

Course code	Course Name	L-T-P - Credits	Year of Introduction
EC204	ANALOG INTEGRATED CIRCUITS	4-0-0-4	2016
<b>Prerequisite: Nil</b>			
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>• To equip the students with a sound understanding of fundamental concepts of operational amplifiers</li> <li>• To understand the wide range of applications of operational amplifiers</li> <li>• To introduce special function integrated circuits</li> <li>To introduce the basic concepts and types of data converters</li> </ul>			
<b>Syllabus</b>			
Differential amplifier configurations, Operational amplifiers, Block diagram, Ideal op-amp parameters, Effect of finite open loop gain, bandwidth and slew rate on circuit performance, op-amp applications-linear and nonlinear, Active filters, Specialized ICs and their applications, Monolithic Voltage Regulators - types and its applications, Data converters - specifications and types.			
<b>Expected outcome .</b>			
The students will			
<ol style="list-style-type: none"> <li>i. have a thorough understanding of operational amplifiers</li> <li>ii. be able to design circuits using operational amplifiers for various applications</li> </ol>			
<b>Text Books:</b>			
<ol style="list-style-type: none"> <li>1. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008</li> <li>2. Salivahanan S. ,V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008</li> </ol>			
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010</li> <li>2. C.G. Clayton, Operational Amplifiers, Butterworth &amp; Company Publ. Ltd. Elsevier, 1971<sup>nd</sup></li> <li>3. David A. Bell, Operational Amplifiers &amp; Linear ICs, Oxford University Press, 2<sup>nd</sup> edition, 2010</li> <li>4. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010</li> <li>5. R.F. Coughlin &amp; Fredrick Driscoll, Operational Amplifiers &amp; Linear Integrated Circuits, 6<sup>th</sup> Edition, PHI,2001</li> <li>6. Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010</li> <li>7. Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013</li> </ol>			
<b>Course Plan</b>			
Module	Contents	Hours	Sem. Exam Marks
<b>I</b>	Differential amplifiers: Differential amplifier configurations using BJT, Large and small signal operations, Input resistance, Voltage gain, CMRR, Non-ideal characteristics of differential amplifier. Frequency response of differential amplifiers, Current sources, Active load, Concept of current mirror circuits, Wilson current mirror circuits (Analysis using hybrid 'pi' model only).	6	15%
	Operational amplifiers: Introduction, Block diagram, Ideal op-amp parameters, Equivalent circuit, Voltage transfer curve, Open loop op-amp configurations, Effect of finite open loop gain, Bandwidth and slew rate on circuit performance	5	
<b>II</b>	Op-amp with negative feedback: Introduction, Feedback	3	15%

	configurations, Voltage series feedback, Voltage shunt feedback, Properties of practical op-amp.		
	Op-amp applications: Inverting and non inverting amplifier, DC and AC amplifiers, Summing, Scaling and averaging amplifiers, Instrumentation amplifier.	4	
<b>FIRST INTERNAL EXAMINATION</b>			
<b>III</b>	Op-amp applications: Voltage to current converter, Current to voltage converter, Integrator, Differentiator, Precision rectifiers, Log and antilog amplifier, Phase shift and Wien bridge oscillators	7	15%
<b>IV</b>	Astable and monostable multivibrators, Triangular and saw tooth wave generators, Comparators, Zero crossing detector, Schmitt trigger	5	15%
	Active filters: Advantages, First and second order low pass, High pass, Band pass and band reject filters, Design of filters using Butterworth approximations	5	
<b>SECOND INTERNAL EXAMINATION</b>			
<b>V</b>	Specialized ICs and its applications: Timer IC 555 : Astable and monostable operations, applications. Analog Multipliers: Introduction, Gilbert multiplier cell. Voltage Controlled Oscillator IC AD633 and their applications.	3	20%
	Phase Locked Loop – Operation, Closed loop analysis, Lock and capture range, Basic building blocks, PLL IC 565, Applications of PLL for AM & FM detection and Frequency multiplication, Frequency division, Frequency synthesizing.	4	
	Monolithic Voltage Regulators - Fixed voltage regulators, 78XX and 79XX series, Adjustable voltage regulators, IC 723 – Low voltage and high voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection.	4	
<b>VI</b>	Data Converters: D/A converter, Specifications, Weighted resistor type, R-2R Ladder type.	3	20%
	A/D Converters: Specifications, Classification, Flash type, Counter ramp type, Successive approximation type, Single slope type, Dual slope type, Sample-and-hold circuits.	5	
<b>END SEMESTER EXAM</b>			

**Assignment**

1. Explain the importance of frequency compensated networks in opamps and the commonly used compensation techniques.
2. Write short notes on commercially available integrated circuits (Opamp, ADC, DAC, VCO, Analog multiplier, PLL ) with pin outs and their important features

**Question Paper Pattern (End Sem Exam)****Maximum Marks: 100****Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with maximum 60 % for theory and 40% for logical/numerical problems, derivation and proof.