

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. [CO1+CO2] [5]

(a) Explain the terms Power-Delay-Product (PDP) and Energy-delay product (EDP) (with mathematical expressions). Which of the two is a better design metric for IC designing? Justify with reason(s) [2+1]

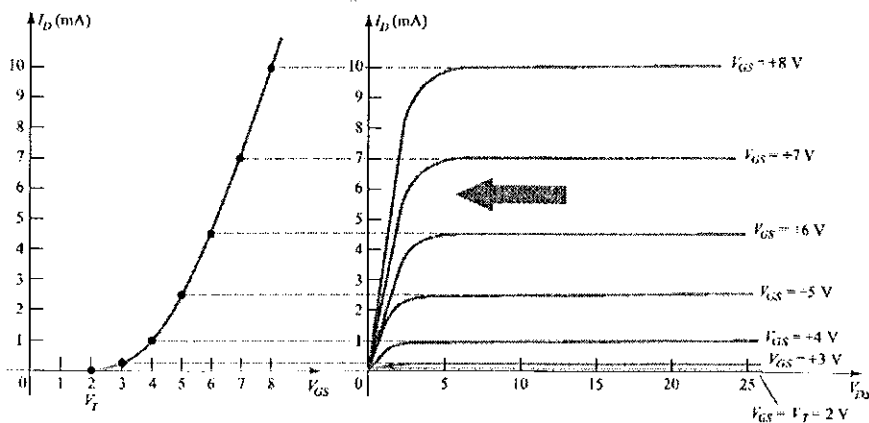
(b) What is Pinch off voltage in JFET? Explain. [1]

(c) Why MOSFETs are call as the field effect Transistors? Describe. [1]

Q2 [CO2+CO3] [4]

(a) List the differences between BJT and MOSFET. Which of the two is preferred for VLSI design and why? [2+1]

(b) In the Figure below are the Transfer characteristics of a BJT or an E MOSFET or a D-MOSFET or a JFET. [1]



Q3. [CO2+CO3] [5]

Explain the construction and working of an Enhancement type n-MOSFET with suitable diagrams while defining inversion layer and threshold voltage with suitable equations of current flow etc. Also plot the Voltage Transfer Characteristics [5]

Q4 [CO3+CO4] [2.5+2.5]

For the circuit and the VTC given below find out what will be the region of the operation of the load transistor and the driver transistor for the following values of I/P and O/P voltages.

Also find out the threshold voltage of the inverter.

V _{in}	V _{out}	Driver Operating Region	Load Operating region
V _{OL}	V _{OH}	?	?
V _{IL}	≈ V _{OH}	?	?
V _{IH}	Small (slightly greater than V _{OL})	?	?
V _{OH}	V _{OL}	?	?
V _{TH}	V _{TH}	?	?

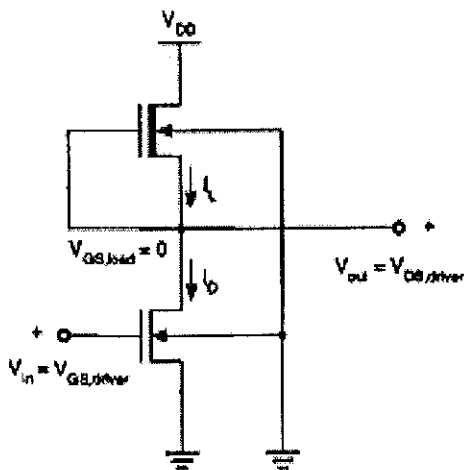


Fig 1(a)

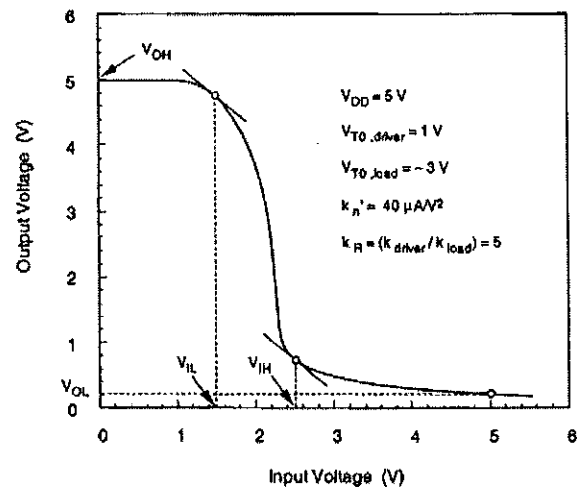


Fig 1(b)

Q5. [CO3+CO4] [6]

Consider a resistive-load inverter circuit with $V_{DD} = 5\text{ V}$, $k' = \mu_n C_{ox} = 20\ \mu\text{A}/\text{V}^2$, $V_{T0} = 0.8\text{ V}$, $R_L = 200\text{ kW}$, and $W/L = 2$. Calculate the critical voltages (V_{OL} , V_{OH} , V_{IL} , V_{IH}) on the VTC.

Also find the noise margins of the circuit. (Draw the required inverter circuit and VTC curve. You may derive expressions and then use them).