Syllabus for S. Y. B.Sc. (Comp. Sci.) Electronics
(2024 Pattern)

Name of the Programme : B.Sc. (Comp. Sci.)

Programme Code : UCSEL

Class : S. Y. B.Sc. (Comp. Sci.)

Semester : IV

Course Type : Minor (Theory)

Course Code : COS-261-MN(C)

Course Title : Analog Electronics

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To introduce the fundamentals of analog electronic systems, sensors, and transducers.
2. To classify sensors into active and passive types and explain their specifications.
3. To explore various types of temperature, optical, displacement, and infrared sensors.
4. To provide an introduction to operational amplifiers (Op-Amps) and their types.
5. To explain signal conditioning techniques and applications using Op-Amps.
6. To understand the working of filters and voltage-to-frequency converters with Op-Amps.
7. To introduce the concepts of Digital-to-Analog Converters (DAC) and Analog-to-Digital Converters (ADC).

Course Outcomes:

CO1: To make students able to understand and differentiate between various analog electronic systems and define sensors and transducers along with their classifications into active and passive types.
CO2: To make students capable of interpreting key sensor specifications and explain the working principles of different sensors.
CO3: To make able to understand the fundamentals of operational amplifiers (Op-Amps), their specifications, types and derive related expressions for various applications.
CO4: To make students capable of applying Op-Amps in real-world applications such as signal conditioning, including the use of passive.
CO5: To make students able to comprehend the working principles of active and passive filters, classify filters based on their order and explain the operation of single-order Op-Amp based filters, along with voltage-to-frequency conversion using Op-Amps.
CO6: To make capable of explaining the concepts of Digital-to-Analog Converters (DAC) and Analog-to-Digital Converters (ADC), including various types of ADCs and DACs.
CO7: To make able to apply the knowledge of DACs and ADCs in various practical applications, highlighting the importance of accurate data conversion in electronic systems.

Learning Points:

UNIT 1: Sensors and transducers **[08]**

Introduction of Analog electronic systems. Definition of sensors and transducers. Classification of sensors: Active and passive sensors. Specifications of sensors: Accuracy, range, linearity, sensitivity, resolution, reproducibility. Temperature sensors (LM-35), optical sensor (LDR), displacement sensor (LVDT), Passive Infrared sensor (PIR).

UNIT 2: Operational amplifier and its application **[12]**

Introduction to Op-amp, specifications of op-amp, types of Op-amp: Inverting and non-inverting with expression, Applications of Op-amp.

Introduction to signal conditioning, Signal conditioning of passive sensors using bridge circuit: Wheatstone's bridge, Level Shifter, Amplifier, Three OP-amp instrumentation amplifier, Filters; active and passive filters, Concept of Order of filters. Working principle of Single order Op-Amp based Low Pass Filter, High Pass Filter, Working of Voltage to frequency Converter using Op-amp.

UNIT- 3: Data Converters **[10]**

Digital to Analog Converter (DAC): Resistive divider, R-2R ladder, Parameters: Linearity, resolution, accuracy, Analog to Digital Converter (ADC): Types of ADC- Flash, Successive approximation, single slope, dual slope, Introduction to sigma-delta ADC. Parameters of ADC: Linearity, resolution,conversion time, accuracy. Applications of DAC and ADC.

CO with PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	1	2	-	1	2	3	2	-	-	3	-	2	-
CO2	1	-	3	2	1	2	-	-	2	-	3	-	2
CO3	1	1	-	2	2	-	3	-	3	-	-	2	1
CO4	1	2	-	1	1	3	-	2	-	2	-	2	-
CO5	1	2	2	-	1	-	3	-	3	-	2	-	1
CO6	1	-	2	-	1	3	-	2	2	-	2	2	1
CO7	1	2	-	1	-	3	3	2	-	2	3	-	-

CO with PO mapping justification:

PO1: Comprehensive Knowledge and Understanding:

CO1: Students are able to understand analog electronic systems and sensor classifications which builds fundamental knowledge, essential for comprehensive understanding of electronic components.

CO2: Interpreting sensor specifications and working principles strengthens the student's technical foundation in sensing technology.

CO3: Students are able to grasp the fundamentals of operational amplifiers (Op-Amps) enhances the ability to analyze and design electronic circuits.

CO4: Students can apply Op-Amps in real-world applications links theoretical knowledge to practical implementation, deepening comprehension.

CO5: Students having understanding filters and their applications with Op-Amps expands knowledge in signal processing, which is crucial in electronic system design.

CO6: Students knowing DACs and ADCs broadens understanding of data conversion, essential for modern electronic systems.
CO7: Students can apply knowledge DACs and ADCs in practical scenarios reinforces the importance of accurate data conversion, completing the knowledge needed for real-world electronic systems.

PO2: Practical, Professional, and Procedural Knowledge:
CO1: Students are able to differentiate and classify analog systems and sensors, enabling practical identification and selection for real-world applications.
CO3: Students are able to analyze and use operational amplifiers in practical applications by deriving key expressions.
CO4: Students can apply Op-Amps in real-world scenarios like signal conditioning, enhancing their ability to design functional electronic systems.
CO5: Students are able to classify and implement active and passive filters in practical designs using Op-Amps.
CO7: Students can apply the knowledge of DACs and ADCs to ensure accurate data conversion in electronic systems.

PO3: Entrepreneurial Mindset and Knowledge:
CO2: Students can apply their understanding of sensor specifications to create optimized and efficient sensor-based solutions for entrepreneurial ventures.
CO5: Students are able to design active and passive filters, providing foundational knowledge for developing custom electronic products.
CO6: Students are able to understand DAC and ADC concepts, which are crucial in designing electronic devices that require accurate data conversion for entrepreneurial innovations.

PO4: Specialized Skills and Competencies:
CO1: Students are able to differentiate between analog systems and sensors, gaining specialized skills in sensor classification and electronic system identification.
CO2: Students can apply their knowledge of sensor specifications to interpret and utilize sensors in specialized applications.
CO3: Students are able to understand and apply operational amplifiers, enhancing their competence in analog circuit design.
CO4: Students can apply Op-Amps in signal conditioning, developing specialized skills for real-world applications of electronic components.
CO7: Students can apply DACs and ADCs in practical applications, enhancing their expertise in accurate data conversion for specialized electronic systems.

PO5: Specialized Skills and Competencies:
CO1: Students are able to differentiate between analog systems and sensors, enhancing their problem-solving and analytical reasoning in selecting appropriate systems for specific applications.
CO2: Students can apply their understanding of sensor specifications to solve real-world challenges by selecting and utilizing appropriate sensors.
CO3: Students are able to analyse and derive expressions for Op-Amps, developing their analytical skills in circuit design and problem-solving.
CO4: Students can apply Op-Amps in practical signal conditioning applications, demonstrating strong problem-solving capabilities in real-world scenarios.
CO5: Students are able to design and classify filters, applying analytical reasoning to solve

complex signal processing problems.
CO6: Students are able to explain DACs and ADCs, applying their knowledge to problem-solve and design efficient data conversion systems.

PO6: Communication Skills and Collaboration:
CO1: Students are able to communicate the differences between analog systems and sensor classifications, fostering effective technical discussions and collaboration.
CO2: Students can apply their understanding of sensor specifications to clearly explain sensor operations and collaborate effectively in team-based projects.
CO4: Students can apply and discuss Op-Amps in real-world signal conditioning applications, enhancing teamwork and communication in project settings.
CO6: Students are able to explain DAC and ADC concepts clearly, facilitating communication and collaboration in teams working on data conversion systems.
CO7: Students can apply and articulate the importance of DACs and ADCs in practical applications, contributing to effective communication and teamwork in system design and implementation projects.

PO7: Research-related Skills:
CO1: Students are able to research and differentiate between various analog electronic systems and sensor types, applying systematic methods to gather and classify information.
CO3: Students are able to conduct research on operational amplifiers, including specifications and types, to derive expressions and understand their applications.
CO5: Students are able to research the working principles of active and passive filters, allowing them to classify and design single-order Op-Amp-based filters effectively.
CO7: Students can apply research skills to investigate the application of DACs and ADCs in practical systems, focusing on improving accuracy in data conversion processes for enhanced electronic systems.

PO8: Learning How to Learn Skills:
CO4: Students can apply self-directed learning to identify and implement the latest Op-Amp applications in real-world scenarios, such as signal conditioning.
CO5: Students will be able to explore and learn about new types of filters and voltage-to-frequency conversions, applying these principles to real-world applications through self-learning.
CO6: Students can apply their self-learning skills to grasp new concepts in DACs and ADCs, adapting to advancements in data conversion technologies.
CO7: Students are able to continuously apply their understanding of DACs and ADCs to emerging practical applications, enhancing their lifelong learning skills in electronic systems and data conversion.

PO9: Digital and Technological Skills:
CO2: Students can apply digital skills to interpret sensor specifications and simulate the working principles of various sensors using modern technological tools.
CO3: Students will develop technological skills to analyze and simulate Op-Amps, using digital tools for deriving expressions and exploring their applications in circuit design.
CO5: Students are able to design, simulate, and test filters using digital tools, applying their knowledge of active and passive filters in real-time simulations.
CO6: Students can use digital platforms to explain and simulate DACs and ADCs, enhancing their ability to understand and apply various types of data conversion techniques.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:

CO1: Students are able to understand and differentiate analog electronic systems, promoting inclusive collaboration by respecting diverse perspectives in sensor and system classifications.
CO4: Students can apply Op-Amps in real-world signal conditioning applications, collaborating inclusively across diverse teams to address unique challenges with empathy.
CO7: Students are able to apply DAC and ADC knowledge to practical applications, highlighting the importance of inclusive and empathetic collaboration to ensure accurate and effective data conversion across various cultural contexts.

PO11: Value Inculcation and Environmental Awareness:
CO2: Students can apply their understanding of sensor specifications to develop environmentally responsible solutions, considering energy-efficient sensor applications.
CO5: Students are able to classify and design filters with an awareness of minimizing environmental impact, such as reducing electronic waste and improving energy efficiency in filter designs.
CO6: Students can explain DAC and ADC concepts with a focus on creating environmentally conscious designs, choosing components and processes that minimize environmental harm.
CO7: Students are able to apply their knowledge of DACs and ADCs in practical applications, promoting accurate data conversion solutions that adhere to sustainable and environmentally responsible practices.

PO12: Autonomy, Responsibility, and Accountability:
CO1: Students are able to autonomously understand and differentiate between analog electronic systems and sensors, taking responsibility for accurate classification and analysis in various contexts.
CO3: Students will be able to independently study and understand Op-Amps, responsibly deriving expressions and applying them accurately in various applications.
CO4: Students can autonomously apply Op-Amps in real-world signal conditioning scenarios, taking responsibility for implementing solutions and ensuring their effectiveness and reliability.
CO6: Students can autonomously explain DAC and ADC concepts, taking responsibility for understanding various types and their applications in diverse scenarios.

PO13: Community Engagement and Service:

CO2: Students can interpret sensor specifications and explain sensor principles, using this knowledge to support community-based projects that require accurate and effective sensor integration.
CO3: Students will be able to understand Op-Amps and apply this knowledge to community service projects, such as designing and implementing electronic solutions that address local challenges.
CO5: Students are able to comprehend and design filters, using this expertise to enhance community projects that involve signal processing and system optimization for better public service.
CO6: Students can explain DAC and ADC concepts and apply them in community-related projects, ensuring effective data conversion for systems that benefit local initiatives.

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Name of the Programme : B.Sc. (Comp. Sci.)

Programme Code : UCSEL

Class : S. Y. B.Sc. (Comp. Sci.)

Semester : IV

Course Type : Minor (Practical)

Course Code : COS-262-MN(C)

Course Title : Electronics Practical III

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To make students study the characteristics of various sensors and transducers like LM-35, LDR and LVDT.
2. To analyze IC-741 Op-Amp and to design and test an inverting / noninverting amplifier circuit.
3. To study and analyze function of data convertors.
4. To study the design of active filters, to analyze the frequency response of an active filters and to build and test the filter circuit.
5. To make students study the design and operation of an instrumentation amplifier.
6. To analyze applications of voltage to current conversions in transducer and sensor circuits.
7. To study various applications of op-amp such as adder, subtractor, differentiator, etc.

Course Outcomes:

CO1: Students will be able to understand the characteristics of various sensors and transducers and apply them in practical sensing systems.
CO2: Students will have the ability to analyze the IC-741 Op-Amp and design, test, and implement amplifier circuits for various applications.
CO3: Students can study and analyze the functioning of data converters and implement circuits like R-2R ladder DAC and Flash ADC.
CO4: Students will be able to design, analyze, and implement active filters and evaluate their frequency response for different applications.
CO5: Students will be able to design and operate an instrumentation amplifier, understanding its role in measurement systems for precise signal amplification.
CO6: Students will be able to analyze and implement voltage-to-current conversion techniques, understanding their applications in transducers and sensor circuits.
CO7: Students can explore various applications of operational amplifiers and apply them in practical circuits.

List of Practical:

Group A – Practical (Any eleven):

1. LM-35 based temperature sensing system.
2. IC-741 Op Amp. as Inverting amplifier.
3. IC-741 Op Amp as Non-inverting amplifier.
4. Build and test DAC using R-2R Ladder network.
5. Flash ADC using discrete components.
6. Build and test LDR based light control system.
7. Study of Linear Variable Differential Transformer.
8. Build and test Instrumentation Amplifier.
9. Build and test active high pass filter.
10. Build and test active low pass filter.
11. Study of V to I convertor.
12. Study of function generator.
13. Study of Schmitt trigger.
14. Op-amp as adder.
15. Op-amp as subtractor.

Group B – Activity (Any two):

1. Seminar/Group Discussion.
2. Internet Browsing
3. Hobby projects

CO with PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	1	2	-	2	1	3	-	-	1	3	3	-	3
CO2	-	1	3	2	-	-	2	3	-	2	-	2	-
CO3	1	-	2	-	1	2	-	-	1	-	-	3	2
CO4	1	-	3	2	-	2	2	-	-	3	-	3	-
CO5	1	2	-	-	1	-	2	2	-	-	3	-	3
CO6	-	2	-	1	1	3	-	-	-	3	-	-	3
CO7	-	1	3	-	2	-	-	2	1	-	3	2	-

CO with PO mapping justification:

PO1: Comprehensive Knowledge and Understanding:
CO1: Comprehensive knowledge of sensors and transducers equips students to apply them in practical sensing systems, aligning with a fundamental understanding of electronic components.
CO3: Analyzing and implementing data converters enhances students' understanding of digital-to-analog and analog-to-digital conversions in real-world systems.
CO4: Active filter design and frequency response evaluation deepens students' comprehension of signal processing, a key area of electronics.
CO5: Designing instrumentation amplifiers builds knowledge of precision signal amplification, essential for advanced measurement systems.

PO2: Practical, Professional, and Procedural Knowledge:
CO1: Practical knowledge of sensors and transducers enables students to integrate them into real-world sensing systems, addressing professional and industrial needs.
CO2: The ability to design, test, and implement amplifier circuits using IC-741 reflects procedural skills required for practical electronics and professional applications.
CO5: Designing and operating an instrumentation amplifier reflects practical expertise in precision measurement, aligning with professional standards for accurate signal amplification.
CO6: Analyzing voltage-to-current conversion techniques equips students with procedural skills for designing sensor circuits, enhancing their readiness for practical applications.
CO7: Exploring various operational amplifier applications enhances procedural understanding, allowing students to create and troubleshoot practical circuits in real-world settings.

PO3: Entrepreneurial Mindset and Knowledge:
CO2: Designing and implementing amplifier circuits using IC-741 enables students to create novel electronic solutions, promoting entrepreneurial thinking in product development.
CO3: Analysing and implementing data converters encourages students to innovate in signal conversion technologies, which can lead to entrepreneurial opportunities in digital electronics.
CO4: Designing active filters with optimized frequency response equips students with the knowledge to create efficient signal processing solutions, nurturing entrepreneurial insights in electronics design.
CO7: Exploring and applying operational amplifiers in diverse circuits encourages creativity and innovation, essential traits for entrepreneurial ventures in electronic system design.

PO4: Specialized Skills and Competencies:
CO1: Understanding sensors and transducers provides students with specialized skills to develop and optimize practical sensing systems.
CO2: Analyzing and implementing IC-741 Op-Amp circuits enhances students' competencies in designing and testing amplifiers for various professional applications.
CO4: Designing and analyzing active filters cultivates students' ability to evaluate frequency response, a specialized competency in signal conditioning.
CO6: Mastering voltage-to-current conversion techniques develops specialized skills in creating efficient circuits for sensors and transducers.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:
CO1: Understanding and applying sensors and transducers enables students to solve real-world sensing problems using analytical reasoning and practical application.
CO3: Analyzing and implementing data converters like R-2R DAC and Flash ADC develops problem-solving skills in handling signal conversion challenges.
CO5: Designing instrumentation amplifiers involves problem-solving and analytical reasoning to achieve precise signal amplification in measurement systems.
CO6: Implementing voltage-to-current conversion techniques cultivates problem-solving skills in applying these methods to real-world transducer and sensor circuits.
CO7: Exploring operational amplifier applications enhances students' capacity for practical problem-solving and analytical reasoning in diverse circuit designs.

PO6: Communication Skills and Collaboration:
CO1: Understanding and applying sensors and transducers requires effective communication

to collaborate in designing practical sensing systems.
CO3: Studying and implementing data converters requires teamwork and communication to ensure proper functionality and integration in circuit designs like R-2R DAC and Flash ADC.
CO4: Designing and analysing active filters enhances communication skills as students collaborate to evaluate frequency response and optimize designs.
CO6: Analysing and implementing voltage-to-current conversion techniques requires effective communication when working in teams to develop sensor circuits and apply them in real-world scenarios.

PO7: Research-related Skills:
CO2: Analysing and designing IC-741 Op-Amp circuits promotes research into amplifier design methods and innovations for various applications.
CO4: Designing and analysing active filters encourages research to evaluate and optimize filter performance and frequency response for specific applications.
CO5: Designing instrumentation amplifiers enhances research skills in precision measurement systems, allowing students to investigate new techniques for accurate signal amplification.

PO8: Learning How to Learn Skills:
CO2: Analyzing and implementing IC-741 Op-Amp circuits fosters adaptability and self-directed learning in designing new amplifier applications.
CO5: Operating instrumentation amplifiers requires students to continuously learn new methods for achieving precise signal amplification in advanced measurement systems.
CO7: Exploring various operational amplifier applications nurtures self-directed learning, pushing students to investigate new designs and practical circuit solutions.

PO9: Digital and Technological Skills:
CO1: Understanding and applying sensors and transducers equips students with technological skills to design and implement digital sensing systems.
CO3: Studying and implementing data converters like R-2R DAC and Flash ADC fosters digital skills in signal conversion, essential for modern electronics systems.
CO7: Exploring various operational amplifier applications enhances students' digital skills in designing and simulating practical circuits for diverse electronic applications.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:
CO1: Understanding various sensors and transducers fosters an inclusive spirit by enabling students to develop practical sensing systems that can be applied across diverse industries and communities.
CO2: Designing and implementing amplifier circuits with IC-741 promotes collaboration and empathy by encouraging students to work together and consider different perspectives in circuit design.
CO4: Designing and analyzing active filters involves collaboration in diverse teams, promoting an inclusive spirit and appreciation for diverse viewpoints in optimizing filter performance.
CO6: Analyzing voltage-to-current conversion techniques fosters multicultural competence by understanding their applications in global industries, where varied sensor systems may be utilized.

PO11: Value Inculcation and Environmental Awareness:

CO1: Understanding sensors and transducers promotes environmental awareness by enabling students to design systems that monitor and protect environmental conditions.
CO5: Operating instrumentation amplifiers instills a sense of responsibility, emphasizing the importance of precise measurement systems in monitoring and protecting the environment.
CO7: Exploring operational amplifier applications nurtures value inculcation, encouraging students to design circuits that minimize environmental impact and promote sustainability in electronics.

PO12: Autonomy, Responsibility, and Accountability:
CO2: Designing and implementing IC-741 Op-Amp circuits promotes accountability by encouraging students to take ownership of their designs, ensuring the circuits meet application requirements.
CO3: Analyzing and implementing data converters like R-2R DAC and Flash ADC enhances responsibility as students are accountable for the accuracy and efficiency of the signal conversion process.
CO4: Designing and analyzing active filters encourages autonomy by enabling students to independently evaluate filter performance and take responsibility for optimizing frequency response.
CO7: Exploring operational amplifier applications promotes responsibility and autonomy, as students apply their knowledge to practical circuits, ensuring they function as intended in real-world scenarios.

PO13: Community Engagement and Service:
CO1: Understanding sensors and transducers allows students to design systems that contribute to community well-being, such as environmental monitoring or healthcare devices.
CO3: Studying and implementing data converters like R-2R DAC and Flash ADC can support community engagement through applications in digital communication, medical devices, and other community services.
CO5: Operating instrumentation amplifiers fosters community engagement by contributing to accurate measurement systems used in healthcare, environmental monitoring, and public safety projects.
CO6: Implementing voltage-to-current conversion techniques enables students to contribute to sensor systems that benefit the community, such as smart infrastructure or environmental sensing.