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**Printed Page:-4** **Subject Code:- BECVL0402**

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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**
**(An Autonomous Institute Affiliated to AKTU, Lucknow)**
**B.Tech**
**SEM: IV - THEORY EXAMINATION (2025 - 2026)**
**Subject: CMOS Analog Integrated Circuit**

**Time: 3 Hours** **Max. Marks: 100**

**General Instructions:**

**IMP:** *Verify that you have received the question paper with the correct course, code, branch etc.*

***1.*** *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

***2.*** *Maximum marks for each question are indicated on right -hand side of each question.*

***3.*** *Illustrate your answers with neat sketches wherever necessary.*

***4.*** *Assume suitable data if necessary.*

***5.*** *Preferably, write the answers in sequential order.*

***6.*** *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*



## SECTION-A 20

1. Attempt all parts:-

(1.1) CMOS technology offers reduced packaging cost because of: (CO1,K1) 1

(a) Low static power dissipation
(b) High noise immunity
(c) Regular and modular layout structure
(d) High switching speed

(1.2) Static power consumption of CMOS technology is: (CO1,K1) 1

(a) Maximum
(b) Moderate
(c) Minimum
(d) Depends on the technology node

(1.3) Which parameter is most improved by using a cascode current mirror? (CO2,K1) 1

(a) Input resistance
(b) Gate capacitance
(c) Threshold voltage
(d) Output resistance

(1.4) Which of the following is the primary disadvantage of a cascode current mirror? (CO2,K1) 1

(a) Low output resistance
(b) High current error
(c) Reduced output voltage swing
(d) Poor matching

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(1.5) For a MOS amplifier, gain is determined by: (CO3,K1) 1

(a) The slope of the VOUT versus VIN curve
(b) The slope of the LOG of VOUT versus VIN curve
(c) The inverse slope of the VOUT versus VIN curve
(d) The slope of the VIN versus VOUT curve

(1.6) MOS inverting amplifier with an active-resistor load suffers from: (CO3,K1) 1

(a) Low gain
(b) Limited output voltage range
(c) Both Limited output voltage range and low gain
(d) None

(1.7) Op-amps are used in applications ranging from: (CO4,K2) 1

(a) Only digital logic
(b) Only high-frequency circuits
(c) DC bias generation to high-speed amplification
(d) Only power electronics

(1.8) An “ideal” op-amp is characterized by: (CO4,K2) 1

(a) Low gain and high output resistance
(b) Low input impedance and high output impedance
(c) High gain, high input impedance, low output impedance
(d) Zero gain

(1.9) In its simplest form, the comparator can be considered as: (CO5,K1) 1

(a) 2-bit A to D converter
(b) 1-bit A to D converter
(c) 1-bit D to A converter
(d) 2-bit D to A converter

(1.10) A comparator behaves like an op-amp with: (CO5,K1) 1

(a) high gain and positive feedback
(b) high gain
(c) high gain and negative feedback
(d) high gain and no negative feedback



2. Attempt all parts:-

(2.1) Define enhancement mode MOSFET. (CO1,K2) 2

(2.2) Name the different regions of operation of a MOS transistor. (CO2,K1) 2

(2.3) Why is CS amplifier called an inverting amplifier? (CO3,K2) 2

(2.4) What is nominal gain? (CO4,K2) 2

(2.5) Define VOH and VOL? (CO4,K2) 2

**SECTION-B** 30

Answer any one of the following:-

(3.1) Derive the expression for drain current in the triode region and explain the assumptions involved. (CO1,K2) 6

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(3.2) Define transconductance and derive its expression in saturation region. Discuss its dependence on drain current. (CO1,K2) 6

Answer any one of the following:-

(3.3) Explain the operation of current sink and current source with circuit diagrams. (CO2,K2) 6

(3.4) Show that the gate-source voltage of a diode-connected MOS depends on drain current. (CO2,K2) 6

Answer any one of the following:-

(3.5) Explain differential and common-mode operation in a differential amplifier. (CO3,K2) 6

(3.6) Draw and explain the small-signal model of a MOS transistor in saturation. (CO3,K2) 6

Answer any one of the following:-

(3.7) Explain the operation of a one-stage op-amp and its gain limitations. (CO4,K2) 6

(3.8) Discuss the concept of Null Port or Virtual Ground in an ideal op-amp. Explain it using a suitable circuit diagram. (CO4,K2) 6

Answer any one of the following:-

(3.9) Explain the operation of an open-loop comparator with transfer characteristics. (CO5,K2) 6

(3.10) Discuss the model for a comparator, including input-offset voltage, using the suitable circuit diagram. (CO5,K3) 6

**SECTION-C** 50

4. Answer any one of the following:-

(4.1) Discuss the operation of a MOS transistor by giving the ID-VGS and ID-VDS characteristics curves. (CO1,K2) 10

(4.2) It is required to operate the MOS shown in circuit, Fig. 2, at the edge of the saturation region with ID = 0.1 mA. If VTH = 0.4 V, find the value of RD. (CO1,K3) 10

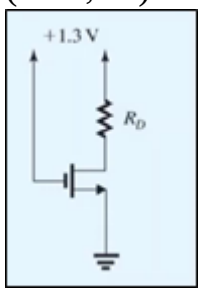


Fig. 2

5. Answer any one of the following:-

(5.1) Discuss the current sink and current source by giving the circuit diagram and their I-V characteristics. (CO2,K3) 10

(5.2) Find the relation between (W/L) of M2 and M3 with M1, shown in Fig. 3. (CO2,K3) 10

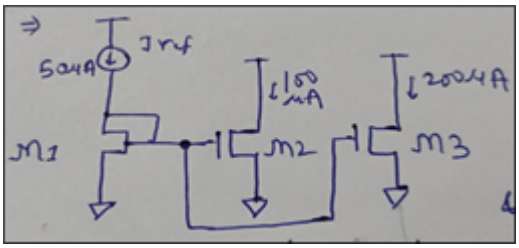


Fig. 3

6. Answer any one of the following:-

(6.1) Draw the circuit diagrams of the three different configurations for active load type CMOS amplifiers. For the PMOS load inverter, using the large-signal voltage transfer function curve, analytically demonstrate that it exhibits a limited output voltage range and low gain. (CO3,K3) 10

(6.2) Calculate the output-voltage swing limits for VDD=5 V, of Fig.7, if W1/L1 is 2μm/1μm and W2/L2 is 1μm/1μm. Data given: VT0=0.7 (nMOS) and -0.7(pMOS), k'=1100(nMOS) and 50 (pMOS). (CO3,K3) 10

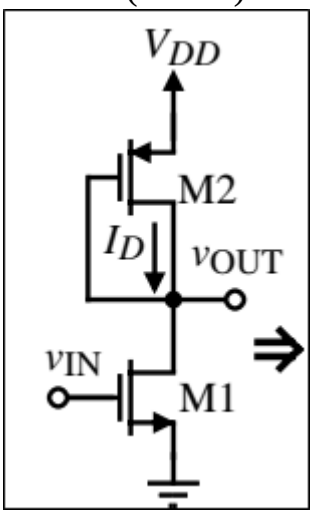


Fig. 7

7. Answer any one of the following:-

(7.1) Discuss the unity gain op-amp with the help of the circuit diagram. Derive the gain expression, also. (CO4,K3) 10

(7.2) Calculate the input common-mode voltage range and the closed-loop output impedance of the unity-gain buffer depicted in Fig. 9. (CO4,K3) 10

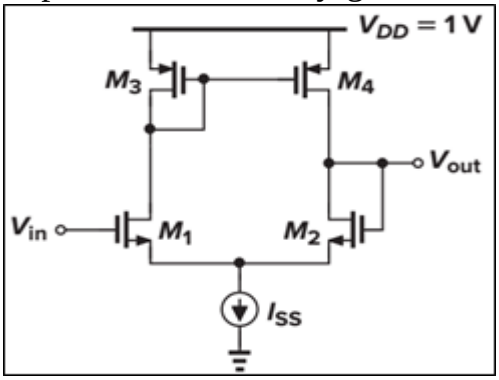


Fig. 9

8. Answer any one of the following:-

(8.1) Discuss the role of the comparator as an analog-to-digital converter. (CO5,K2) 10

(8.2) Discuss the transfer curve of a comparator with finite gain and its equivalent model. (CO5,K3) 10