UNIVERSITY COLLEGE LONDON

MENG MECHANICAL ENGINEERING

MECH0071 ELECTRICAL POWER SYSTEMS AND ELECTRICAL PROPULSION

PSCAD COURSEWORK

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1.1 Circuit diagram

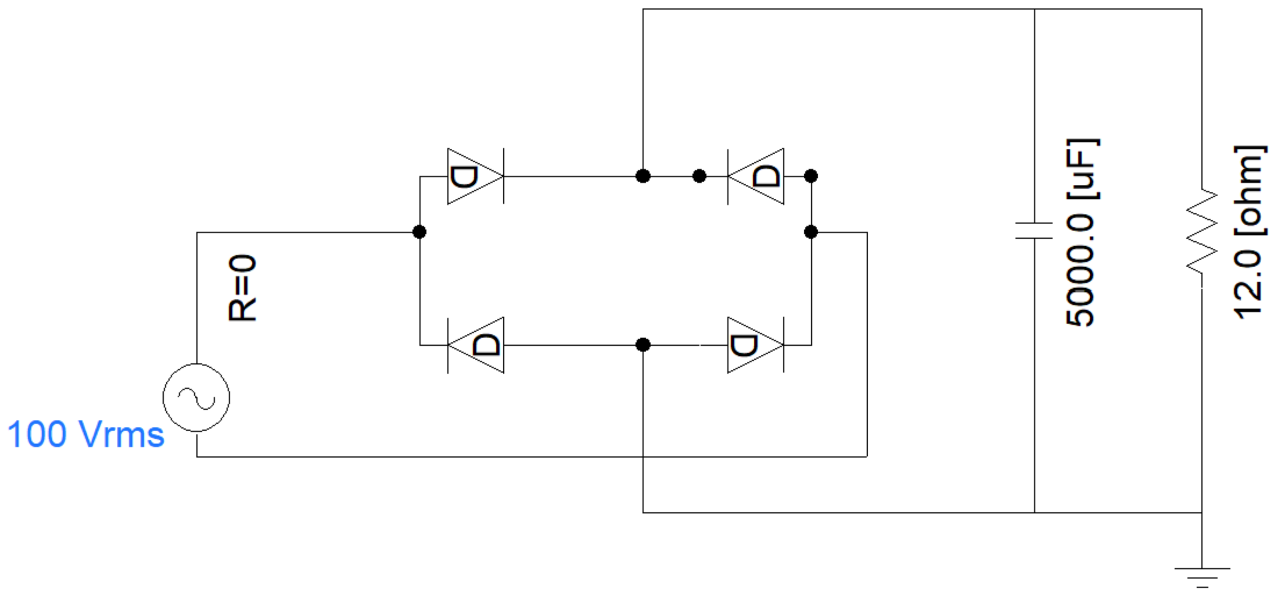

Figure 1: Circuit diagram to show diode bridge circuit.

1.2 Instantaneous voltages

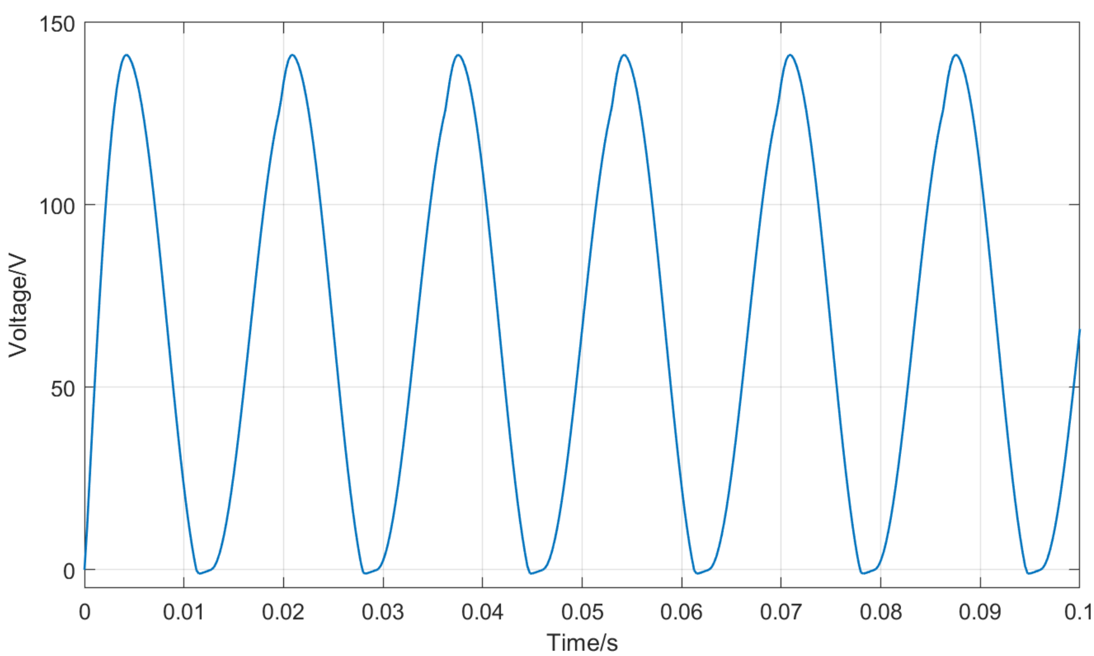

Figure 2: Graph to show instantaneous input voltage across the voltage source.

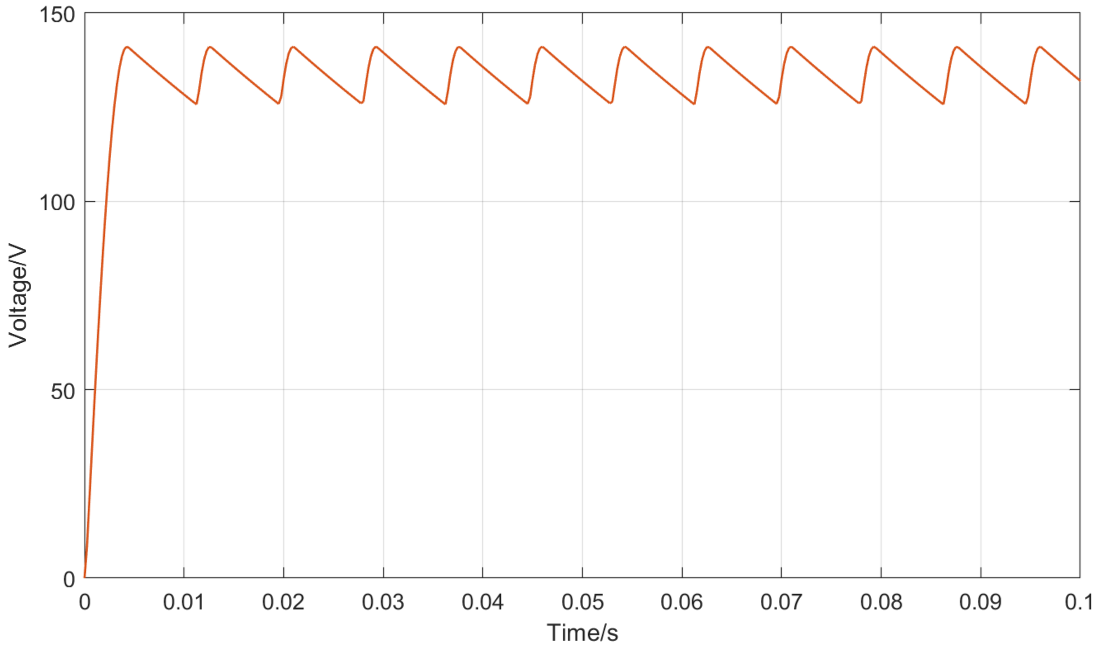

Figure 3: Graph to show instantaneous output voltage across the resistive load.

1.3 Effect of increasing capacitcance to $25\,\mu\mathrm{F}$

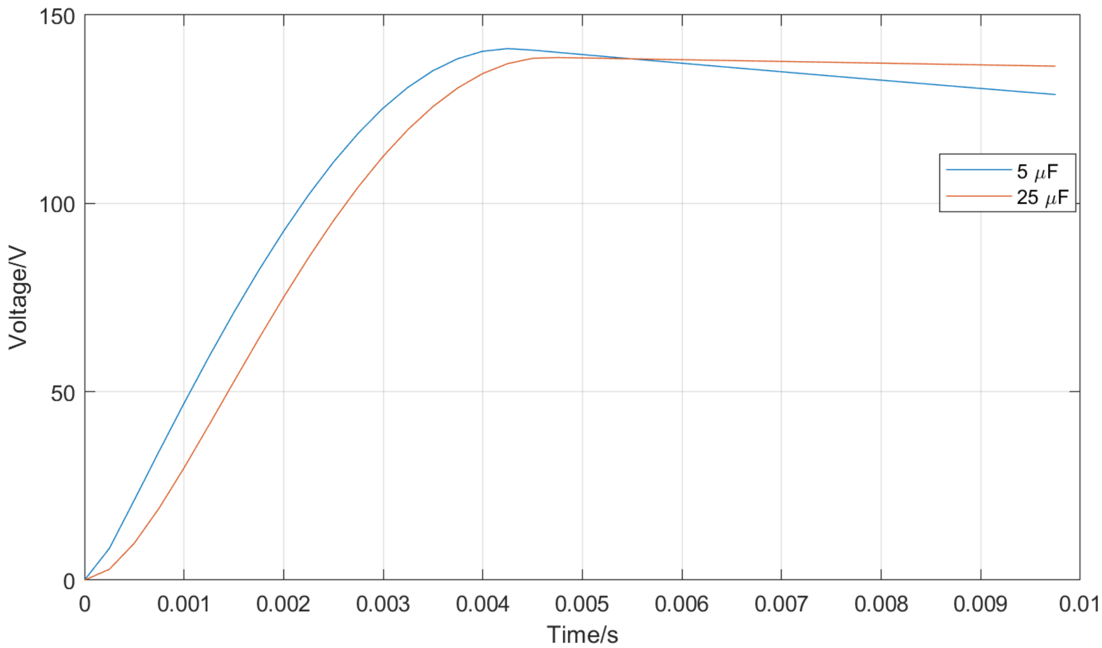

Figure 4: Graph to show comparison between instantaneous output voltage across the resistive load for different capacitance values.

The purpose of the capacitor in this diode bridge circuit is to filter/reduce the amount of voltage ripple, inherent to bridge diode circuits. We can see in Figure 3 that our voltage drop is approximately $25\,\mathrm{V}$ between pulses. By increasing the capacitance, our voltage drop reduces (from data: voltage drop with $25\,\mu\mathrm{F} \approx 4\,\mathrm{V}$.) This is desirable as this achieves a more stable DC output. However, increasing the capacitance also increases the rise time and reduces the peak voltage of the output, shown in Figure 4.

2 Equivalent transformer

2.1 Circuit diagram

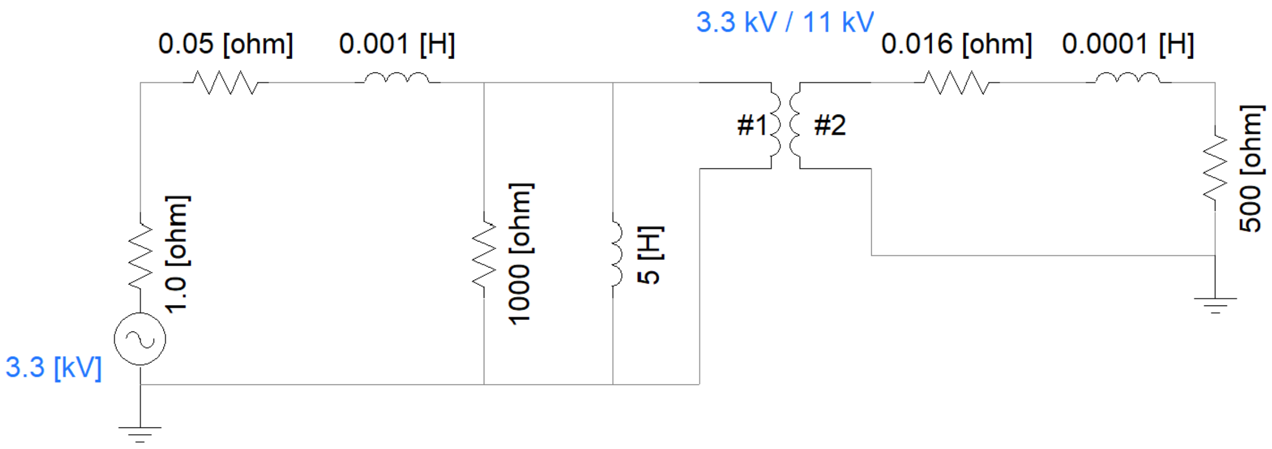

Figure 5: Circuit diagram to show equivalent transformer.

2.2 RMS Voltage across the load

Measuring the voltage across the load over $0.1\,\mathrm{s}$, the voltage values were put into MATLAB (see Appendix A.2). The RMS voltage can be calculated using the following equation.

$$V_{RMS} = \sqrt{\frac{\sum_{i=1}^{n} x_i^2}{n}} \tag{1}$$

- Number of data points (n): 401
- Number of complete AC cycles in time frame: 6

$$V_{RMS,load} = 10.72\,\mathrm{kV} \tag{2}$$

A MATLAB code

A.1 Question 1

```
%HD
clc
clear

%import data
data = readmatrix('dataimport.xlsx','Sheet','q1');

%datasets
VSource = cat(2,data(:,5),data(:,6));
VResistor = cat(2,data(:,7),data(:,8));
VResistor2 = cat(2,data(:,9),data(:,10));

%graph plots
%plot(VResistor2(:,1),VResistor2(:,2),'LineWidth',1,'color',[0.4940 0.1840
    0.5560])
plot(VResistor(1:40,1),VResistor(1:40,2),VResistor2(1:40,1),VResistor2(1:40,2))
grid on
axis 'auto xy'
xlim([0,0.01])
ylim([0,150])
xlabel('Time/s')
ylabel('Voltage/V')
legend('5 {\mu}F','25 {\mu}F')

%'color',[0.4940 0.1840 0.5560]
```

A.2 Question 2

```
%HD
clc
clear

%import data
data = readmatrix('dataImport.xlsx','Sheet','q2');

%datasets
VResistor = cat(2,data(:,5),data(:,6));
PhaseResistor = cat(2,data(:,7),data(:,8));

%VRMS
VSq1 = VResistor(:,2).^2;
VRMSResistor = sqrt(sum(VSq1)/numel(VSq1));

%PF
PFResistor = cos(PhaseResistor(:,2));

%graph plotting
plot(VResistor(:,1),VResistor(:,2))
grid on
axis 'auto xy'
xlim([0,0.1])
xlabel('Time/s')
ylabel('Voltage/kV')
```