# Universal coefficient theorem

**Theorem 1.** *Let $P$ be a flat complex with each $d(P_n)$ flat. Then for all $R$-modules $M$ we have a short exact sequence*

$$0 \to H_n(P) \otimes M \to H_n(P \otimes M) \to Tor_1(H_{n-1}(P), M) \to 0$$

***Proof*** (proof goes here) ■

**Theorem 2.** *Let $P$ be a flat complex with each $d(P_n)$ flat and let $Q$ be any chain complex. Then we have a short exact sequence*

$$0 \to (H_*(P) \otimes H_*(Q))_n \to H_n(P \otimes Q) \to \bigoplus_{p+q=n-1} Tor_1(H_p(P), H_q(Q)) \to 0$$

***Proof*** Same idea as above. ■