SCHOOL OF ELECTRICAL ENGINEERING			
Subject :	**2ND YEAR ELECTRONIC DESIGN LABORATORY**	Review Release Date Last Amendment Procedure Number	: **2** : **2020** : **2013** : **PK-UTM-FKE-(0)-10**
Subject Code :	**SKEE 2742**		

UTM UNIVERSITI TEKNOLOGI MALAYSIA | School of Electrical Engineering

SKEE 2742
BASIC ELECTRONIC LAB

EXPERIMENT 1

ZENER DIODE

PART 1 – ZENER DIODE I-V CHARACTERISTICS

OBJECTIVES:

1. To acquaint the students with basic electronic instruments.
2. To measure and plot the reverse biased I-V characteristic of a zener diode.
3. To determine zener impedance.

PARTS AND EQUIPMENT:

- Zener diode (1N4742)
- Resistors (470 Ω)
- Breadboard (Use own breadboard)
- Oscilloscope
- DC power supply
- Ammeter
- Voltmeter
- Multi-meter

THEORY

Zener Diode

All diodes experience avalanche breakdown when the reverse voltage becomes large enough. In the breakdown region, the current may rise rapidly with very little increase in reverse voltage. A zener diode is designed to experience breakdown at a fixed reverse voltage. Commercial zener diodes are available for the range from 3.3 V to several hundred volts. When forward biased, a zener diode has the same characteristic as any other forward biased diode.

Figure 1.1 shows the I-V characteristic of a typical zener diode. The reverse breakdown region can be approximated to a straight line with a slope of $1/r_z$ where r_z is the incremental resistance in this region. r_z can be as small as 5 Ω. The intercept V_{zk} is known as the zener knee voltage.

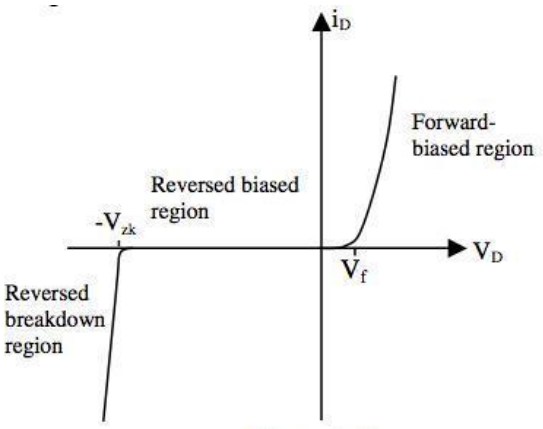

Figure 1.1

PRE-LAB PART 1:

Determine the specifications of the zener diode (V_Z, I_{ZT}, Z_Z at I_{ZT}, I_{ZK}, and P_{Dmax}) that will be used in the experiment. Attach the related spec sheet.

Note: All pre-lab works must be completed before coming to the lab and must be handed-in to the lab instructor at the beginning of lab session.

IN-LAB PROCEDURES:

Zener diode I-V characteristics

1. Connect the circuit in Figure 1.2.
2. For V_S between 0 to 22 V, obtain values for I_Z and V_Z. Complete Table 1.1.
3. Plot a graph of I_Z versus V_Z for the breakdown region (3rd quadrant).
4. From your graph obtain the value of zener knee voltage, V_{zk}, and estimate the dynamic resistance, r_Z.

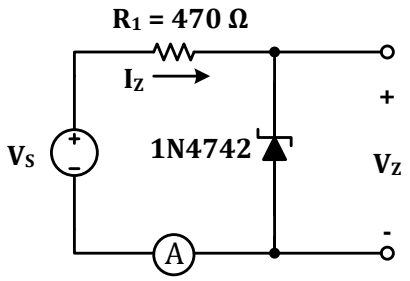

Figure 1.2

Table 1.1

V_S (V)	1	5	10	11	12	13	14	16	18	20	22
V_Z (V)											
I_Z (mA)											

PART 2 – ZENER VOLTAGE REGULATOR

OBJECTIVES:

1. To acquaint the students with basic electronic instruments.
2. To measure performance characteristics of a basic power supply circuit.

PARTS AND EQUIPMENT:

- Zener Diode: 12 V (1N4742)
- Capacitor: 100 μF
- 2 diodes (IN4001)
- 12 V IC regulator (LM7812)
- Resistors: (2 x 1 kΩ, 100 kΩ)
- Breadboard (Use own breadboard)
- Transformer: 2.25 A, 15 V_{rms}
- Digital Voltmeter (DVM)
- Oscilloscope

THEORY

Voltage Regulator

Almost all basic household electronic circuits need an unregulated alternating current (ac) to be converted to constant direct current (DC), in order to operate the electronic device. All devices will have a certain power supply limit and the electronic circuits inside these devices must be able to supply a constant DC voltage within this limit.

The work of converting an ac voltage to a limited DC voltage to make the output voltage constant regardless of the fluctuations in input or load variations, is done by a regulated power supply circuit. A regulated power supply essentially consists of an ordinary power supply and a voltage regulating device. The function of a voltage regulator is to provide a constant output voltage to a load connected in parallel with it.

The ability of zener diode to control its voltage can be used to great effect to regulate or stabilize the output voltage against supply or load variations. In spite of the ripples in the supply voltage (that cannot be blocked by the filter) or the variation in the load current, the zener diode will continue to regulate the voltage with low ripple as long as its current remains in the break down region. However, there are a few limitations for a zener voltage regulator. Zener diode "shares" current with the load; the more is drawn by a load the less goes through zener, and that is one reason for not very stable voltage regulation with zeners. The zener impedance also slightly affects the output voltage. Hence a zener voltage regulator is considered effective for low voltage applications.

On the other hand, an IC voltage regulator draws a bias current from power source which is almost constant regardless of the load and input voltage. Therefore, IC regulator has got much better load regulation and current rating.

PRE-LAB PART 2:

Use MULTISIM or any software of equivalence to simulate and to produce all relevant waveforms for zener voltage regulator circuit given in Pre-Lab: Zener Voltage Regulator.

IN-LAB PROCEDURES:

1. Connect the circuit in Figure 1.3.
2. Observe and sketch the waveform voltage with complete values and labels of v_{01} (voltage across transformer at the secondary), v_{02} (voltage across rectifier) and v_o (voltage across R_L). Make all the sketches refer to 4 complete cycles of v_{o1}.
3. Measure and record the DC output voltage v_o for cases with and without load resistor, R_L. Calculate the voltage regulation, V_{reg}.

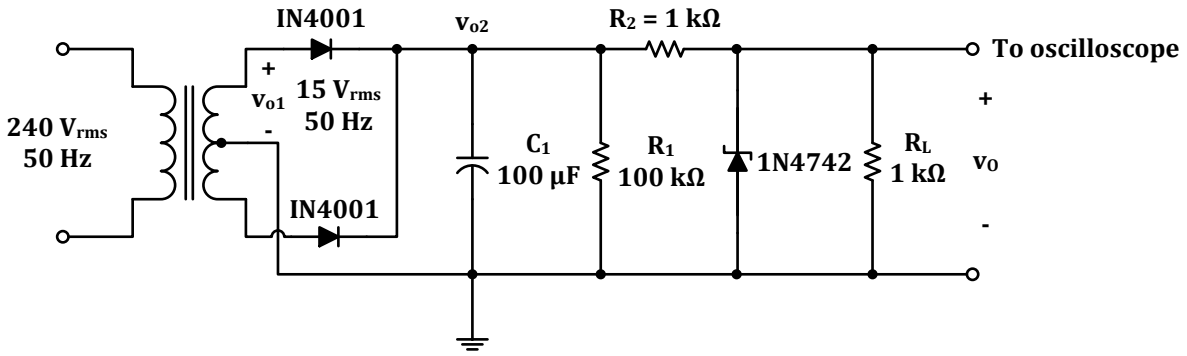

Figure 1.3

4. Replace the Zener diode with a LM7812 voltage regulator as shown in Figure 1.4. No series resistor is necessary with the IC regulator.
5. Measure the DC output voltage for cases with and without load resistor, R_L, and tabulate the readings.
6. Compare the results of the two experimental circuits and state your observation.

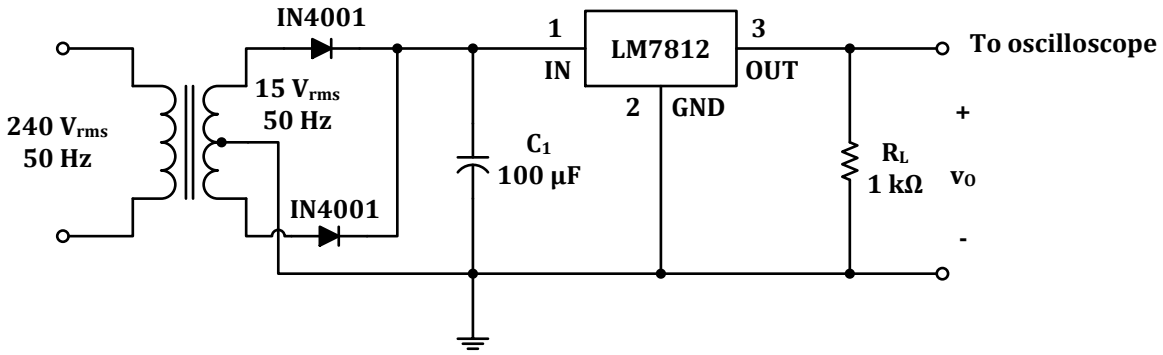

Figure 1.4

Reminding note:

Keep this final circuit connected on the breadboard until all experiments completed as it is going to be used in the next two following experiments.