

Analog Electronic Circuits  
 Department of Electrical and Computer Engineering  
 Seoul National University

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Quiz #2

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Student ID number :

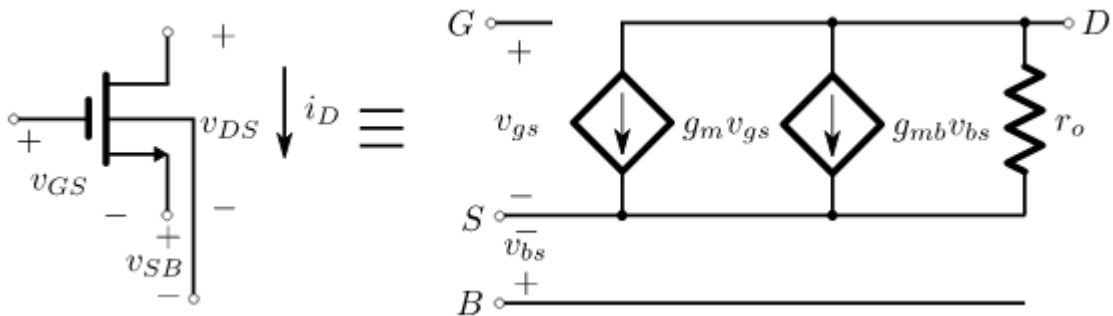
Student name :

Using specifications and parameters below, answer the following questions.

(Q) When there is the voltage difference between the source and the bulk(as shown in the figure), the threshold voltage changes which is called as “Body Effect”. Use the equation below, and answer the following questions. For the simplicity, all transistors we are talking about are NMOSs.

$$V_{th} = V_{th0} + \gamma(\sqrt{2\phi_F + V_{SB}} - \sqrt{2\phi_F}) \quad (\gamma, \phi_F \text{ are constant})$$

Derive  $g_{mb}$  of a new small signal model which includes “Body Effect” in terms of  $g_m$ .



(A)