Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure For F. Y. B. Sc. Electronic Science

Semester	Paper Code	Title of Paper	No. of Credits
II	ELE1201	Semiconductor Devices	2
	ELE1202	Digital Circuits And IC Technology	2
Annual	ELE1203	Practical	4

Semester II
ELE 1201 : Semiconductor Devices (Paper I)
Credits: 2

Course Objectives:

1. To study characteristic features of semiconductor devices.
2. To study characteristic features of diode, BJT, FET, UJT.
3. To learn applications of BJT, FET and UJT.
4. To understand basics and applications of operational amplifiers.
5. To understand analysis and design of simple diode circuits.
6. To give understand of various type of amplifier circuits.
7. To develop skill to build digital circuits.

Course Outcome:

After completion of this course student is able to
CO1 - Demonstrate and analyze the behavior of semiconductor devices
CO2 - To get an insight about the operation of B JT, FET, UJT in order to design the basic circuits
CO3- Understand the basic material and properties of semiconductors
CO4 - Explore constructional features and I-V characteristics of semiconductor devices diode, Transistors
CO5 - Apply basic concepts of P-N junction in developing simple application circuits
CO6 - Attain knowledge of various amplifiers and their comparison
CO7 - Understand the operational amplifier and their application

Unit 1: Bipolar Junction Transistor and Circuits (12L)

Bipolar Junction Transistor (BJT) symbol, types, construction, working principle, I-V characteristics, parameters, specifications.

Concept of amplification, Transistor amplifier configurations - CB, CC and CE, Biasing circuits - voltage divider, collector feedback bias and emitter feedback bias, DC load line (CE), Q point

Transistor as a switch, Concept of class A, B and class C amplifiers, Single stage RC coupled CE amplifier, concept of frequency response and bandwidth

Unit-2: FET, UJT and Applications (12L)

Symbol, types, construction, working principle, I-V characteristics, Specifications and parameters of : Junction Field Effect Transistor (JFET),

Metal Oxide Semiconductor FET (MOSFET), Symbol, types, construction, working principle, I-V characteristics, Specifications and parameters of :Uni-Junction Transistor (UJT), UJT as a relaxation oscillator.

Unit 3: Operational Amplifier (12L)

Symbol, block diagram, Opamp characteristics, basic parameters (ideal and practical) such as input and output impedance, bandwidth, differential and common mode gain, CMRR, slew rate, Concept of virtual ground, concept of feedback,
Study of general purpose IC-741

Applications- Opamp as inverting and non-inverting amplifier, Adder, Subtractor,

Text/ Reference Books:

1. Electronic Principles : Albert Malvino, David J Bates, McGraw Hill 7th Edition. 2012
2. Principles of Electronics: V.K. Mehta, S.Chand and Co.
3. A text book of electrical technology: B.L.Theraja, S.Chand and Co.
4. Basic Electronics and Linear Circuits: Bhargava N.N., Kulshreshtha D.C.,Gupta S.C., Tata McGraw Hill.
5. OP-AMPS and Linear Integrated Ciruits: Ramakant A. Gayakwad

Mapping of Program Outcomes with Course Outcomes

Weightage: 1=Weak or low relation, 2=Moderate or partial relation, 3=Strong or direct relation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	-	-	3	-	-	3
CO2	2	3	2	-	-	2	-	-	2
CO3	3	3	2	-	1	3	-	1	3
CO4	2	2	1	-	-	2	-	-	2
CO5	3	3	-	-	-	3	-	-	3
CO6	3	3	-	-	-	2	-	-	3
CO7	2	2	-	1	-	2	-	-	2

Justification of Mapping

PO1-Disciplinary Knowledge:

CO1- Demonstrating and analyzing the behavior of semiconductor devices directly aligns with the comprehensive knowledge of the discipline and the theoretical understanding required in the graduate program.

CO2- Gaining insight into the operation of BJT, FET, UJT for designing basic circuits is a practical application of the theoretical understanding within the graduate program.

CO3- Understanding the basic material and properties of semiconductors is foundational knowledge for comprehending the behavior and characteristics of semiconductor devices.

CO4- Exploring the constructional features and I-V characteristics of basic semiconductor devices (diodes, transistors) directly aligns with the graduate program's emphasis on theoretical and practical understanding.

CO5- Applying basic concepts of P-N junction in developing simple application circuits demonstrates the integration of theoretical knowledge into practical applications within the discipline.

CO6- Attaining knowledge of various amplifiers and comparing them aligns with the graduate program's objective of comprehensive knowledge and theoretical understanding.

CO7- Understanding the operational amplifier and its applications directly relates to the theoretical and practical aspects of the graduate program.

PO2-Critical Thinking and Problem solving:

CO1- Analyzing the behavior of semiconductor devices requires critical thinking and problem-solving skills to understand and address complex electronic characteristics.

CO2- Designing basic circuits based on the operation of BJT, FET, UJT involves critical thinking and problem-solving, demonstrating the application of theoretical knowledge in practical situations.

CO3- Understanding the basic material and properties of semiconductors is crucial for problem-solving in the design and analysis of semiconductor devices.

CO4- Exploring constructional features and I-V characteristics of basic semiconductor devices (diodes, transistors) involves critical thinking in addressing circuit design challenges and troubleshooting.

CO5- Applying basic concepts of P-N junction in developing simple application circuits requires problem-solving skills to create effective solutions.

CO6- Comparing various amplifiers involves critical thinking to evaluate their characteristics and choose the most suitable one for a given application.

CO7- Understanding the operational amplifier and its applications demonstrates critical thinking in solving problems related to amplifier configurations and applications.

PO3-Social competence:

CO2- Gaining insight into the operation of BJT, FET, UJT for designing basic circuits may require collaborative work, contributing to group interactions and social competence.

CO3- Understanding the basic material and properties of semiconductors may have limited direct impact on social competence but could indirectly support effective communication within a team.

CO4- Exploring constructional features and I-V characteristics of basic semiconductor devices may involve collaboration and communication, enhancing social competence.

PO4-Research-related skills and Scientific temper:

CO7- Understanding the operational amplifier and its applications involves practical application and experimentation, fostering research-related skills and a scientific temper.

PO5-Trans-disciplinary knowledge:

CO3- Understanding the basic material and properties of semiconductors draws on principles from materials science and electronics, contributing to a trans-disciplinary understanding.

PO6-Personal and professional competence:

CO1- Demonstrating and analyzing the behavior of semiconductor devices involves teamwork and collaboration, contributing to personal and professional competence.

CO2- Gaining insight into the operation of BJT, FET, UJT for designing basic circuits may require collaboration within a team, fostering personal and professional competence.

CO3- Understanding the basic material and properties of semiconductors may involve collaborative efforts in a laboratory setting, contributing to personal and professional competence.

CO4- Exploring constructional features and I-V characteristics of basic semiconductor devices involves teamwork and collaboration, enhancing personal and professional competence.

CO5- Applying basic concepts of P-N junction in developing simple application circuits may involve collaborative efforts within a team, contributing to personal and professional competence.

CO6- Attaining knowledge of various amplifiers and their comparison may require collaborative discussions, fostering personal and professional competence.

CO7- Understanding the operational amplifier and its applications may involve teamwork and collaboration, contributing to personal and professional competence.

PO8-Environment and Sustainability:

CO3- Understanding the basic material and properties of semiconductors may have implications for sustainable material use in electronic components.

PO9- Self-directed and Life-long learning:

CO1- Demonstrating and analyzing the behavior of semiconductor devices encourages independent learning through research and experimentation, fostering a self-directed approach.

CO2- Gaining insight into the operation of BJT, FET, UJT for designing basic circuits promotes self-directed learning and the acquisition of knowledge necessary for lifelong learning.

CO3- Understanding the basic material and properties of semiconductors requires continuous learning to stay updated on advancements in materials science and semiconductor technology.

CO4- Exploring constructional features and I-V characteristics of basic semiconductor devices encourages ongoing learning and adaptation to new developments in device design.

CO5- Applying basic concepts of P-N junction in developing simple application circuits necessitates continuous learning to stay abreast of evolving applications and technologies.

CO6- Attaining knowledge of various amplifiers and their comparison encourages ongoing learning in the dynamic field of amplifier technology.

CO7- Understanding the operational amplifier and its applications promotes lifelong learning by staying informed about new applications and advancements in operational amplifier technology.

ELE1202 : Digital Circuits And IC Technology (Paper II) Credit: 2

Course Objectives:

1. To get familiar with concepts of digital circuits.
2. To learn combinational circuits.
3. To learn sequential circuits.
4. To study different flip-flops.
5. To study different shift resisters.
6. To study logic families and IC technology.

Course Outcome:

CO1- Analyze and design combinatorial circuits.
CO2- Analyze and design sequential circuits.
CO3- Realize combinational circuits and sequential circuits for given application.
CO4- Implement combinational logic circuits using programmable logic devices.
CO5- Recognizes different type of flip flop that are falling edges, rising edges and surface trigger.
CO6- Prepare logical symbol and truth tables of RS, JK and T flip-flop
CO7- Understand how logical problems can be solved by using multiplexer, demultiplexer, comparator.

Unit 1: Combinational Circuits (12L)
Multiplexer (2:1, 4:1, 8:1),Design of higher MUX using lower MUX, Applications.
Demultiplexer (1:2, 1:4, 1:8) and their applications, Code converters – Types of Encoders- Decimal to binary, Hexadecimal to binary, Priority encoder, Keyboard encoder
Types of Decoders- Binary to decimal decoder, BCD to seven segment decoder.

Unit 2: Sequential Circuits (12L)
Flip flops :RS using NAND/NOR , clocked RS, JK, D and T.
Counters: Ripple Binary counter, up down counter, concept of modulus counters, Decade counter, Counters for high-speed applications (Synchronous counters) with timing diagrams.
Shift registers: SISO, SIPO, PISO, PIPO shift registers, universal 4-bit shift register and Applications.

Unit 3: Logic Families (12L)
Classification of logic families, Introduction to Integrated circuit technologies- TTL, ECL, CMOS
IC parameters- Logic levels, propagation delay, power dissipation, noise margins and fan-in ,fan-out of TTL, ECL and CMOS.
TTL NAND & NOT gate, Comparison of TTL and CMOS gates.

Text/ Reference Books:
1. Digital Principles and Applications: Malvino, Leach, Tata McGraw-Hill.
2. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education

Mapping of Program Outcomes with Course Outcomes
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CO2	3	3	2	-	-	2	-	-	2
CO3	3	3	1	-	1	-	-	1	3
CO4	2	2	1	-	-	1	-	-	2
CO5	3	2	-	-	-	3	-	-	3
CO6	2	3	2	-	1	2	-	-	3
CO7	3	2	-	-	-	2	-	-	2

Justification of Mapping

PO1-Disciplinary Knowledge:
CO1- Combinatorial circuits form a fundamental aspect of the broader discipline, requiring a deep understanding of digital logic and logical operations, aligning with the comprehensive knowledge expected at the graduate level.
CO2 – Sequential circuits are an integral part of digital circuit design, and their analysis and

design involve advanced concepts beyond combinatorial circuits, contributing significantly to the depth of understanding expected at the graduate level.

CO3- The ability to realize both combinational and sequential circuits for specific applications show cases a practical application of the theoretical knowledge acquired in the graduate program, aligning with the execution of strong theoretical and practical understanding.

CO4- While programmable logic devices are not exclusive to combinational circuits, the implementation of combinational logic circuits using these devices involves a degree of specialization, making it moderately related to the broader disciplinary knowledge.

CO5- Understanding various flip-flop types is relevant to sequential circuit design, contributing to the theoretical knowledge expected in the graduate program but not as directly tied to the broader disciplinary knowledge.

CO6- The preparation of logical symbols and truth tables for different flip-flop types demonstrates a strong theoretical understanding of these essential components in sequential circuits, aligning well with the expected graduate-level knowledge.

CO7- Solving logical problems using multiplexers, demultiplexers, and comparators requires a comprehensive understanding of their functionality, linking directly to the broader disciplinary knowledge and practical application in the given context.

PO2- Critical Thinking and Problem solving:

CO1- Analyzing and designing combinatorial circuits directly aligns with the critical thinking and problem-solving skills emphasized in PO2, requiring analysis and design in response to specific situations.

CO2- Analyzing and designing sequential circuits is closely tied to critical thinking and problem-solving, requiring the application of logical reasoning and problem-solving skills to design sequential circuits.

CO3- Realizing combinational and sequential circuits for given applications involves critical thinking and problem-solving skills, making it strongly related to the skills emphasized

CO4- Implementing combinational logic circuits using programmable logic devices requires problem-solving skills, making it strongly related to the critical thinking and problem-solving

CO5- Recognizing different types of flip-flops involves analysis and inference, contributing to a moderate relationship with critical thinking and problem-solving skills

CO6- Preparing logical symbols and truth tables of flip-flops involves analysis and interpretation, contributing to a moderate relationship with critical thinking and problem-solving skills

CO7- Understanding how logical problems can be solved by using multiplexers, demultiplexers, and comparators involves analysis and problem- solving, resulting in a moderate relationship with the skills.

PO3 – Social competence:

CO2- Analyzing and designing sequential circuits is more focused on technical aspects, with limited direct relevance to the behavioral skills needed for successful social adaptation and group work .

CO3- Realizing combinational and sequential circuits for given applications is primarily a technical skill, with limited direct relevance to the social competence

CO4- Implementing combinational logic circuits using programmable logic devices is a technical task and has limited direct relevance to the social competence

CO6- Preparing logical symbols and truth tables of flip-flops is primarily a technical skill, with limited direct relevance to the social competence.

PO5- Trans-disciplinary Knowledge:

CO3- Realizing combinational and sequential circuits for given applications is primarily a technical skill, with limited direct relevance to the integration of different disciplines.

CO6- Preparing logical symbols and truth tables of flip-flops is primarily a technical skill, with limited direct relevance to the integration of different disciplines.

PO6-Personal and Professional competence:

CO1- Analyzing and designing combinatorial circuits requires collaboration and interdisciplinary understanding, promoting personal and professional competence.

CO2- Analyzing and designing sequential circuits involves teamwork, meeting objectives, and adapting to diverse requirements, contributing to personal and professional competence.

CO4- Implementing combinational logic circuits using programmable logic devices involves teamwork and interdisciplinary work, contributing to personal and professional competence.

CO5- Recognizing different types of flip-flops involves self-motivation and adaptability skills, contributing to personal competence.

CO6- Preparing logical symbols and truth tables of RS, JK, and T flip-flops involves interpersonal relationships and a commitment to professional ethics, enhancing personal and professional competence.

CO7- Understanding how logical problems can be solved by using multiplexer, demultiplexer, comparator involves collaboration and interdisciplinary understanding, contributing to personal and professional competence.

PO8- Environment and Sustainability:

CO3- Realizing combinational and sequential circuits for given applications may not have immediate ties to environmental sustainability but could indirectly contribute through efficient circuit implementations.

PO9- Self-directed and Lifelong learning:

CO1- Analyzing and designing combinatorial circuits encourages independent learning through research and application, fostering a self-directed approach.

CO2- Analyzing and designing sequential circuits necessitates continuous learning and adaptation to evolving technologies, promoting a self-directed and lifelong learning approach.

CO3- Realizing combinational and sequential circuits for given applications requires ongoing learning to stay updated on advancements, contributing to a self-directed and lifelong learning attitude.

CO4- Implementing combinational logic circuits using programmable logic devices involves continuous learning and adaptation to new devices and technologies, supporting a self-directed approach.

CO5- Recognizing different types of flip-flops requires ongoing learning and adaptation to changes in technology, fostering a self-directed and lifelong learning mindset.

CO6- Preparing logical symbols and truth tables of RS, JK, and T flip-flops involves continuous learning, contributing to a self-directed and lifelong learning approach.

CO7- Understanding how logical problems can be solved by using multiplexer, demultiplexer, comparator requires continuous learning, supporting a self-directed and lifelong learning attitude.

ELE1203: Practical Course (Paper III) Credits: 4

Course Objectives:

1. To teach students how to draw different symbols, logic diagrams and circuit diagrams.
2. To develop skill of circuit connections.
3. To train them to design and analyses circuits for specific purpose.
4. To motivate them to work on different mini projects.
5. To get familiar with concepts of analog electronics.
6. To get familiar with concepts of digital electronics.
7. To develop skill to build analog circuits.

Course Outcome:

At the end of this course, students should be able to:

1. To identify different components, devices, IC's, as well as their types.
2. To understand basic parameters.
3. To know operation of different instruments used in the laboratory.
4. To connect circuit and do required performance analysis
5. Capability to develop experimental skills, analyzing the results.
6. Understand concepts of analog electronics.
7. Understand concepts of digital electronics.

Preparatory experiments (**2 Compulsory**)

1. Study of Components.
2. Study of Basic Electronic Devices (Multimeters, Signal Generators, CRO)
3. Study of AC and DC sources

All the students are required to complete **16** experiments from the following list :

Group A (Any Four)

1. Study of forward and Reverse biased characteristics of PN Junction Diode
2. Study of breakdown characteristics and voltage regulation action of Zener diode
3. Study of output characteristics of Bipolar Junction Transistor in CE mode
4. Study of output and transfer characteristics JFET/MOSFET
5. Study of I-V characteristics of UJT and UJT based relaxation oscillator.
6. Study of solar cell.

Group B (Any Four)

1. Verification of network theorems: KCL and KVL,
2. Verification of network theorems: Thevenin/ Norton/ Maximum Power Transfer.
3. Design, build and test Low pass / High pass RC filters.
4. Study of low voltage Half-wave, Full-wave and Bridge rectifier circuits.
5. Build and test Inverting / non inverting amplifier using OPAMP.
6. Build and test adder and subtractor circuits using OPAMP.

Group C (Any Four)

* Minimum Two experiments may be carried out with CMOS ICs

1. Basic Logic gates using Diodes and transistors
2. Inter conversions and realizations of logic expressions using ICs
3. Study of RS, JK and D flip flops using NAND gates
4. Study of Up/Down Counter
5. Study of decade counter IC circuit configurations
6. Study of 4-bit Shift register IC

Group D (Any Four)

1. Build and Test 4 bit parity checker/ generator using X-OR gate IC
2. Build and Test Half Adder, Full Adder and Subtractor using basic gates
3. Build and Test 2:1 Multiplexer / 1:2 Demultiplexer using gates
4. Build and Test 3X4 matrix Keyboard Encoder
5. Build and Test Diode matrix ROM
6. Study of Four bit Universal Adder/Subtractor / ALU

Mapping of Program Outcomes with Course Outcomes

Weightage: 1=Weak or low relation, 2=Moderate or partial relation, 3=Strong or direct relation

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CO4	2	2	2	-	3	3	-	-	2
CO5	3	2	-	-	2	3	-	-	3
CO6	3	3	-	-	2	2	-	-	3
CO7	3	2	1	-	2	2	-	-	1

Justification of Mapping

PO1-Disciplinary Knowledge:

CO1- Identifying different components and devices aligns with comprehensive knowledge in the graduate program, demonstrating theoretical and practical understanding.

CO2- Understanding basic parameters associated with each device contributes to strong theoretical knowledge in the graduate program.

CO3- Knowing the operation of different instruments used in the laboratory supports practical understanding within the graduate program.

CO4- Connecting circuits and performing required performance analysis demonstrates a strong blend of theoretical and practical skills in the graduate program.

CO5- Comparing simulated and actual results of experiments aligns with the practical application of theoretical knowledge in the graduate program.

CO6- Developing experimental skills, analyzing results, and interpreting data showcase a comprehensive understanding of both theoretical and practical aspects in the graduate program.

CO7- Developing hobby projects involves practical application and demonstrates a degree of theoretical understanding, contributing to the overall knowledge in the graduate program.

PO2- Critical Thinking and Problem solving:

CO1- Identifying different components and devices requires critical analysis and observation, contributing to critical thinking and problem-solving skills.

CO2- Understanding basic parameters associated with each device involves analysis and inference, fostering critical thinking in problem-solving scenarios.

CO3- Knowing the operation of different instruments used in the laboratory requires problem-solving skills and interpretation of data, aligning with critical thinking.

CO4- Connecting circuits and performing required performance analysis involves problem-solving and critical analysis of circuit behavior.

CO5- Comparing simulated and actual results of experiments necessitates critical analysis and problem-solving to reconcile differences and draw meaningful conclusions.

CO6- Developing experimental skills, analyzing results, and interpreting data require critical thinking and problem-solving capabilities.

CO7- Developing hobby projects involves critical thinking and problem-solving in the design and implementation of projects.

PO3-Social competence:

CO1- Identifying different components and devices may involve collaboration, enhancing social competence in group work.

CO2- Understanding basic parameters associated with each device may require effective communication of ideas, contributing to social competence.

CO3- Knowing the operation of different instruments used in the laboratory involves collaboration and effective communication, fostering social competence in group settings.

CO4- Connecting circuits and performing required performance analysis may involve teamwork, enhancing social competence in collaborative environments.

CO7- Developing hobby projects involves effective communication of thoughts and ideas, contributing to social competence.

PO5-Trans-disciplinary knowledge:

CO1- Identifying different components and devices involves integrating knowledge from various

disciplines, contributing to a trans-disciplinary approach.
CO2- Understanding basic parameters associated with each device requires the integration of knowledge from different disciplines, supporting a trans-disciplinary perspective.
CO3- Knowing the operation of different instruments used in the laboratory involves integrating knowledge from various disciplines, fostering a trans-disciplinary understanding.
CO4- Connecting circuits and performing required performance analysis integrates knowledge from electronics and other disciplines, supporting a trans-disciplinary approach.
CO5- Comparing simulated and actual results of experiments involves integrating knowledge from simulations and practical experimentation, contributing to a trans-disciplinary understanding.
CO6- Developing experimental skills, analyzing results, and interpreting data requires the integration of knowledge from various disciplines, supporting a trans-disciplinary approach.
CO7- Developing hobby projects involves integrating knowledge from different domains, contributing to a trans-disciplinary perspective.

PO6-Personal and professional competence:

CO1- Identifying different components and devices involves teamwork, contributing to personal and professional competence.
CO2- Understanding basic parameters associated with each device requires self-motivation and adaptability, enhancing personal and professional competence.
CO3- Knowing the operation of different instruments used in the laboratory involves collaboration and teamwork, fostering personal and professional competence.
CO4- Connecting circuits and performing required performance analysis requires interpersonal relationships and collaboration, contributing to personal and professional competence.
CO5- Comparing simulated and actual results of experiments involves teamwork and collaboration, enhancing personal and professional competence.
CO6- Developing experimental skills, analyzing results, and interpreting data requires self-motivation and adaptability, contributing to personal and professional competence.
CO7- Developing hobby projects involves collaboration and interpersonal relationships, fostering personal and professional competence.

PO8-Environment and Sustainability:

CO3- Knowing the operation of different instruments used in the laboratory may have limited direct ties to environmental sustainability but could indirectly contribute through efficient laboratory practices.

PO9- Self-directed and Life-long learning:

CO1- Identifying different components and devices encourages self-directed learning and staying updated on technological changes.
CO2- Understanding basic parameters associated with each device promotes continuous learning and adaptability in response to technological changes.
CO3- Knowing the operation of different instruments used in the laboratory fosters a self-directed approach to learning and staying abreast of technological advancements.
CO4- Connecting circuits and performing required performance analysis requires ongoing learning to adapt to changes in technology, supporting a self-directed and lifelong learning attitude.
CO5- Comparing simulated and actual results of experiments necessitates continuous learning and adaptability to evolving technologies.
CO6- Developing experimental skills, analyzing results, and interpreting data involve ongoing learning and adaptability, fostering a self-directed and lifelong learning approach.
CO7- Developing hobby projects encourages continuous learning and self-motivation, aligning with the goal of lifelong learning.

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