GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC- Electronic Communication Engineering

Semester: IV

Subject Name: **Integrated Circuits and Applications**

Sr. No.	Course content
1.	**Introduction to Operational Amplifiers:** Introduction, Block diagram representation of a typical op-amp, its equivalent circuit, types of ICs, Manufacturers' designations and package types for ICs, Power supplies for ICs
2.	**Interpretation of Data Sheets and Characteristics of an op-amp:** Interpreting datasheet, Ideal op-amp, Equivalent circuit of an op-amp, Ideal voltage transfer curve, Open-loop op-amp configurations
3.	**An Op-amp with Negative Feedback:** Voltage-series feedback amplifier, voltage-shunt feedback amplifier, differential amplifier
4.	**The Practical op-amp:** Introduction, input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, effect of variation in power supply voltage on offset voltage, change in input offset voltage and input offset current with time, other op-amp parameters which changes with change in temperature and supply voltage, noise, common-mode configuration and common-mode rejection ratio, slew rate and it equations, effect of slew rate in applications, difference between bandwidth, transient response and slew rate
5.	**General linear applications:** DC and AC amplifiers, AC amplifiers with single supply voltage, peaking amplifier, summing, scaling and averaging amplifier, instrumentation amplifier - its block diagram along with applications, differential input and differential output amplifier, voltage-to-current converter with floating load (low-voltage DC voltmeter, low-voltage AC voltmeter, Diode match finder, Zener diode tester, Light-emitting diode tester), Current-to-voltage converter, very high-input impedance circuit, integrator, differentiator
6.	**Comparators and Converters:** Comparator, Zero Crossing Detector, Schmitt Trigger, Voltage Limiters, Clipper and Clampers, Absolute Value Output circuit, Peak Detector, Sample and Hold Circuit, Precision Rectifier – Half/Full Wave, Square, Triangular and Saw tooth Wave Generator, Log/ Antilog Amplifier

7.	**Active Filters:** Classification of filters, Magnitude and frequency Scaling, Magnitude and attenuation characteristics of ideal and practical filters, design Parameter Q & ω0, Biquad (Universal) filter design, Butter worth Low pass and Highpass filters-1st and 2nd order circuits design, Butterworth pole location, Sallen & Key circuit, Butterworth Bandpass Filters-Frequency Transformation, Deliyannis- Friend circuit , Chebyshev filter characteristics, Band reject filters.
8.	**Specialized IC Applications:** a. **555 Timer and its Applications**: Block Diagram, Monostable and Astable Multivibrator, Applications as Frequency Divider, Square Wave Generator, Free- b. Running Ramp Generator c. **Phase Locked Loop and Its Applications**: Block Diagram and Operation, Applications as Frequency Multiplier, Frequency Shift Keying d. **Design of Power Supply:** Simple OP-AMP Voltage regulator, Three terminal Voltage regulators, Fixed and Adjustable Voltage Regulators (78XX, LM317), Heat Sink, Dual Power supply (LM320, LM317), Basic Switching Regulator and its characteristics e. **Power Amplifiers:** Monolithic Power Amplifiers (LM380) f. **Function Generator**: IC XR 2206
9.	**Operational trans-conductance amplifier:** Introduction, internal diagram, analysis,Active Filter

List of Experiments:

1. Measurement of input and output offset voltage of 741 ICs.
2. To configure op-amp in voltage follower mode and to measure its slew rate.
3. To configure op-amp in inverting and non-inverting amplifier mode and measure their gain and bandwidth.
4. To prepare precision rectifier using op-amp and verify its operation using measurements.
5. To prepare full-wave rectifier using op-amp and verify its operation using measurements.
6. To measure PSRR and CMRR of given op-amp.
7. To design Schmitt trigger circuit using op-amp and take measurements
8. To design ,build astable and monostable multi-vibrators using 741 IC and verify their operation using measurements by observing waveforms .
9. T design ,build and obtain the frrquency responses of First order Low-Pass and Band-Pass Active Filters.
10. To design triangular wave generator using op-amp and verify it operations with measurements.
11. To design and build second order Low-pass ,Band-pass, High-pass, All pass and Band Elimination filters using BIQUAD Circuit.
12. To design Butterworth low-pass filter (Sallen-key citcuit), construct the same circuit on breadboard and take necessary measurements.
13. To design Friend Deliyannis band-pass filter, construct the same circuit on breadboard and take necessary measurements.

14. To design monostable and astable multi-vibrators using 555 timer IC and verify their operation using measurements.
15. To design,build and test Linear Voltage Regulators.

Miniproject based on 555/741/PLL applications/Analog filter is mandatory.

Reference Books:

1. Op-amps and Linear Integrated Circuits, by Ramakant A. Gayakwad
2. Design with Operational Amplifiers and Analog Integrated Circuits, by Sergio Franco, Tata Mcgraw-hill 2009 Edition
3. Linear Integrated Circuits, by D. Roy Choudhury and Shail B. Jain, New Age International Publishers, 3rd Edition
4. Design of Analog Filers, by R. Schaumann, and Mac E. Van Valkenburg