Time: 1 hour   **Max. marks:** 15

There is a choice between Qns 1&2, 4&5, 7&8. Other questions are compulsory.

1. For the emitter follower shown below, the signal is directly coupled to the base. If the DC component of v_{sig} is 0, find the DC emitter current. Assume $\beta = 100$, $V_T = 25$ mV, $V_{EB} = 0.7$V. Neglecting r_o, find R_{in}, and the output resistance R_{out}. (5 marks)
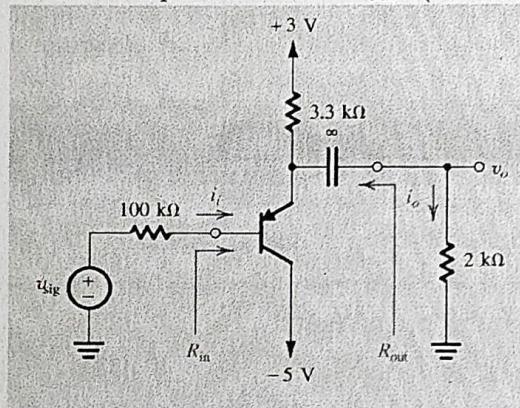

OR

2. Consider the circuit provided below. $V_t = 0.7$V. Let $I_D = 0.5$ mA and $V_{OV} = 0.3$ V.
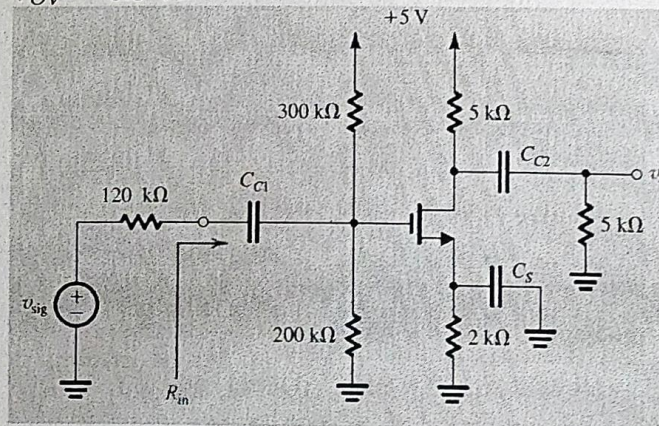
If $C_{gs} = 1$ pF and $C_{gd} = 0.6$pF, what are the two high frequency poles (one at the input and the other at the output) of this amplifier? You may use Miller approximation. Assume that C_{C1}, C_{C2} and C_S are large enough to not affect the high frequency response. (5 marks)

3. The following figure shows the input referred noise voltage power spectral density of OP196 (a commercial opamp). Which type of noise is dominant in the frequency regions denoted as A and B? (1 mark)
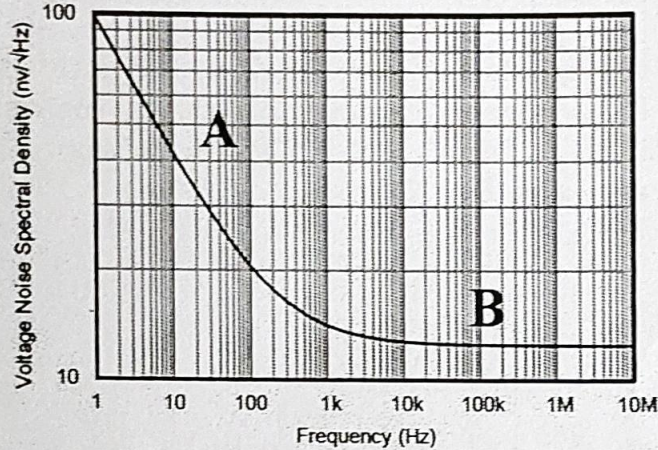

4. Draw the circuit and derive the threshold values of a non-inverting Schmitt trigger using an opamp. (5 marks)

OR

5. The astable multivibrator circuit using a 555 timer is shown below. Find the values of R_A and R_B if $C = 0.1$ μF for generating a square wave of 1 KHz with a duty cycle of 70%. (5 marks)

2
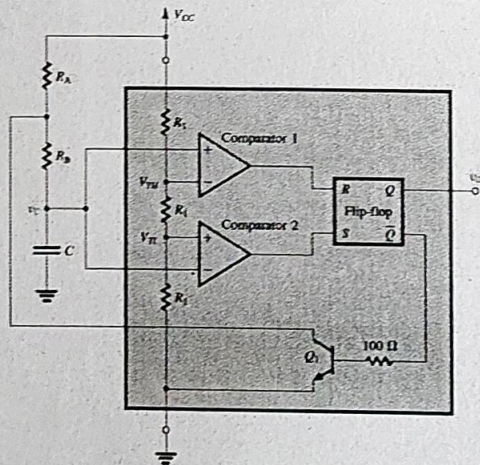
6. Consider the circuit given below, which is designed to provide a constant current of 2 mA to the load R_L, which is functional with V_{DD} variations. The Zener voltage is 1.2 V. $V_{DD} = 15V$.
Mark the correct polarity of the opamp terminals. (1 mark)
What is the value of the resistor R for this circuit to function correctly? (1 mark)
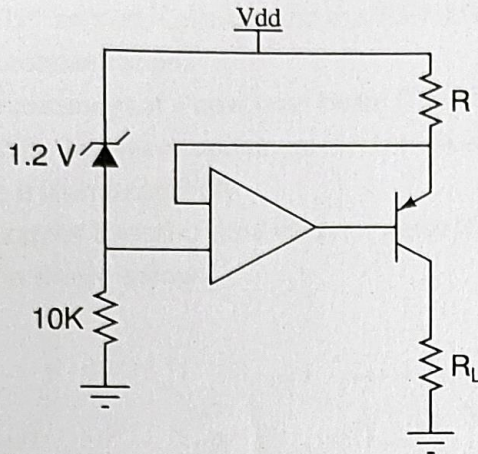
7. An opamp has an open-loop voltage gain of 100 dB with a unity gain frequency of 8 MHz when driving a given load capacitance. This opamp is used with feedback as a non-inverting amplifier to obtain a closed loop gain of 40 dB while driving the same load capacitance. What is the 3-dB bandwidth of this non-inverting amplifier? (2 marks)

OR

8. A negative feedback amplifier has a closed loop gain of $A_f = 100$ and an open loop gain of $A = 10^5$. What is the feedback factor? If a manufacturing error results in a reduction of A to 10^4, what is the closed loop gain? What is the percentage change in A_f? (2 marks)