ELEC 2420 Basic Electronics

Instructor: Professor Wing-Hung Ki (暨永雄)

Course Website: http://canvas.ust.hk/

ECE Department, HKUST, Clear Water Bay

Instructors Information

Lecture I

Instructor: Professor Ki, Wing-Hung (暨永雄)
Schedule: Wed 1:30pm – 2:50pm Room 2502 + zoom
Fri 1:30pm – 2:50pm Room 2502 + zoom
Office: Room 2520 2358-8516 eeki@ust.hk
Office Hrs: Tues & Thurs 2:00pm-3:00pm
Ki's website: http://www.ee.ust.hk/~eeki

Lecture II

Instructor: Professor Srivastava, Abhishek Kumar
Schedule: Mon 12:00pm – 1:20pm Room 4620 + zoom
Wed 12:00pm – 1:20pm Room 4620 + zoom
Office: CYT 4012 3469-2485 eeabhishek@ust.hk
Office Hrs: Tues & Thurs 3:00pm – 4:00pm
Srivastava's website:
http://www.ece.ust.hk/ece.php/profile/facultydetail/eeabhishek

Class Information

Lecture I

Wed	1:30pm – 2:50pm Room 2502 + zoom
Fri	1:30pm – 2:50pm Room 2502 + zoom
Password:	ELEC2420L1

Ki's Office Hour: Tues & Thurs 2:00pm – 3:00pm

Zoom ID:	
Password:	OfficeHour

Lecture II

Mon	12:00pm – 1:20pm Room 4620 + zoom
Wed	12:00pm – 1:20pm Room 4620 + zoom

Lab Sessions (Room 2133 near Lift 19, 21, 22)

LA2	Tues	9:00am – 11:00am
LA3	Tues	11:30M – 1:30pm
LA1	Thurs	10:30am – 12:30pm
LA4	Thurs	1:00pm – 3:00pm

Tutorial Sessions: Online tutorial

Teaching Staff Information

Demonstrator:	Choi, Yiu Kee Ricky（蔡耀基）	eericky@ust.hk
Office Hrs:	Mon 9:30am - 10:30am	Rm 2395/ZOOM
	Wed 10:30am - 11:30am	Rm 2395/ZOOM

TAs:

GAO, Yiyang	ygaobg@connect.ust.hk
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Technical Officers:

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Course Information

ELEC 2420 Basic Electronics (3 credits)

Course description:
Basic electronic concepts and components; DC, AC and transient analyses of analog electronic circuits; operational amplifiers and circuits; digital electronics includes binary number systems, Boolean algebra, and combinational and sequential logic.

Pre-requisite: *MATH1014 or MATH1020 or MATH1024*
Co-requisite: *PHYS1112 or PHYS1152*

Text: (On reserve in the library)
D. V. Kerns Jr. and J. D. Irwin, *Essentials of Electrical and Computer Engineering*, Pearson, 2004/2014.

OBE (Outcome-Based Education) Information

ELEC 2420 Intended Learning Outcomes (ILOs):

On successful completion of this course, students will be able to

ILO1: ***recognize*** **basic concepts of electronic components and circuits;**

ILO2: ***analyze*** **DC, AC and transient behaviors of electronic circuits;**

ILO3: ***recognize*** **basic logic functions and logic gates;**

ILO4: ***analyze*** **and** ***design*** **combinational and sequential logic circuits;**

ILO5: ***employ*** **electronic instruments to** ***perform*** **experiments.**

OBE Learning Information

Lectures:

Introduce key concepts and theories, and teach analysis skills with worked examples. (ILO1 – ILO4)

Labs and Lab briefings:

1. Learn to use electronic instruments (ILO5);
2. Learn to analyze, design and debug analog and digital circuits (ILO5).

Teaching and Learning Activities

Lectures: Two 80-minute lectures each week (instructor)
Introduce key concepts and theories, and teach analysis skills with worked examples. (ILO1 – ILO4)

Tutorials: 50-minute tutorial session on no-lab week (IA)

1. Review lecture notes with worked examples and supplementary materials. (ILO1 – ILO4)
2. Introduce equipment and software. (ILO5)

Labs: Three 110-minute lab sessions (TOs and TAs)

1. Learn to use electronic instruments. (ILO5)
2. Learn to use software tool. (ILO5)
3. Learn to analyze, design and debug analog and digital circuits. (ILO5)

Office Hours: Four 1-hour sessions each week for students to ask questions (instructor, IA)

Outcome-Based Assessment

Homework sets, midterm and final examinations: to test whether students have achieved ILO1, ILO2, ILO3 and ILO4.

Lab performance and lab reports: to test whether students have achieved ILO5.

Assessment	Weight
Homework	10%
Labs (3 x 5%)	15%
Midterm	25%
Final exam	50%
Total	100%

Lab	Weight
Lab performance	20%
Lab report	80%

Student Learning Resources

Extensive lecture notes, tutorial notes and lab manuals are provided and could be downloaded from the course website.

Additional problems are posted with numerical solutions for students to conduct self-learning.

Besides web materials, students are encouraged to read the textbook to learn the subject systematically:

Textbook: on reserve in the library
D. V. Kerns Jr. and J. D. Irwin, *Essentials of Electrical and Computer Engineering*, Pearson, 2004/2014.

Timetable

	MON	TUES	WED	THURS	FRI
9:00		Lab 2 Room 2133			
9:30	Ricky Office Hour 2395				
10:00					
10:30			Ricky Office Hour 2395	Lab 1 Room 2133	
11:00					
11:30		Lab 3 Room 2133			
12:00	Lecture II		Lecture II		
12:30					
1:00				Lab 4 Room 2133	
1:30			Lecture I		Lecture I
2:00		Ki Office Hour Room 2520		Ki Office Hour Room 2520	
2:30					
3:00		Srivastava CYT 4012		Srivastava CYT 4012	
3:30					
4:00					
4:30					
5:00					
5:30					
6:00					
6:30					
7:00					
7:30					

ELEC 2420 Lecture 1 (Week 1 – Week 7)

SUN	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT
Aug 29	Aug 30	Aug 31	Sept 1 **2420 L01**	Sept 2	Sept 3 **2420 L02**	Sept 4
Sept 5	Sept 6 **5510 L01**	Sept 7	Sept 8 **2420 L03**	Sept 9	Sept 10 **2420 L04**	Sept 11
Sept 12	Sept 13 **5510 L02**	Sept 14	Sept 15 **2420 L05**	Sept 16	Sept 17 **2420 L06**	Sept 18
Sept 19	Sept 20 **5510 L03**	Sept 21	Sept 22 Mid Autumn	Sept 23	Sept 24 **2420 L07**	Sept 25
Sept 26	Sept 27 **5510 L04**	Sept 28	Sept 29 **2420 L08**	Sept 30	Oct 1 National Day	Oct 2
Oct 3	Oct 4 **5510 L05**	Oct 5	Oct 6 **2420 L09**	Oct 7	Oct 8 **2420 L10**	Oct 9
Oct 10	Oct 11 **5510 L06**	Oct 12	Oct 13 **2420 L11**	Oct 14 Chung Yang	Oct 14 **2420 L12**	Oct 16

ELEC 2420 Lecture 1 (Week 8 – Week 14)

SUN	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT
Oct 17	Oct 18 5510 L07	Oct 19	Oct 20 2420 L13	Oct 21	Oct 22 2420 L14	Oct 23
Oct 24	Oct 25 5510 L08	Oct 26	Oct 27 2420 L15	Oct 28	Oct 29 2420 L16	Oct 30
Oct 31	Nov 1 5510 L09	Nov 2	Nov 3 2420 L17	Nov 4	Nov 5 2420 L18	Nov 6
Nov 7	Nov 8 5510 L10	Nov 9	Nov 10 2420 L19	Nov 11	Nov 12 2420 L20	Nov 13
Nov 14	Nov 15 5510 L11	Nov 16	Nov 17 2420 L21	Nov 18	Nov 19 2420 L22	Nov 20
Nov 21	Nov 22 5510 L12	Nov 23	Nov 24 2420 L23	Nov 25	Nov 26 2420 L24	Nov 27
Nov 28	Nov 29 5510 L13	Nov 30 Last Day	Dec 1	Dec 2	Dec 3	Dec 4

ELEC 2420 Lecture 1 (Week 15 – Week 16)

SUN	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT
Dec 5	Dec 6	Dec 7	Dec 8	Dec 9	Dec 10	Dec 11
Dec 12	Dec 13	Dec 14	Dec 15	Dec 16	Dec 17	Dec 18

Course Outline

Course description:
Basic electronic concepts and components; DC, AC and transient analyses of analog electronic circuits; operational amplifiers and diodes, and their circuits; digital electronics includes binary number systems, Boolean algebra, and combinational and sequential logic.

Chapter 1	Fundamentals
Chapter 2	Resistive Networks and DC Analysis
Chapter 3	Op Amps and Circuits
Chapter 4	Reactive Elements and Transient Analysis
Chapter 5	Binary Number Arithmetic
Chapter 6	Boolean Algebra and Combinational Logic
Chapter 7	Sequential Logic

Chapter 1: Fundamentals

1. Units and Derived Units
2. Charge
3. Current
4. Voltage
5. Circuit and Network
6. Lumped Circuit Model
7. Terminals and Ports
8. Reference Direction
9. Power
10. Active and Passive Components
11. Voltage and Current Sources

Chapter 2: Resistive Networks and DC Analysis

1. Resistance and Ohm’s Law
2. Circuit Terminology
3. Kirchhoff's Current Law
4. Kirchhoff's Voltage Law
5. Resistive Network
6. Resistors in Series and in Parallel
7. Voltage and Current Dividers
8. Nodal Analysis
9. Linearity and Superposition
10. Equivalence and Source Transformation
11. Thevenin's and Norton's Theorems
12. Maximum Power Transfer
13. Efficiency

Chapter 3: Op Amps and Circuits

1. Dependent Sources
2. Types of Amplifiers
3. Ideal Operational Amplifier
4. Unity Gain Buffer
5. Positive and Negative Feedback
6. Non-Inverting Amplifier
7. Inverting Amplifier
8. Summing Amplifier and Synthesizer
9. Difference Amplifier
10. Effect of Finite Op Amp Gain
11. Op Amp as Comparator
12. Bistable Circuits: Schmitt Trigger

Chapter 4: Reactive Elements and Transient Analysis

1. Capacitors
2. Switches and Operations
3. Charging Capacitor with Current Source
4. Capacitors in Parallel and in Series
5. Charging Capacitor with Voltage Source (RC Circuit Response)
6. First Order Linear Differential Equations
7. Continuity of Capacitor Voltage
8. Capacitor as Short Circuit and Open Circuit
9. Applications

Chapter 5: Binary Number Systems

1. Decimal Numbers and Binary Numbers
2. Convert Binary Number to Decimal Number
3. Convert Decimal Number to Binary Number
4. Addition of Binary Numbers
5. 1's and 2's Complement
6. Negative Binary Number in 2's Complement
7. Octal and Hexadecimal Numbers
8. ASCII Code
9. Digitizing Analog Signal
10. Analog-to-Digital and Digital-to-Analog Converters

Chapter 6: Boolean Algebra and Combinational Logic

1. Boolean Algebra and Binary Logic
2. Operations NOT, AND, OR and Truth Table
3. Identities
4. Commutative, Associative, and Distributive Laws
5. De Morgan's Theorem
6. Logic Functions and Minterms
7. Logic Minimization and K-Map
8. Operations NAND, NOR, XOR
9. Sum of Products
10. NAND Implementation
11. Half Adder, Full Adder, 4-bit Adder

Chapter 7: Sequential Logic

1. Bistability
2. SR Latch (NOR Latch)
3. SR Latch (NAND implementation)
4. Debouncing Switch
5. D Latches with Enable
6. Edge-Triggered D Flip-Flops
7. Timing Comparison of D Latch and DFF
8. Register

Chapter Information (Tentative)

	Content	Pages	Lectures
Ch 1	Fundamentals	42	1
Ch 2	DC Analysis	75	4
Ch 3	Op Amps and Circuits	62	4
Ch 4	Transient Analysis	61	4
Ch 5	Binary Number Systems	36	3
Ch 6	Combinational Logic	42	4
Ch 7	Sequential Logic	22	4
		340	24