

G.R. No.

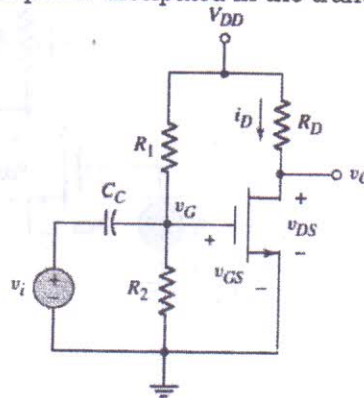
Paper Code - U218-134 (T2)

OCTOBER 2018/IN-SEM (T2)**S. Y. B. TECH. (E&TC) (SEMESTER - I)****COURSE NAME: SEMICONDUCTOR DEVICES & CIRCUITS****COURSE CODE: ETUA21174****(PATTERN 2017)****Time: [1 Hour]****[Max. Marks: 30]****(*) Instructions to candidates:**

- 1) Answer Q.1 OR Q.2, Q.3 OR Q.4
- 2) Figures to the right indicate full marks.
- 3) Use of scientific calculator is allowed
- 4) Use suitable data where ever required

Q1 a) Consider an n-channel enhancement-mode MOSFET with the following parameters: $V_{TN} = 0.4$ V, $W = 20$ μm , $L = 0.8$ μm , $\mu_n = 650$ $\text{cm}^2/\text{V-s}$, $t_{ox} = 200$ \AA , and $\epsilon_{ox} = 34.52 \times 10^{-14}$ F/cm. Determine the drain current when the transistor is biased in the saturation region for (a) $v_{GS} = 0.8$ V and (b) $v_{GS} = 1.6$ V. [6]

b) For the circuit shown in figure, assume that $R_1 = 30$ k Ω , $R_2 = 20$ k Ω , $R_D = 20$ k Ω , $V_{DD} = 5$ V, $V_{TN} = 1$ V, and $K_n = 0.1$ mA/V². Calculate the drain current and drain-to-source voltage of a common source circuit with an n-channel enhancement-mode MOSFET. Find the power dissipated in the transistor. [6]

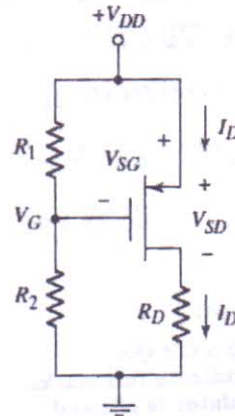


c) Explain working of n-channel E-MOSFET with the help of neat cross-sectional view diagram. [4]

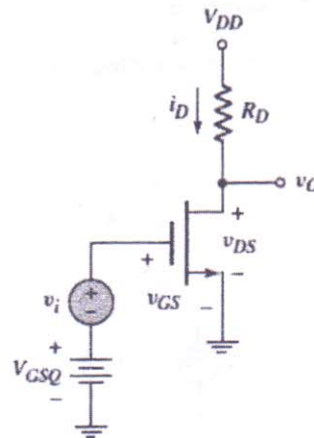
OR

Q2 a) The parameters of an NMOS enhancement-mode device are $V_{TN} = 0.25$ V and $K_n = 10$ $\mu\text{A}/\text{V}^2$. The device is biased at $V_{GS} = 0.5$ V and $V_{DS} = 1.2$ V. Calculate the drain current for (a) $\lambda = 0$ and (b) $\lambda = 0.03$ V⁻¹. (c) Calculate the output resistance r_o for parts (a) and (b). [6]

- b) The transistor in figure has parameters $V_{TP} = -0.6$ V and $K_p = 0.2$ mA/V². The circuit is biased at $V_{DD} = 3.3$ V. Assume $R_1 \parallel R_2 = 300$ k Ω . Design the circuit such that $I_{DQ} = 0.5$ mA and $V_{SDQ} = 2.0$ V. [6]



- c) What is body effect in MOSFET? Explain with the help of diagram and equation. [4]
- Q3 a) Determine the small-signal voltage gain of the circuit shown in figure below. Given parameters are: $V_{GSQ} = 2.12$ V, $V_{DD} = 5$ V, and $R_D = 2.5$ k Ω . Assume transistor parameters are: $V_{TN} = 1$ V, $K_n = 0.80$ mA/V², and $\lambda = 0.02$ V⁻¹. Assume the transistor is biased in the saturation region. [6]

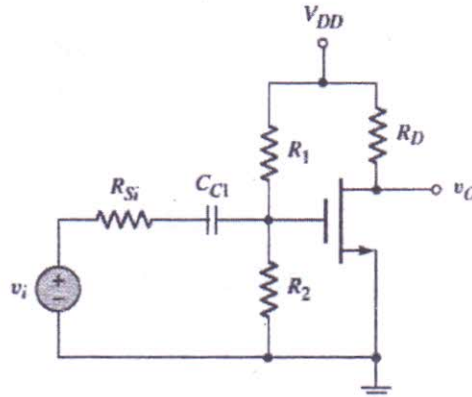


- b) What is transconductance? Derive the expression for transconductance. [4]
- c) Calculate the transconductance of an n-channel MOSFET. Consider an n-channel MOSFET with parameters $V_{TN} = 0.4$ V, $k'_n = 100$ μ A/V², and $W/L = 25$. Assume the drain current is $I_D = 0.40$ mA. [4]

OR

- Q4 a) Determine the small-signal voltage gain and input and output resistances of a common-source amplifier shown in figure. The [6]

parameters are: $V_{DD} = 3.3 \text{ V}$, $R_D = 10 \text{ k}\Omega$, $R_1 = 140 \text{ k}\Omega$, $R_2 = 60 \text{ k}\Omega$, and $R_{Si} = 4 \text{ k}\Omega$. The transistor parameters are: $V_{TN} = 0.4 \text{ V}$, $K_n = 0.5 \text{ mA/V}^2$, and $\lambda = 0.02 \text{ V}^{-1}$.



- b) Draw small-signal AC equivalent circuit of common-source amplifier with NMOS transistor with the help of neat diagram and explain it. [4]
- c) Determine the small-signal voltage gain of a PMOS transistor circuit shown in figure below. The transistor parameters are $K_p = 0.80 \text{ mA/V}^2$, $V_{TP} = -0.5 \text{ V}$, and $\lambda = 0$. The quiescent drain current is found to be $I_{DQ} = 0.297 \text{ mA}$. [4]

