ID:	Sec:	Name:

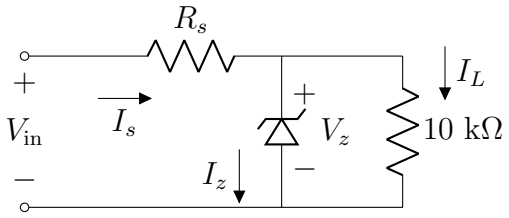
Brac University

Set: 02

Semester: Spring 2022 | Final
Course No: CSE251 | Full Marks: 40
Course Title: Electronic Devices and Circuits | TIme: 2 hours
Section: 1 to 14 | Date: May 13, 2022

Answer all 4 questions. All the questions carry equal marks.

Question 1 [CO1, CO2] 10



In the circuit, the input voltage V_{in} has a nominal voltage of 10 V with a fluctuation of ±10%. The Zener diode in the circuit is specified with parameter $V_z = 5.75$ V at $I_z = 5$ mA, $r_z = 0.05$ kΩ, and $I_{\text{zk}} = 0.3$ mA.

(a) **Compute** the Zener diode parameter V_{z_0}. [2]

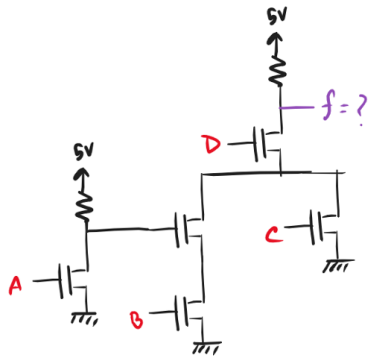
(b) **Identify** the worst-case conditions and **calculate** the Zener current (I_z), Zener voltage (V_z), and the input voltage in this worst-case scenario. [1+1+1+1]

(c) **Calculate** the load current I_L and the source current I_s in the worst-case conditions. [2]

(d) **Design** the circuit, i.e., find the value of R_s, such that even in the worst-case scenario voltage regulation is maintained. [2]

Question 2 [CO3, CO4] 10

(a) **Analyze** the circuit below to find an expression of f in terms of *boolean* inputs A, B, C, D, and E. [3]



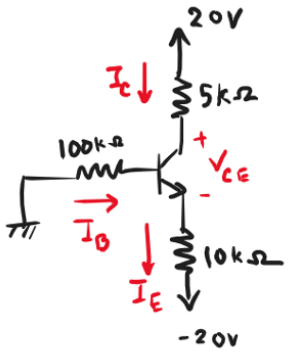
Set: 2

(b) **Design** a circuit using ideal BJTs (S-model) to implement the logic function $f = \overline{AC + \overline{(B + D)}}$ [2]

(c) **Show** (draw) and **label** the circuit diagram of a MOSFET common-source small-signal amplifier. **Describe** its operation in short in the saturation region. [2+2]

Question 3 [CO1, CO4] 10

Analyze the following circuit to find the values of I_B, I_C, I_E, and V_{CE}. Here, **use** the Method of Assumed State. You must **validate** your assumptions. [7 + 3]



$V_{BE(ACTIVE)} = 0.7V$

$V_{BE(SAT)} = 0.8V$

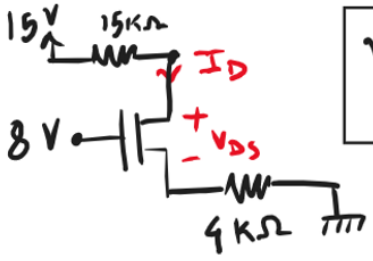
$V_{CE(SAT)} = 0.2V$

$\beta = 100$

$\alpha = 0.99$

Question 4 [CO1, CO4] 10

Analyze the following circuit to find the values of I_D and V_{DS} **using** the Method of Assumed State. You must **validate** your assumptions. [7 + 3]
Hint: Use I_D as unknown x. Use Ohm's law to represent V_D and V_S in terms of x.



$V_T = 1V$

$k_n' = 4mA/V^2$

For MOSFET

$$I_D = 0, \text{ if } V_{GS} < V_T$$

$$I_D = k_n' \left[(V_{GS} - V_T) V_{DS} - \frac{1}{2} V_{DS}^2 \right], \text{ if } V_{GS} \geq V_T \text{ and } V_{DS} < (V_{GS} - V_T)$$

$$I_D = \frac{1}{2} k_n' (V_{GS} - V_T)^2, \text{ if } V_{GS} \geq V_T \text{ and } V_{DS} \geq (V_{GS} - V_T)$$