SYLLABUS

Date/ Revision	03 August 2016
Faculty	Engineering
Approval	Dean of Engineering Faculty

SUBJECT : ELECTRONIC DEVICES AND CIRCUIT

1. Identification of Subject:

Name of Subject	: Electronic Devices and Circuit
Code of Subject	: ELEC-2200
SKS	: 3
Semester	: 3
Study Program	: ELE, MTE, BME
Lecturer	: Dipl.-Ing. Maralo Sinaga

2. Competency

After studying the Electronic Devices and Circuit course, the student able to:

- Identify the basic semiconductor materials and describe the process of semiconductors diodes production;
- Describe the basic characteristics of pn-junction diodes, Zener diodes and LEDs;
- Apply the ideal-diode model, offsets'-voltage diode model, and piecewise linear model in the circuits to determine the conducting status of the diode;
- Analyze, design and build basic half-wave, full-wave, and bridge rectified power supply circuits;
- Describe the basic characteristics of BJT's and the BJT region of operation;
- Apply the dc-analysis in the BJT circuit;
- Apply basic BJT operating parameters from a datasheet when replacing or selecting a transistor;
- Design and analyze common-emitter, common-base and common-collector amplifiers;
- Calculate the voltage, current and power gain of various single and multistage amplifiers;
- Perform ac analysis on class A, class B and class C amplifiers;
- Design and analyze dc biasing circuits and operations of JFETS and MOSFETS;
- Demonstrate appropriate static control measures a round MOSFET devices;
- Perform ac analysis on common-source, common-drain and common-gate amplifiers;
- Analyze the frequency response of BJT, JFET and MOSFET amplifiers;
- Describe the ideal characteristics of Op-Amps and identify the basic op-amp circuit configurations;
- Analyze, design and develop an active filter by using Op-Amp;
- Analyze, design a comparator using Op-amp;
- Wire a timing circuit using a 555 timer;
- Wire and describe the expected operation of basic logic gates.
- Describe the operation of analog – to digital and digital – to -analog converters.
- Apply logic families and general definitions important to digital circuits;
- understand complex digital circuits such as flip - flops, digital multivibrator circuits, memory elements, and analog – to - digital interface circuits

DAAD
Federal Ministry of Education and Research
Coordinator TECHNISCHE UNIVERSITÄT ILMENAU
PO Box 150, BSD CPA 15330
Tel. +62 21 50588000
+62 852 12318000
info@iuli.ac.id; www.iuli.ac.id
IULI – Eco Campus, The Breeze
Jl. BSD Grand Boulevard
BSD City 15345
Island of Java

3. Description of Subject:

The course provides an introduction to the electronic devices at the heart of all modern technology. It explores the semiconductor materials, pn-junction diode characteristics, principles and applications for diodes (rectifier, Zener and LED), transistors (BJT, JFET and MOSFET) and operational amplifiers. The circuit analysis and design are aligned with Electronic Design and Automation (EDA) flow principles including schematic capture, circuit simulation (with TINA or similar), prototyping, and test and measurement. This course also embedded with lab-activity.
Students learn how to analyze, design, build and troubleshoot a variety of circuits including rectifier circuits, power supplies and voltage regulators, transistor switches, as well as transistor amplifiers, and open- and closed loop Op-amp circuits. Students emerge with comprehensive and practical hands-on experience in basic electronic device analysis and design which provides a foundation for subsequent studies. The foundation of digital electronics, digital number and codes, basic gates, Boolean function, Boolean algebra and simplification of Boolean Function by using of Karnaugh-Map, and also sequential logic circuit such as latches and flip-flops are also studied.

4. Learning Approach

Approach	: Combination of Expository - inquiry and colaborative
Method	: Discussion, question answer, sample problem, group work
Student Task	: Home work, presentation, Laboratory experiment
Media	: LCD projector, Teaching Aids (components), Simulation SW, film.

5. Evaluation

a)	Absence maximum	: 25%
b)	Participation in discussion	: 5 points
c)	Homework, Classwork	: 5 points
d)	Presentation, Simulation	: 10 points
e)	Daily Quiz	: 20 points
f)	Final Examination	: 60 points
	Total	: 100 points

6. Contents/ Topics of Lecturing:

Week	Content/ Topics of Lecturing	Text Book Chapter	Remark
1	**Semiconductors Diodes** • Semiconductor Materials • Covalent Bonding and Intrinsic • *n* -Type and *p* -Type Materials • pn-junction Diode • Diode modeling (Ideal-model, Offset-voltage model and piecewise linear model) • Understanding the Diode Specification Sheets • Exercises	Ch-1	

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2	**Semiconductors Diodes** • Semiconductor Diode Notation • Diode Testing • Zener Diodes • Light-Emitting Diode (LED) • Exercises	CH-1, Ch-2	
3	**Diode Applications** • Load-Line Analysis • Series Diode-, Parallel diode-, and Series–Parallel Configurations • Sinusoidal Inputs; Half Wave-, Full Wave-Rectification • Diode Clippers, Diode Clampers; • Diode circuit containing with a dc and ac Source • Zener Diodes and Voltage Regulation • Exercises	Ch-2	Quiz-1
4	**Bipolar Junction Transistors (BJT):** • BJT construction, NPN and PNP Transistor • BJT input- and output- characteristic curve • BJT working operations region • Switching with BJTs • **BJT DC-Analysis**: Biasing techniques and configuration • Exercises	Ch-3 Ch4	
5	**Bipolar Junction Transistors (BJT) as Amplifier:** • BJT Small Signal Amplifiers (CE, CC, and CB – Configuration). • BJT AC – Analysis • Darlington configuration. • Understanding the BJT Datasheets • Exercises	Ch-4 Ch-5	
6	**Field Effect Transistors:** • FET's (Construction, characteristics, and biasing technique) • FET as Amplifier • D-Type and E-Type MOSFET's, (Construction, characteristics, and biasing technique) • Exercises	Ch-6 Ch-7	Quiz-2
7	**Field Effect Transistors:** • D-Type and E-Type MOSFET's, (Construction, characteristics, and biasing technique) • Switching with MOSFETs • MOSFET as Amplifier • Exercises	Ch-7 Ch-8	Quiz-2
8	**MIDTERM SEMESTER BREAK**		
9	**Operational Amplifiers (Review):** • Review of Ideal Op-Amps. • Another Op-Amp type • Understanding the Op-Amp Datasheets	Ch-10	

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	• Active Filters (LPF, HPF, BPF and BSF/BRF); • Frequency responses simulation using Software; • Exercises		
10	**Operational Amplifiers (Review):** • Analysis and design of open loop Op-amp circuit such as comparators • Another Op-Amp Applications: AD-Converter, DA-Converter • Exercises	Ch-11	Quiz-3
11	**Power Amplifier** • Transformer coupled Class-A Amplifier • Class B Amplifier Operation and circuit • Class C Amplifier Operation and circuit • Class D Amplifier Operation and circuit • Amplifier Distortion • Applications and Exercises	Ch-12	
12	**Oscillator:** • The concept of negative feedback • Various types of oscillator circuits: phase-shift oscillator , Wien bridge oscillator, crystal oscillator, LM555 - timer • Applications and Exercises	Ch-14	Quiz-4
13	**Power Supply:** • General Filter Consideration • Capacitor Filter, RC-Filter and LC-Filter • Linear Voltage Regulation ; Transistor and IC-Regulator • Exercises	Ch-15	
14	**Fundamental of Digital System** • Numbering System: Decimal-, Binary-, Octal-, and Hexadecimal-Number System • Basic Gates : AND-, OR-, NOT-, NAND-, NOR- and XOR-Gates • Combinatorial Logic Circuits using the basic gates • Applications: Multiplexer, Demultiplexer, Encoder, Decoder • Boolean Algebra: Simplification using Boolean Algebra • Karnaugh-Map (K-Maps): Simplification of Boolean Function using K-Maps • Exercises	Ch-13 Supplement Text Book: G. Rizzoni	
15	**Sequential Logic Circuit** • Latches • Flip-Flops: RS-FF, JK-FF • Flip-Flop applications: Counter, Shift-Registers, SRAM • Exercises	Ch-14 Supplement Text Book: G. Rizzoni	Quiz-5
16	**FINAL EXAMINATION**		

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info@iuli.ac.id; www.iuli.ac.id Island of Java

7. Book Reference:

a) Main Text Book: **"***Electronic Devices and Circuit Theory - 11th Edition, 2013*", Authors: Robert L. Boylestad and Louis Nashelsky, Publisher: Pearson Education, Inc, ISBN: 978-0-13-262226-4

b) Supplement Textbooks:

- *"Principle and Application of Electrical Engineering- 6th Edition"*, **Author**: Giorgio Rizzoni and James Kearns, **Publisher**: McGraw Hill Higher Education, ISBN: 978-0-073529592
- *"Electronics: Principles And Applications-8th-Edition, 2013"",* **Author:** *Charles A.Schuler,* **Publisher:** *McGraw Hill Higher Education,* **ISBN:** *0073373796*
- *"Electronic Devices (Conventional Current Version), 9th-Edition, 2014",* **Author:** *Thomas L. Floyd,* **Publisher:** Prentice Hall, **ISBN**: 0-13-028484-X
- *"Microelectronic Circuits – 7th Edition, 2015",* **Authors:** *Adel S. Sedra and Kenneth C. Smith,* **Publisher:** Oxford University Press – New York, **ISBN:** 978-0-19-933913-6
- *"Electronic Principles, 8th-Edition, 2016"*" **Authors:** *Albert Malvino, David J. Bates,* **Publisher:** McGraw-Hill Education, **ISBN**: 978-0-07-337388-1

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