

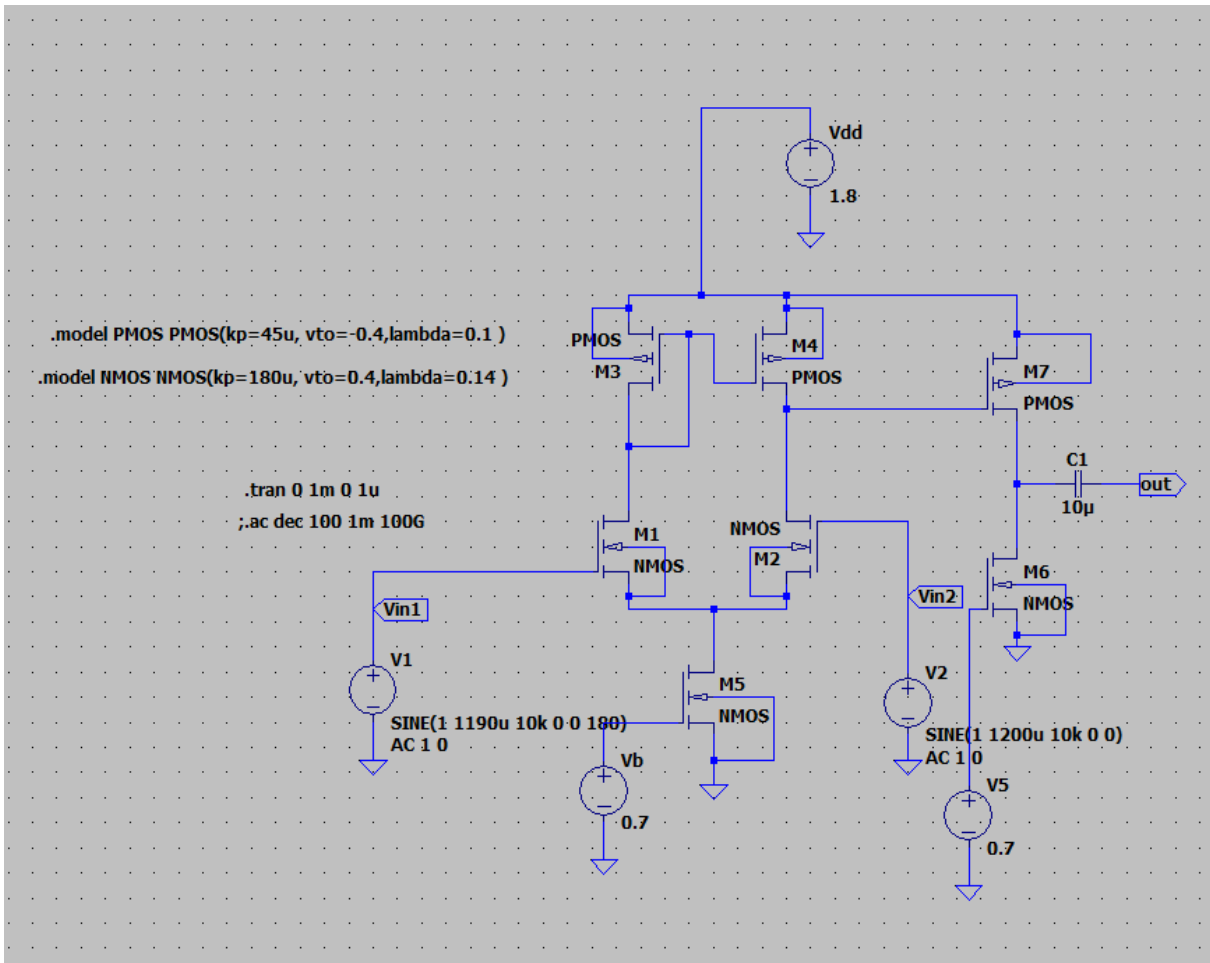
## Experiment-10

**Aim:** Design a two-stage operational amplifier with the first stage as a differential amplifier with active load for a gain of 30V/V and the second stage as a CS Amplifier with a gain of 20V/V. Assume  $I_{SS} = 0.1\text{mA}$ ,  $V_{GS} = 0.7\text{V}$ ,  $V_{th} = 0.4\text{V}$  and consider suitable technology parameters values.

- I) Compare the result with LTSPICE Simulation.
- II) Perform the transient analysis of the same.

**Apparatus required:** LTSpice Software.

**Circuit:**



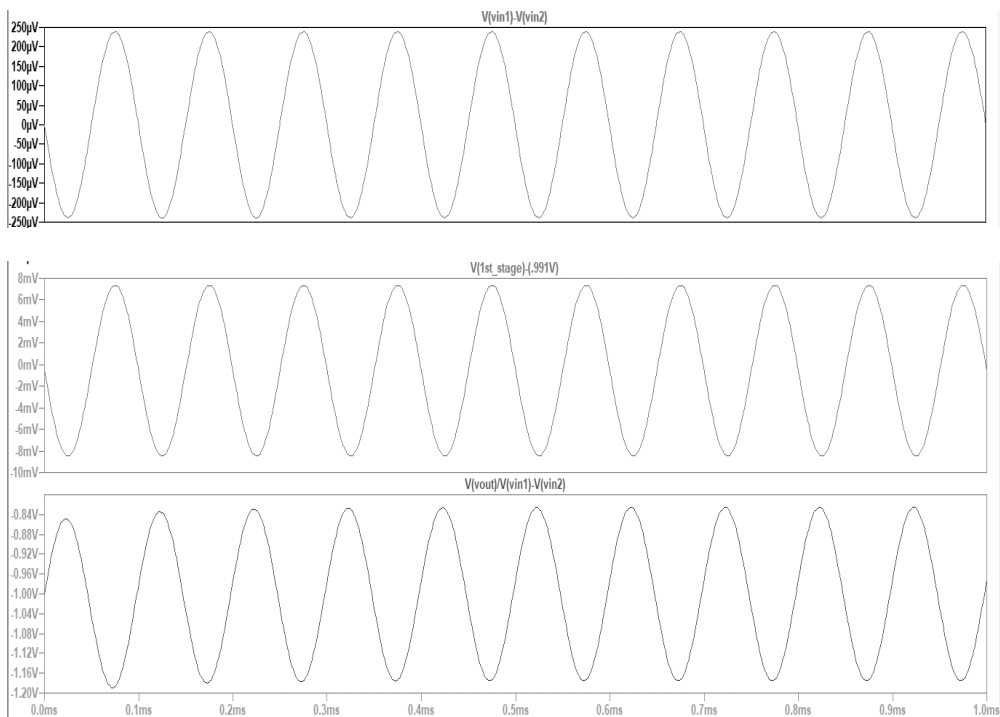
**Transfer Function:**

```

--- Operating Point ---
V(n001):      1.8          voltage
V(n002):      0.990444    voltage
V(1st_stage): 0.990444    voltage
V(vin2):      1           voltage
V(n004):      0.329224    voltage
V(vin1):      1           voltage
V(n006):      0.7         voltage
V(n003):      0.599478    voltage
V(vout):      5.99478e-017 voltage
V(n005):      0.7         voltage
Id(M6):       0.000108321  device_current
Ig(M6):       0           device_current
Ib(M6):       -6.09478e-013 device_current
Is(M6):       -0.000108321 device_current
Id(M5):       0.00010454   device_current
Ig(M5):       0           device_current
Ib(M5):       -3.39224e-013 device_current
Is(M5):       -0.00010454   device_current
Id(M1):       5.22699e-005  device_current
Ig(M1):       0           device_current
Ib(M1):       -6.7122e-013  device_current
Is(M1):       -5.22699e-005  device_current
Id(M2):       5.22699e-005  device_current
Ig(M2):       0           device_current
Ib(M2):       -6.7122e-013  device_current
Is(M2):       -5.22699e-005  device_current
Id(M7):       0.000108321  device_current
Ig(M7):       -0           device_current
Ib(M7):       1.21052e-012   device_current
Is(M7):       -0.000108321  device_current
Id(M3):       5.22699e-005  device_current
Ig(M3):       -0           device_current
Ib(M3):       8.19556e-013   device_current
Is(M3):       -5.22699e-005  device_current

```

Output:



Result:

The two-stage operational amplifier with the first stage as a differential amplifier with an active load is implemented and the gain of 600 V/V is Obtained.