- Under ***application*** of an ***ac signal*** (v_i), the ***dynamic operating point*** (DOP) will ***move along the load line***
- For ***positive*** v_i, the DOP ***will move*** Q ***towards saturation*** ($V_{CE} \rightarrow 0$, $I_C \rightarrow I_{C,max}$)
  - The ***output signal*** (v_0) will be in its ***negative excursion***
  - If Q enters ***saturation***, ***negative peak*** of v_0 will get ***clipped***
  - ***Distorted output***

- For ***negative*** v_i, the DOP ***will move*** Q ***towards cutoff*** ($V_{CE} \to V_{CC}$, $I_C \to 0$)
  - The ***output signal*** (v_0) will be in its ***positive excursion***
  - If Q ***cuts off***, ***positive peak*** of v_0 will get ***clipped***
  - ***Distorted output***
- ***Golden rule of thumb for BJT biasing***:
  - ***To get maximum undistorted peak-to-peak swing of v_0, Q-point must be chosen to be at the middle of the load line***

- ***Role of R_C***:
  - Under ***FA mode***, ***R_C does not control I_C***, however, it ***changes V_{CE}*** ($= V_{CC} - I_C R_C$)
  - If $R_C \uparrow$, $V_{CE} \downarrow \Rightarrow$ Q moves ***towards saturation***
  - If $R_C \downarrow$, $V_{CE} \uparrow \Rightarrow$ Q moves ***towards cutoff***
  - Thus, ***different values of R_C*** can produce ***different Q-points*** (***in terms of V_{CE}***)
- ***DC Power Dissipation***:
  - $P_D = V_{BEQ} \times I_{BQ} + V_{CEQ} \times I_{CQ}$
    $\approx V_{CEQ} \times I_{CQ}$ (***under FA mode***)

Some Observations

- Q should be ***biased*** such that it is in the ***FA*** mode of operation
  - Behaves like a ***constant and ideal current source with infinite output resistance***, since I_C is ***independent*** of V_{CE}
  - ***Ideal region to bias a BJT***
- For ***very high*** R_C, $I_{C,max}$ ***very small***
  - ***Load line may not have any intersection point in the FA region at all***

- ***Q-point moves to saturation region***
- ***Ceases to become a constant current source***, since in ***saturation***, I_C becomes a ***strong function*** of V_{CE}
- ***Disastrous way of biasing a BJT***

- ***Similar situation*** will arise if R_C is ***very small***
  - $I_{C,max}$ will become ***very large*** and ***Q-point will move towards cutoff***
  - ***Another disastrous way of biasing a BJT***

- **Example**: Let $V_{CC} = V_B = 5$ V, $R_B = 430$ kΩ, and $\beta = 100$
  - ➢ $I_B = (V_B - V_{BE})/R_B = (5 - 0.7)/(430\ \text{k}\Omega) = 10$ μA (assuming ***FA*** mode of operation with $V_{BE} = 0.7$ V)
  - ➢ $I_C = \beta I_B = 1$ mA
  - ➢ V_{CE} will ***depend*** on our ***choice*** of R_C
  - ➢ R_C for ***best biasing*** (BB) ($V_{CE}(BB) = V_{CC}/2$):
    - ▪ $R_C(BB) = V_{CC}/(2I_C) = 2.5$ kΩ
  - ➢ R_C that puts Q at OS (VCE(OS) = 0.7 V):
    - ▪ $R_C(OS) = [V_{CC} - V_{CE}(OS)]/I_C = 4.3$ kΩ

- ***Any value of R_C higher than 4.3 kΩ would push Q in saturation***
- Choose R_C = 20 kΩ:
  - Assuming ***FA*** operation is maintained, V_{CE} comes out to be –15 V!
  - ***Golden rule***:
    - ***Potential at any point in a circuit can never go beyond the positive and negative extremes of the power supply voltages, unless there is a power source within the circuit***
  - Thus, V_{CE} = –15 V is ***absurd***
  - Hence, Q is ***no more*** in the ***FA*** mode of operation, rather it has been pushed into ***saturation***