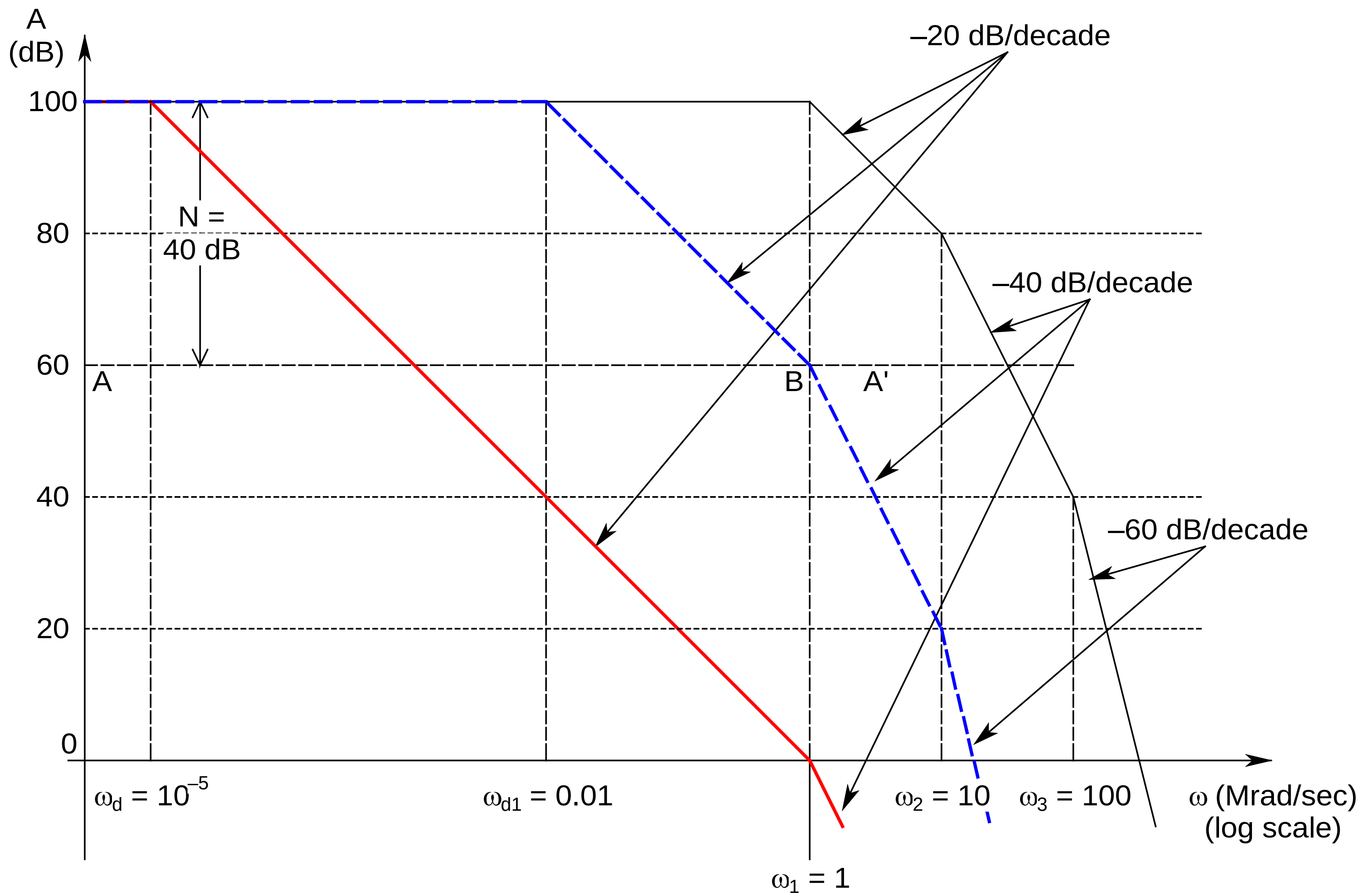
- ***Two widely used methods***:
  - ***Dominant Pole Compensation*** (***DPC***)
  - ***Pole Zero Compensation*** (***PZC***)
- ***Dominant Pole Compensation (DPC)***:
  - This technique introduces a ***dominant pole*** (***DP***) into the system
  - Also known as ***Miller Compensation Scheme***
  - This ***DP*** is chosen such that the ***compensated gain characteristic*** meets the ***first pole*** of the ***uncompensated system*** at ***0 dB***, with a ***slope*** of ***–20 dB/decade***

- This will make the system ***unconditionally stable***, i.e., the ***stability*** of the system will be ***independent*** of the the ***amount of feedback***
- ***Example***:
  - Assume A = 10^5 (100 dB), ω_1 = 1 Mrad/sec, ω_2 = 10 Mrad/sec, ω_3 = 100 Mrad/sec
  - Refer to the slide on the next page
  - For ***unconditional stability***:
    - Refer to the ***red line***
    - The ***compensated transfer function*** should meet the ***first pole*** (ω_1) of the ***uncompensated system*** at ***A = 0 dB*** with a ***slope*** of ***–20 dB/decade***



Normal Line: Open-loop system
Red Line: Compensated system for unconditional stability
Blue Line: Compensated system with conditional stability
(till a feedback of 40 dB)

- To construct the ***compensation characteristic***, ***start at ω_1*** and ***go back 5 decades*** (= 100/20)
- ***Ends up at the DP frequency (ω_d) of 10 rad/sec***
- ***Note that in between ω_d and ω_1, the system behaves as if it has a single-pole transfer function***
- The ***total phase*** of the system at ω_1 will be ***–135°*** [***–90° due to the pole at ω_d***, and ***–45° due to the pole at ω_1*** (***since ω_2 is ten times away from ω_1***, the ***phase due to ω_2 is yet to start at this point***)]
- Thus, the ***PM of the compensated system will be 45°***
- This implies a ***stable system***, since the ***PM is positive***
- Note that ***if ω_2 and ω_1 were closer than 10 times***, the ***PM would have been less than 45°***, but ***still positive***, and thus, ***would have retained the stable nature of the system***

- Note that in order to achieve ***unconditional stability*** of the system, the ***bandwidth*** has ***reduced drastically*** from ***1 Mrad/sec*** to only ***10 rad/sec***!
- ***This is the most severe limitation of the DPC technique***

- ***For conditional stability***:
  - The ***previous compensation scheme*** ensured ***system stability*** for f all the way ***up to unity*** (corresponding to the ***amount of feedback*** of ***100 dB***, i.e., the ***entire output is fed back to the input***)
  - In some cases, it may be an ***overkill***, if it is known ***a priori*** that the ***entire output*** will ***NOT*** be ***fed back*** to the ***input***, ***rather only a part of it***
  - This is what is known as ***conditional stability***
  - Suppose that the ***maximum amount of feedback*** that the system would have is ***40 dB***