

Subject Code	EC8453	L	P	T	C
Subject Title	LINEAR INTEGRATED CIRCUITS	3	0	0	3
Year / Dept / Sem	II/ECE/IV	Regulation Year		2017	
Faculty Name / Desig / Dept	<b>Mrs.T.V.Vanitha AP/ECE</b>				
Course Prerequisite	To introduce the fundamental concepts of Integrated circuits <ul style="list-style-type: none"> <li>➤ Basics of Electronic Circuits and Analysis</li> <li>➤ Basics of Op-Amp</li> <li>➤ Special functions of IC</li> </ul>				

**EC8453 LINEAR INTEGRATED CIRCUITS LT P C 3 0 0 3**  
**UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9**

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – JFET Operational amplifier – LF155 and TL082.

**UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9**

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

**UNIT III ANALOG MULTIPLIER AND PLL 9**

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and Clock synchronisation.

**UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9**

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R-2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

## UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs

9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop Out (LDO) Regulator - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

**TOTAL: 45 PERIODS**

Course Objectives (CO)	<p>CO1: To give the basic building blocks of linear integrated circuits</p> <p>CO2: To learn the linear &amp; non-linear applications of operational amplifiers.</p> <p>CO3: To understand theory and applications of analog multiplier and PLL</p> <p>CO4: To learn the theory of ADC and DAC.</p> <p>CO5: To give the concept of waveform generation and special function ICs.</p> <p>CO6: To give the concept of Voltage regulators.</p>											
Expected Course Outcomes (ECO)	<p>At the end of the course, the students should be able to:</p> <p>ECO1: Design linear and non linear applications of op – amps.</p> <p>ECO2: Design applications using Analog multiplier and PLL</p> <p>ECO3: Generate waveforms using op-amp circuits.</p> <p>ECO4: Design ADC and DAC using op – amps.</p> <p>ECO5: Analyze special function ICs.</p> <p>ECO6: Explain the types of voltage regulators</p>											
<b>Mapping of CO &amp; PO(Specify the PO's) - (Fill the col.s with the legend given below)</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	C,1										B,1	
CO2					B,2							
CO3			E,3									C,2
CO4	C,4									D,4		
CO5						D,5						
CO6	C,3			C,6							B,2	
<b>Bridging the Curriculum Gap</b> (Additional Topics beyond syllabus/Seminars/Assignments)	<p>BCG1: Application of S/H Circuit</p> <p>BCG2: CMOS operational amplifier</p> <p>BCG3: Applications of Opto-coupler.</p>											
Virtual Lab	<p>VIL1: Op-Amp based Inverting and Non - inverting Amplifier.</p> <p>VIL2: Op-Amp based Differentiator and Integrator.</p> <p>VIL3: Design and simulate Voltage follower.</p>											



Related Website URLs	<p>W1: <a href="http://www.analog.com">http://www.analog.com</a></p> <p>W2: <a href="http://www.circuitgallery.com/video">http://www.circuitgallery.com/video</a></p> <p>W3: <a href="http://www.classic.net">http://www.classic.net</a></p> <p>W4: <a href="http://www.radio-electronics.com/info/data/semicond/phototransistor">http://www.radio-electronics.com/info/data/semicond/phototransistor</a></p>
Related Video Course Materials (min. 3 no.s)	<p>V1: Slew-rate.</p> <p>V2: Op-amplifier fundamentals.</p> <p>V3: Applications of Fiber-optics.</p> <p>V4: Waveform generator.</p>
Text books	<ol style="list-style-type: none"> <li>1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.</li> <li>2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.</li> </ol>
Reference Books	<ol style="list-style-type: none"> <li>1. Ramakant A. Geyakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.</li> <li>2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.</li> <li>3. B.S.Sonde, "System design using Integrated Circuits", 2nd Edition, New Age Pub, 2001</li> <li>4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.</li> <li>5. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 1996.</li> <li>6. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 2004.</li> <li>7. S.Salivahanan &amp; V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.</li> </ol>

S.No	Topic Name	Book – P. No	Teaching Aids	No of hrs	Cumulative hrs
<b>UNIT I BASICS OF OPERATIONAL AMPLIFIERS</b>					
1	Introduction	T1-11	BB	1	1
2	Current mirror and current sources	T1-66-67	BB	1	2
3	Current sources as active loads	T1-71-72	BB	1	3
4	Voltage sources, Voltage References	Notes	BB	2	5
5	BJT Differential amplifier with active loads	T1-77-79	BB	1	6
6	Basic information about op-amps & Ideal Operational Amplifier	T1-41-45	PPT	1	7
7	General operational amplifier stages & internal ckt diagrams of IC 741	T1-85-87	PPT	1	8
8	DC and AC performance characteristics, Slew rate	T1-104-125	BB	2	10
9	Open and closed loop configurations	T1-42, R7-128-130	PPT	1	11
10	JFET Operational amplifier – LF155 and TL082	Notes	BB	1	12
<b>UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS</b>					
1.	Sign changer and Scale Changer	T1-135	BB	1	13
2.	Phase shift circuits, Voltage follower	T1-49	BB	2	15
3.	V to I and I to V converters	T1-146-47	PPT	1	16
4.	Adder, Sub tractor	T1-138	BB	1	17
5.	Instrumentation amplifier, Integrator, Differentiator	T1-164,168	PPT	2	19
6.	Logarithmic amplifier, Antilog amplifier	T1-155	BB	2	21
7.	Comparator, Schmitt trigger	T1-207	BB	1	22
8.	Precision Rectifier	T1-212	BB	1	23
9.	Peak detector, clipper & clamper	T1-151-153	BB	1	24
10.	Low pass filter	T1-264	BB	1	25
11.	High pass and Band pass butter worth filter	T1-274	BB	2	27



**UNIT III ANALOG MULTIPLIER AND PLL**

1	Analog multiplier using Emitter Coupled Transistor pair	T1-159	BB	1	28
2	Gilbert Multiplier Cell, Variable transconductance technique	T1-181-187	BB	2	30
3	Analog multiplier ICs and their applications	T1-160-164	BB	2	32
4	Operation of the basic PLL	T1-327	BB	1	33
5	Closed loop Analysis	Notes	BB	1	34
6	Voltage controlled Oscillator	T1-334	BB	2	36
7	Monolithic PLL IC565 and Clock synchronisation	T1-339-342	BB	1	37
8	Application of PLL for AM detection, FM detection.	T1-343-344	BB	1	38
9	FSK modulation and Demodulation, Frequency Synthesizing	T1-345	BB	1	39

**UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**

1	Analog and digital data conversions D/A converter specifications	T1-349	BB	1	40
2	Weighted Resistor type DAC, R-2R Ladder type	T1-349	BB	1	41
3	Voltage mode and Current mode R-2R Ladder types	T1-350	BB	1	42
4	Switches for D/A converter	T1-352	BB	1	43
5	High speed sample and hold circuit	T1-153	PPT	1	44
6	A/D converter & specifications	Notes	PPT	1	45
7	Flash type ADC & Sigma – Delta Converter	T1-358	BB	1	46
8	Successive Approximation Type	T1-362-363	BB	1	47
9	Single slope & Dual slope A/D converter using Voltage to Time conversion	T1-364 - 365	BB	2	49
10	Over sampling A/D Converter	Notes	BB	1	50

**UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs**

1	Sine wave generators, Multivibrators	T1-223-226	BB	2	52
2	Triangular & Saw tooth wave generator	T1-221	BB	1	53
3	ICL8038 Function generator Timer 555	T1-312-316	BB	1	54
4	IC Voltage Regulator –Three terminal Fixed and adjustable voltage regulator	T1-241	BB	1	55
5	IC 723 General purpose regulator, LDO & Monolithic switching regulator	T1-248	BB	1	56
6	Switched Capacitor Filter IC MF10 F/V & V/F conversion	T1-295	BB	1	57
6	Audio Power Amplifier	T1-191-196	PPT	1	58
7	Video amplifier & Isolation amplifier	Notes	PPT	1	59
8	Opto-couplers and fiber optic IC	Notes	PPT	1	60