Tshwane University of Technology

PRACTICAL

SUBJECT: ELECTRONICS 126

SUBJECT CODE: EL2F06D

DUE DATE : 10 OCTOBER 2024

SUBMIT : HARD COPY

QUALIFICATION(S):	
N DIP: COMPUTER SYSTEM ENGINEERING:	

EXAMINER: MR D T MATSHIBA

MODERATOR: T C TSHIPOTA

Initials:	Surname:	Student No:

POWER SUPPLY: Feedback Regulated Power Supply with Operational Amplifier error sensing

This experiment has to be studied in detail before the laboratory period: The calculations have to be finished, the values written into the open spaces where calculated answers are required. The required circuit should be built and ready when arriving at the laboratory.

OUTCOME 1

The student should build an AC to DC power supply with operational amplifier error sensing and a zener reference voltage.

Assessment Criteria:

1) Build an electronic circuit from a given circuit diagram
2) Verify operation and perform fault finding techniques if operation is not as expected
3) Measure the regulation of the power supply
4) Measure the ripple rejection of the power supply

COMPONENTS 1.1

(Included in the components given to you at the beginning of the course)

- Four rectifier diodes
- A 1000µF capacitor. The voltage rating should be sufficient for the peak of the secondary voltage of the transformer in the laboratory you will be using.
- A 100 Ω resistor 1 watt
- A 2200 Ω resistor ¼ watt
- A 1kΩ resistor ¼ watt
- A 470 Ω resistor ¼ watt
- A Zener diode (supplied with the components, usually 5.6V 1 Watt)
- An operational amplifier (741 or equivalent)
- A NPN series pass transistor BD241

EQUIPMENT 1.2

The following equipment is used in the TUT laboratory:

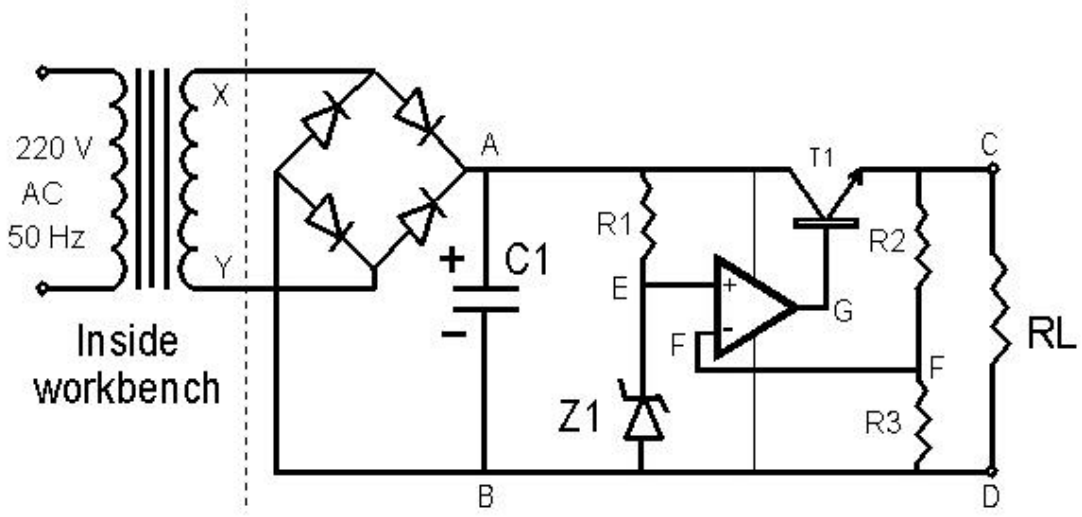
- Oscilloscope
- Mains transformer installed in the workbench with an output of 12 - 18 V AC (depending on what is available in the laboratory)
- Connecting leads (Wires to connect input and output terminals of equipment)
- Bread board and link wires
- Your own multimeter with test leads

PREPARATION FOR THE EXPERIMENT 1.3

Perform the following preparation **before entering the laboratory:**

a) Build the circuit shown below on bread board and have it ready when entering the laboratory.

Circuit diagram:



Four rectifier diodes: 1N4007 C1: 1000µF RL: 100 Ω resistor 1 watt

R1: 2200 Ω resistor ¼ watt; R2: 470 Ω resistor ¼ watt; R3: 1kΩ resistor ¼ watt

Z1: Zener diode (supplied with the components, usually 5.6V 1 Watt)

Operational amplifier: 741 or equivalent and NPN series pass transistor: BD241

b) **Table 1:** Prepare by determining the following:

Which version operational amplifier will you be using?	
Which pins of the Operational Amplifier are the following? [Also write the correct pin numbers next to the terminals of the operational amplifier in the circuit above]	Positive Supply?
	Negative Supply?
	Non-inverting Input?
	Inverting Input?
	Output?

What are the supply voltage limits for this type of operational amplifier?	
What is the maximum output current capability of this type of operational amplifier?	

c) Using terminals B and D in the circuit diagram above as common ground, perform calculations for the predicted voltage values and write the answers into the table below:

Table 2: Predicted voltages if the transformer has an 18 volt (18 V_{RMS}) secondary voltage

Voltage at A:	Voltage at E:
Voltage at F:	Voltage at G:
Voltage at C:	

Table 3: Predicted values if the transformer has an 18 volt secondary voltage

The current through R1:	The power wasted in Z1:
The current through RL:	The power wasted in RL:
V_{CE}(T1):	The power wasted in T1:

EXPERIMENT 1.4

a) Using your multimeter, measure the RMS voltage of the transformer secondary you will be using. Calculate the resultant peak voltage after the rectifier
b) Determine if the capacitor voltage rating is sufficient. **[IMPORTANT:** Make sure about the **polarity** and **rated voltage** of the capacitor before connecting it. Measure the polarity at the connecting points with your multimeter on DC volt, if necessary. Electrolytic capacitors could explode, resulting in **serious injury** to your eyes**]**
c) **First remove the load resistor RL and connect the input of the rectifier to a laboratory DC power supply** with a current limit set to less than 50 mA at a voltage corresponding to the peak voltage of the transformer secondary
d) Observe the current drawn by the circuit. If the circuit does not draw excessive current, start measuring voltages using your multimeter. Write results into Table 4
e) If voltages are acceptable, disconnect the circuit from the DC laboratory supply and connect the input of the rectifier to the transformer secondary
f) Using the multimeter, measure all the voltages including V_{AVE} across the load terminals (C and D). Tabulate in Table 5
g) Replace the load resistor and measure V_{AVE} across the load terminals (C and D, with RL connected). Write results into Table 5
h) Calculate the regulation of the power supply between No Load and Full Load and write answer into Table 5
i) Using the oscilloscope with input set to AC; measure $V_{Ripple(P-P)}$ before the series transistor and across the load, with the load resistor connected. Calculate ripple rejection and write results into Table 6

RESULTS 1.5

Table 4: Measured voltages with the circuit connected to a DC laboratory supply with current limit set to less than 50 mA [Using terminals B and D in the circuit diagram above as common ground]

Voltage at A:	Voltage at E:
Voltage at F:	Voltage at G:
Voltage at C:	

Is the current drawn acceptable? [Is it safe to proceed by connecting the circuit to the transformer?]	**If "NO", identify mistakes in the circuit by analysing the voltages obtained above. Fix the circuit and measure again**

Table 5: Measured voltages with the circuit connected to the secondary of the transformer

RMS voltage at input of rectifier:(XY)	
Voltage at A:	Voltage at E:
Voltage at F:	Voltage at G:
Voltage at C:With RL disconnected	Voltage at C: With RL connected

MARK SHEET 1

OUTCOME 1

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Outcome Assessed	Maximum Mark	Mark Allocated
An electronic circuit is built following a given diagram which should result in an AC to DC power supply	4	
Fault finding techniques are performed and operations are verified if the circuit's performance is not as expected (If performance is up to standard, any typical given fault criterion should be stated for verification)	4	
Regulation of power supply is measured	4	
Ripple rejection of the power supply is measured	4	
TOTAL	16	

SIGNATURE OF LECTURER: .....DATE: .....