SEMESTER S4

LINEAR INTEGRATED CIRCUITS

Course Code	PCECT403	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Analog Circuits (PCECT303)	Course Type	Theory

Course Objectives:

1. To develop skills to design and analyze circuits using operational amplifiers for various applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Differential Amplifiers:** Differential amplifier configurations using BJT, DC Analysis - transfer characteristics; AC analysis - differential and common mode gains, CMRR, input and output resistance, voltage gain, constant current bias, constant current source. **Concept of current mirror**: two-transistor current mirror, Wilson and Widlar current mirrors. **Operational amplifiers (Op Amps):** The 741 Op Amp, Block diagram, Ideal Op Amp parameters, typical parameter values for 741, equivalent circuit, open loop configurations, voltage transfer curve, frequency response curve.	11
2	**Op Amp with negative feedback:** General concept of Voltage Series, Voltage Shunt, Current Series and Current Shunt negative feedback, Op Amp circuits with Voltage Series and Voltage Shunt feedback, Virtual ground concept. Analysis of inverting and non-inverting amplifier for closed loop gain, Input Resistance and Output Resistance. **Op Amp applications:** Summer, Voltage Follower, Differential and Instrumentation Amplifiers, Voltage to Current and Current to Voltage converters, Integrator, Differentiator, Precision Rectifiers, Comparators,	11

	Schmitt Triggers, Log and Antilog amplifiers.	
3	**Oscillators and Multivibrators:** Phase Shift and Wien-bridge Oscillators, Triangular and Sawtooth waveform generators, Astable and Monostable multivibrators. **Active filters:** Comparison with passive filters, First and Second order Low pass, High pass, Band pass and Band Reject active filters, State Variable filters. **Voltage Regulators:** Fixed and Adjustable voltage regulators, IC 723 – Low voltage and High voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection.	**11**
4	**Timer and VCO:** Timer IC 555 - Functional diagram, Astable and monostable operations, Basic concepts of Voltage Controlled Oscillator and application of VCO IC LM566. **Phase Locked Loop**: Basic building block, Operation, Closed loop analysis, Lock and capture range, Applications of PLL, PLL IC565. **Data Converters:** Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Specifications, Flash type and Successive approximation type.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the concepts of operational amplifiers and differential amplifier configurations	**K2**
CO2	Design operational amplifier circuits for various applications.	**K3**
CO3	Choose integrated circuit chips for various linear circuit applications.	**K2**
CO4	Implement various applications using specific integrated circuit chips	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	2	3	3	2							2
CO3	3				2							2
CO4	3	2	2	2	2							2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Linear Integrated Circuits	Roy D. C. and S. B. Jain	New Age International	5/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design with Operational Amplifiers and Analog Integrated Circuits	Sergio Franco	Tata McGraw Hill	3/e, 2017
2	Op-Amps and Linear Integrated Circuits	Gayakwad R. A.	Prentice Hall	4/e, 2015
3	Integrated Circuits	Botkar K. R.	Khanna Publishers	10/e, 2013
4	Operational Amplifiers	C.G. Clayton	Butterworth & Company Publ. Ltd. Elsevier	5/e, 2005
5	Operational Amplifiers & Linear Integrated Circuits	R.F. Coughlin & Fredrick Driscoll	PHI	6/e, 2000
6	Operational Amplifiers & Linear ICs	David A. Bell	Oxford University Press	3/e, 2011
7	Microelectronic Circuits	Sedra A. S. and K. C. Smith	Oxford University Press	6/e, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117101106
2	https://nptel.ac.in/courses/117101106
3	https://nptel.ac.in/courses/117101106
4	https://nptel.ac.in/courses/117101106