Southeast University

School of Science and Engineering

Department of Electrical and Electronic Engineering

Program: B.Sc. Engineering in EEE

Course Outline/Syllabus, Spring2022

EEE 215 Electronics I

Course Credits: 3.0, **Pre-requisite:** EEE 1101, EEE 1301

Course instructor

Dr. Nahid A. Jahan

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Office Time: Every Sunday-Thurseday (09:00 AM – 05:00 PM) (Friday, Saturday are day-off)
Course Counseling Time: Every Monday-Thursday (3:00 PM – 4:00 PM)
Class Time: Monday and Wednesday (11:30-12:50 PM)
Class Room # 413
[It is worth mentioning that this is a 3(theory) credit course]

Routine of Faculty

<table>
<tr><th rowspan="2">Day</th><th colspan="2">Class Hours</th><th colspan="2">Counseling Hours</th></tr>
<tr><th>Courses</th><th>Time</th><th>Day</th><th>Time</th></tr>
<tr><td rowspan="3">Sunday/Tuesday</td><td>EEE111.6
Room # 415</td><td>10:00—11:20</td><td>Sunday</td><td>3:00-4:00</td></tr>
<tr><td>EEE111.5
Room # 413</td><td>11.30—12.50</td><td rowspan="2">Tuesday</td><td rowspan="2">3:00-4:00</td></tr>
<tr><td>EEE111.1 (evening)
Room # 417</td><td>6:00—-7:20</td></tr>
<tr><td rowspan="2">Monday/Wednesday</td><td rowspan="2">EEE215 and EEE323
Room # 408 and Room # 410</td><td rowspan="2">11.30—12.50
1.30—2.50</td><td>Monday</td><td>4:00-5:00</td></tr>
<tr><td>Wednesday</td><td>4:00-5:00</td></tr>
<tr><td>Thursday</td><td></td><td></td><td colspan="2">Departmental Meeting
2:00 –5:00</td></tr>
</table>

1. Importance of the course/Course Rationale:

For the undergraduate students studying electronic and Electrical Engineering, one of the core requirements is to develop their understanding of basic operation of electronic devices, and their real-life applications. The basic of pn junction and therefore to semiconductor diodes, BJT and MOSFET is considered as one of the major branches of electronics and integrated circuits. This course will focus on designing electronic circuits, their biasing, characteristics, physical and region of operations etc. This course is essential because it provides the fundamentals for designing and analyzing electronic circuits

2. Learning outcomes:

A course in electronic circuit theory may be a student's one of the prime exposure to electrical engineering, therefore, each content opens with discussions about how to enhance skills that contribute to successful problem-solving or career-oriented talks on a sub-discipline of electrical engineering. After completing this course, students will gain the following specific course outcomes:

- ♣ Students will be able to familiarize with the concept of Fermi level, energy band diagram, carrier dynamics and terminal characteristics of p-n junction (both heavily doped and lightly doped).
- ♣ Student will be able to solve the basic diode circuits using the diode models and identifies the commonly used basic diode circuits. They will be also able to explain the diode current-voltage curve, compose the diode models using the diode current-voltage curve, dynamic resistance and capacitance and eventually design basic diode circuits.
- ♣ They will be able to understand some of the real world applications of p-n junction diode such as rectifier, clipper, clamper, logic gates, voltage regulation, light emitting devices, etc.
- ♣ They will be able to comprehend the basic theory of operation and terminal characteristics of bipolar junction transistors (BJT), the BJT biasing, the BJT switching.
- ♣ They will be able to identify different operating areas of the BJT and MOSFET transistors.
- ♣ Will be able to compose the small signal model of the BJT and MOSFET transistors.
- ♣ Will be able to analyze the basic MOSFET amplifier circuits.
- ♣ Student will be able to gain understanding on the physical operations, terminal characteristics, threshold voltage, body effect, biasing, and amplifying action of J*FET*, DE-MOS*FET*, and E-MOS*FET* configurations.
- ♣ Will be able to understand the switching action of n-channel MOS*FET*" and perform calculations on MOS*FET* switching circuits, and will also be able to compare the performance of MOS*FET* and transistor switches.
- ♣ As a whole, this course will ensure the enhancement of the student's basic design skills in terms of designing various transistor audio amplifiers, pre-amplifiers, small signal amplifiers, voltage amplifiers, and switching circuits.

3. Course Contents:

P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, simplified DC and AC diode models, dynamic resistance and capacitance. Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a Zener diode, Zener shunt regulator, clamping and clipping circuits. Bipolar Junction Transistor (BJT) as a circuit element: current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits. Metal Oxide Semiconductor Field Effect Transistor (MOSFET) as circuit

element: structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.

4. Course Outcomes (COs) and corresponding

Program Outcomes (POs):

After successful completion of this course students will be able to achieve the following COs.

CO	Description	PO	K/P (Knowledge profile/Complex engineering attributes)	Bloom's Taxonomy Domain/ Level	Delivery Methods and Activities	Assessment Tools
CO1	**Explain** the basic concept of band structure, doping and carrier transport in semiconductors and **apply** the concept and operation principles of PN junction as various circuit elements, i.e., its application as rectifier, clipper, clamper, logic gates and voltage regulator.	1	K3, K4/P1	Cognitive/ L3	Lecture, Discussion	Mid-term exam, Assignment
CO2	**Explain** the operation principles of BJT, MOSFET and their characteristics under DC bias/condition.	1	K3, K4/P1	Cognitive/ L3	Lecture, Discussion	Mid-term exam, Assignment
CO3	**Analyze** the AC response of the BJT amplifier and MOSFET amplifier circuits to evaluate different performance parameters.	2	K3, K4/P1	Cognitive/ L3	Lecture, Discussion	Final exam, Assignment
CO4	**Design, test** and **analyze** various amplifiers, pre-amplifiers, oscillators, switching and electronic controller circuits using the basic diode, BJT, MOSFET and CMOS.	1	K3, K4, K5/P1, P2	Cognitive/ L2	Lecture, Discussion	Final exam

Three domains of teaching (cognitive, affective and psychomotor) that may be used in this course.

Level	Cognitive (C)	Affective (A)	Psychomotor (P)

1	Remember	Receiving	Imitation
2	Understand	Responding	Manipulation
3	Apply	Valuing	Precision
4	Analyze	Organization	Articulation
5	Evaluate	Characterization	Naturalization
6	Create		

Lecture plans:

Lecture #	Course Topics	Learning Outcomes	Related Course Outcomes	Taxonomy Domain and Level	Teaching-Learning Strategy	Learning Resources
1	▪ Introduction to the course ▪ A brief discussion on semiconductors ▪ Semiconductors in equilibrium: Energy bands ▪ Intrinsic and extrinsic semiconductors ▪ Formation of p-n junction: basic structure ▪ Equilibrium conditions ▪ Finding contact potential of p-n junction	Students will be introduced of the topics of the courses and what they are going to learn. They will also learn about the fundamental concepts of semiconductor.	CO1	C1 C2	Icebreaking session TL1 TL3 TL4	Course Outline, Lecture slides
1	▪ Equilibrium Fermi level ▪ Space charge at a junction ▪ Depletion region ▪ Carrier transport processes and excess carriers: drift and diffusion processes	Students will learn about 1. Carrier dynamics and all possible current flow in a p-n junction.	CO1	C1 C2 C3	TL1 TL3 TL4 TL6	Lecture slides Reference Books.

	▪ Diffusion equations for holes and electrons and quasi-Fermi level ▪ Built-in-field					
2-3	▪ Operational principle of p-njunction diode ▪ Reversed biased junction ▪ Forward biased junction ▪ Junction temperature effects ▪ Shockley equation ▪ Current-voltage characteristics of a diode ▪ Minority and majority carrier currents	Students will learn 1. Reversed biased junction 2. Forward biased junction 3. Junction temperature effects 4. Shockley equation 5. Current-voltage characteristics of a diode 6. Minority and majority carrier currents 7.	CO1	C1 C2 C3	TL1 TL3 TL4	Lecture slides. Reference Book.
4	▪ Ideal diodes and real diodes ▪ Piecewise linear characteristics ▪ DC equivalent circuits ▪ DC load lines, Q point, calculating load resistance and supply voltage ▪ Diode dynamic resistance ▪ Junction capacitances ▪ AC equivalent Circuits ▪ Reverse recovery time	Students will learn 1. All the models of diodes and its resistance and capacitance.	CO1	C1 C2 C3	TL1 TL3 TL5 TL6	Lecture slides. Reference Book.
5	▪ Half wave rectifier ▪ Full wave	Students will learn 1. Applications	CO1	C1 C2 C3	TL1 TL3 TL5	Lecture slides.

	rectifier ▪ Capacitor Filter Circuit ▪ Ripple Amplitude and Capacitance, Approximate calculation ▪ Capacitor selection and polarity ▪ Numerical problems	of diodes			TL6 TL11	Reference Book.
6	▪ Reverse bias breakdown ▪ Zener breakdown ▪ Avalanche breakdown ▪ Zener Diode Voltage Regulator ▪ Regulator performance and design	Students will learn about 1. Application of zener diodes	CO1	C2 C3 C4	TL1 TL3 TL6 TL11	Lecture slides. Reference Book.
7	▪ Series Clipping Circuits ▪ Shunt Clipping Circuits ▪ Zener diode shunt clipper	Students will learn 1. To design Clipping circuits	CO1	C2 C3 C4	TL1 TL3 TL6	Lecture slides. Reference Book.
8	▪ Clamping circuits ▪ Negative and positive voltage clamping ▪ Voltage doubler ▪ Multistage voltage multiplier ▪ Diode logic Circuits	Students will learn 1. To design clamping circuits	CO1	C2 C3 C4	TL1 TL3 TL6	Lecture slides. Reference Book.
9-10	▪ Introduction to Bipolar Junction Transistor (BJT) as a circuit element: current components ▪ BJT characteristics and regions of operation: terminal voltages and currents	Students will learn about 1. Bipolar Junction Transistor (BJT) as a circuit element: current components 2. BJT	CO2	C2 C3 C4	TL1 TL3 TL5 TL6	Lecture slides. Reference Book.

	▪ Common Base characteristics ▪ Common Emitter characteristics ▪ Common collector characteristics	characteristics and regions of operation: terminal voltages and currents 3. Common Base characteristics 4. Common Emitter characteristics 5. Common collector characteristics				
11-12	▪ BJT as an amplifier, biasing the BJT for discrete circuits ▪ DC load line and bias points ▪ Selection of Q point ▪ Design calculation and Comparison of basic bias circuits ▪ BJT as a switch.	Students will learn 1. About biasing, load line and BJT as switched	CO2	C1 C2 C3	TL1 TL3 TL5 TL6 TL11	Lecture slides. Reference Book.
13	▪ Review of lectures delivered so far and discussion with the students	Review of previous lectures	CO1 CO2	C2 C3	TL4 TL5 TL6	Lecture slides. Reference Book.
	Midterm Examination		-	-	-	Lecture slides. Reference Book.
14-15	▪ A brief discussion on BJT AC analysis ▪ The application in AC domain, BJT transistor modeling, ▪ Small signal equivalent circuit models	Students will learn 1. About AC analysis of BJT based amplifiers 2. The application in AC domain,	CO3	C1 C2 C3	TL1 TL3 TL4 TL5 TL6	Lecture slides And Reference Book.

	▪ Determining input impedance, output impedance, voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits. ▪ Single stage mid-band frequency BJT amplifier circuits	BJT transistor modeling, 3. Small signal equivalent circuit models 4. Determining input impedance, output impedance, voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits. 5. Single stage mid-band frequency BJT amplifier circuits				
16-17	▪ ▪ ▪ Introduction to FET JFET characteristics ▪ Drain, and transfer characteristics DE-MOSFET and its characteristics	Students will be introduced of the topics of the courses and what they are going to learn. They will also learn about the FET 1. JFET characteristics 2. Drain, and transfer characteristics 3. DE-MOSFET and its characteristics	CO4	C1 C2 C3 C4	TL1 TL3 TL4 TL5 TL6 TL11	Lecture slides Reference Books.
18-19	▪ JFET, DE-MOSFET Biasing ▪ Fixed bias ▪ Self Bias	Students will learn about 2. How to solve DEMOSFET	CO4	C2 C3 C4	TL1 TL3 TL4 TL5	Lecture slides. Reference Book.

	▪ Voltage divider and common gate bias ▪ Load line and Q-point determinations	based amplifier circuits.			TL6 TL11	
20-22	▪ E- MOSFET and its characteristics ▪ structure and physical operation of an enhancement MOSFET, ▪ Threshold voltage, Body effect ▪ Current-voltage characteristics of an enhancement MOSFET: ohmic and saturation mode. ▪ E-MOSFET biasing ▪ E-MOSFET Drain feedback configuration ▪ E-MOSFET voltage divider configuration	Students will learn 8. How to solve EMOSFET based amplifier circuits.	CO4	C2 C3 C4	TL1 TL3 TL6 TL9	Lecture slides. Reference Book.
23-24	▪ ▪ MOSFET as a ▪ switch FET ▪ amplification Designing MOS ▪ amplifier circuits single-stage MOS amplifiers, CMOS inverter.	Students will learn 1. MOSFET as a switch 2. FET amplification 3. Designing MOS amplifier circuits 4. single-stage MOS amplifiers, 5. CMOS inverter.	CO4	C2 C3 C4	TL3 TL4 TL5 TL6 TL11	Lecture slides. Reference Book.
	▪ Review of lectures delivered so far after the midterm	Review of lectures delivered so far after the midterm examination and	CO3 CO4	C2 C3 C4	TL4 TL5 TL6	Lecture slides. Reference Book.

	examination and discussion with the students	discussion with the students				
Total 24 lectures						
	Final Examination		-	-	-	-

6. Teaching & Learning Method (TL):

1) Online Learning Management System (Google Classroom)
2) Lecture in Physical Classroom
3) Lecture Materials Sharing in Google Classroom
4) Discussion during the office hours mentioned in my routine
5) Group Discussion/flip class room.
6) Question and answer session
7) Assignments

This course is calculation intensive as well as learning various theories, equations and diagrams. The teaching style will be more interactive and sharing. Team work will be an integral part of the course during the entire semester of the course. The course is demanding and the success of the course depends on the level of active involvement of the learner. So, students should come to the class with the followings:

- A class note used only for this course
- Graph paper
- Pen (at least 2 different colors)
- Scientific calculator
- Sharpened pencil
- Eraser
- Textbook
- Data Sheets

7. Assessment Schedule (Tentative):

Sl. No.	Assessment Type	Schedule	Comments
1.	Quiz 1	Week 3	
2.	Assignment-1	Week 5	
3.	Quiz 2	Week 6	
4.	Midterm examination	Week 7	
5.	Quiz 3	Week 9	

6.	Assignment-2	Week 10	
7.	Quiz 4	Week 12	
8.	Final examination	Week 14	

Grading Policy:

This university follows UGC's uniform grading policy:

Marks out of 100	Letter Grade	Grade Point
80 - 100	A+	4.00
75 - 79	A	3.75
70 - 74	A-	3.50
65 - 69	B+	3.25
60 - 64	B	3.00
55 - 59	B-	2.75
50 - 54	C+	2.50
45 - 49	C	2.25
40 – 44	D	2.00
00 - 39	F	0.00

Besides, 'W', and 'I' grade may be awarded as per university rule.

Marks Distribution

For Direct Assessment:

There are two types of direct assessment, e.g., formative and summative assessment. The final course grade will be awarded based on the marks distribution shown in the table above. Percentages of marks for the different heads are given below:

Formative Assessment:

Attendance [A]:	05 %
Class Performance:	05 %
Quizzes/Class test:	15 %
Assignment [CA]:	25 %

Summative Assessment:

Midterm Exam [ME]:	20 %
Final Exam [FE]:	30 %
Total:	**100 %**

Continuous assessment may be class tests, quiz, assignment, class presentation, report writing, case studies, course project and its report/ presentation, seminar participation, field visit and its report etc.

Assignment Submission and Assessment Rubrics:

The assignment must have a cover page where student name, ID, section, course code, course title, assignment topics, date of submission etc. must be clearly written.

The assignment must be an original piece of work that has never been submitted in any other course at the Southeast University or elsewhere. It may be computer typed or hand written. Assignment should be written in A4/Letter sized offset paper with 1 inch margin at left, right, top and bottom. After top sheet, the page should be numbered. It should be on single side of the paper. Figures must be drawn using pencil and should be labeled properly. If there is any graph then standard graph paper should be used.

An assignment that does not meet the criteria may receive zero mark. If all the problems/ topics are not addressed then marks will proportionally be reduced. Even if all the problems/ topics are not correctly submitted then also marks will proportionally be reduced.

A common form of plagiarism today is cutting and pasting text from websites into one's own paper without referencing. Such academic dishonesty will result zero mark in the assignment.

Class Attendance:

If your attendance falls **below 75%** of the total classes conducted in the course then you may not be allowed to sit for the final examination of the course. In that case, special permission may be sought from the departmental Chairman well before the examination starts.

Feedback on Academic Performance:

During the course learner's performance will be assessed based on various dimensions. There is opportunity for the learners to discuss with course teacher that how he/she may develop his/her performance further.

Classroom Disciplines:

All students shall prepare the guidelines for the class and they must follow it till the end of the semester.

General rules:

- No makeup for exams unless illness or emergency cases.
- There will be no make up for class tests for any reason.
- It is the responsibility of the students to make up the missed classes or lectures.
- Cell phone should be switched off inside the class.
- Exchanging ideas are permitted orally but don't require any kind of copying.

8. Recommended Textbook:

1. Microelectronic Circuits, Sedra and Smith, Oxford University Press.

Reference Book:

1. **Electronic devices and circuit theory, Robert L Boylestad, Prentice Hall.**
2. Microelectronic Circuits and Devices, M. N. Horenstein, Prentice Hall.
3. The Art of Electronics, P. Horowitz and W. Hill, Cambridge University Press.

9. Facilities Required for Teaching and Learning:

1. Internet Connectivity
2. SEU official email ID.
3. Should know how to use “Google Classroom”

***10. Study Tips & R*egulations:**

- Students are advised to follow the following regulations throughout the semester:
- *If you have any difficulty with understanding, I suggest you not to hesitate asking questions in the class.*
- Plagiarism is strictly discouraged.
- Taking notes is important: Please take your own notes during my online lectures.
- Students must attend class on time.
- Please don’t be casual during online classes. You must take preparation before attending the class with note pad, pen, calculator etc.
- Submit the assignments/home works in google classroom in due time.
- *Students are encouraged to work together on finding solutions to the assignments. However, copying of solutions from another student is not permitted. Cheating or plagiarism can result in a reduction of the mark given for the course.*
- Best *n*-1 out of *n* quizzes will be counted.
- Course materials, assignment related documents/questions will be available in Google classroom.
- Check your email every day to have the updates of classes and assessments.

Program Outcomes:

The program outcomes (POs) of the EEE department of Southeast University (SEU) have been set in such a way so that after graduation the students can demonstrate the ability to-

[PO1] **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex electrical and electronic engineering problems;

[PO2] **Problem Analysis:** Identify, formulate, research the literature and analyze complex electrical and electronic engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences;

[PO3] **Design/ Development of Solutions:** Design solutions for complex electrical and electronic engineering problems and design systems, components or processes that meet the specified needs with appropriate consideration for manufacturability and sustainability, public health and safety as well as cultural, societal, economic, political, ethical and environmental concerns;

[PO4] **Investigation:** Conduct investigations of complex electrical and electronic engineering problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions;

[PO5] **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex electrical and electronic engineering activities with an understanding of the limitations;

[PO6] **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional electrical and electronic engineering practice;

[PO7] **Environment and Sustainability:** Understand the impact of professional electrical and electronic engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development;

[PO8] **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the electrical and electronic engineering practice;

[PO9] **Individual Work and Teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings;

[PO10] **Communication:** Communicate effectively about complex electrical and electronic engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions;

[PO11] **Project Management and Finance:** Demonstrate knowledge and understanding of the electrical and electronic engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments;

[PO12] **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

Mapping of COs to POs:

Mapping Course Learning Outcomes (CLOs) with the PLOs:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	√											
CO 2	√											
CO 3		√										
CO 4			√									

Signature of Course Teacher

Dr. Nahid A Jahan
Associate Professor, EEE, Southeast Univ.

Signature of Chairperson

Dr. Nahid A Jahan
Associate Professor, EEE, Southeast Univ.