

## NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN			
Course Title	ANALOG IC Design		
Course Code	ECHO19	No. of Credits	03
Department	Electronics and Communication Engineering	Faculty	Dr. B Venkataramani
Pre-requisites Course Code	-		
Course Coordinator	-		
Other Course Teacher(s)/Tutor(s) E-mail		Telephone No.	<a href="mailto:bvenki@nitt.edu">bvenki@nitt.edu</a> 7708977953 0431 2503303
Course Type	Program Core/ Honours elective		

## COURSE OVERVIEW

This course develops the expertise to draw the equivalent circuits for single stage and multistage amplifiers using MOS. The effect of different types of loads on the performance is studied. The evaluation of the frequency response of the circuits and the application of different types of feedback on MOS amplifiers are studied. The different sources of noise in MOS circuits and computation of noise in MOS amplifiers is studied. The implementation of switched capacitor circuits, current mirrors and bandgap reference are also introduced

## COURSE OBJECTIVES

To develop the expertise for designing and analysing the MOS analog VLSI circuits including single stage and multistage amplifiers with and without feedback and with different types of loads

## COURSE OUTCOMES (CO)-

Students are able to

- CO1: To design single stage MOS amplifiers and analyse its performance
- CO2: To design and understand the operation of differential amplifiers, Compute the common mode and differential gain, and evaluate the effect of mismatches and different loads
- CO3: Study and implementation of two stage MOS operational amplifiers and techniques for gain enhancement and common mode feedback
- CO4: Study and understand switched capacitor based circuits, their imperfections and remedies. Study and realise bandgap reference circuits, current mirrors
- CO5: Study and analyse the frequency response of MOS amplifiers and the effect of feedback on MOS amplifiers. : Study and analyse the noise in single stage and multistage amplifiers

## COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1.	1-3 AUG 2018 Week 1 (3 Contact Hours)	Why Analog? Basic MOS Device Physics – MOS I/V Characteristics, Second Order effects,	Lecture C&T/ PPT or any suitable mode

2.	Week 2 & 3 (3 Contact Hours)	MOS Device models.. Single Stage Amplifiers – Basic Concepts, Common Source Stage with different loads	
3.	Week 4 (3 Contact Hours)	Source Follower, Common Gate Stage, Cascode Stage.	
<b>ASSESSMENT I - 10 Marks</b>			<b>Quiz</b>
4.	Week 5 (3 Contact Hours)	Differential Amplifiers – Single Ended and Differential Operation, Basic Differential Pair,	
5.	5 – 7 SEP Week 6 (3 Contact Hours)	Common-Mode Response, Differential Pair with MOS loads, Gilbert Cell.	<b>Lecture C&amp;T/ PPT or any suitable mode</b>
6.	Week 6 (3 Contact Hours) 12-14 SEP	Passive and Active Current Mirrors – Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors. Frequency Response of Amplifiers – General Considerations, Common Source Stage,	
	Week 7	<b>ASSESSMENT II - 20 Mark</b>	<b>Descriptive/Numerical (Written)</b>
7.	Week 8 (3 Contact Hours) SEP 26-28	Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair.	<b>Lecture C&amp;T/ PPT or any suitable mode</b>
8.	Week 9 (3 Contact Hours) 3-5 OCT	Feedback Amplifiers – General Considerations,	
9.	Week 10 (3 Contact Hours) 10-12 OCT	Feedback Topologies, Effect of Loading	
<b>ASSESSMENT III - 10 Marks</b>			<b>Quiz</b>
10.	Week 11 (3 Contact Hours)	Introduction to switched capacitor circuits, MOS Switches, Speed Considerations, Precision Considerations, Nonidealities of MOS switches, Charge injection cancellation	<b>Lecture C&amp;T/ PPT or any suitable mode</b>
11.	Week 12 (3 Contact Hours)	Switched Capacitor amplifiers, Unity gain buffer- speed and precision considerations, Non inverting amplifier-speed and	

		precision considerations	
12.	Week 13 (3 Contact Hours)	Operational Amplifiers – General Considerations, One Stage Op Amps, Two Stage Op Amps,	
	Week 14	<b>ASSESSMENT IV - 20 Marks</b>	<b>Descriptive/Numerical (Written)</b>
13.	Week 15 (3 Contact Hours)	Gain Boosting, Common – Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps. Stability and Frequency Compensation.	<b>Lecture C&amp;T/ PPT or any suitable mode</b>
14.	Week 16 (3 Contact Hours)	Bandgap References, Nonlinearity and Mismatch	
15.	Week 17 (3 Contact Hours)	Noise – Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in Differential Pairs.	
16.	(3 Contact Hours)	<b>END ASSESSMENT – 40 Marks</b>	<b>Descriptive/Numerical (Written)</b>

#### COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Assessment I (Quiz)	3 <sup>rd</sup> Week of August	60 Minutes	10
2.	Assessment II	3 <sup>rd</sup> Week of September	60 Minutes	20
3.	Assessment III (Quiz)	1 <sup>st</sup> Week of October	60 Minutes	10
4.	Assessment IV	1 <sup>st</sup> Week of November	60 Minutes	20
5.	Assessment V (CPA)	3 <sup>rd</sup> Week of November	60 Minutes	20
6.	End Assessment	1 <sup>st</sup> Week of December	180 Minutes	40

#### ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

##### Text Books

*Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Edition 2002.*

##### References:

*David A. Johns and Ken Martin, Analog Integrated Circuit Design, Wiley, 1997.*

*R. Jacob Baker, CMOS Circuit Design, Layout, and Simulation, Wiley, (3/e), 2010.*

*Philip.E.Allen, et al. CMOS Analog Circuit Design, Oxford University Press, 2002.*

*Paul. R.Gray, et al. Analysis and Design of Analog Integrated Circuits, Wiley, (4/e), 2001.*

#### COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

Feedback from the students during class committee meetings

Anonymous feedback through questionnaire

#### COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

### CORRESPONDENCE

1. All the students are advised to check their NITT WEBMAIL/group mail/suggested by the course faculty, class representative regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through them only.
2. Queries (if required) to the course teacher shall only be emailed to the email id specified by the teacher.

### ATTENDANCE

3. Attendance will be taken by the faculty in all the contact hours. Every student should try to be present in the class during these contact hours.
4. Those students who missed any of the continuous assessments (CAs) due to genuine reasons can appear for retest . The scores in the retest will be taken into account for computing marks for CA.

### ASSESSMENT

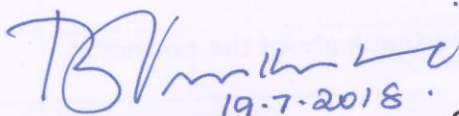
5. Attending all the assessments are MANDATORY for every student.
6. Every student is expected to score minimum 40% of the maximum mark of the class in the total assessment (1, 2, 3, 4 and 6) to pass the course. Otherwise the student would be declared fail and 'F' grade will be awarded. Further he can take up only FORMATIVE ASSESSMENT.

### ACADEMIC HONESTY & PLAGIARISM

1. All the students are expected to be genuine during the course work. Taking of information by means of copying simulations, assignments, looking or attempting to look at another student's paper or bringing and using study material in any form for copying during any assessments is considered dishonest.
2. Tendering of information such as giving one's program, simulation work, assignments to another student to use or copy is also considered dishonest.
3. Preventing or hampering other students from pursuing their academic activities is also considered as academic dishonesty.
4. Any evidence of such academic dishonesty will result in the loss of marks on that assessment. Additionally, the names of those students so penalized will be reported to the class committee chairperson and HoD of the concerned department.
5. Students who honestly producing ORIGINAL and OUTSTANDING WORK will be REWARDED.

### ADDITIONAL COURSE INFORMATION

### FOR SENATE'S CONSIDERATION

  
19.7.2018

Course Faculty \_\_\_\_\_

CC-Chairperson \_\_\_\_\_



HOD \_\_\_\_\_

