



SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19ECB201-ANALOG ELECTRONIC CIRCUITS

II YEAR /III SEMESTER

Unit 4- OSCILLATORS & MULTIVIBRATOR CIRCUITS

Topic 7 : Astable multivibrator



Multivibrators



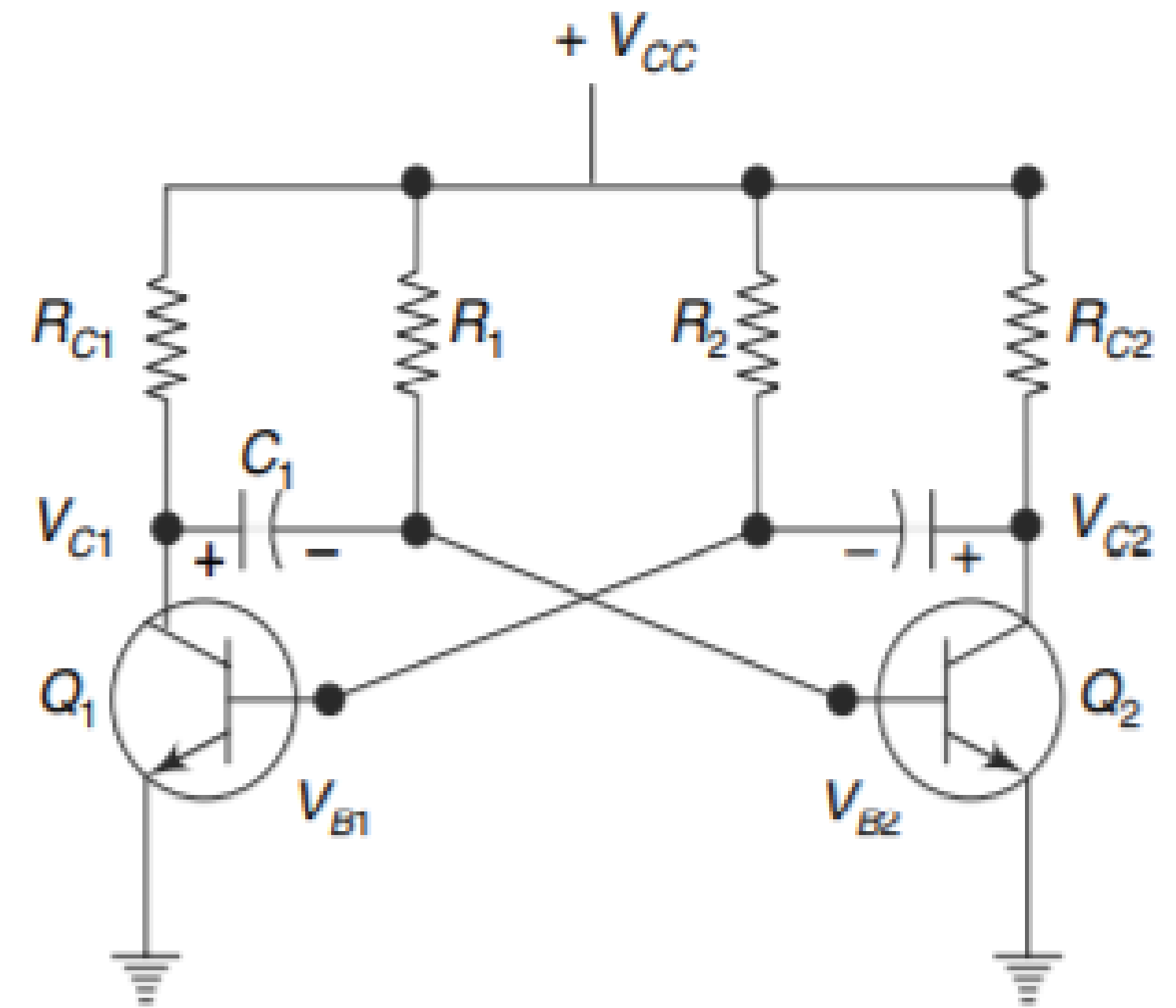
- Multivibrators are two-stage switching circuits in which the output of the first stage is fed to the input of the second stage and vice-versa.
- The outputs of two stages are complementary.
- Multivibrators are of three types, namely,
 - (i) Astable multivibrator,
 - (ii) Bistable multivibrator, and
 - (iii) Monostable multivibrator.



Collector Coupled Astable Multivibrator



- The astable or free running multivibrator generates square wave without any external triggering pulse.
- It has no stable states, i.e. it has two quasi stable states.

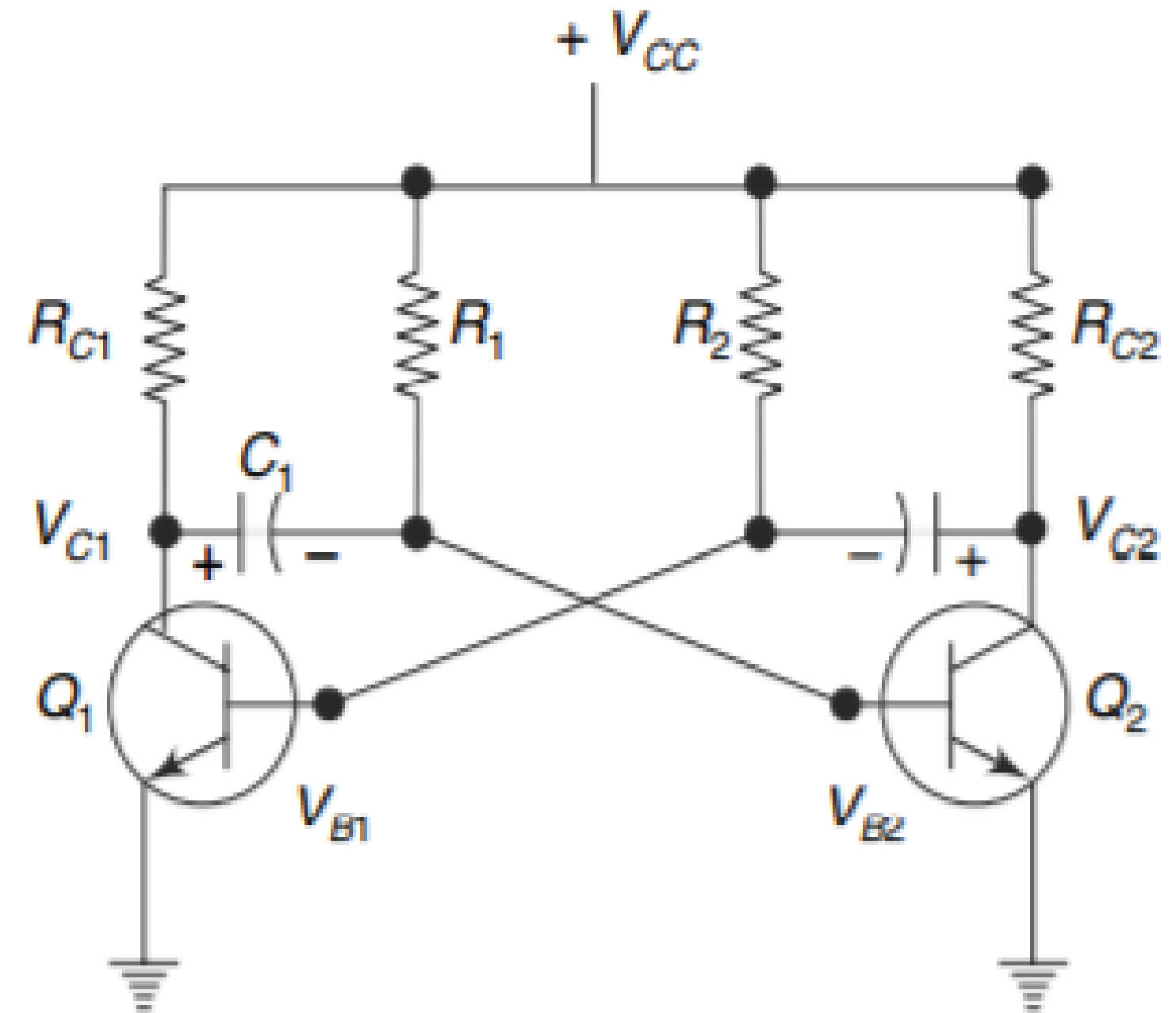




Collector Coupled Astable Multivibrator



- It switches back and forth from one state to the other, remaining in each state for a time depending upon the discharging of a capacitive circuit.





Working of Astable Multivibrator



- When the supply voltage $+V_{CC}$ is applied, one transistor will conduct more than the other due to some circuit imbalance.
- Initially, let us assume that Q1 is conducting and Q2 is cut-off.
- Then V_{C1} , the output of Q1 is equal to $V_{CE(sat)}$, i.e. approximately zero volt and $V_{C2} = +V_{CC}$.
- At this instant, C1 charges exponentially with a time constant R_1C_1 towards the supply voltage through R1 and correspondingly V_{B2} also increases exponentially towards V_{CC} .



Working of Astable Multivibrator



- When V_{B2} crosses the cut-in voltage, $Q2$ starts conducting and V_{C2} falls to $V_{CE(sat)}$.
- Also, V_{B1} falls due to capacitive coupling between collector of $Q2$ and base of $Q1$, thereby driving $Q1$, into OFF state.
- Now, the rise in voltage V_{C1} is coupled through $C1$ to the base of $Q2$, causing a small overshoot in voltage V_{B2} .
- Thus $Q1$ is OFF and $Q2$ is ON.
- At this instant, the voltage levels are: V_{B1} is negative, $V_{C1} = V_{CC}$, $V_{B2} = V_{BE(sat)}$ and $V_{C2} = V_{CE(sat)}$.



Working of Astable Multivibrator



- When Q1 is OFF and Q2 is ON, the voltage V_{B1} increases exponentially with a time constant R_2C_2 towards V_{CC} .
- Therefore, Q1 is driven into saturation and Q2 is cut-off.
- Now, the voltage levels are: $V_{B1} = V_{BE}(\text{sat})$, $V_{C1} = V_{CE}(\text{sat})$, V_{B2} is negative and $V_{C2} = V_{CC}$.



Working of Astable Multivibrator



- It is clear that when Q2 is ON, the falling voltage V_{C2} permits the discharging of the capacitor C2 which drives Q1 into cut-off.
- The rising voltage of V_{C1} feeds back to the base of Q2 tending to turn it ON.
- This process is said to be regenerative.



Time Period Calculation

ON time for Q_2 is $T_2 = 0.693 R_2 C_2$

ON time T_1 for Q_1 can be expressed as $T_1 = 0.693 R_1 C_1$

Therefore, the total period of the waveform is

$$T = T_1 + T_2 = 0.69 (R_1 C_1 + R_2 C_2)$$

If $R_1 = R_2 = R$ and $C_1 = C_2 = C$, we have a symmetrical multivibrator, with outputs at the two collectors having the same waveforms but out of phase with each other.

Therefore, $T = 1.386 RC$ and $f = \frac{1}{T} = \frac{1}{1.386 RC}$



Applications of Astable Multivibrator



- The astable multivibrator is used as square wave generator, voltage to frequency convertor and in pulse synchronisation, as clock for binary logic signals, and so on.
- Since it produces square waves, it is a source of production of harmonic frequencies of higher order.
- It is used in the construction of digital voltmeter and SMPS.
- It can be operated as an oscillator over a wide range of audio and radio frequencies.



References



Electronic Devices and Circuits By Salivahanan

Thank You