BACHELOR OF COMPUTER SCIENCE
SCHOOL OF COMPUTER SCIENCE
BINA NUSANTARA UNIVERSITY
JAKARTA

ASSESSMENT FORM

Course: SCIE6063001– Computational Physics

Method of Assessment: Case Study

Semester/Academic Year : 3/2023 – 2024

Name of Lecturer : Agung Trisetyarso, S.Si., M.Si., Ph.D.

Date : January 6, 2024

Class : LB01

Topic : Voltage and Current

Resistance and Capacitance

Circuits Design & Analysis

Induction and inductance

Electromagnetic Oscillation and Alternating Current

Group Members :	1 Jonathan Alvindo Fernandi 2____________ 3____________ 4____________ 5____________ 6____________ 7____________ 8____________

Student Outcomes:

(SO 1) Mampu menganalisis masalah komputasi yang kompleks dan mengaplikasikan prinsip komputasi dan keilmuan lain yang sesuai untuk mengidentifikasi solusi.

Able to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions

Learning Objectives:

(LObj 1.2) Mampu menerapkan prinsip komputasi dan disiplin ilmu terkait lainnya untuk mengidentifikasi solusi.

Able to apply principles of computing and other relevant disciplines to identify solutions

No	Assessment criteria	Weight	Excellent (85 - 100)	Good (75-84)	Average (65-74)	Poor (0 - 64)	Score	(Score x Weight)
1	Ability to use potential method, serial, and parallel connection concept to provide the solution.	**50%**	Able to solve in both numerical and computational approaches well without errors.	Able to solve in both numerical and computational approaches well with some errors.	Able to solve in either numerical or computational approaches well with some errors	Able to solve in either numerical or computational approaches with major errors, or not able to solve at all.		
2	Ability to solve problems in topics of Voltage and Current, Resistance and Capacitance, Electromagnetic Oscillation and Alternating Current	**50%**	Able to solve in both numerical and computational approaches well without errors.	Able to solve in both numerical and computational approaches well with some errors.	Able to solve in either numerical or computational approaches well with some errors	Able to solve in either numerical or computational approaches with major errors		
	Total Score: $\sum$(Score x Weight)							

Remarks:

____

____

____

____

ASSESSMENT METHOD

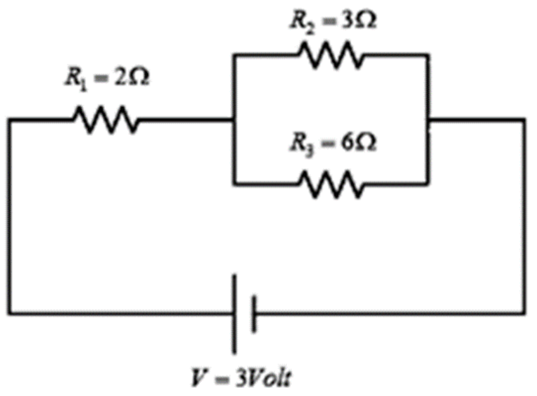
<u>Instructions</u>

Individual Assignment

Answer these problems in numerical approach and computational approach using Python Power Electronics. Beside your numerical answer, attached your circuit topology, parameters, and simulation output graph. Submit your answer in .PDF format

Problem 1

From the following circuit, proof your manual calculation using PPE simulation to calculate parameters below:



1. Total current flow in the circuit
2. Potential difference at each end of the resistance
3. The amount of current that passes through resistance 2 and resistance 3

Answer:

a. Numerical Approach
   1. Total current flow in the circuit
      $R_1 = 2\ \Omega$
      $R_2 = 2\ \Omega$
      $R_3 = 2\ \Omega$
      $V = 3\ V$

      1) Resistor total
         i. Resistor paralel
            $\frac{1}{Rp} = \frac{1}{R2} + \frac{1}{R3}$
            $\frac{1}{Rp} = \frac{1}{3} + \frac{1}{6}$

$\frac{1}{Rp} = \frac{1}{2}$

Rp = 2 Ω

ii. Resistor seri

$Rs = R_1 + Rp$

Rs = 2 + 2

Rs = 4 Ω

Rt = Rs

Rt = 4 Ω

2) Total current

$It = \frac{V}{Rt}$

$It = \frac{3}{4}$

It = 0,75 A

2. Potential difference at each end of the resistance

It = 0,75 A

$R_1 = 2\ \Omega$

Rp = 2 Ω

$V_1 = It \cdot R_1$

$V_1 = 0{,}75 \cdot 2$

$V_1 = 1{,}5$ V

$V_2 = It \cdot Rp$

$V_2 = 0{,}75 \cdot 2$

$V_2 = 1{,}5$ V

$V_3 = It \cdot Rp$

$V_3 = 0{,}75 \cdot 2$

$V_3 = 1{,}5$ V

3. The amount of current that passes through resistance 2 and resistance 3

   $V_2 = 1{,}5$ V

   $R_2 = 3\ \Omega$

   $V_3 = 1{,}5$ V

   $R_3 = 6\ \Omega$

   $I_2 = \frac{V2}{R2}$

   $I_2 = \frac{1{,}5}{3}$

   $I_2 = 0{,}5$ A

   $I_3 = \frac{V3}{R3}$

   $I_3 = \frac{1{,}5}{6}$

   $I_2 = 0{,}25$ A

b. Computational Approach using PPE

1) Circuit topology

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1									wire	Voltmeter_load2	wire	wire	wire			
2									wire				wire			
3		wire	wire	Voltmeter_load1	wire	wire		wire	wire	Resistor_load2	wire	Ammeter_load2	wire	wire		
4		wire				wire		wire						wire		
5		wire				wire		wire						wire		
6	wire	wire	Resistor_load1	wire	Ammeter_load1	wire	wire	wire						wire	wire	wire
7	wire							wire						wire		wire
8	wire							wire						wire		wire
9	wire							wire	wire	Resistor_load3	wire	Ammeter_load3	wire	wire		wire
10	wire								wire				wire			wire
11	wire								wire	Voltmeter_load3	wire	wire	wire			wire
12	wire															wire
13	wire															wire
14	wire															wire
15	wire															wire
16	wire	wire	Ammeter_source	wire	Resistor_source	wire	VoltageSource_dcsource	wire	wire	wire	wire	wire	wire	wire	wire	wire

2) Circuit parameters

1. Component type: Ammeter
Component name: load1
Component position: 6E
Positive direction of current: 6F

2. Component type: Ammeter
Component name: load2
Component position: 3L
Positive direction of current: 3M

3. Component type: Ammeter
Component name: load3
Component position: 9L
Positive direction of current: 9M

4. Component type: Ammeter
Component name: source
Component position: 16C
Positive direction of current: 16B

5. Component type: Resistor
Component name: load1
Component position: 6C
Resistor value: 2.0

6. Component type: Resistor
Component name: load2
Component position: 3J
Resistor value: 3.0

7. Component type: Resistor
Component name: load3
Component position: 9J
Resistor value: 6.0

8. Component type: Resistor
Component name: source
Component position: 16E
Resistor value: 0.01

9. Component type: VoltageSource
Component name: dcsource
Component position: 16G
Peak value: 4.243
Frequency: 60.0
Phase angle: 0.0
Dc offset: 0.0
Positive polarity: 16F

10. Component type: Voltmeter
Component name: load1
Component position: 3D
Voltage level: 1000.0
Positive direction of voltage: 3C

11. Component type: Voltmeter
Component name: load2
Component position: 1J
Voltage level: 1000.0
Positive direction of voltage: 1I

12. Component type: Voltmeter
Component name: load3
Component position: 11J
Voltage level: 1000.0
Positive direction of voltage: 11I

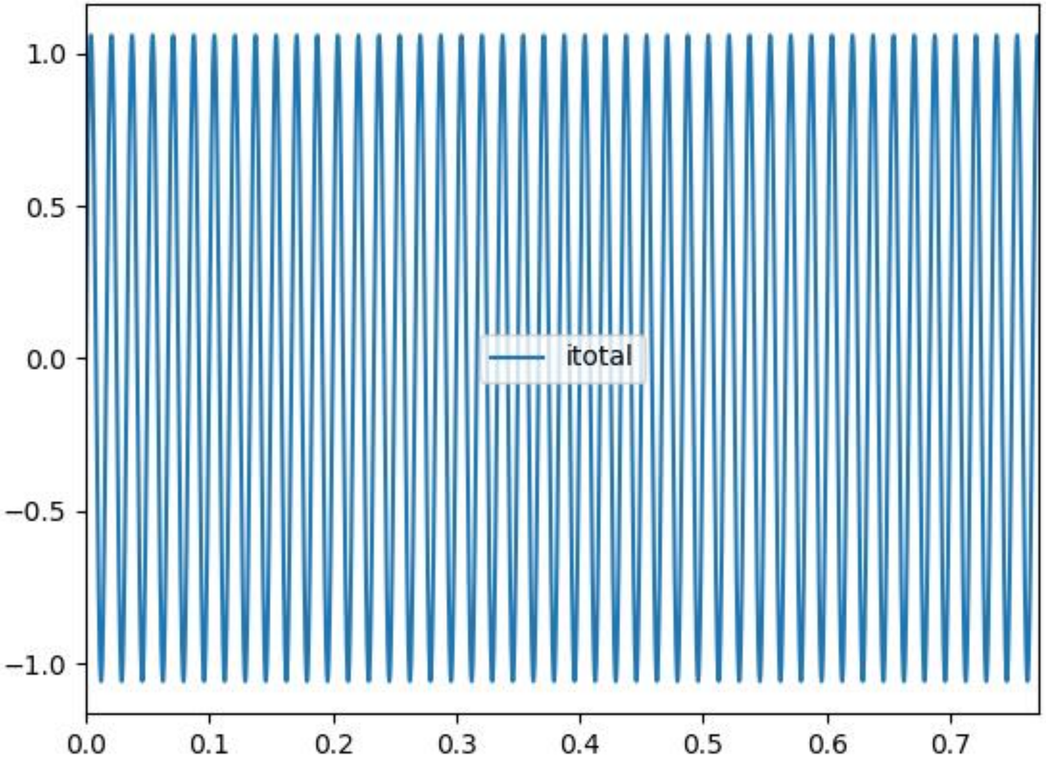
Ammeter positive direction of current: searah jarum jam

Resistor_source value = 0.01 Ω (bernilai rendah guna menjaga stabilitas tegangan dan arus)

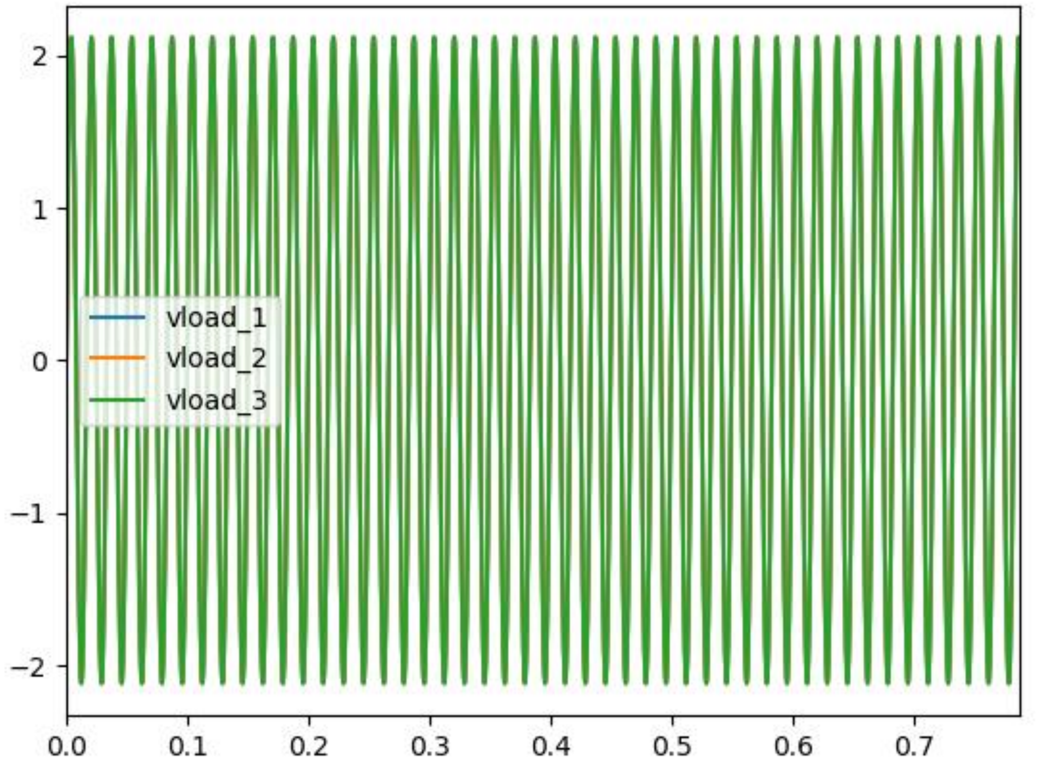
VoltageSource_dcsource peak value = $V \cdot \sqrt{2}$
VoltageSource_dcsource peak value = $3 \cdot \sqrt{2}$
VoltageSource_dcsource peek value = 4,243 V

Voltmeter_load voltage level = 1000 V (memerlukan tegangan tinggi)

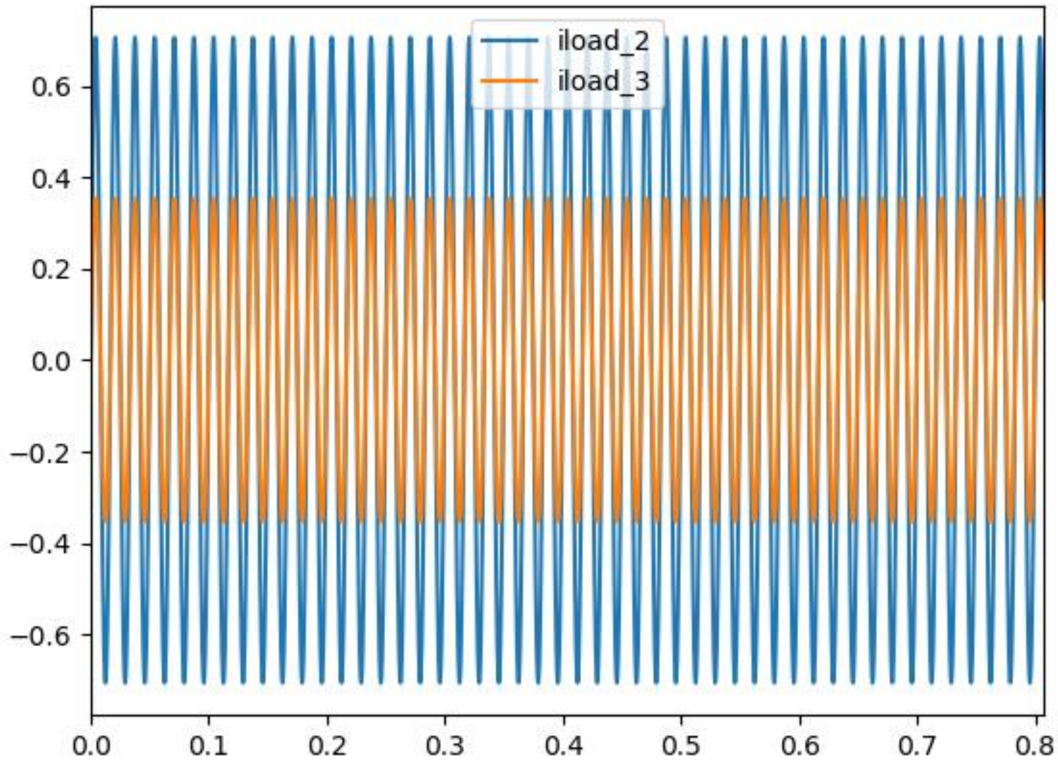
3) Simulation output graph
   1. Total current flow in the circuit



   2. Potential difference at each end of the instance



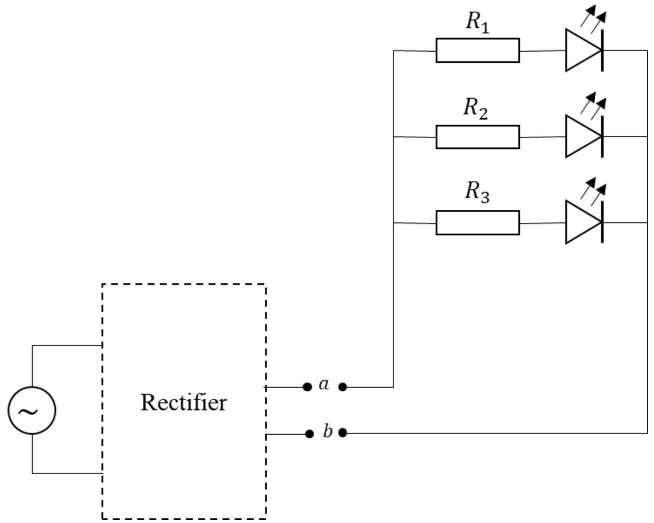
3. The amount of current that passes through resistance 2 and resistance 3



PPE simulation files: https://drive.google.com/drive/folders/1SmjqZFVOmJM8qQlxkeFPpewiryQ_RpOb?usp=sharing

Problem 2

You are planning to conduct a small electronic project. You are planning to make a simple LED circuit (see diagram). The circuit contains three green LED lights that connected using parallel connections. From the LED specification sheet, you know that the LED will works on a minimum voltage of 2 V. Also, you gain information that the LED will break if the current that flow through it exceed 20 mA. For that, you need to use some resistor to limit the current that flow through the LED.



To power the circuit, you are planning to use a micro hydro generator that you already have. However, you realize that you need to convert the current from AC to DC so you can light up the LED. But you don't have the proper converter at the moment. So, you decide to make your own rectifier, ***a basic RLC rectifier***, from only the components you have (see table) at hand. Assume that your component supply is large enough, so you can use any number of each component.

Assume that your LED does not have any internal resistance. The LED circuit will be connected to the rectifier at point a and b (see diagram). The generator has an output of 5 V with frequency of 20 Hz. **<u>So, what is your solution for the basic RLC rectifier?</u>** Assume that each component on the table (including the EMF) has internal resistance of 0.1 Ω.

No	Component	Value
1	Resistor	3 Ω
2		24 Ω
3		36 Ω
4		100 Ω
5		130 Ω
6		220 Ω
7		510 Ω
8	Capacitor	1.0 μF
9		3.3 μF
10		22 μF
11	Inductor	2 μH
12		5.1 μH
13		2 mH
14		400 mH

Answer:

a. Numerical Approach

Minimum voltage for the LED to work = 2 V

LED maximum current = 20 mA

LED maximum current = $20 \cdot 10^{-3}$ A

LED maximum current = 0,02 A

Generator output voltage = 5 V

Frequency = 20 Hz

Internal resistance = 0,1 Ω

Resistors, capacitors, and inductors values:

No	Component	Value
1	Resistor	3 Ω
2		24 Ω
3		36 Ω
4		100 Ω
5		130 Ω
6		220 Ω
7		510 Ω
8	Capacitor	1.0 μF
9		3.3 μF
10		22 μF
11	Inductor	2 μH
12		5.1 μH
13		2 mH
14		400 mH

$$\frac{1}{Rp} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

$$\frac{1}{Rp} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1}$$

$$\frac{1}{Rp} = 3$$

Rp = $\frac{1}{3}$ Ω

1. Resistor value
   1) 3 Ω Resistor

      R = $\frac{1}{3} \cdot 3$

      R = 1 Ω

      I = $\frac{V}{R}$

      I = $\frac{2}{1}$

      I = 2 A (tidak dapat digunakan karena I > 0,02 A)

   2) 24 Ω Resistor

      R = $\frac{1}{3} \cdot 24$

      R = 8 Ω

      I = $\frac{V}{R}$

      I = $\frac{2}{8}$

      I = 0,25 A (tidak dapat digunakan karena I > 0,02 A)

   3) 36 Ω Resistor

      R = $\frac{1}{3} \cdot 36$

      R = 12 Ω

      I = $\frac{V}{R}$

      I = $\frac{2}{12}$

      I = 0,167 A (tidak dapat digunakan karena I > 0,02 A)

   4) 100 Ω Resistor

$R = \frac{1}{3} \cdot 100$
$R = 33{,}333\ \Omega$

$I = \frac{V}{R}$
$I = \frac{2}{33{,}333}$
I = 0,06 A (tidak dapat digunakan karena I > 0,02 A)

5) 130 Ω Resistor
$R = \frac{1}{3} \cdot 130$
$R = 43{,}333\ \Omega$

$I = \frac{V}{R}$
$I = \frac{2}{43{,}333}$
I = 0,046 A (tidak dapat digunakan karena I > 0,02 A)

6) 220 Ω Resistor
$R = \frac{1}{3} \cdot 220$
$R = 73{,}333\ \Omega$

$I = \frac{V}{R}$
$I = \frac{2}{73{,}333}$
I = 0,027 A (tidak dapat digunakan karena I > 0,02 A)

7) 510 Ω Resistor
$R = \frac{1}{3} \cdot 510$
$R = 170\ \Omega$

$I = \frac{V}{R}$

$I = \frac{2}{170}$

I = 0,012 A (dapat digunakan karena I ≤ 0,02 A)

$R_1 = R_2 = R_3 = 510\ \Omega$

2. Generator resistor
   1) 3 Ω Resistor

      $I = \frac{V}{R}$

      $I = \frac{5}{3}$

      I = 1,667 A (tidak digunakan karena I kurang mendekati 0,02 A)

   2) 24 Ω Resistor

      $I = \frac{V}{R}$

      $I = \frac{5}{24}$

      I = 0,208 A (tidak digunakan karena I kurang mendekati 0,02 A)

   3) 36 Ω Resistor

      $I = \frac{V}{R}$

      $I = \frac{5}{36}$

      I = 0,139 A (tidak digunakan karena I kurang mendekati 0,02 A)

   4) 100 Ω Resistor

      $I = \frac{V}{R}$

      $I = \frac{5}{100}$

      I = 0,05 A (tidak digunakan karena I kurang mendekati 0,02 A)

   5) 130 Ω Resistor

I = $\frac{V}{R}$
I = $\frac{5}{130}$
I = 0,038 A (tidak digunakan karena I kurang mendekati 0,02 A)

6) 220 Ω Resistor
I = $\frac{V}{R}$
I = $\frac{5}{220}$
I = 0,023 A (tidak digunakan karena I kurang mendekati 0,02 A)

7) 510 Ω Resistor
I = $\frac{V}{R}$
I = $\frac{5}{510}$
I = 0,01 A (tidak digunakan karena I kurang mendekati 0,02 A)

rload = 220 Ω

b. Computational Approach using PPE
   1) Circuit topology

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1																wire	wire	wire	wire	Voltmeter_load1	wire	wire	wire	wire	wire
2																wire			wire				wire		wire
3																wire			wire	Resistor_load1	wire	Ammeter_load1	wire		wire
4																wire									wire
5																wire	wire	wire	wire	Voltmeter_load2	wire	wire	wire	wire	wire
6																wire			wire				wire		wire
7																wire			wire	Resistor_load2	wire	Ammeter_load2	wire		wire
8																wire									wire
9																wire	wire	wire	wire	Voltmeter_load3	wire	wire	wire	wire	wire
10																wire			wire				wire		wire
11																wire			wire	Resistor_load3	wire	Ammeter_load3	wire		wire
12																wire									wire
13																wire									wire
14																wire									wire
15																wire									wire
16																wire									wire
17	wire	wire	Ammeter_Isource	wire	Resistor_Ramm	wire	Diode_Dfilter	Inductor_Ifilter	wire	Resistor_Rfilter	wire	wire	wire	wire	wire	wire									wire
18	wire										wire														wire
19	wire										wire														wire
20	wire	wire	wire								wire	wire	wire												wire
21	wire		wire								wire		wire												wire
22	wire		wire								wire		wire												wire
23	Resistor_Rsource		wire								Capacitor_Cfilter		wire												wire
24	wire		Voltmeter_Vsource								wire		Voltmeter_Cfilter												wire
25	VoltageSource_Vsource		wire								Resistor_Cfilter		wire												wire
26	wire		wire								wire		wire												wire
27	wire		wire								wire		wire												wire
28	wire	wire	wire								wire	wire	wire												wire
29	wire										wire														wire
30	wire										wire														wire
31	wire	wire	wire	wire	wire	wire	wire	Resistor_Rload	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire	wire

2) Circuit parameters

1. Component type: Ammeter
Component name: Isource
Component position: 17C
Positive direction of current: 17D

2. Component type: Ammeter
Component name: load1
Component position: 3V
Positive direction of current: 3W

3. Component type: Ammeter
Component name: load2
Component position: 7V
Positive direction of current: 7W

4. Component type: Ammeter
Component name: load3
Component position: 11V
Positive direction of current: 11W

5. Component type: Capacitor
Component name: Cfilter
Component position: 23K
Capacitor value: 1e-06
Positive polarity: 24K

6. Component type: Diode
Component name: Dfilter
Component position: 17G
Voltage level: 1000.0
Direction of cathode: 17H

7. Component type: Inductor
Component name: Ifilter
Component position: 17H
Inductor value: 0.001

8. Component type: Resistor
Component name: Cfilter
Component position: 25K
Resistor value: 0.01

9. Component type: Resistor
Component name: Ramm
Component position: 17E
Resistor value: 0.01

10. Component type: Resistor
Component name: Rfilter
Component position: 17J
Resistor value: 0.01

11. Component type: Resistor
Component name: Rload
Component position: 31H
Resistor value: 220.0

12. Component type: Resistor
Component name: Rsource
Component position: 23A
Resistor value: 0.01

13. Component type: Resistor
Component name: load1
Component position: 3T
Resistor value: 510.0

14. Component type: Resistor
Component name: load2
Component position: 7T
Resistor value: 510.0

15. Component type: Resistor
Component name: load3
Component position: 11T
Resistor value: 510.0

16. Component type: VoltageSource
Component name: Vsource
Component position: 25A
Peak value: 7.071
Frequency: 20.0
Phase angle: 0.0
Dc offset: 0.0
Positive polarity: 24A

17. Component type: Voltmeter
Component name: Cfilter
Component position: 24M
Voltage level: 1000.0
Positive direction of voltage: 23M

18. Component type: Voltmeter
Component name: Vsource
Component position: 24C
Voltage level: 1000.0
Positive direction of voltage: 23C

19. Component type: Voltmeter
Component name: load1
Component position: 1T
Voltage level: 1000.0
Positive direction of voltage: 1S

20. Component type: Voltmeter
Component name: load2
Component position: 5T
Voltage level: 1000.0
Positive direction of voltage: 5S

21. Component type: Voltmeter
Component name: load3
Component position: 9T
Voltage level: 1000.0
Positive direction of voltage: 9S

Ammeter positive direction of current: searah jarum jam

Capacitor_Cfilter value = 1 uF
Capacitor_Cfilter value = $1 \cdot 10^{-6}$ F
Capacitor_Cfilter value = 1e-06 F

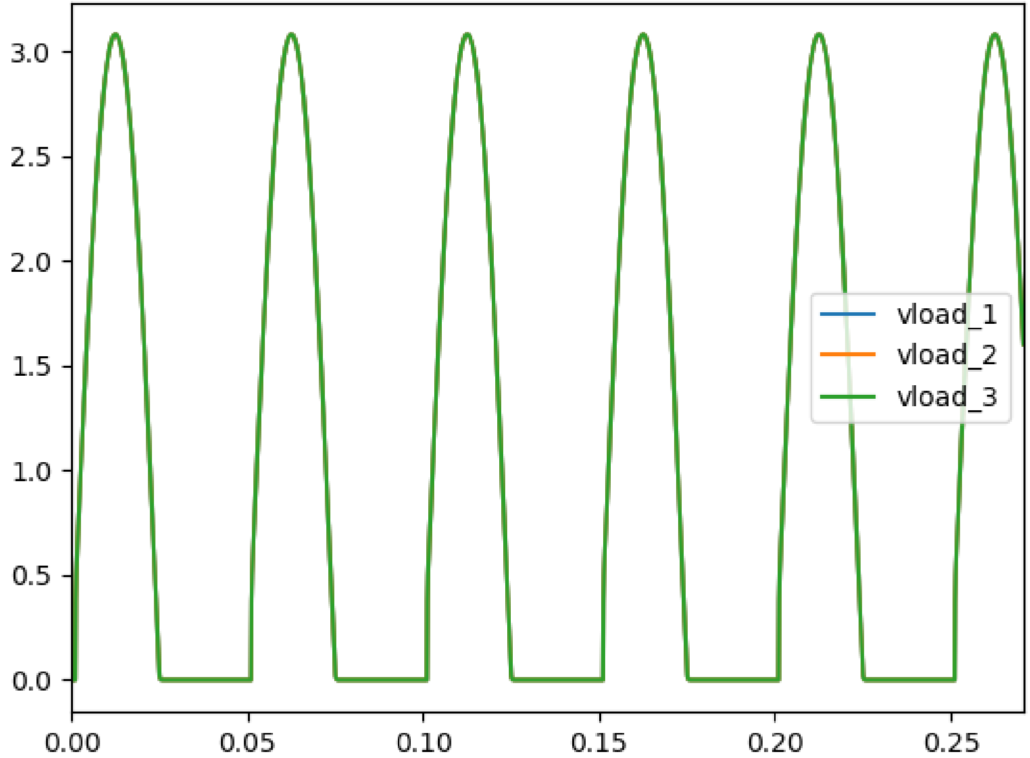
Diode voltage level = Voltmeter voltage level = 1000 V (memerlukan tegangan tinggi)
Diode direction of cathode: searah jarum jam
Voltmeter positive direction of voltage: berlawanan arah jarum jam

Inductor value = 1 mH
Inductor value = $1 \cdot 10^{-3}$ H
Inductor value = 0,001 H

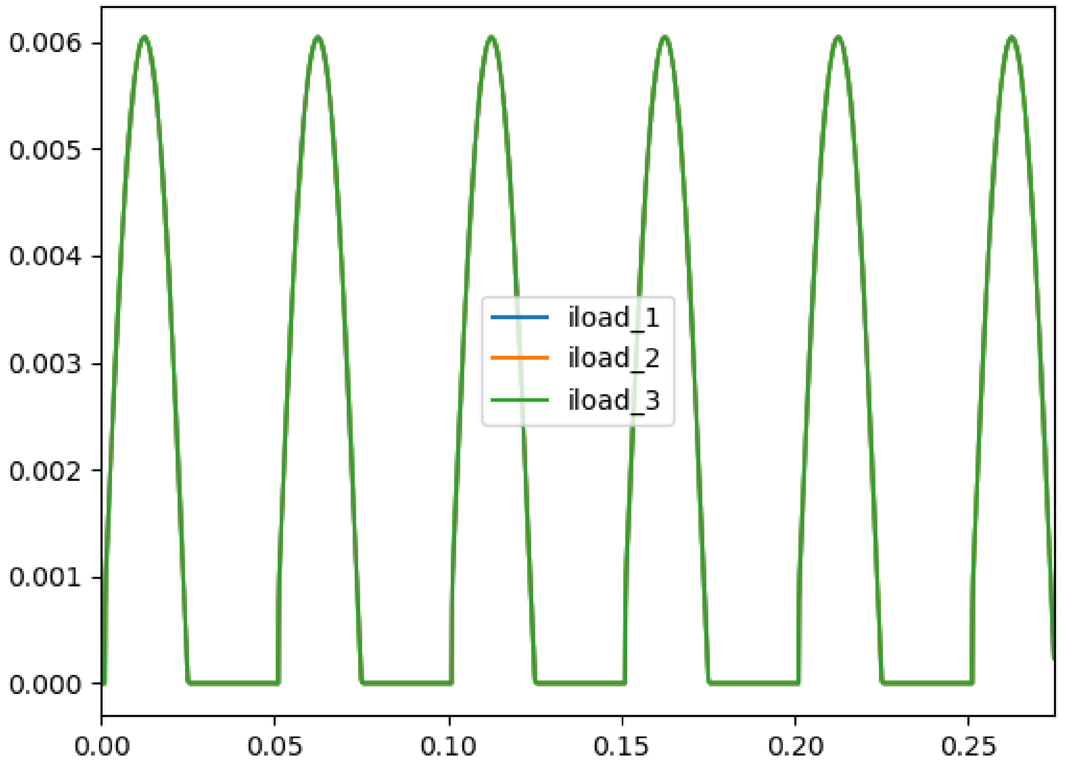
Resistor value = 0,01 Ω (bernilai rendah guna menjaga stabilitas tegangan dan arus)

VoltageSource peak voltage = $V \cdot \sqrt{2}$
VoltageSource peak voltage = $5 \cdot \sqrt{2}$
VoltageSource peak voltage = 7,071 V

3) Simulation output graph
   1. Voltage at each resistance



   2. The amount of current at each resistance



PPE Simulation Files: https://drive.google.com/drive/folders/1RA0fDDzcEF70HYXHN8ydTsX_pAqjDaHZ?usp=sharing

Note for Lecturers:

1. The lecturers are advised to assess student's understanding towards the topics included in the assignment.
2. The students will submit their answer in .pdf format through BINUSMAYA.
3. The deadline of this comprehensive assignment is at the end of the semester.