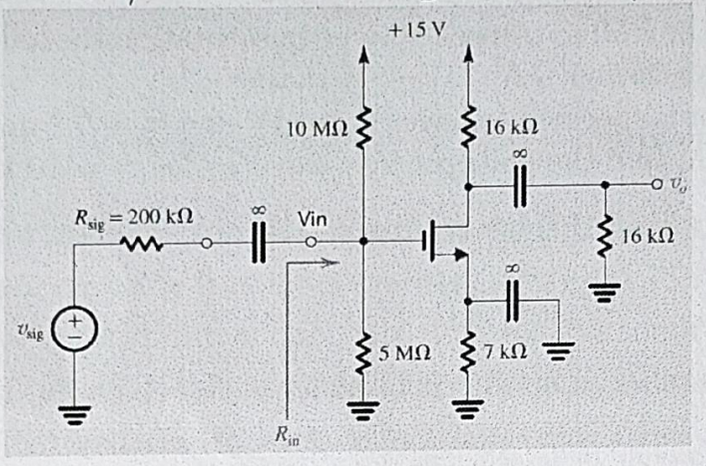
Indian Institute of Space Science and Technology
Department of Avionics
AV 211 Analog Electronic Circuits
Quiz 1

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

Answer all the questions

1. For the circuit given below, the transistor $V_{TH} = 1$V, $k_n = \mu_n C_{ox} W/L = 4$ mA/V^2. The current $I_D = 0.5$ mA. (7 marks)



   (a) What is the V_{GS} required by the transistor? (1 mark)

   (b) What is the transconductance of the transistor (g_m)? (1 mark)

   (c) What is the input impedance of the amplifier R_{in}? (1 mark)

   (d) Draw the complete small signal equivalent circuit for the given amplifier (1 mark)

   (e) Derive and calculate the small signal voltage gain $\frac{v_o}{v_{in}}$ (2 marks)

   (f) Derive and calculate the small signal overall voltage gain $\frac{v_o}{v_{sig}}$ (1 mark)

2. You are required to design a common base amplifier. The circuit is given a unipolar supply of +15 V and GND (0V). The amplifier is required to match a TV cable of characteristic impedance 75 Ω. In other words, the input impedance of the amplifier is required to be equal to that of the characteristic impedance of the TV cable. (5 marks)

   (a) Draw the full circuit of your amplifier, including biasing arrangements. You do not need to provide the resistor values at this point. (1 mark)

(b) Draw the small signal equivalent circuit and derive the small signal input impedance of your amplifier (take necessary approximations with justification). (1.5 marks)

(c) What is the value of DC collector current that is required to ensure that the required input impedance is achieved? You can take V_T = 25 mV. (1 mark)

(d) If the collector resistor is 20 K Ω, what is the small signal voltage gain? (1.5 mark)

3. For the circuit shown below, (3 marks)
(a) Show that for the PMOS transistor to be in saturation the following condition must be satisfied: $IR \leq |V_{tp}|$. (1 mark)
(b) If the transistor is specified to have $|V_{tp}| = 1$V and $k_p = 0.2$ mA/V^2, and for $I = 0.1$mA, find the voltages V_{SD} and V_{SG} for $R = 10$ kΩ. (2 marks)