

[Time: 3 Hours]

[Total Marks: 80]

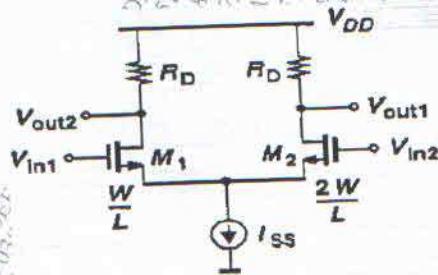
Note: 1) Question ONE is compulsory

2) Solve any THREE out of remaining questions

3) Draw neat and clean diagrams, wherever necessary

4) Assume suitable data, if required

- 1 (a) Analyze following circuit to get voltage gain equation if M₂ is twice wide as that of M₁ and $V_{in1} = V_{in2}$



- (b) Explain importance of Miller Theorem. 5
- (c) Explain input output characteristics of phase detector (PD) circuit. 5
- (d) Draw and explain AMS design flow. 5
- 2 (a) Derive expression for Voltage gain A_v and output resistance R_o of Source follower stage. 10
- (b) Explain in detail how to generate temperature independent references. 10
- 3 (a) Explain qualitative analysis of differential pair. 10
- (b) Explain concept of switched capacitor circuits and hence explain switched capacitor amplifiers in detail. 10
- 4 (a) Explain common mode response of differential pair with necessary derivations 10
- (b) Explain White & Flicker noise in MOSFET. Derive equation for output and input referred noise voltage of CS stage 10

TURN OVER

5

Design two stage Operational Transconductance Amplifier (OTA) to meet following specifications-.

$A_v > 4000 \text{ V/V}$, $V_{DD} = 2.5\text{V}$, $V_{SS} = -2.5\text{V}$ $\text{GBW} = 6\text{MHz}$, $C_L = 10\text{pF}$,

$\text{SR} > 10\text{V}/\mu\text{s}$, 60° phase margin, $-2\text{V} \leq V_{out} \text{ range} \leq 2\text{V}$,

$\text{ICMR} = -1.125\text{V}$ to 2V , $P_{diss} \leq 2.5\text{mW}$

Use, $K_N = 110\mu\text{A}/\text{V}^2$, $K_P = 50\mu\text{A}/\text{V}^2$, $V_{TN} = |V_{TP}| = 0.7\text{V}$, $\lambda_N = 0.04\text{V}^{-1}$,

$\lambda_P = 0.05\text{V}^{-1}$, $\text{Cox} = 2.47\text{fF}/\mu\text{m}^2$. Verify that the designed circuit meets required Voltage Gain and Power Dissipation specifications.

- 6 (a) Give comparison between Full-custom and Semi-custom design 5
 (b) Compare various opamp topologies 5
 (c) Explain in detail charge pump PLL 5
 (d) Write a short note on Gilbert Cell 5

Robotics . (3 Hours)

[Total Marks: 80]

N.B. (1) Question No. 1 is compulsory.

(2) Attempt any three questions from remaining.

(3) Assume suitable data wherever necessary.

Q1) Answer the following questions: (20)

- Define the following terms: Tool Path, Tool Trajectory, Degree of Freedom , Precision and Accuracy. (05)
- Define robot kinematic parameters. (05)
- What are Generalised Voronoi Diagrams (GVD) and their use in motion planning. (05)
- Explain perspective transformation and its relevance. (05)

Q2)a) Explain significance and use of DH algorithm. Develop DH representation of a four axis SCARA robot. (15)

b) Explain the significance of major and minor axes. (05)

Q3) a) Write a brief note on Robot classification. (10)

b) Develop the Inverse Kinematic solution for a two axis planar robot. (10)

Q4) a) Explain robot pick-and-place operation. (10)

b) Explain four fundamental operations for merging of frame K-1 with frame K. Obtain the general link coordinate transformation matrix T for mapping the (k-1)th frame into the kth frame. (10)

Q5) a) Explain robot motion planning using Bug 1 and Bug 2 algorithm. (10)

b) Explain role of line and area descriptors for analyzing shape of an object. (10)

Q6) Write short notes on any two: (10x2) (20)

- Potential functions
- Wave front planner.
- Cartesian space trajectory.
- Template matching algorithm.