



**National Institute of Technology Meghalaya**  
An Institute of National Importance

**CURRICULUM**

Programme	<b>Master of Technology in VLSI and Embedded Systems</b>	Year of Regulation	<b>2018-19</b>
Department	<b>Electronics and Communication Engineering</b>	Semester	<b>II</b>

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total

<b>EC 502</b>	<b>Analog System Design</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>200</b>	
Course Objectives	To learn about CMOS models and parameters	Course Outcomes	CO1	Able to learn about the CMOS models and parameters						
	To learn about the Amplifiers (Single stage, differential, Cascode Based) design and its frequency based properties		CO2	Able to design the Amplifiers (Single stage, differential, Cascode Based)						
	To learn about the Current Mirrors, Current, Voltage Reference, Feedback and frequency compensation circuit		CO3	Able to design the Current Mirrors, Current, Voltage Reference, Feedback and frequency compensation circuit						
	To learn designing of CMOS based Operational Amplifier		CO4	Able to analyze the CMOS based design of Operational Amplifier						

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	2	3	2	1	0	3	0	0	2	0	0	0	3	0	3
2	CO2	3	2	0	1	0	0	0	0	2	0	0	0	2	0	2
3	CO3	2	3	3	1	2	0	0	0	0	0	0	0	2	3	0
4	CO4	2	2	3	0	2	2	3	0	2	0	0	1	0	3	2

**SYLLABUS**

No.	Content	Hours	COs
I	CMOS Device Fundamentals Basic MOS Models, Device Capacitances, Parasitic Resistances, Substrate Models, Transconductance, Output Resistance, Frequency Dependence of Device Parameters.	4	CO1
II	Single Stage and Differential Amplifiers Common Source Amplifier, Source Degeneration, Source Follower, Common Gate Amplifier, Cascade Stage, Basic Differential Pair, Common Mode Response, Differential Pair with MOS Loads, Gilbert Cell, Device Mismatch Effects, Input Offset Voltage.	8	CO2
III	Frequency Response of Amplifiers Miller Effect, CS Amplifier, Source Follower, CG Amplifier, Cascode Stage, Differential Amplifier, Multistage Amplifier.	6	CO2
IV	Current Mirrors, Current and Voltage Reference Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors, Low Current Biasing, Supply Insensitive Biasing, Constant Transconductance Biasing, Temperature Insensitive Biasing, PTAT Current Formation, Impact of Device Mismatch.	7	CO3
V	Feedback, Stability and Frequency Compensation Feedback Topologies, Effect of Load, Modeling Input and Output Ports in Feedback Circuits, Multi Pole Systems, Phase Margin, Frequency Compensation, Voltage Controlled Oscillator (VCO), Phase Lock Loop (PLL).	7	CO3
VI	Operational Amplifiers Performance Parameters, One-Stage and Two-Stage Op-Amps, Gain Boosting, Comparison, Common Mode Feedback, Input Range, Slew Rate, Power Supply Rejection, Noise in Op-Amps, High Performance CMOS Op-Amp.	4	CO4
Total Hours		36	

**Essential Readings**

1. B. Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill, 1st Edition, 2002.
2. P. R. Gray, P. J. Hurst, S. H. Lewis and R.G. Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley and Sons, 5th Edition, 2009

**Supplementary Readings**

1. R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design Layout and Simulation, John Wiley and Sons, 3rd Edition, 2002.
2. P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, Oxford University Press, 2nd Edition, 2004