SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester IV

Subject Name: **Analog Electronics** **Subject Code: BTEC13403**
Type of course: **PCC**
Prerequisite: Basic knowledge of electronic active and passive components and low and high-frequency circuit analysis techniques etc.
Rationale: This course aims to familiarize students with various oscillators, differential amplifiers, op-amp and their applications including active filter circuits, voltage regulators, and specialized ICs

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module % Weightage
1.	**Introduction to Operational Amplifiers:** Block diagram representation of a typical op-amp, its equivalent circuit, Transistor-based Differential Amplifier, The Emitter Coupled Differential Amplifier. Characteristics of Ideal op-amp. **Parameters of Practical op-amp:** Input offset voltage, input bias current, input offset current, Total output offset voltage, Effect of variation in power supply voltage on offset voltage, Common-mode configuration and common-mode rejection ratio, Slew rate. **Op Amp in open loop configuration:** Zero Crossing Detector, Positive level detector, negative level detector, schimit trigger	8	20
2.	**General Linear Applications:** Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Virtual ground concept, Voltage Buffer, Differential amplifier using one and two op-amps, Instrumentation amplifier, Summing, Scaling and Averaging amplifiers,	12	30

	Integrator, Differentiator		
3.	**Converters and Oscillators:** Voltage to current converter for floating and grounded loads - Current to voltage converter, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifier – Half/Full Wave, Requirements for oscillations, Wein Bridge Oscillator and Phase Shift Oscillator. Square, Triangular and Sawtooth Wave Generator, Log/ Antilog Amplifier.	9	20
4.	**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, Frequency response characteristics of major active filters, first and higher-order low pass and high pass filters, all-pass filter, Bandpass, Bandstop, and Notch filter.	10	20
5.	**Specialized ICs and its Applications:** (i) 555 Timer and its applications: Block diagram, Monostable, and Astable multivibrator, Applications as Frequency divider, Square wave generator(ii) Phase-Locked Loops and its Applications: Block diagram and operation, Applications as Frequency Multiplier, Frequency Shift Keying.(iii) 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.	6	10

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	25	30	10	10	0

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

Reference Text Books:

Sr. No.	**Title of book /article**	**Author(s)**	**Publisher and details like ISBN**	**Year of publication**	**Publication Edition**
1	Op-Amps and Linear	Ramakant	Pearson	2008	4th

	integrated circuits	Gayakwad,	978-9332549913		
2	Operational Amplifier and Linear Integrated circuit	Coughlin & Driscoll	Pearson 978-0130149916	1997	5th
3	Design With Operational Amplifiers and Analog Integrated Circuits	Sergio Franco	MGH 978-9352601943	2016	4th

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Analyze important parameters for OP-AMP.	10
CO-2	Design and implement various comparators, converters and measure performance parameters using OP-AMP.	25
CO-3	Design OP-AMP based active filters.	25
CO-4	Design OP-AMP based oscillators and wave shaping circuits.	20
CO-5	Design and implement a time-based application using 555 Timer IC.	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	2	2	2	1	2	2	1	2	1	1	2	1	2
CO-2	3	3	3	3	3	2	2	1	2	2	1	3	2	1	3
CO-3	3	3	3	3	3	3	2	1	2	2	1	3	3	1	3
CO-4	3	3	3	2	3	2	2	1	2	2	1	3	3	1	3
CO-5	3	3	3	2	3	2	2	1	2	2	1	3	3	1	3

List of practical:

1. Design & implement ZCD, PLD & NLD using Inverting configuration. and Non-inverting configuration.
2. Design & implement Inverting and Non-inverting Amplifiers with feedback for a given value of gain.
3. Design & implement, (a) Differential amplifier circuit using 1 op-amp. (b) Differential amplifier circuit using 2 op-amps. (c) Differential amplifier circuit using 3 op-amps.
4. Design & implement Summing, Scaling & Averaging circuit with Inverting configuration.
5. Design & implement Phase shift oscillator to generate 1KHz sine wave.
6. Design & implement Wein bridge oscillator to generate 2KHz sine wave.
7. Design & implement Integrator circuits using OP-AMP for the cut-off frequency 5KHz.
8. Design & implement Differentiator circuits using OP-AMP for the cut-off frequency 1KHz.
9. Design and implement a Full-wave rectifier using op-amp and observe waveform for input and

output signal. Also, observe transfer characteristics.

10. Design and implement Astable multivibrator using timer IC 555. Calculate the frequency of oscillation and duty cycle.
11. Design and implement2 KHz symmetric square wave using timer IC 555.
12. Design and implement first-order High pass and low pass filter at 10 kHz cut-off frequency. Plot the frequency response for both.
13. Design and implement second-order High pass and low pass filter at 10 kHz cut-off frequency. Plot the frequency response for both.

List of Open Source/learning websites:

- https://nptel.ac.in/courses/108/101/108101094/
  Module 3,4,5