GUJARAT TECHNOLOGICAL UNIVERSITY

Subject Name: Analog and Mixed Signal IC Design (Elective)
Subject Code: 3725206

Semester II

Type of course: ME-Electronics & Communication Engineering (VLSI & Embedded Systems Design)

Prerequisite: Solid state device modelling and simulation

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE(V)	PA (I)	
4	2#	0	5	70	30	30	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment;

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Review of transistor operation, Single stage amplifiers and Differential amplifier MOS I/V characteristics. Transistor second order effects. Small signal analysis. Small signal model. Gain of common-source stage amplifier using small signal analysis. Common-source stage with resistive load, diode-connected load, current-source load, triode load, source degeneration. Source follower stage. Common-gate stage. Cascade stages. Single-ended and differential operation. Basic differential pair. Common-mode response. Differential pair with MOS loads. Gilbert Cell	10	20
2	Current Mirrors, Response of Amplifiers, Noise characteristics Basic and cascode current mirrors. Using active current mirrors as loads. The Miller theorem. Frequency response of source follower, common-gate amplifier, cascode stage, differential pair.Noise characteristics. Noise types: thermal noise, flicker noise. Representation of noise in circuits. Properties of feedback circuits. Feedback Configurations. Effect of loading in feedback	10	25
3	Operational amplifiers Operational amplifier's performance parameters. One-Stage Op Amps. Two-Stage Op Amp. Op Amps Gain Boosting. Op Amps Common-Mode Feedback. Op Amps Input Range Limitation: unity-gain buffer, extension of input CM range, variation of equivalent trans-conductance with the input CM level. Op Amps Slew Rate. Noise in Op Amps and Power Supply	10	25

Reference Books:

1. R.J. Baker, H.W. Li, D.E. Boyce. CMOS. Circuit design, Layout, and Simulation (2nd Edition), 2005.
2. 1038p.

3. P. Horowitz, W. Hill, Electronic Circuit Design: Art and Practice, 2001. 192p.
4. B. Razavi, Design of Analog CMOS Integrated Circuits, 2000. 684p.
5. R.J. Baker, CMOS Mixed-Signal Circuit Design, 2002. 502p
6. B. Razavi. Principles of Data Conversion System Design. 1994. 272P

Course Outcome:

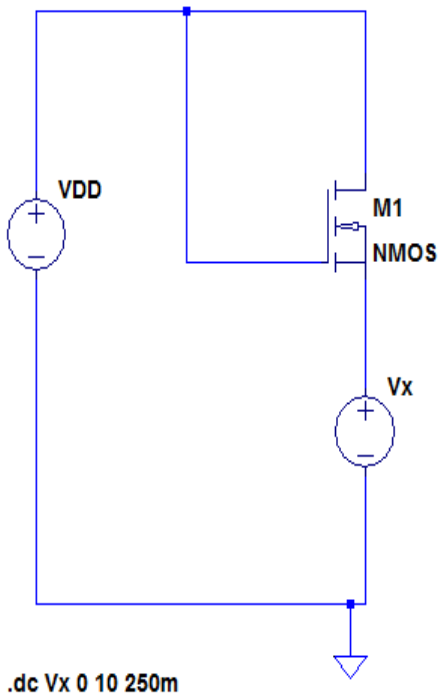
1. After learning the course the students should be able to:
2. Understand about the transistor second order effects and single stage amplifiers.
3. Analyse the response of amplifiers different types of noise like thermal noise and flicker noise.
4. Evaluate the performance parameters of operational amplifiers and noise in op amps.
5. Evaluate the stability and frequency compensation of the single stage amplifiers and operational amplifiers in detail.
6. Understand how the biasing is done for the circuit in current mirrors.

List of Experiments: (with Open Ended Problems)

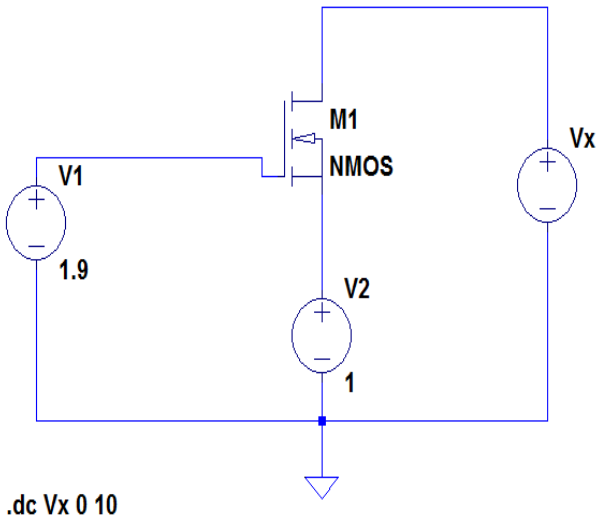
1. For W/L=50/0.5,plot the drain current of an NMOS and a PMOS as a function of VGS as VDS varies from 0 to 3v.assume VDS=3v.

2. Plot the output characteristics of NMOS and PMOS,(Id vs Vds). Identify the variations in output current, when channel length is reduced.
3. Sketch Ix vs Vx for the following circuit and write your observation.

a)

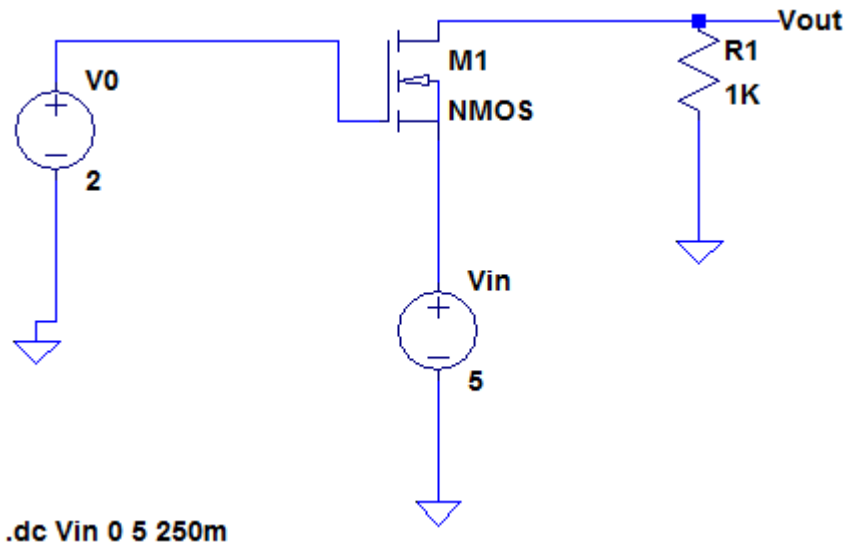


b)

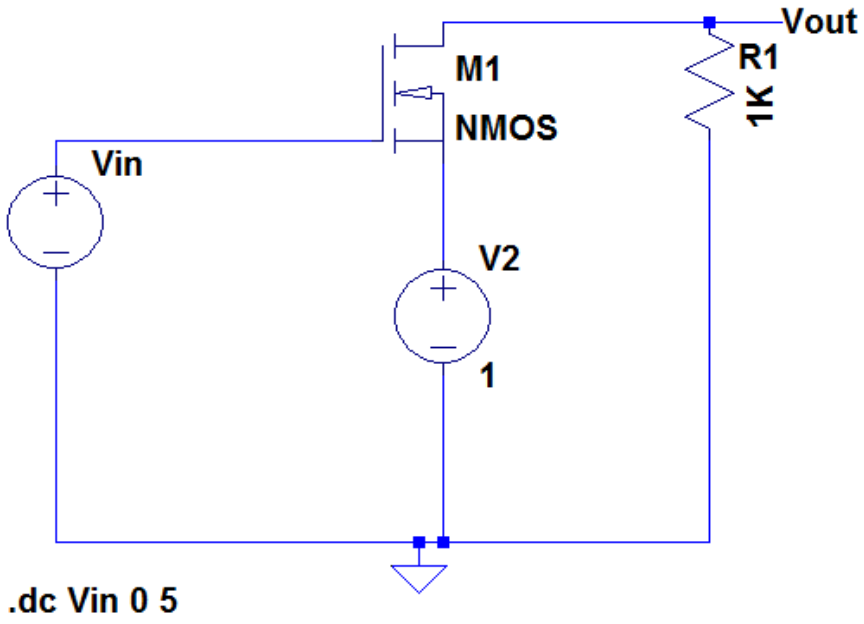


4. Sketch Vout as a function of Vin for the following.

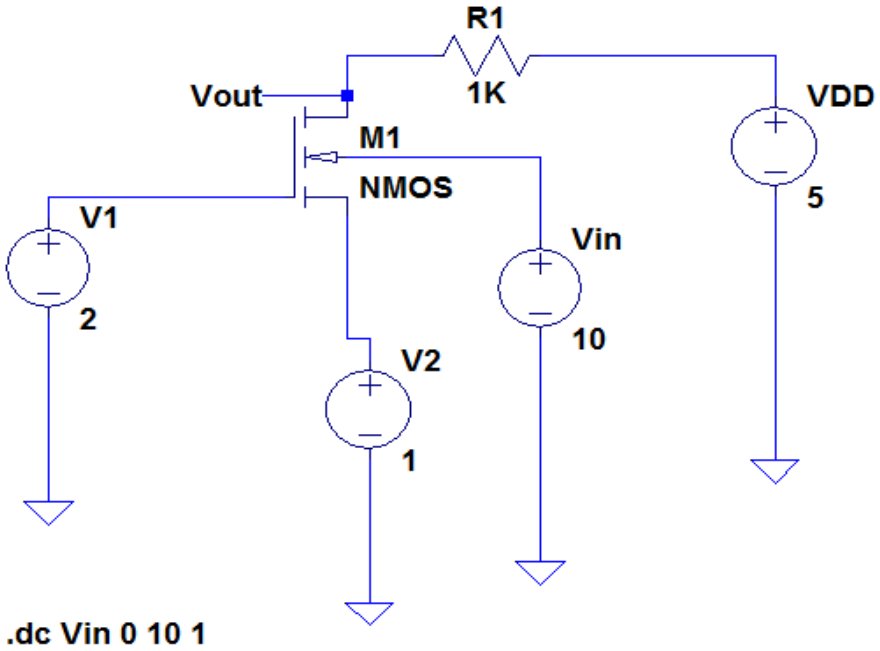
a)



b)

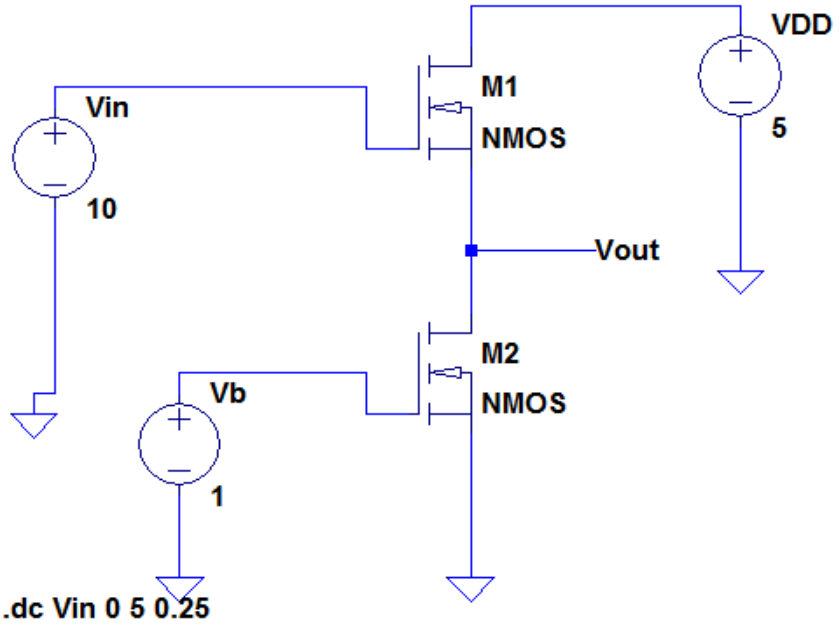


5. Sketch Vout as a function of Vin for the following.

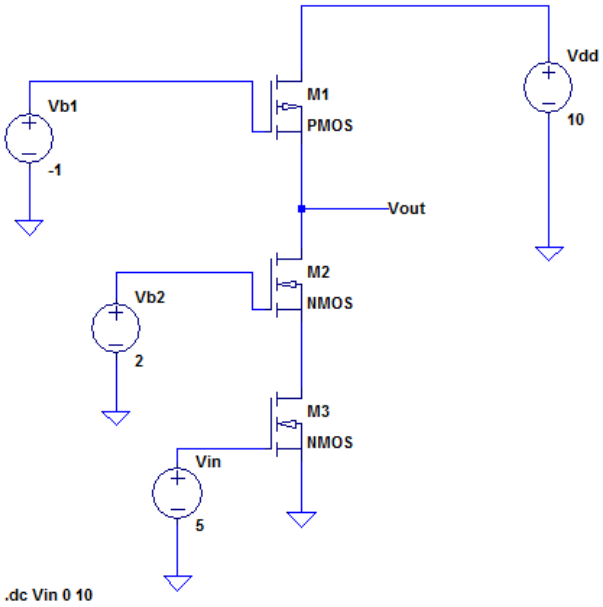


6. Sketch Vout as a Vin for the following circuit(Vin varies from o to VDD).

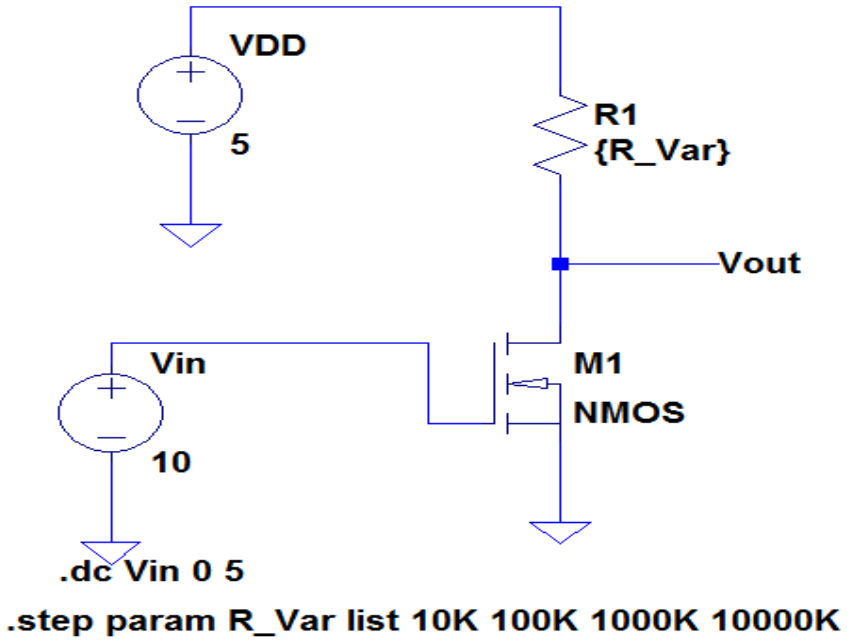
a)



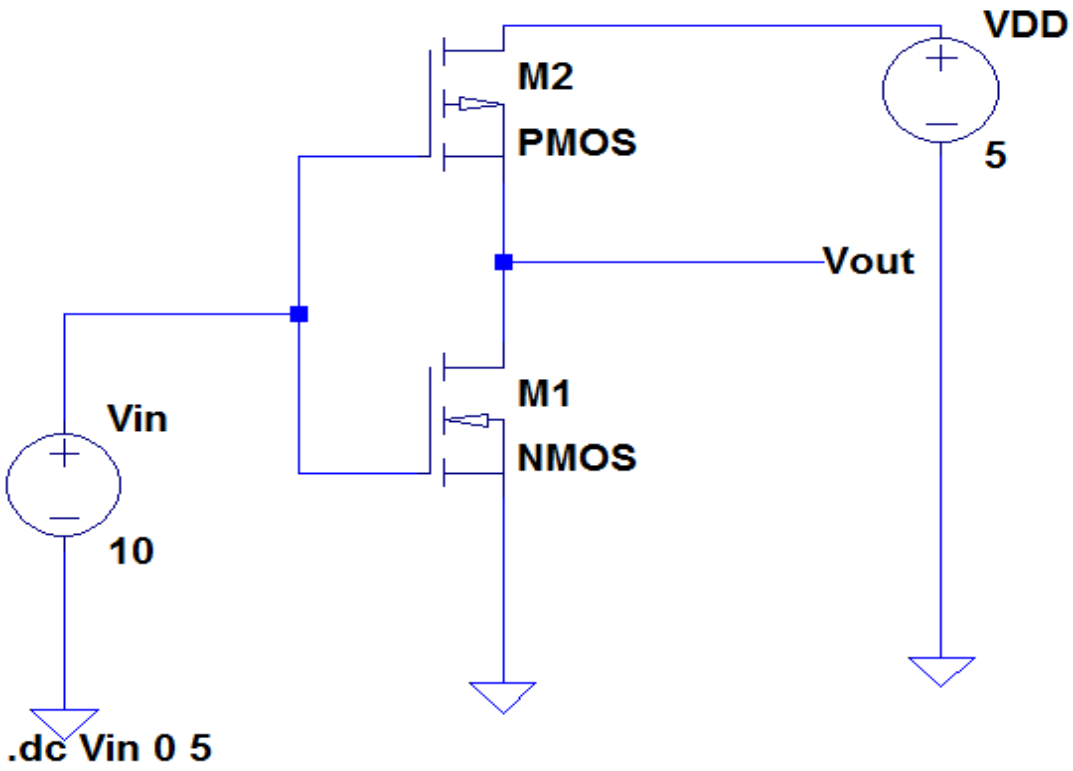
b)



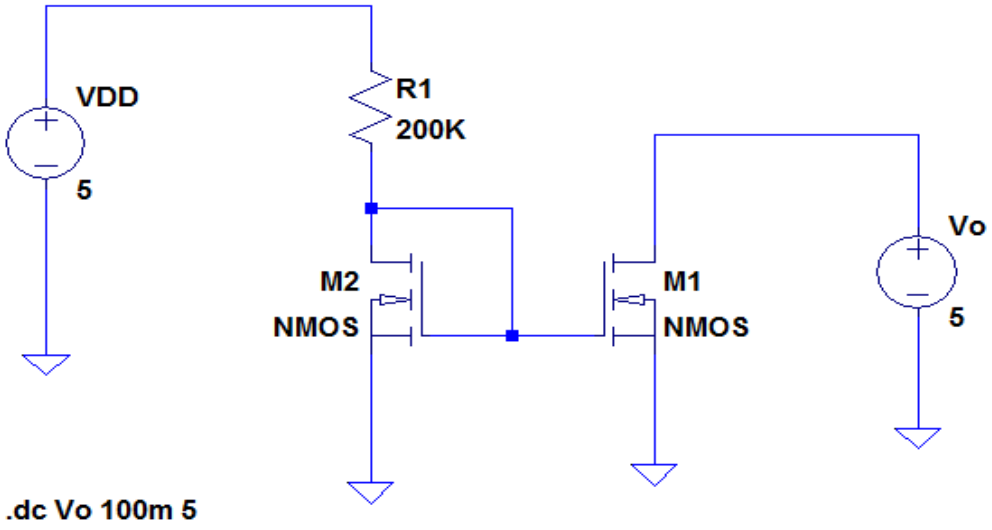
c) R varies from 10k to 10M



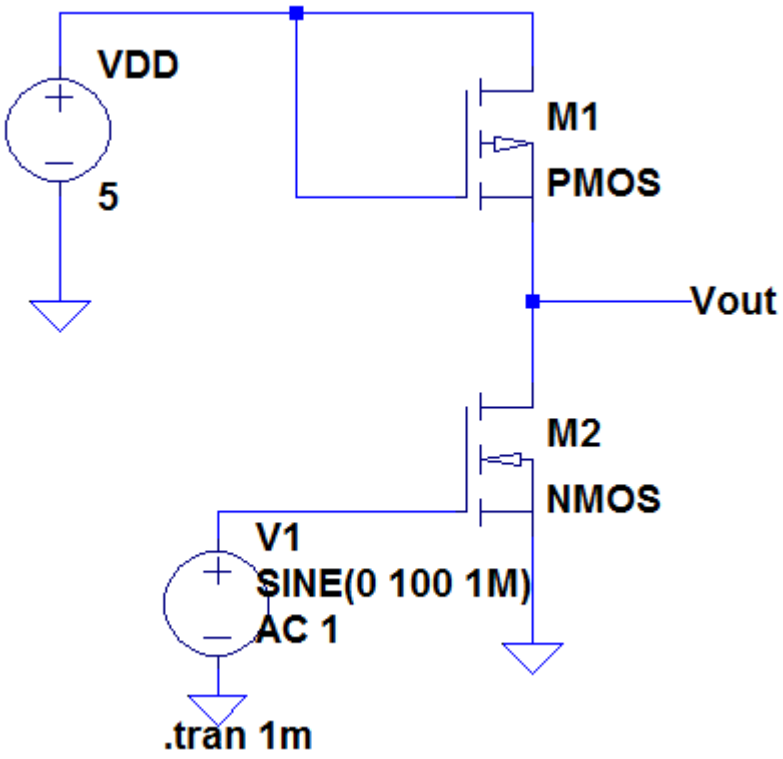
7. Plot the cmos inverter transfer characteristics(vout vs vin).



8. Plot vout vs Id(M1) and I2(M2) for the following

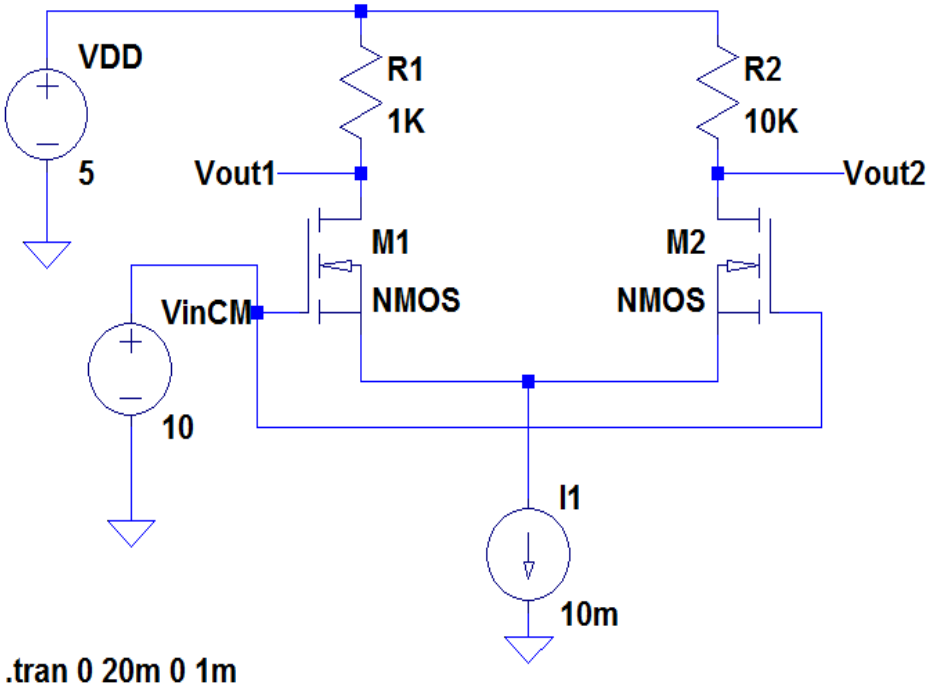


9. Plot transient analysis, showing amplification done by common source amplifier.



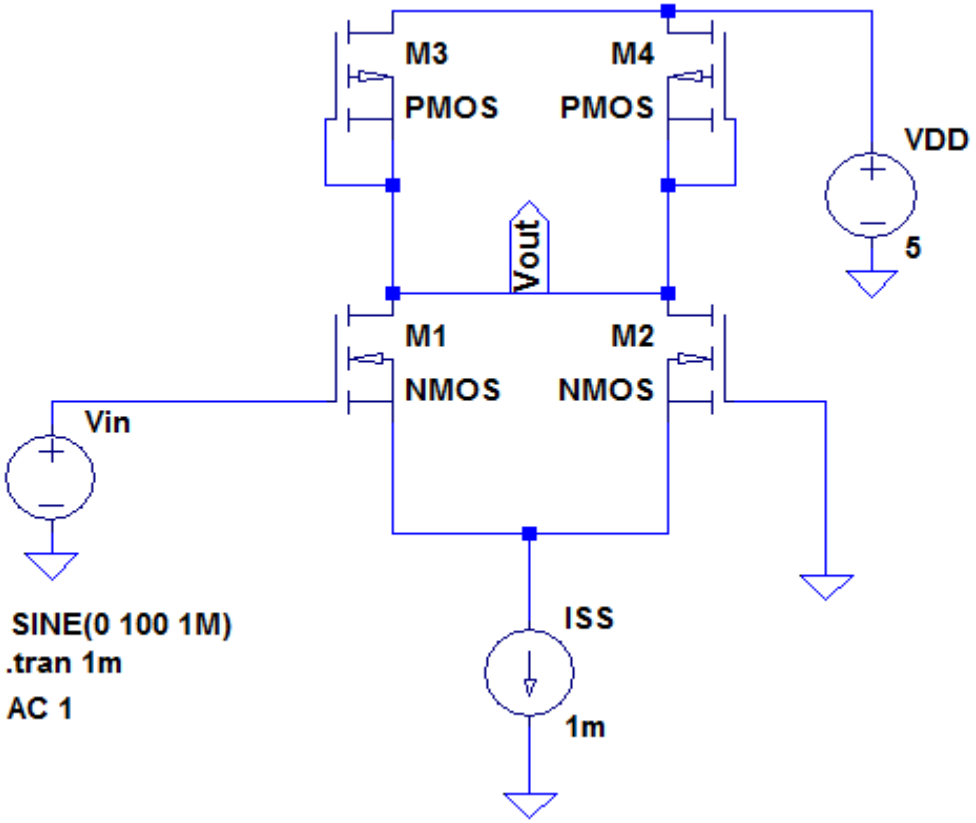
10. Plot common mode response of a differential amplifier.

a)



.tran 0 20m 0 1m

b)



Major Equipments:

List of Open Source Software/learning website: LT Spice

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website