

- ✓ Write down your student ID on the **top right corner of each of the pages**.
- ✓ Clearly write the solutions, along with the questions, on white paper with black ink (no need to use color pen, don't use pencils).
- ✓ Use **CamScanner**, or **Adobe Scan**, or **Microsoft Office Lens**, or any other software to scan the pages and make a **single PDF file**.
- ✓ After creating the PDF, make sure that **(a)** there are no pages missing, **(b)** all of the pages are legible, **(c)** your student ID on each page are visible.
- ✓ Please note, **collaboration ≠ copying**. You are allowed to discuss the questions and clear confusion you might have, but you have to write your solutions independently and be able to explain your answers during a random viva.
- ✓ **[Very Important]** Rename the PDF in the following format: "**A1_StudentID_FullNameWithoutSpace.pdf**". For example, if my student ID is 12345678 and my name is Shadman Shahid, the filename should be "**A1_12345678_ShadmanShahid.pdf**".
- ✓ **Submission Link: Section 15 - <https://forms.gle/W5aa69aB87v3e9M28>, Section – 21 - <https://forms.gle/SisEKRxY4yFNJgbDA>**

Question 1:

12 Marks

The input of a **Full-wave rectifier** is expressed by, $V_s(t) = 7\sin(400\pi t)$, and the output load resistance is $R = 5\text{ k}\Omega$. Silicon diodes are used in this circuit for which the forward drop is $V_{D0} = 0.3\text{ V}$.

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|--|---|
| (a) Calculate the input and output wave frequency. | 1 |
| (b) Show the input and output waveforms. | 1 |
| (c) Calculate the DC value of the output voltage. | 2 |

Now after connecting a capacitor, $C = 100\text{ }\mu\text{F}$ in parallel with the load.

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|--|---|
| (d) Calculate the peak-to-peak ripple voltage, | 2 |
| (e) Calculate the average of the output voltage V_{DC} after connecting the capacitor. | 2 |

Compare this with the DC value determined in 'c' and comment on the difference between these two.

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|--|---|
| (f) How can you provide better filtering for the output waves? | 2 |
| (g) What is the frequency of the Ripple voltage? | 2 |

Question 2:

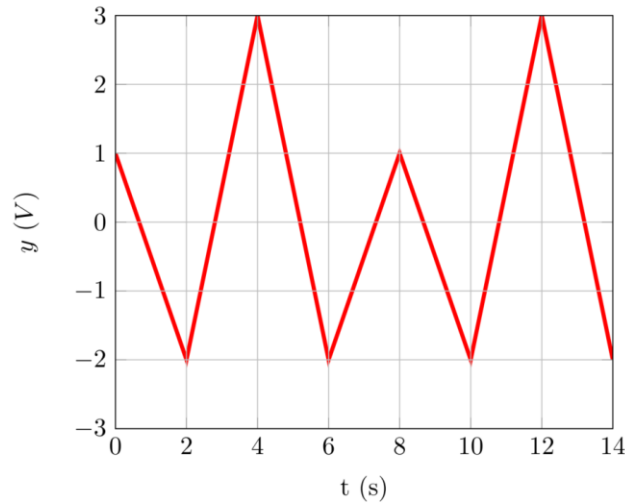
6 Marks

The input of a **Half-wave rectifier** is a **Square** wave voltage with peak $V_M = 15\text{ V}$ and frequency 0.5 Hz , and the output load resistance is $R = 5\text{ k}\Omega$. Silicon diodes are used in this circuit for which the forward drop is $V_{D0} = 0.7\text{ V}$.

- | | |
|---|---|
| i. Show the input and output waveforms. | 3 |
| ii. Draw the VTC (Voltage Transfer Characteristics) curve | 3 |

Question 3:

2*6 Marks



(b) Input of the FW rectifier

Part 2: A voltage waveform $V_i = 15 \sin(2000\pi t)$ V is fed into a Half-wave rectifier with a load resistance $R = 5 \text{ k}\Omega$. Silicon diodes are used in this circuit for which the forward drop is $V_{D_0} = 0.7 \text{ V}$.

- Illustrate** the input and output waveforms in separate graphs. Label the graph and **indicate** the voltage levels properly. [2]
- Calculate** the DC/Average value of the output. [1]
- A capacitor is now added to reduce the fluctuation of the output voltage, which makes the peak to peak ripple voltage **4%** of the maximum output voltage V_P . **Deduce** is the value of the capacitor from the given data. [2]
- The input of a Full-wave rectifier is shown in Figure 1(b) above and output load resistance is $R = 10 \text{ k}\Omega$. Germanium diodes are used in this circuit for which the forward drop is $V_{D_0} = 0.3 \text{ V}$. **Show** the input and output waveforms [1]

Question 4:

10 Marks

A voltage waveform $v_i = 10 \sin(200\pi t)$ V is fed into a Half-wave rectifier with a load resistor, $R = 10 \text{ k}\Omega$. Silicon diodes are used in this circuit where, $V_{D_0} = 0.7 \text{ V}$.

- Draw** the rectifier circuit. **Label** the input and output voltages properly. Briefly **explain** the application of the circuit. [1+1+1]
- Calculate** the DC value of the output voltage, V_{dc} and the output frequency, f_o . [1+1]
- Draw** the Voltage Transfer Characteristics (VTC) of the Half-wave rectifier and **label** it properly. [2]
- Now, you have to connect a capacitor in parallel with the load resistor. You have two capacitors of $4 \mu\text{F}$ and $7 \mu\text{F}$ at your disposal. Which capacitor will you use? **Explain** briefly with necessary calculations. [3]
- [Bonus]** A different input waveform is fed into the half-wave rectifier. The new peak-to-peak ripple voltage is 50% of the previous one calculated from (d) with the $4 \mu\text{F}$ capacitor. The new output frequency is 300 Hz. **Determine** the equation of the input waveform. [2]