RAMA UNIVERSITY

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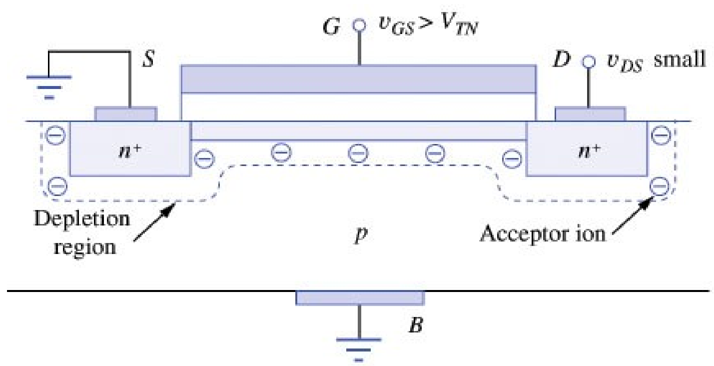
FACULTY OF ENGINEERING AND TECHNOLOGY

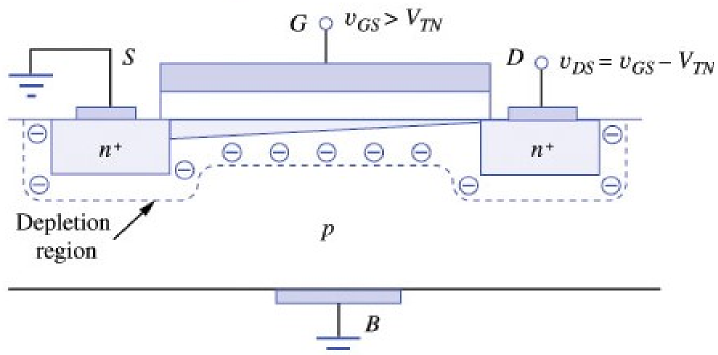
MEC-022

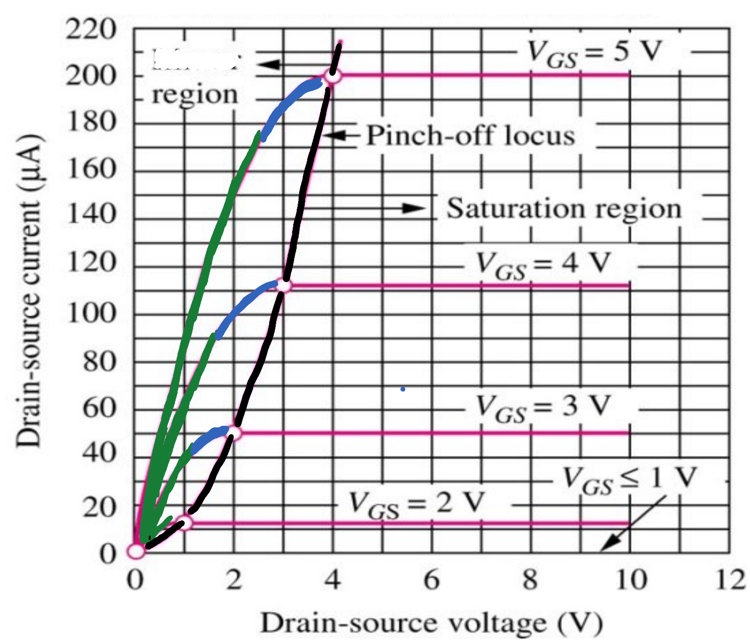
Lecture - 08

NMOS Transistor: Region Summary



- If $v_{DS} << V_{GS} - V_{TN}$ MOSFET is **in linear portion of the triode region**
- If $v_{DS} < V_{GS} - V_{TN}$ MOSFET is in **quadratic portion of the triode region**





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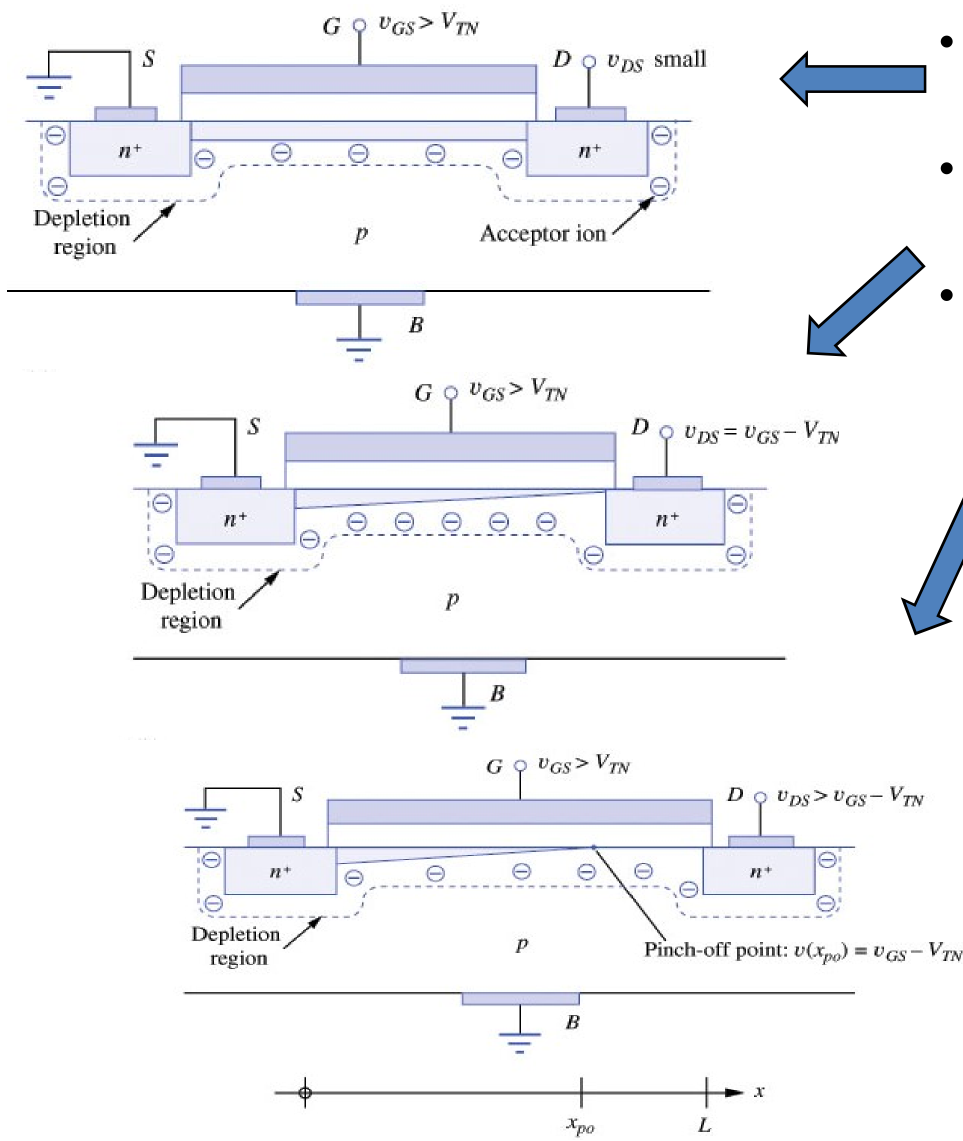
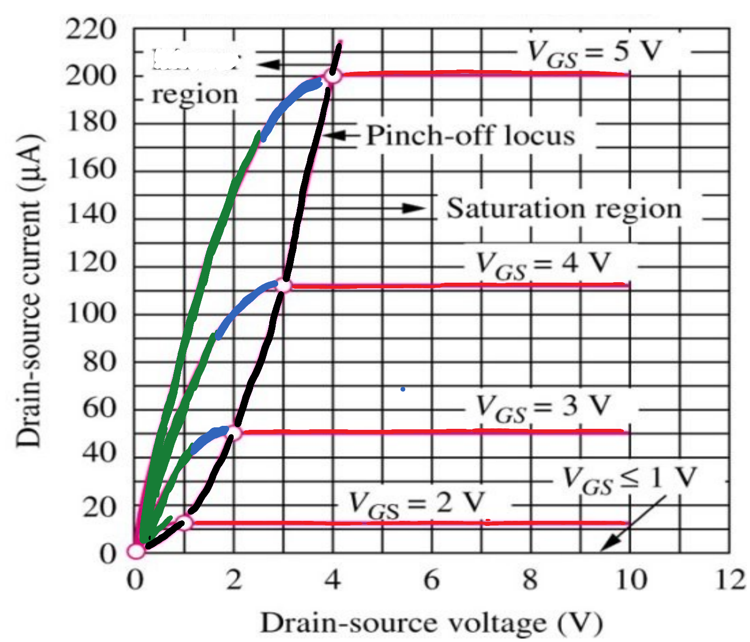


- If $v_{DS} << V_{GS} - V_{TN}$ MOSFET is in **linear portion of the triode region**
- If $v_{DS} < V_{GS} - V_{TN}$ MOSFET is **in quadratic portion of the triode region**
- If $v_{DS} < V_{GS} - V_{TN}$ MOSFET is in **saturation region** and current saturates at (almost) constant value, independent of v_{DS}.



Discuss how to build the *iv* graph

Transconductance of a MOS Device

- Transconductance is the important characteristics that relates the change in drain current to a change in gate-source voltage

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- The larger the device transconductance, thmore gain we can expect from the e amplifier that uses the transistor.

- Transconductance is inverse to the R_{on} defined earlier and slightly differently.

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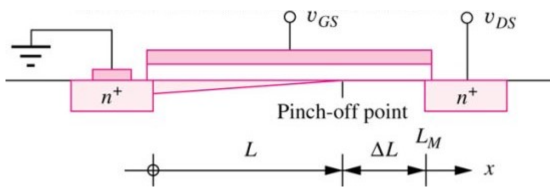
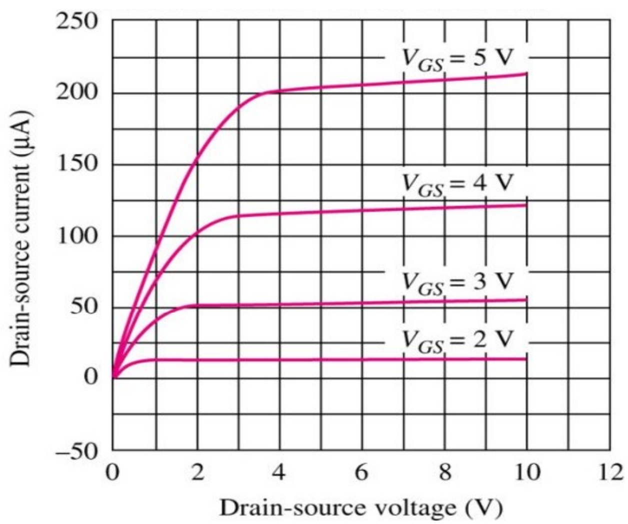
Channel-Length Modulation





- On the previous *iv*-characteristics, the saturation part was horizontal (the current was constant, as v_{DS} increases). However, it's not exactly so.
- As v_{DS} increases above v_{DSAT}, length of depleted channel beyond pinch-off point, ∆L, increases and actual L decreases.
- Since *L* is in denominator of the current expression, it compensate slightly the general increase of resistivity, which normally makes the curve flat.
- As a result, i_D increases slightly with v_{DS} instead of being constant and we can rewrite equation in the form:

$$i_D = \frac{K'_n}{2}\frac{W}{L}\left(v_{GS} - V_{TN}\right)^2 \Rightarrow i_D = \frac{K_n'}{2}\frac{W}{L}\left(v_{GS} - V_{TN}\right)^2\left(1 + \lambda v_{DS}\right)$$


Thank You!