undergo the following penalty:
 - a. All reports submitted after 10 am on the due date will be reduced by 1 mark for the report per day, including weekends.
 - b. The lab report may be marked at a later date without a late submission penalty only in special circumstances AND if permission is sought in advance.
4. **[Attendance Policy]**
 - a. Any student absent from their HLab or CLab group will receive a 0 mark.
 - b. For CLabs, the attendance requirement may be waived only in special circumstances AND if permission is sought in advance.
 - c. The late submission & attendance policies will be strictly enforced for fairness to all.

3.9 Software Packages

PSPICE (9.1 student version) and DigitalWorks software packages are required for this course and are available on all Info Commons computers.

Please note the following regarding PSPICE:-

1. When a PSPICE schematics file (*.sch extension) is executed, it creates a number of additional files. In webct, only the *.sch files are made available for download in zip format.
2. An introduction to PSPICE video demo movie (*.avi file) is available in webct labs page.

The following (optional) software packages are also available on all Info Commons computers:

1. Matlab 2007b (for numerical calculations)
2. Microsoft Visio 2003 (due to ANU licencing restrictions, Visio 2003 is available only on the 20 PCs in the Law G17 computer lab. Law G17 has the same software as the Engineering lab)
3. Latex (Winedt and MikTex)
4. Note that the Problem Sets in this course are typeset using Latex and the majority of the figures are drawn using Visio and/or Matlab.

[4] TENTATIVE COURSE SCHEDULE

Week	Lectures	Textbook Chapters	ProbSets	Labs
1 (23Feb-01Mar)	L01 Intro to ENGN2211		P01 Capacitors and Inductors	
	L02 Circuit Elements			
	#			
2 (02Mar-08Mar)	L03 Mesh Loop	RC & RL circuits Chapter 4 (4.1–4.3)	P02 NodeMesh Analysis P03 RC and RL circuits	
	L04 RC and RL circuits			
	#			
3 (09Mar-15Mar)	L05 Diode Circuits	Diode Circuits Chapter 10 (10.1–10.7)	P04 Diode Rectifier Circuits	
	L06 Rectifier Circuits			
	#			
4 (16Mar-22Mar)	#		P05 Diode Clipper Ccts P06 ZenerDiode Circuits	CLab1 RC circuits & Diodes
	L07 Clipper Circuits			
	L08 Zener Diode Circuits			
5 (23Mar-29Mar)	#	BJT Circuits Chapter 11 (11.1,11.2,11.6)	P07 BJT Bias Circuits	HLab1 Diode xtics & Power Supply CLab1 due
	L09 Semiconductor Materials			
	L10 Intro to BJT			
6 (30Mar-05Apr)	L11 BJT Bias Circuits		Chapter 13 (13.1–13.8)	P08 BJT Amplifier Circuits
	#			
	L12 BJT AC Circuits			
7 (06Apr-12Apr)	L13 BJT CE Amplifiers			HLab2 CE amplifier CLab2 due
	#			
	L14 + L15 (non-assessable)			
Mid Semester Exam				
8 (27Apr-03 May)	L16 RC Filtering Circuits	Op Amp Circuits Chapter 14 (14.1–14.4, 14.9)	P09 Complex Impedances P10 Op-amp Circuits	
	#			
	L17 Op-amp Circuits			
9 (04May-10May)	#	Filter Circuits Chapter 6 (6.1–6.4)	P11 Lowpass Filter Circuits	HLab2 due
	L18 Op-amp Filters			
	#			
10 (11May-17May)	L19 Digital Circuits	Digital Electronics Circuits Chapter 7 (7.1–7.5)	P12 Digital Logic Gates	CLab3 RC filters Op-amps
	#			
	L20 Logic Gates			
11 (18May-24May)	L21 Boolean Algebra		P13 Boolean Algebra	HLab3 Zener Diodes & Op-amps CLab3 due
	L22 BJT Switch			
	L23 SOP Implementation			
12 (25May-31May)	L24 Karnaugh Maps	P14 Karnaugh maps	CLab4 Digital Electronics HLab3 due	
	#			
	L25 Seven Segment Display			
13 (01Jun-07Jun)	L26 Combinational Circuits	P15 Combinational Logic Circuits	HLab4 Digital Electronics	
	L27 Complement Arithmetic			
	L28 Final Exam			
Final Exam				

Note:

1. All assessable item due 10am on Thursday of that week in ENGN2211 Assignment Box. Note that CLab4 and HLab4 will be marked during the lab.
2. The symbol # means that the lecture topic continues.
3. Red color indicates assessment item due that week.