

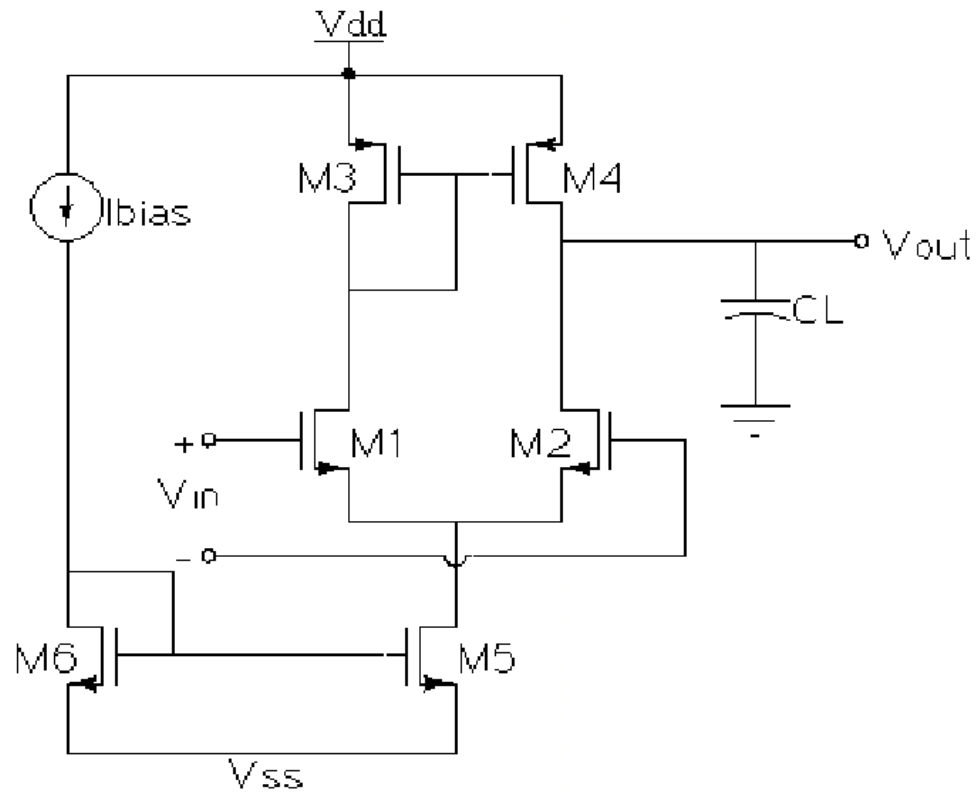
Lab 3

Differential Amplifier

09/19/2022

TA: You Zhou

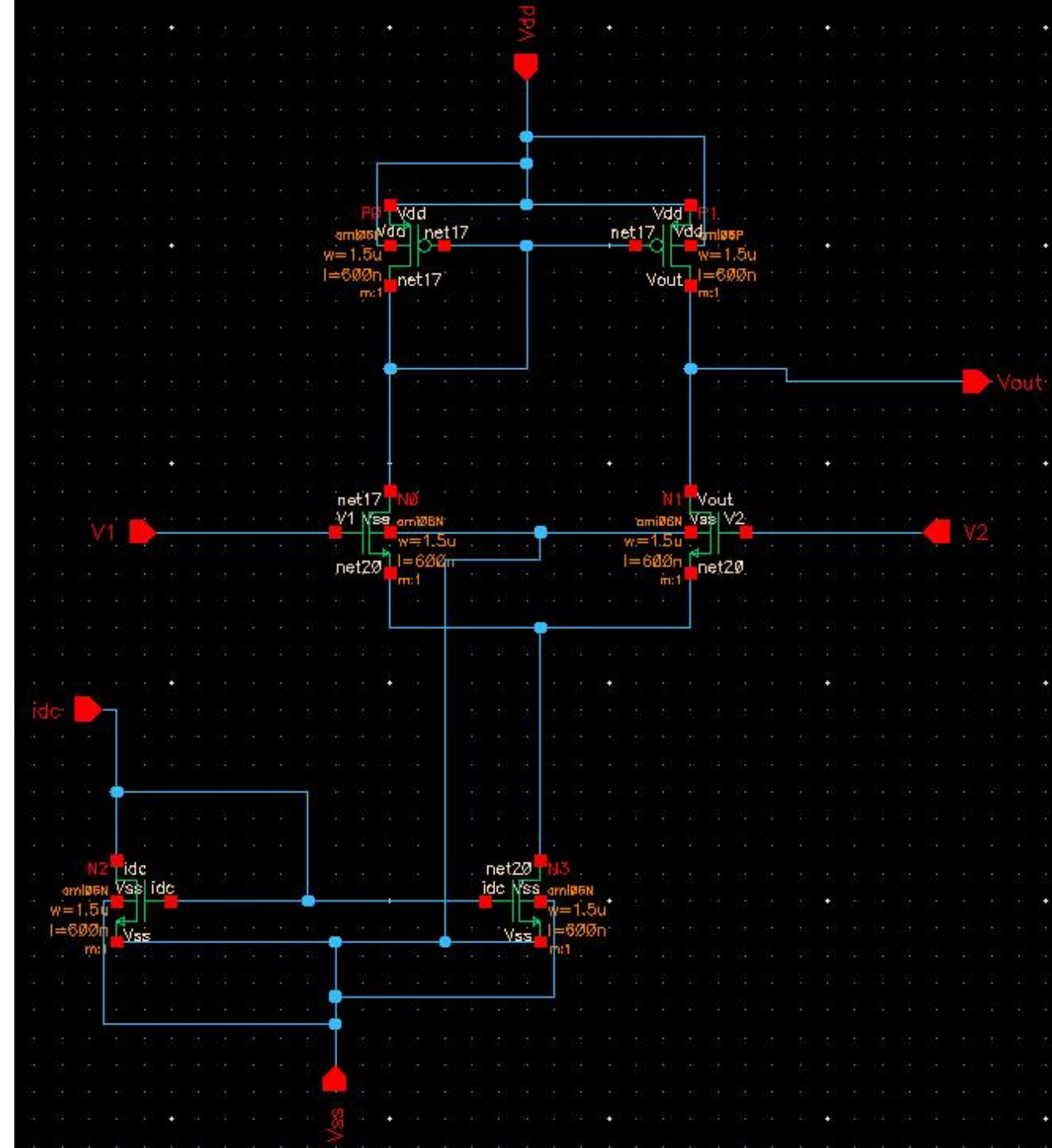
Differential Amplifier



IEEE Press Series on Microelectronic Systems) R. Jacob Baker
- CMOS_ Circuit Design, Layout, and Simulation -Wiley-IEEE
Press (2010)
Chapter 21 & Chapter 22

Schematic

1. Create 2 PMOS and 4 NMOS
2. Create input Pins: Vdd, Vss, idc, V1, V2
3. Create output Pins: Vout
4. Connect the components with wires
5. Save as symbol



Place the Pins

Symbol Generation Options ✕

Library Name	Cell Name	View Name
ECE6217_lab	Differential_Amplifier	symbol

Pin Specifications Attributes

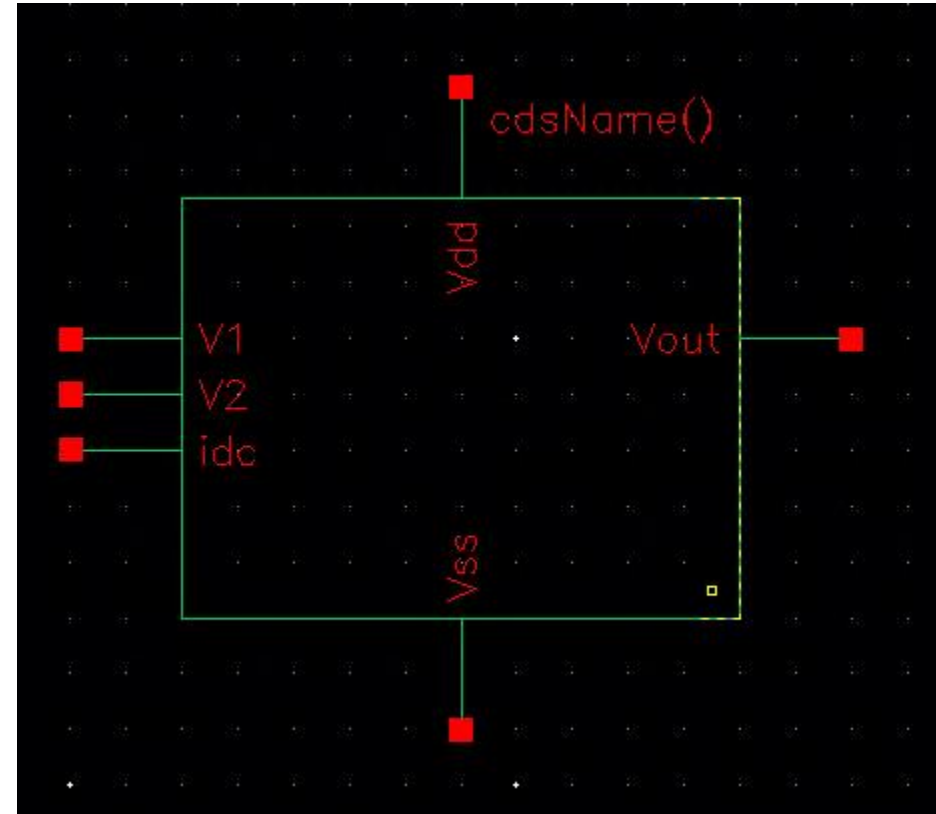
Pin Specification	Value	Action
Left Pins	V1 V2 idc	List
Right Pins	Vout	List
Top Pins	Vdd	List
Bottom Pins	Vss	List

Exclude Inherited Connection Pins:

☒ None ☐ All ☐ Only these:

Load/Save ☐ Edit Attributes ☐ Edit Labels ☐ Edit Properties ☐

OK Cancel Apply Help



Create Testbench

- 1. Create an Output Pins: Vout
- 2. Create vdc where DC voltage = 5V
- 3. Create Vsin and idc
- 4. Connect V1 to the Vsin
- 5. Connect V2 to the gnd

Please see the next page

Property

Value

Display

Library Name

NCSU_Analog_Parts

off

Cell Name

vsin

off

View Name

symbol1

off

Instance Name

V2

off

Add

Delete

Modify

User Property

Master Value

Local Value

Display

Ivsignore

TRUE

off

CDF Parameter

Value

Display

AC magnitude

1 V

off

AC phase

off

Offset voltage

off

Amplitude

5m V

off

Frequency

1K Hz

off

Delay time

off

Damping factor

off

D C voltage

off

Noise file name

off

Number of noise/freq pairs

0

off

Initial phase for Sinusoid

off

FM modulation index

off

FM modulation frequency

off

AM modulation index

off

AM modulation frequency

off

AM modulation phase

off

Temperature coefficient 1

off

Temperature coefficient 2

off

OK

Cancel

Apply

Defaults

Previous

Next

Help

Apply To

only current

instance

Show

☐ system

☒ user

☒ CDF

Browse

Reset Instance Labels Display

Property

Value

Display

Library Name

NCSU_Analog_Parts

off

Cell Name

idc

off

View Name

symbol

off

Instance Name

I1

off

Add

Delete

Modify

User Property

Master Value

Local Value

Display

Ivsignore

TRUE

off

CDF Parameter

Value

Display

AC magnitude

off

AC phase

off

D C current

100u A

off

Noise file name

off

Number of noise/freq pairs

0

off

Multiplier

1

off

Temperature coefficient 1

off

Temperature coefficient 2

off

Nominal temperature

off

OK

Cancel

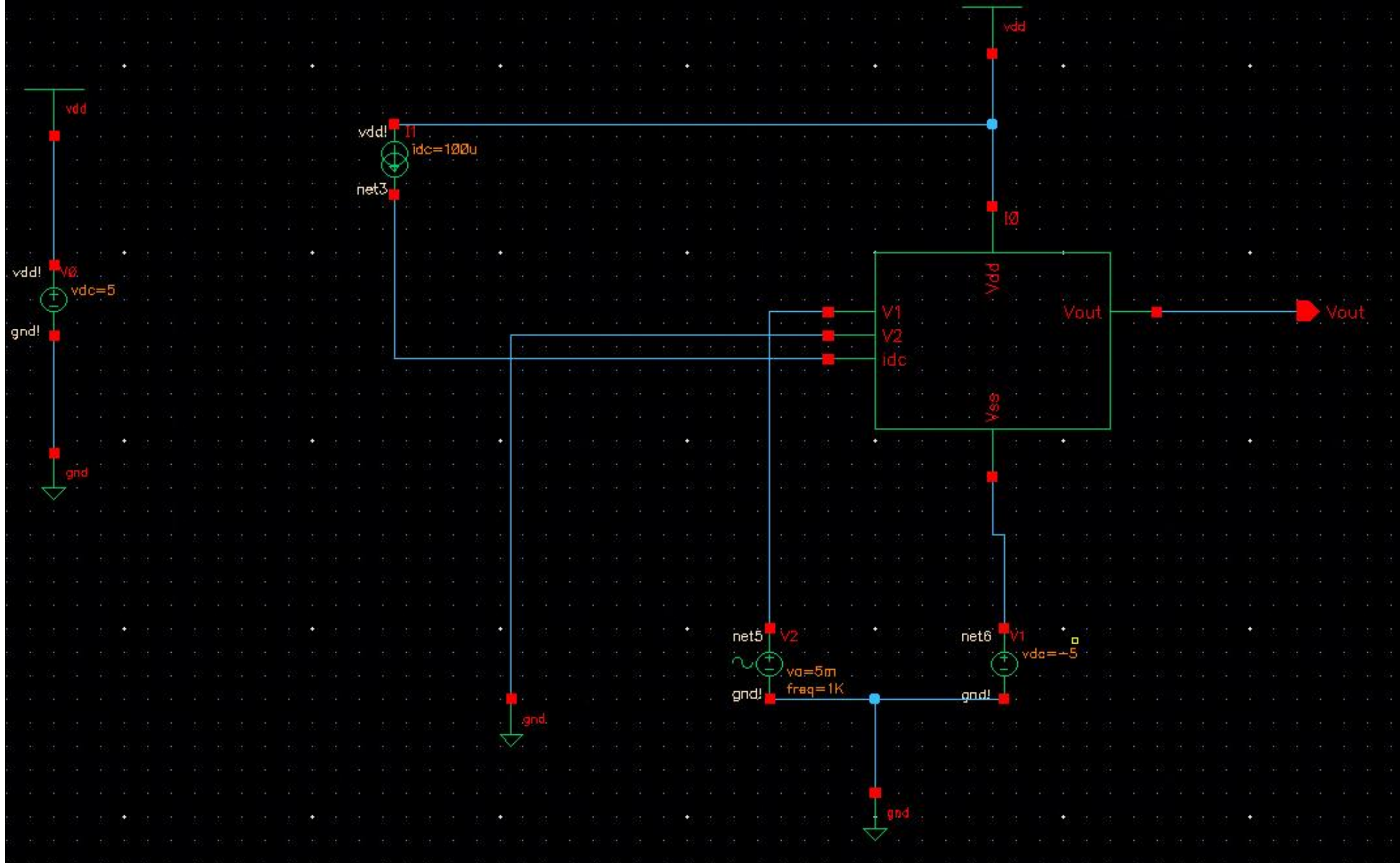
Apply

Defaults

Previous

Next

Help



Launch ADE L Analyses

Tran -> Stop time: 5m -> moderate -> Enabled
Click Apply

Choosing Analyses -- ADE L (2)

Analysis

☒ tran

☐ xf

☐ stb

☐ envlp

☐ pnoise

☐ qpac

☐ hb

☐ hbbsp

☐ dc

☐ sens

☐ pz

☐ pss

☐ pxp

☐ qpnoise

☐ hbp

☐ hbsp

☐ ac

☐ dcmatch

☐ lf

☐ pac

☐ psp

☐ qpac

☐ hbac

☐ hbac

☐ noise

☐ acmatch

☐ sp

☐ pstb

☐ qpss

☐ qpss

☐ hnoise

☐ hnoise

Transient Analysis

Stop Time

5m

Accuracy Defaults (errpreset)

☐ conservative

☒ moderate

☐ liberal

☐ Transient Noise

Dynamic Parameter

☐

Enabled

☒

Options...

OK

Cancel

Defaults

Apply

Help

Choosing Analyses -- ADE L (2)

Analysis

☐ tran

☐ xf

☐ stb

☐ envlp

☐ pnoise

☐ qpac

☐ hb

☐ hbbsp

☒ dc

☐ sens

☐ pz

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☐ hbsp

☐ ac

☐ dcmatch

☐ lf

☐ pac

☐ psp

☐ qpac

☐ hbac

☐ hbac

☐ noise

☐ acmatch

☐ sp

☐ pstb

☐ qpss

☐ qpss

☐ hnoise

☐ hnoise

DC Analysis

Save DC Operating Point

☒

Hysteresis Sweep

☐

Sweep Variable

☐ Temperature

☐ Design Variable

☒ Component Parameter

☐ Model Parameter

Component Name

/V2

Select Component

Parameter Name

dc

Sweep Range

☒ Start-Stop

☐ Center-Span

Start

-5

Stop

5

Sweep Type

Automatic

Add Specific Points

☐

Enabled

☒

Options...

OK

Cancel

Defaults

Apply

Help

dc -> Save DC operating point -
>Component parameter -> select component -> choose Vsin ->choose dc – vdc-DC voltage
-> click ok
Start-Stop : -5 to 5 -> click Apply

Select Component Parameter

type	srcType	"Source type"
dc	vdc	"DC voltage"
mag	acm	"AC magnitude"
phase	acp	"AC phase"
delay	td	"Delay time"
sinedc	vo	"Offset voltage"
ampl	va	"Amplitude"
sinephase	sinephase	"Initial phase for Sinusoid"
freq	freq	"Frequency"
fmodindex	fmodindex	"FM modulation index"
fmodfreq	fmodfreq	"FM modulation frequency"
ammodindex	ammodindex	"AM modulation index"
ammodfreq	ammodfreq	"AM modulation frequency"
ammodphase	ammodphase	"AM modulation phase"
damp	theta	"Damping factor"
tc1	tc1	"Temperature coefficient 1"
tc2	tc2	"Temperature coefficient 2"
tnom	tnom	"Nominal temperature"

OK

Cancel

Help

ac
Frequency -> Start-Stop ->100, 150M
Sweep Type ->Logarithmic -> 20
Click Apply and ok

Choosing Analyses -- ADE L (2)

Analysis

☐ tran

☐ xf

☐ stb

☐ envlp

☐ pnoise

☐ qpac

☐ hb

☐ hbsp

☐ dc

☐ sens

☐ pz

☐ pss

☐ pxf

☐ qpnoise

☐ hbac

☐ hbx

☒ ac

☐ dcmatch

☐ lf

☐ pac

☐ psp

☐ qpnoise

☐ hbstb

☐ noise

☐ acmatch

☐ sp

☐ pstb

☐ qpss

☐ qpfp

☐ hbnoise

AC Analysis

Sweep Variable

☒ Frequency

☐ Design Variable

☐ Temperature

☐ Component Parameter

☐ Model Parameter

☐ None

Sweep Range

☒ Start-Stop

☐ Center-Span

Start100Stop150M

Sweep Type

Logarithmic

☒ Points Per Decade

☐ Number of Steps

20

Add Specific Points

Specialized Analyses

None

Enabled

Options...

OKCancelDefaultsApplyHelp

Click Outputs
Choose V1, V2 and Vout from schematic
Run simulation

ADE L (2) - ECE6217_lab Differential_Amplifier_TB schematic

SessionSetupAnalysesVariablesOutputsSimulationResultsToolsHelp

27

Design Variables

	Name	Value
1	p5vonly	0

Analyses

	Type	Enable	Arguments
1	tran	<input checked="" type="checkbox"/>	0 5m moderate
2	ac	<input checked="" type="checkbox"/>	100 150M 20 Logarithmic Points Per Decade Start-Stop
3	dc	<input checked="" type="checkbox"/>	t -5 5 Automatic Start-Stop /V2

Outputs

	Name/Signal/Expr	Value	Plot	Save	Save Options
1	gnd!		<input checked="" type="checkbox"/>	<input type="checkbox"/>	allv
2	net5		<input checked="" type="checkbox"/>	<input type="checkbox"/>	allv
3	Vout		<input checked="" type="checkbox"/>	<input type="checkbox"/>	allv

Plot after simulation: AutoPlotting mode: Replace

6(10) Select On Schematic | Status: Selecting outputs to be plotted... | T=27 C | Simulator: spectre

Click Split All stripes
You will see your simulation result

