

## Brac University

Semester: Spring 2025

Course Code: CSE251

Electronic Devices and Circuits

Section: 01-30

Set
02

Assessment: *Final Exam*

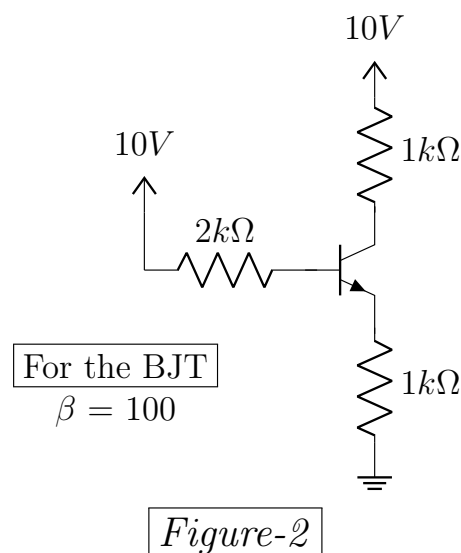
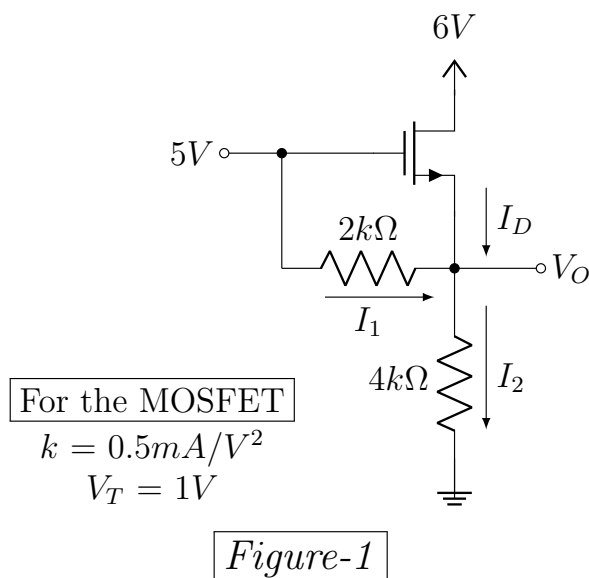
Duration: 1 hour 30 minutes

Date: 18 May, 2025

Full Marks: 50

===== Answer all questions =====

### ■ Question 1 [CO2] [20 marks]



- (a) [2 marks] **Analyze** the circuit in *Figure-1*, and **show** that, the MOSFET will operate in Saturation mode if it conducts current. [Hint: You don't need to solve the circuit]
- (b) [6 marks] **Analyze** the circuit in *Figure-1*, and **calculate**  $V_O$ ,  $I_1$ ,  $I_2$  &  $I_D$  using the method of assumed states. You must **validate** your assumption.

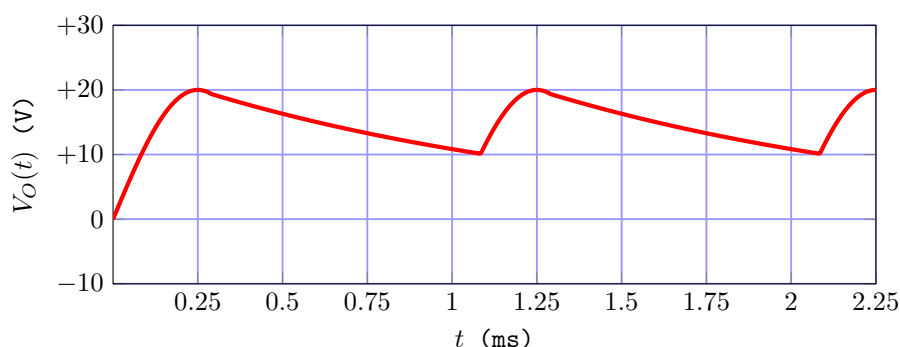
#### Equations of MOSFET

**Cut-off Mode:**  $I_D = 0$

**Triode Mode:**  $I_D = k [(V_{GS} - V_T)V_{DS} - \frac{1}{2}V_{DS}^2]$

**Saturation Mode:**  $I_D = \frac{1}{2}k(V_{GS} - V_T)^2$

- (c) [8 marks] **Analyze** the circuit in *Figure-2*, and **calculate**  $I_B$ ,  $I_C$ ,  $I_E$ ,  $V_C$  &  $V_E$  using the method of assumed states. You must **validate** your assumption.
- (d) [4 marks] **Analyze** the graph of the output voltage waveform of a rectifier circuit in *Figure-3*, and **calculate** the output frequency,  $f_{out}$  & average output voltage,  $V_{avg}$  (i.e. dc value of the output voltage,  $V_{dc}$ ).



*Figure-3*

**■ Question 2 [CO3] [20 marks]****Specifications**

- $V_{in} = 10\sin(200\pi t)$
- $f_{out} = 100\text{Hz}$
- $V_{D0} = 0.7\text{V}$
- $V_{r(p-p)} = 10\% \text{ of } V_{out(max)}$

- (a) [10 marks] **Analyze** the specifications given above, and **design** a rectifier circuit according to the specifications (i.e. **determine** the appropriate values of the rectifier components). **Assume** any value if necessary. Now, **draw** the designed circuit.
- (b) [10 marks] **Design** a circuit with boolean inputs A, B, and C using MOSFETs to implement the boolean logic function,

$$f = \overline{C}.A + \overline{A}.B + \overline{B}.C$$

**■ Question 3 [CO1] [10 marks]**

- (a) [4 marks] If  $V_{in}$  and  $V_{out}$  are the input and output voltages of a Half-Wave rectifier respectively with a cut-in voltage of  $V_{D0}$  for the diode, **write** an equation relating  $V_{out}$ ,  $V_{in}$ , and  $V_{D0}$ . Now, **draw** the Voltage Transfer Characteristics (VTC) graph of the rectifier and **label** the graph properly.
- (b) [2 marks] “BJTs can be used as electronic switches” - **Explain** the statement briefly.
- (c) [4 marks] **Draw** the I-V characteristics graph of a MOSFET. **Label** the graph properly and **identify** the different operating regions in the graph.