Course Code	Course Name	Credits
26PH513	LINEAR, DIGITAL ICS AND APPLICATIONS	04

Course Objectives

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of PLL.
- To introduce the concepts of waveform generation and introduce one special function ICs.
- To Expose the digital IC‘s.

Learning Outcomes

After completion of the course, students will be able to:

- Understand IC classifications, Op-Amp 741 characteristics, ideal op-amp parameters, and internal circuit functioning for analog signal processing.
- Design linear op-amp applications (instrumentation amplifiers, V/I converters, equation solvers) and non-linear circuits (log/antilog, comparators, multivibrators, waveform generators).
- Implement active Butterworth filters (low/high/band pass/reject), IC 555 timer (monostable/astable), and Phase Locked Loops (phase detectors, VCO IC 566) for signal conditioning.
- Apply voltage regulators (series op-amp, IC 723, switching), and analyze DAC/ADC techniques (weighted resistor, R-2R, successive approximation, dual slope) with performance specifications.
- Build CMOS logic gates (inverter, NAND/NOR, AND-OR-INVERT), TTL 74XX combinational circuits (adders, comparators, decoders, mux/demux, BCD/7-segment), and sequential circuits (flip-flops, shift registers, counters).

Unit 1 - Integrated Circuits and Operational Amplifier (12 Hrs.)

Introduction, Classification of IC‘s, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit and Op-Amp. Characteristics.

Unit 2 – Applications of Op-Amp (12 Hrs.)

LINEAR APPLICATIONS OF OP-AMP: Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters. NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators.

Unit 3 - Active Filters& Timer and Phase Locked Loops (12 Hrs.)

ACTIVE FILTERS: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters. TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and a stable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage-controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL.

Unit 4 – Voltage Regulator & D to A AND A to D Converters (12 Hrs.)

VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator. D to A AND A to D CONVERTERS: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Unit 5 - CMOS Logic, Combinational Circuits using TTL 74XX ICs &Sequential Circuits using TTL 74XX ICs (12 Hrs.)

CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC 74154), BCD to 7- segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). SEQUENTIAL CIRCUITS USING TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).

Reference Books:

1. Choudhury, D. R., & Jain, S. B. (2012). Linear integrated circuit, (4th Ed.). New Age International Pvt. Ltd.
2. Gayakwad, R. A. (2012). OP-AMP and linear integrated circuits, (4th Ed.). Prentice Hall / Pearson Education.
3. Theraja, B. L., &Theraja, A. K. (2004). A textbook of electrical technology. S. Chand & Company. M Sc Physics 11
4. Mehta, V. K., & Mehta, R. (2008). Principles of electronics, (12th Ed.). S. Chand & Company.
5. Vijayendran, V. (2008). Introduction to integrated electronics (Digital & Analog). S. Viswanathan Printers & Publishers Private Ltd, Reprint.

Websites and eLearning Sources:

1. https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2. https://youtu.be/WklUVqD8RXs?si=AuRpc0dGE0e4HqA8
3. https://youtu.be/SaJsL9_M1_w?si=JtomHiYyLoqxwnqK

COs and Bloom's Taxonomy Mapping – 26PH513		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain the fundamentals of integrated circuits, Op-Amp characteristics, and CMOS logic principles.	K1, K2
CO2	Apply Op-Amp concepts to analyze linear and non-linear applications such as amplifiers, waveform generators, and converters.	K3
CO3	Analyze active filters, timer circuits, and phase-locked loops for signal processing applications.	K4
CO4	Evaluate voltage regulators and data conversion techniques including ADC and DAC systems.	K5
CO5	Design and develop combinational and sequential circuits using TTL and CMOS ICs for digital applications.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH513													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	2	2	1	2	2	2	2	2	1	2	2	2	1.92
CO2	2	3	2	3	2	2	2	3	2	3	2	2	2.33
CO3	3	3	3	3	2	2	3	3	3	3	2	2	2.58
CO4	3	3	3	3	3	2	3	3	3	3	3	2	2.75
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3.00
												Total	2.52

Mean Score: 3- High, 2- Medium/Moderate, 1-Low