Course Type	Course Code	Name of Course	L	T	P	Credit
E/SO	ECE301	Analog Interface Electronics	3	0	0	9

Course Objective

With the proliferation of low cost microcontrollers, the scenario in the process industry now a days has changed to digital processing from analog processing. Data converters play an important role in ever increasing digital world because more products perform calculation in digital domain. Data acquisition systems are becoming user friendly, cheaper and more powerful in carrying the measurement and control on process.

The primary focus in this course will be interfacing analog outputs from sensors to digital inputs of microcontroller/computer. The subsystem blocks between analog input and digital output will be studied in this course. Signal processing block, filtering, analog multiplexing /demultiplexing, sample and hold (S/H) and data converters will be covered. Students will be able to design an interface circuit between transducer and the computer after completion of this course.

Learning Outcomes

Upon successful completion of this course, students will:

- Have an understanding of the basic concepts of interfacing a transducer with a data acquisition system.
- Acquire skills in designing various analog subsystem blocks used in interfacing.
- Have a knowledge of D.A and A.D converters.
- Have an understanding of different types of interface with real system

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Data acquisition system (DAS) – Introduction to DAS, Block diagram of a DAS for process control system, Some typical examples of DAS in mining, Oil and gas, mechanical engg., chemical engg. Etc.	4	This will provide the basic concepts and needs for interfacing a transducer with a data acquisition system.
2	**Signal Processing Blocks** Operational amplifier – Characteristics, inverting and non-inverting amplifier, unity gain buffer, summer, Differential amplifier, integrator and differentiator, instrumentation amplifier, Signal conversion – Current mirror, voltage to current converters, current to voltage converter, frequency to voltage converter	10	Acquiring skills in designing various analog signal processing blocks used in design of data acquisition system like amplifiers, signal converters etc.
3	**Op amp Applications** Precision diode, ac to dc converters using precision diodes, comparator, Schmitt trigger and Square wave oscillators **Active Filter circuits** Classification of filters, their specifications and transfer functions, First order and second order filter transfer functions and their implementation using active filters (Sallen and Key structure), all pass filters	8	The linear and nonlinear applications of op amp will be learnt by students. Understanding the needs for filter and design techniques will be learnt in this section.
4	**Multiplexing/demultiplexing (MUX/DEMUX)** Introduction to multiplexing and demultiplexing, BJT and FET as analog switching element, Design of multiplexer and demultiplexe using analog switches, Selection of mux/demux based on frequency of signal, data rate etc. **Timing circuits** Oscillators - RC oscillators and LC oscillators, Timing circuits, 555 and its applications, Voltage controlled oscillators.	8	Understanding different techniques for sending multiple analog data over a single line and vice versa and the design of oscillator circuit for timing and control.
5	**Sample and hold (S/H) circuits** MOSFET as switch, introduction to S/H circuits and their applications, Basic circuits, Performance parameter of S/H circuit, Non-ideal behaviour of S/H circuits, closed loop S/H circuit **Data converters** Analog versus discrete signals, sampling, Nyquist criterion	12	Understanding of S/H circuits and their needs in data transmission and , different types of data converters for analog to digital and digital to analog conversion and interfacing with real systems.

	Digital to analog converter DAC Characteristics, resolution and sampling frequency, differential and integrated nonlinearity, offset and gain error, dynamic range. R-2R ladder DAC, current switched DAC, multiplying DAC, signed number DAC **Analog to digital converter** ADC Characteristics, quantization errors, linearity error, offset and gain error, integrating and non-integrating ADC, Flash ADC, Successive approximation ADC, Dual slope ADC		

Text Book:

1. Jacob Millman and Arvin Grabel, Microelectronics,, 2nd Ed. Tata Macgraw Hill, New Delhi
2. **Operational Amplifiers & Linear Integrated Circuits: Theory and Application**, **by James M. Fiore, 3rd ed.,** https://www2.mvcc.edu/users/faculty/jfiore/OpAmps/OperationalAmplifiersAndLinearICs_3E.pdf

Reference Book:

1. Donald Neamen, Electronic Circuit Analysis, McGraw-Hill 2001
2. R. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th Edition, Pearson **2001**
3. H.R. Taylor, Data Acquisition for Sensor Systems, Chapman and Hall, London (UK) 1997
4. T. H. Wilmshurst, Analog Circuit Techniques: With Digital Interfacing 1st Edition, Butterworth- Heinemann 2001.