

Academic Year	AY1920	Semester	2
Course Coordinator	Rainer Dumke		
Course Code	PH2901		
Course Title	Electronics for the Experimentalist		
Pre-requisites	-		
No of AUs	3 AU		
Contact Hours	1 hr lecture, 6 hr tutorial and lab		
Proposal Date	19 November 2019		

Course Aims

This course introduces basic concepts and applications of electronic elements and circuits. Elements in analog and digital electronics will be discussed. Tools for circuit design and board layout will be introduced. Additionally an overview of typical circuits for scientific instrumentation for data acquisition and signal processing will be given. The lab sessions are an integral part in this course and focus on hands-on experiments with the goal to realize prototypes of given circuits. During your project work, you have to design and realize an electronic device capable of managing a given tasks. By doing this project work, you will gain experience in actual electronics construction and can apply this experience to your scientific environment.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

- 1.) apply safety procedure for a safe working with electronic circuits and components.
- 2.) identify individual electronic components with their purpose inside an electronic circuit.
- 3.) describe the working principle of standard circuit diagrams
- 4.) solve independently simple electronic problems.
- 5.) analyse potential solutions by simulating and optimizing the proposed circuit.
- 6.) use electronic laboratory equipment.
- 7.) verify and test the solution by assembling an experimental test setup.
- 8.) apply tools to analyse circuits and solve practical problems.

Course Content

Foundation
 Transistors
 Field Effect Transistors
 Operational Amplifiers
 Electronic Construction Technique
 Circuit Design Tools
 Filters and Oscillators
 Precision Circuits and Low Noise Techniques
 Digital Electronics

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment Rubrics
1. Midterm Examinations	All	Competence (1,2,3,4,5) Creativity (2) Communication (1)	30%	Individual	Rubric-based marking
2. Continuous Assessment 1 (CA1): Electronic Lab Reports	All	Competence (1,2,3,4,5) Creativity (2) Communication (1)	30%	Individual	Rubric-based marking (See Appendix 2)
3. Individual Project Report	All	Competence (1,2,3,4,5) Creativity (2) Communication (1)	20%	Individual	Rubric-based marking (See Appendix 2)
4. Individual Project Viva	All	Competence (1,2,3,4,5) Creativity (2) Communication (1)	20%	Individual	Rubric-based marking (See Appendix 1)
5.					
Total			100%		

Formative feedback

Formative feedback is given through discussion within lab sessions, a discussion after the midterms, a discussion after the presentation and viva.

Learning and Teaching approach

Lectures	The lectures provide concrete examples for calculations of the type and difficulty you are expected to be able to do.
Lab Assignments	The lab assignments provide practice problems for the topics covered during the lectures in the current week, allowing you to apply and practice their newly-acquired knowledge. The lab work can be performed in small

	groups to encourage peer learning. Feedback is provided directly to the individual groups.
Viva/Report	You have to write individually for each weekly assignment a lab report. You also need to write a report and hold a viva session on a selected semester electronic project. This develops your ability to apply newly learned principles to solve problems on a selected and formulate it coherently in a scientific correct report.

Reading and References

The Art of Electronics, 2nd ed, Paul Horowitz and Winfield Hill, Cambridge University Press, 978-0521370950, 1989

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to attend electronics lab sessions and work on the electronics lab project.

You are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions you have missed. You are expected to participate in all seminar discussions, activities and lab sessions. You are expected to hand in reports for the lab activities and the semester project.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Rainer Dumke	04-16		rdumke@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction and Safety	1	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
2	DC Circuits	1,2,3,6,7	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
3	Electronic Circuit Design Tools	5	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab; online manual and notes
4	Capacitor and Capacitor Circuits	1,2,3,6,7	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
5	LC circuits and Diodes	1,2,3,6,7	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
6	Transistor and Transistor Circuits	1,2,3,6,7	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
7	Field Effect Transistors and Circuits	1,2,3,6,7	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
8	Operational Amplifier I	1,2,3,4,5,6,7,8	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab; Mid-Term
9	Operational Amplifier II	1,2,3,4,5,6,7,8	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
10	Digital Electronics I	1,2,3,6,7	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
11	Digital Circuits I	1,2,3,4,5,6,7,8	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture; Lab
12	Digital Circuits II	1,2,3,4,5,6,7,8	Horowitz, Hill; "Art of Electronics" text book

			and Student Manual; Lecture; Lab ; End Term
13	Revision	Revision	Horowitz, Hill; "Art of Electronics" text book and Student Manual; Lecture;
1-13	Semester Project / Each Student (or group of 2) has to select an electronics project involving digital and analog electronics. They have the semester to finish the project, and hand in a Report and viva.	1-8	

Appendix: Assessment 1

Project Viva (Adapted and modified from PH2102)

Criteria	Exceeds Standard (10 – 9)	Meets Standard (8.5 – 6)	Almost Meets Standard (5.5 – 3.5)	Does not meet standard (3 – 0)
Communication	Communicates difficult or complex ideas in an effective and understandable manner	Communicates ideas in an effective and understandable manner	Communicates ideas somewhat effectively, which are mostly understandable.	Does not communicate ideas effectively.
Understanding	Understands the topic beyond textbook knowledge and can answer open end questions.	Understands the topic within textbook knowledge and can answer well defined questions.	Understands the topic within textbook knowledge.	Does not understand topic.
Argumentation / Discussion	During the QA session the candidate argued logical and scientifically correct.	The argumentation was scientifically correct but had some minor parts missing.	The argumentation was mostly scientifically correct.	The candidate had difficulties in answering the questions. His argumentation was disconnected and not logical.

Appendix: Assessment 2

Reports (Adapted and modified from <https://www.cte.cornell.edu/documents/Science%20Rubrics.pdf> and PH2102)

Criteria	Exceeds Standard (10 – 9)	Meets Standard (8 – 6)	Almost Meets Standard (5.5 – 3.5)	Does not meet standard (3 – 0)
Problem	Clearly and accurately communicated, and gives background or context and motivation.	Clearly and accurately communicated.	Somewhat unclear or unable to accurately portray the problem.	Unclear and inaccurate or illogical statement.
Correct and appropriate argumentation	Correct and appropriate use of argumentation, with assumptions, approximations, experimental techniques, and derivations that are accurate and detailed.	Correct and appropriate use of argumentation, with some clarity on assumptions, approximations, experimental techniques, and derivations.	Mostly correct and appropriate use of argumentation.	Incorrect or inappropriate use of argumentation in most areas.
Approach	Appropriate and addresses the problem from multiple perspectives.	Appropriate and address the problem from a single perspective.	Somewhat appropriate, and addresses an incomplete subset of the problem.	Inappropriate or illogical, and does not address the problem.
Significance of Results and Conclusions	Presents a logical and complete explanation for findings and addresses most of the questions. Ends with logical, effective and relevant conclusion	Presents a logical explanation for findings and addresses some of the questions. Ends with coherent conclusion based on evidence.	Presents an incomplete explanation for findings and addresses few questions. Ends with a conclusion based on evidence.	Presents an incomplete or wrong explanation for findings and does not address any of the questions. Ends without a conclusion.
References and Citations	Proper, accurate and clear citations and attribution of others' work.	Proper, accurate and clear citations and attribution of others' work.	Proper and clear citations and attribution of others' work, with minor errors.	Proper and clear citations and attribution of others' work, with major errors.
Development of Ideas	Introduces the topic clearly and creatively. Maintains clear focus on the topic. Development of and connection between ideas are clear and correct.	Introduces the topic clearly. Maintains focus on the topic. Development of and/or connection between ideas are clear and correct.	Introduces the topic. Somewhat maintains focus on the topic. Development of some ideas are clear.	Does not clearly introduce the topic. Does not establish or maintain focus on the topic.