AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering
Program: B.Sc. in Computer Science and Engineering
Semester Final Examination: Spring 2020
Year: 2nd Semester: 2nd
Course Number: CSE2209
Course Name: Digital Electronics and Pulse Techniques

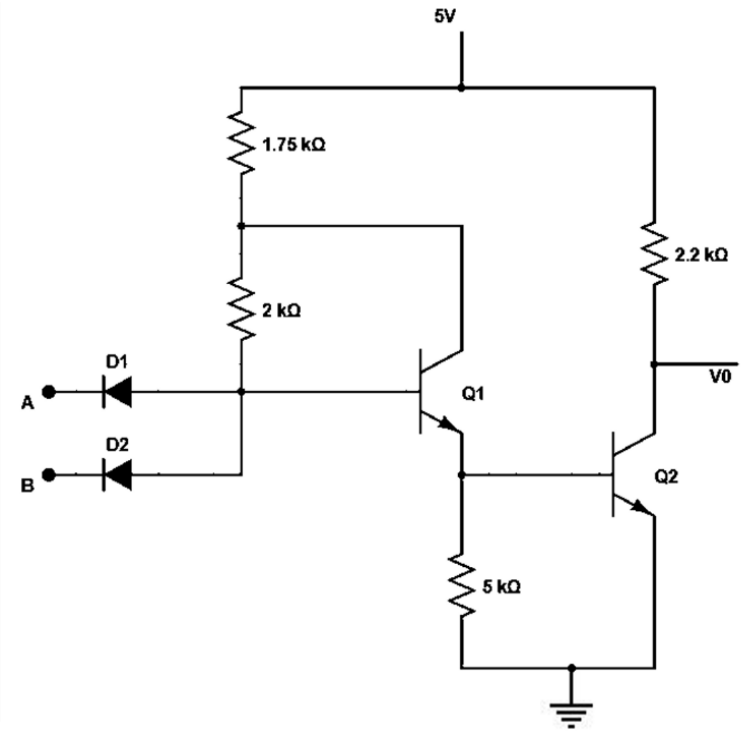
Time: 3 (Three) Hours **Full Marks: 60**

Use single answer script

Instructions:	i)	Answer script should be hand written and should be written in A4 white paper. You must submit the hard copy of this answer script to the Department when the university reopens.
	ii)	You must write the following information at the top page of each answer script: **Department:** **Program:** **Course no:** **Course Title:** **Examination:** **Semester (Session):** **Student ID:** **Signature and Date:**
	iii)	Write down Student ID, Course number and put your signature on top of every single page of the answer script.
	iv)	Write down page number at the bottom of every page of the answer script.
	v)	Upload the scan copy of your answer script in PDF format through provided **google form** at the respective course site (i.e., **google classroom)** using institutional email within the allocated time. Uploading clear and readable scan copy (uncorrupted) is your responsibility and you must cover all the pages of your answer script. However, for clear and readable scan copy of the answer script student should use only one side of a page for answering the questions.
	vi)	You must avoid **plagiarism,** maintain **academic integrity, and ethics**. You are not allowed to take any help from another individual and if taken so can result in stern disciplinary actions from the university authority.
	vii)	Marks allotted are indicated in the **right margin.**
	viii)	Necessary **charts/tables** are attached at the end of the question paper. You may use graph papers where necessary.
	ix)	Assume any reasonable data if needed.
	x)	Symbols and characters have their usual meaning.
	xi)	Before uploading, rename the PDF file as **CourseNo_StudentID.pdf** e.g., CSE2209_180204001.pdf

The answer script **(one single PDF file)** must be uploaded at designated location in the provided **Google Form link** available in the Google classroom.

There are 7 (Seven) Questions. Answer any 5(Five).

Question 1. [Marks: 12]		
a)	Draw and explain the operation of a positive logic transistorized NOT gate. Assume that, $V_{BE(Sat)}$ = 0.8V, $V\gamma$ = 0.5V and $V_{CE(Sat)}$ = 0.2V. Logic levels for state 0 is 0.2V and for state 1 is 12V. Find $h_{FE(min)}$.	**[4]**
b)	For the positive logic circuit given in figure 1, assume that $V_{BE(Sat)}$ = 0.8V, $V\gamma$ = 0.5V, $V_{CE(Sat)}$ = 0.2V. The drop across a conducting diode is 0.7V and $V\gamma(diode)$ = 0.6V. Logic levels for state 0 is 0.2V and for state 1 is 5V. Answer the following questions.  Figure – 1	
	i. Prove that the circuit works as a positive logic NAND gate.	**[4]**
	ii. Calculate NM(0) and NM(1).	**[3]**
	iii. Find the fan-in of the circuit.	**[1]**
Question 2. [Marks: 12]		
a)	For the positive logic circuit given in figure 2, assume that $V_{BE(Sat)}$ = 0.8V, $V\gamma$ = 0.5V, $V_{CE(Sat)}$ = 0.2V. Logic levels for state 0 is 0.2V and for state 1 is 5V. Now, answer the following questions.	

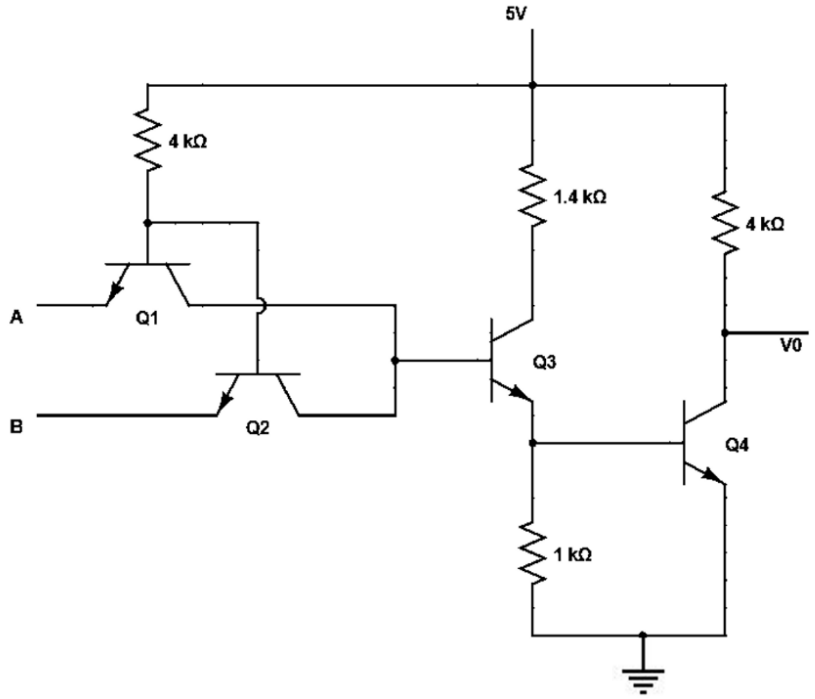


Figure – 2

	i. The circuit in the figure 2 belongs to which logic family? Draw the equivalent circuit of the figure 2. Verify that the circuit acts as a positive logic NAND gate.	**[6]**
	ii. What is a passive pull-up circuit? Draw and explain.	**[2]**
	iii. How can you convert the equivalent circuit of figure 2 to a "totem-pole" configuration? Draw and explain the "totem-pole" circuit behavior. Assume that, the drop across a conducting diode in the "totem-pole" configuration is 0.7V and $V\gamma(diode)$ = 0.6V.	**[4]**
Question 3. [Marks: 12]		
a)	Implement the function **F =** $(\overline{\boldsymbol{A}} + \boldsymbol{BC})\overline{(\boldsymbol{A} + \boldsymbol{B})}$ using CMOS.	**[5]**
b)	What is a transmission gate? Implement **F =** $\overline{\boldsymbol{A}} + \boldsymbol{B}$ using 2x1 MUX. Use CMOS transmission gate to implement the MUX. You may choose any expression as control signal.	**[3]**
c)	Implement the function **F =** $\overline{\boldsymbol{X}} + \boldsymbol{YZ} + \boldsymbol{ZX}$ using 4x1 ROM.	**[4]**
Question 4. [Marks: 12]		
a)	For the clipper circuit in figure 3, find the output equation with necessary conditions and draw the output signal for the given input signal in figure 4. Consider, V_i = 10V, V_{R1}= 3V, V_{R2}= 7V and R = 100 kΩ. Ignore the voltage drop across the conducting diodes.	**[6]**

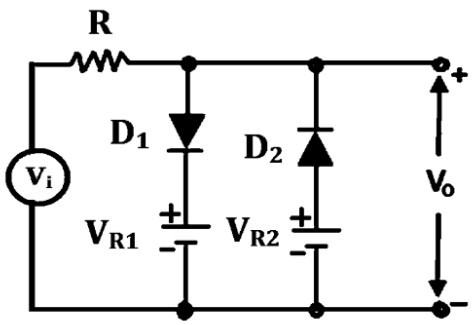


Figure – 3

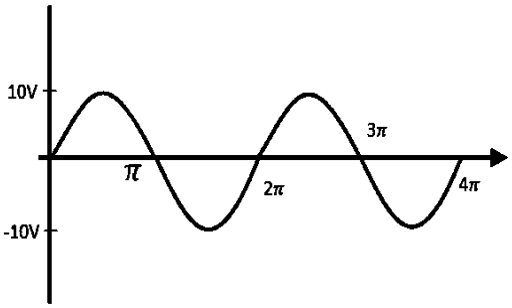


Figure – 4

b)	How can you make an inverter ratioless? Give a short note on dynamic ratioless inverter.	**[2]**
c)	Draw the circuit diagram of the two phased ratioed dynamic NMOS Shift Register. Calculate the value of C_1, C_2, C_3 and Vo in the two phased ratioed dynamic NMOS shift register for the given clock pulses in figure 5.	**[4]**

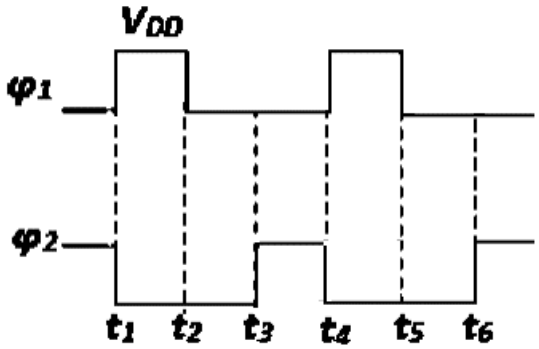


Figure – 5

Question 5. [Marks: 12]

a)	For high pass RC circuit, derive the equations of the voltages of peak points when input is a symmetric waveform. Sketch the output waveform for the symmetric wave input.	**[5]**
b)	If a sinusoidal input voltage V_i is given at the input of a high pass RC circuit, then show that the amplification $\|A\| = 0.707$	**[4]**
c)	In a high pass RC circuit, if a 6V pulse is given as input for 0.05 seconds, find the output waveform. Assume that the resistance is 4kΩ and capacitance is 15μF.	**[3]**

Question 6. [Marks: 12]

a)	Analyze the given circuit in figure 6 and find its output voltage equation.	**[4]**

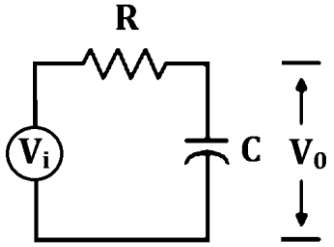


Figure – 6

b)	For a low pass RC circuit, find the output voltage V_0 when the given signal $V_i(t)$ is used as input. Find the transmission error for both ($\frac{t}{RC} \ll 1$ and $\frac{t}{RC} \gg 1$) conditions for the given input. $$V_i(t) = \begin{cases} \alpha t, & if\ t \geq 0 \\ 0, & Otherwise \end{cases}$$	**[6]**
c)	Verify, for low pass RC circuit, the output voltage is proportional to the integration of the input voltage.	**[2]**
Question 7. [Marks: 12]		
a)	Which type of multivibrator is used in Oscillators? Explain with its working principle.	**[6]**
b)	Obtain the expression for percentage tilt in the response of a high pass RC circuit to symmetrical square wave.	**[2]**
c)	For low pass RC circuit, find the output voltage equation for the given input $V_i(t)$. $$V_i(t) = \begin{cases} V, & 0 \leq t \leq t_p \\ 0, & Otherwise \end{cases}$$	**[4]**