FMTH0303 - 3.1

Laboratory Plan

Laboratory Course Plan: BE in EC 2018-2022

Laboratory Title: **Analog Electronic Circuits Lab**	Lab. Code: **15EECP202**
Total Hours: **24**	Duration of ESA Hours: 2hrs
ISA Marks:80	ESA Marks:20
Lab. Plan Author: Mrs.ShraddhaHiremath Shruti M, R.V.Hangal	Date: 04-06-2019
Checked By: Dr. Nalini C Iyer	Date: 07-06-2019

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Design clipper and clamper circuits for the given specifications by choosing appropriate electronic deviceand Verify the functionality of circuits using simulator tool.
2. Design an application circuit using BJT/MOSFET for a given specifications and implement the circuit to determine the performance parameters such as region of operation, Gain, BW, I/P and O/P impedance and Verify the functionality of circuits using simulator tool.
3. Determine the power efficiency of a push-pull amplifier experimentallyand Verify the functionality of circuits using simulator tool.
4. Design and build the regulated power supply for a given specifications.

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Program Outcomes

Course Title: Analog Electronic Circuits Lab	Semester:3 - Semester
Course Code:15EECP202	Year: 2019-20

Course Outcomes / Program Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Design clipper and clamper circuits for the given specifications by choosing appropriate electronic device and Verify the functionality of circuits using simulator tool				**M**	L					L					
Design an application circuit using BJT/MOSFET for a given specifications and implement the circuit to determine the performance parameters such as region of operation, Gain, BW, I/P and O/P impedance and Verify the functionality of circuits using simulator tool				**M**	L					L					

Determine the power efficiency of a push-pull amplifier experimentallyand Verify the functionality of circuits using simulator tool				**M**	L					L					
Design and build the regulated power supply for a given specifications			**M**	**M**					**L**	**L**		**L**			

Degree of compliance **L**: Low **M**: Medium **H**: High

Competency addressed in the Course and corresponding Performance Indicators

Competency: PO3.4	Demonstrate an ability to advance an engineering design to defined end state
PI Code: PO3.4.1	Refine a conceptual design into a detailed within the existing constraints (of the resources)
Competency: PO4.1	Demonstrate their ability to conduct investigations of technical issues consistent with their level of knowledge and understanding
PI Code: PO4.1.1	Define a problem for purposes of investigation, its scope and importance
Competency: PO4.2	Demonstrate their ability to design experiments to solve open ended problems
PI Code: PO4.2.1	Ability to identify the constraints and assumptions for the experiments/open ended problems.
PI Code: PO4.2.2	Develop and design experimental approach, specify appropriate equipment and procedures, implement these procedures, and interpret the resulting data to characterize an engineering material, component, or system.
Competency: PO5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources
PI Code: PO5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
Competency: PO9.3	Demonstrate success in a team-based project
PI Code: PO9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
Competency:	Demonstrate an ability to comprehend technical literature and document

PO10.1	project work.
PI Code: PO10.1.2	Produce clear, well-constructed, and well-supported written engineering documents
Competency: PO10.2	Demonstrate competence in listening, speaking, and presentation.
PI Code: PO10.2.2	Deliver effective oral presentations to technical and non-technical audiences
Competency: PO12.3	Demonstrate an ability to identify and access sources for new information.
PI Code: PO12.3.1	Demonstrate an ability to source and comprehend technical literature and other credible sources of information

Experiment wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Demonstration		**Total Weight age: 0.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Study of multimeters, power supplies, function generators, Oscilloscopes; Identification of various components and devices, e.g. resistors, capacitors,diodes,transistors	1.00	0.00	
	□Learning Outcomes: □The students should be able to: 1. Identify & use different circuit components/ devices and also the equipments to be used for measurements.			Introduction
Category: Exercise		**Total Weight age: 48.00**		**No. of lab sessions: 7.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**

1	Title: Design & analyze Diode Clipping (single/double ended) circuits.	1.00	8.00	*Diode applications*
	□Learning Outcomes: □The students should be able to: 1. To illustrate the effect of changing the reference voltage on clipping action of the diode. 2. To illustrate the function of diode in following circuits 1. Positive clipping 2. Negative clipping 3. Two way clipping			
2	Design & analyze Positive and Negative Clamping circuits	1.00	8.00	Diode applications
	□Learning Outcomes: □The students should be able to: 1. To illustrate the effect of dc restorer on the input signal 2. To illustrate the function of diode in following circuits 1. Positive clamping 2. Negative clamping			

3	Study of BJT as a Switch	1.00	5.00	BJT applications
	□Learning Outcomes: □The students should be able to: 1. Understand the operation of bipolar transistor as a switch and analyze basic digital gate circuits			
4	Study the input and output characteristics of MOSFET	1.00	8.00	MOSFET
	□Learning Outcomes: □The students should be able to: 1. Explain the concept of threshold voltage in MOSFET. 2. To determine the drain and transfer characteristics of MOSFET and realize the importance of Threshold voltage			
5	To study the basic current mirror circuit	1.00	8.00	MOSFET
	□Learning Outcomes: □The students should be able to: 1. To determine the constant current source using current mirror circuit with BJT/MOSFET			
6	MOSFET as a Switch	1.00	5.00	MOSFET
	□Learning Outcomes: □The students should be able to: 1. To explain the VGS voltage over VDS.			

	2. To illustrate the effect of varying ID current.			
7	Study of transformer-less Class B push pull power amplifier and determination of its conversion efficiency	1.00	6.00	POWER AMPLIFIER
	□Learning Outcomes: □The students should be able to: 1. Design class B push-pull amplifier for the given conversion efficiency. 2. Differentiate between Small signal and large signal amplifiers 3. Explain cross-over distortion in large signal amplifier and how it is overcome.			
Category: Structured Enquiry		**Total Weight age: 20.00**		**No. of lab sessions: 2.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	To determine the frequency response of RC Coupled single stage BJT amplifier(CE mode)&also the gain, input & output impedances	1.00	10.00	BJT Applications

	□Learning Outcomes: □The students should be able to: 1. Determine the performance parameters of the following Amplifiers using BJT. a. Single stage RC coupled amplifier			
2	Design an Amplifier using MOSFET and determine its gain, input & output impedance	1.00	10.00	MOSFET
	□Learning Outcomes: □The students should be able to: 1. Determine the performance parameters of the following Amplifiers using MOSFET. a .Single stage CS amplifier using MOSFET			
Category: Open Ended		**Total Weight age: 12.00**		**No. of lab sessions: 1.00**
Expt./ Job No.	**Experiment / Job Details**	**No. of Lab Session(s) per batch (estimate)**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Design a regulated power supply for the given specifications	1.00	12.00	DIODE/BJT/MOSFET

	□Learning Outcomes: □The students should be able to: 1. To determine the efficiency of the fixed regulated power supply	

2. ***Materials and Resources Required***:

Books/References:

i. "Integrated Electronics",by Jacob Millman and Christos Halkias**,** McGraw Hill,
ii. "Microelectronic Circuits", by A.S. Sedra& K.C. Smith**,** 5th Edition, Oxford Univ. Press, 1999.
iii. **"**Electronic Devices and Circuits" by David A. Bell, 4thedition, PHI publication 2007.
iv. "Analysis and design of analog integrated circuits," by Grey, Hurst, Lewis and Meyer, 4thedition.
v. Device data sheets.
vi. KLETECH Electronics and Communication Engineering Department 2019-20Analog Electronics Lab manual.

3. ***Evaluation***:

Students Assessment through ISA (80%) + ESA (20%)

In Semester Assessment (80%)	**Assessment**	**Weight age in Marks**
	Based on the performance of student during regular	50

	laboratory hours+ Quiz.	
	Based on the journal written for the above set of experiments.	10
	Based on the performance in laboratory test conducted after the completion of all the above experiments.	20
End Semester Assessment (20%)	Write up & viva	08
	Conduction and Result	12
	Total	100

Date: **Head of School**

Evaluation Criteria of the Laboratory:

Analog Electronics Circuits Lab Rubrics

III Semester 2019-20

Exercise Experiments						
Assessment Factor	**PI**	**Max. Marks**	**Evaluation Parameters**	**Good (100 %)**	**Average (50 %)**	**Poor (0 %)**
Problem Definition	4.1.1	2	Concept illustration **(1M)**	Well defined problem with clear understanding of concepts	Partial understanding of the problem and incomplete design.	Lack of concept clarification and no design
Conceptualization, Development and Debugging of the designed circuit	4.2.2	3	Apprehend specifications, assumptions and constraints for a given problem **(1M)**	Interpretation of assumptions and constraints for a given problem.	Partial knowledge of assumptions and constraints.	Mis-interpretation of assumptions and constraints, lack of understanding.
			Experimental setup **(1M)**	Arrive at an optimized solution.	Arrive at a solution with instructors intervention	Unable to realize the circuit.
			Testing of components, devices and	Ability to demonstrate the working condition	Partial knowledge to test devices and components.	Not able to illustrate the working of all the components, devices

			equipments **(1M)**	of all the components, devices and equipments		and equipments.
			Troubleshooting the circuit, **(1M)**	Ability to connect the circuit, fault finding by tracing the circuit and analyzing the results.	Ability to connect, but no trouble shoots analysis.	Not able to connect the circuit.
Analysis of the obtained data	4.3.3	1	Analysis of results **(1M)**	Ability to Draw conclusions by accurate measurement of parameters	Ability to tabulate the readings but no analysis	Not able to tabulate the readings from the performed experiment
Modern Engineering tools	5.1.1	1	Simulating the circuit using suitable EDA tool. **(1M)**	Able to performsimulation of the given circuit and obtain the results.	Able to simulate but no results.	Unable to performsimulation using EDA tools

Journal and observation book	10.1.2	1	Well constructed document **(1M)**	Able to represent observations, clearly states the conclusion.	Able to represent only few observations with deviations from appropriate results.	Unable to represent observations.

Structured Experiments						
Assessment Factor	**PI**	**Max. Marks**	**Evaluation Parameters**	**Good (100 %)**	**Average (50 %)**	**Poor (0 %)**
Problem Definition	4.1.1	1	Concept illustration **(1M)**	Well defined problem with clear understanding of concepts.	Partial understanding of the concepts.	Lack of concept clarification
Problem analysis Defining constraints and assumptions	4.2.1	1	Understanding the problem by defining constraints and assumptions **(1M)**	Ability to assess the constraints and assumptions to build design parameters	Partial assessment of constraints and assumptions	Lack of ability to define constraints and assumptions
		4	Apprehend	Interpretation of	Partial knowledge	Mis-interpretation

Design conceptualization and development of experimental Approach	4.2.2		specifications, assumptions and constraints for a given problem **(1M)**	assumptions and constraints for a given problem	of assumptions and constraints.	of assumptions and constraints, lack of understanding(0M)
			Experimental setup **(1M)**	Arrive at an optimized solution.	Arrive at a solution with instructors intervention	Unable to realize the circuit.
			Design of the circuit **(1M)**	Obtain the expressions and arrive at optimum design of the circuit	Arrive at only few design parameters of the circuit	Not able to design the parameter of the circuit.
			Testing of components, devices and equipments	Ability to demonstrate the working condition of all the components, devices and equipments.	Ability to test equipments alone	Not able to illustrate the working of all the components, devices and equipments
			Troubleshooting the circuit. **(1M)**	Ability to connect the circuit, fault finding by tracing the circuit.	Ability to connect, no trouble shoot analysis	Not able to connect the circuit
Analysis of the obtained data	4.3.3	1	Analysis of results **(1M)**	Ability to Draw conclusions by accurate measurement of parameters	Ability to tabulate the readings but no analysis	Not able to tabulate the readings from the performed experiment

Modern Engineering tools	5.1.1	1	Simulating the circuit using suitable EDA tool **(1M)**	Able to performsimulation of the given circuit and obtain the results	Able to simulate circuit but no results	Unable to performsimulation using EDA tools
Team Presentation	9.3.1	0.5	Effective communication by the means of demonstration and oral presentation **(0.5M)**	Ability to effectively present the results by demonstration.	Able to produce the results but not effectively demonstrate the same.	Unable to present the obtained partial results
Journal and observation book	10.1.2	0.5	Well constructed document **(0.5M)**	Able to represent observations, clearly states the conclusion in specified time.	Able to represent only few observations with deviations from appropriate results.	Unable to represent observations.
Source and comprehendtechnical literature	12.3.1	1	Referring datasheets **(1M)**	Able to refer the datasheet for understanding the limitations of devices and design circuit as per given specifications.	Able to design circuit as per given specifications with instructors intervention	Unable to arrive at the solution.

Open Ended Experiments						
Assessment Factor	**PI**	**Max. Marks**	**Evaluation Parameters**	**Good (100 %)**	**Average (50 %)**	**Poor (0 %)**
Problem Definition	4.1.1	1	Concept illustration **(1 M)**	Well defined problem with clear understanding of concepts.	Partial understanding of the concepts.	Lack of concept clarification
Problem analysis Defining constraints and assumptions	4.2.1	1	Understanding the problem by defining constraints and assumptions **(1 M)**	Ability to assess the constraints and assumptions to build design parameters	Partial assessment of constraints and assumptions	Lack of ability to define constraints and assumptions
Design conceptualization and development of experimental Approach	4.2.2	4	Apprehend specifications, assumptions and constraints for a given problem **(1M)**	Interpretation of assumptions and constraints for a given problem	Partial knowledge of assumptions and constraints.	Mis-interpretation of assumptions and constraints, lack of understanding(0M)
			Experimental setup **(1M)**	Arrive at an optimized solution.	Arrive at a solution with instructors intervention	Unable to realize the circuit.
			Design of the circuit	Obtain the expressions and arrive at optimum	Arrive at only few design parameters	Not able to design the parameter of the

			(1M)	design of the circuit	of the circuit	circuit.
			Testing of components, devices and equipments **(0.5M)**	Ability to demonstrate the working condition of all the components, devices and equipments.	Ability to test equipments alone	Not able to illustrate the working of all the components, devices and equipments
			Troubleshooting the circuit. **(0.5M)**	Ability to connect the circuit, fault finding by tracing the circuit.	Ability to connect, no trouble shoot analysis	Not able to connect the circuit
Analysis of the obtained data	4.3.3	2	Analysis of results **(2M)**	Ability to Draw conclusions by accurate measurement of parameters	Ability to tabulate the readings but no analysis	Not able to tabulate the readings from the performed experiment
Modern Engineering tools	5.1.1	1	Simulating the circuit using suitable EDA tool **(1M)**	Able to performsimulation of the given circuit and obtain the results	Able to simulate circuit but no results	Unable to performsimulation using EDA tools
Team Presentation	9.3.1	0.5	Effective communication by the means of demonstration and oral presentation **(0.5M)**	Ability to effectively present the results by demonstration.	Able to produce the results but not effectively demonstrate the same.	Unable to present the obtained partial results
Journal and	10.1.2	0.5	Well constructed	Able to represent	Able to represent	Unable to represent

observation book			document **(0.5M)**	observations, clearly states the conclusion in specified time.	only few observations with deviations from appropriate results.	observations.
Oral Presentation	10.2.2	1	Well presented using presentation tools **(1M)**	Able to effectively present the obtained results with proper inference making use of PPT	Able to represent the results but not communicate effectively	Not able to present the results
Source and comprehendtechnical literature	12.3.1	1	Referring datasheets **(1M)**	Able to refer the datasheet for understanding the limitations of devices and design circuit as per given specifications.	Able to design circuit as per given specifications with instructors intervention	Unable to arrive at the solution.

Open Ended Experiment - A sample report

Design a fixed DC voltage adaptor with output voltage 5V,-5V,3V.

Team members:

1. Sanobar Mateen – 186 (01fe18bec156)

2. Sakshi.D – 181 (01fe18bec149)

3. Prince Kumar – 153 (01fe18bec119)

4. Rajnish Pandey – 163 (01fe18bec130)

School of Electronics & Communication Engineering

AIM:

Design a DC voltage regulator.

OBJECTIVE:

Design a fixed DC voltage regulator(5V,-5V and 3V) with short circuit protection.

SPECIFICATIONS:

Output voltage: 5V, -5V,3V

Current: 1A

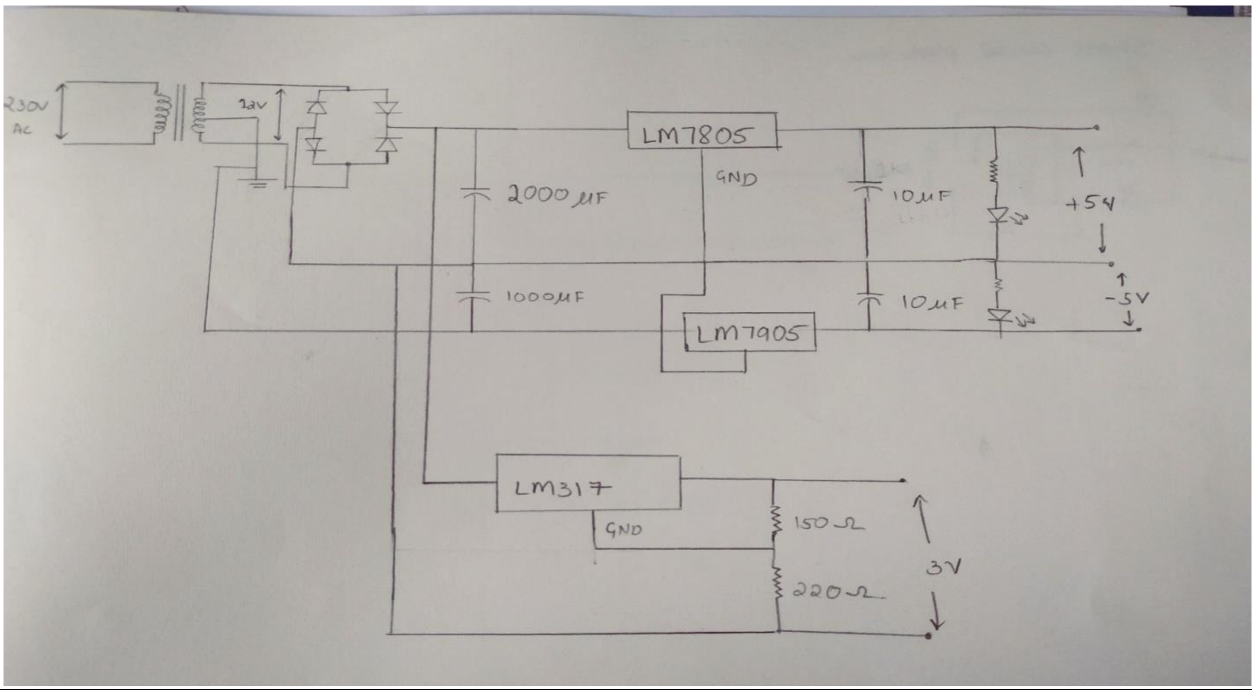
COMPONENTS USED:

SL NO.	COMPONENTS	SPECIFICATIONS	QUANTITY
1	Transformer	12-0-12	1
2	Diodes	Max. forward current 15mA	4
3	LM317	37V,1.5A	1
4	7905	-5V,1.5A	1
5	7805	5.2V,1.5A	1
6	Capacitor	2200µF,1000µF,10µF	4
7	Resistor	150Ω,220Ω,1KΩ	4
8	LED's	---	6
9	6V relay	Voltage:250V AC/30V DC Max. current:5A AC/DC	2

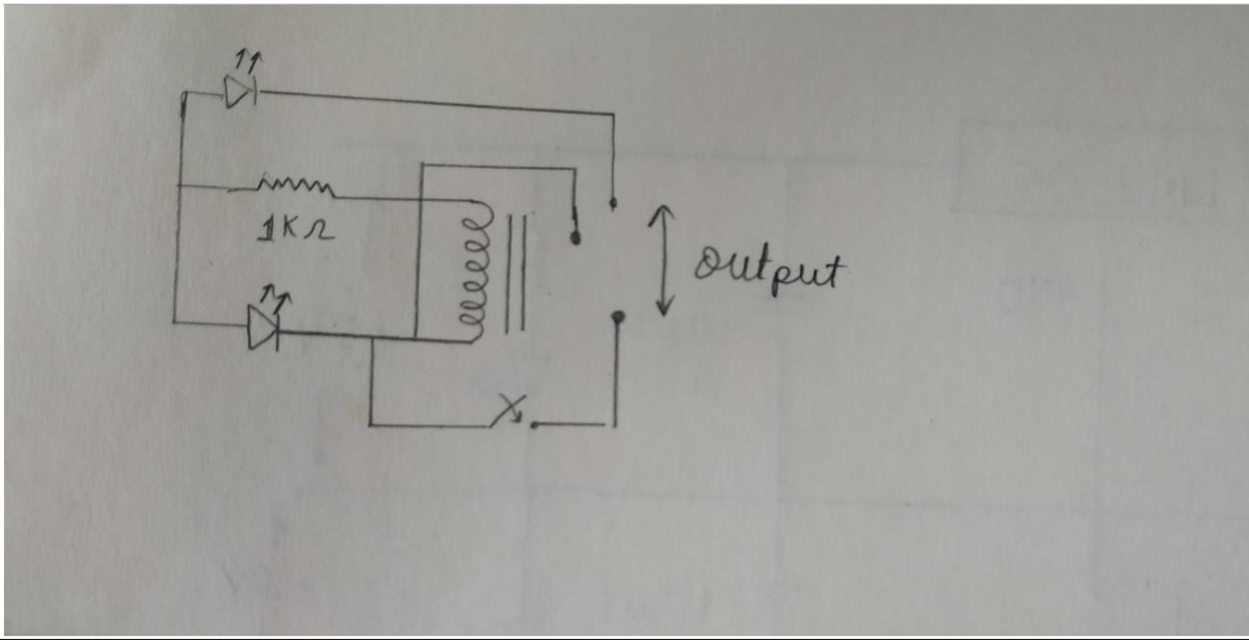
THEORETICAL BACKGROUND:

The four diodes are used to form bridge rectifier. The two terminals of secondary winding of transformer are connected to the bridge rectifier to have pulsating DC. Ground is taken from the secondary winding of transformer. One 1000µF capacitor is connected between the positive output of bridge rectifier with respect to ground. Another2000µF capacitor is connected between the negative output of the bridge rectifier with respect to ground. The capacitors are called as filter capacitors. LM7805 is used for positive voltage and LM7905 is used for negative voltage to have +5 and -5 voltages. Whereas, LM317T is an adjustable 3-terminal positive voltage regulator capable of supplying different DC voltage output other than the fixed voltage power it also has current limiting and thermal shut down capabilities which makes it short circuit proof and ideal for any low voltage. The output voltage of the LM317T is determined by ratio of the two feedback resistors R5 and R6 which form a potential divider network across the output terminal.

CIRCUIT DIAGRAM:



SHORT CIRCUIT PROTECTION:



DESIGN:

Step 1: The selection of regulator IC

The selection of a regulator IC depends on output voltage. In our case, we are designing for the 5V output voltage; we will select the LM7805 linear regulator IC. In the design process, the next thing is, we need to know the voltage, current and power ratings of the selected regulator IC. This is done by using the datasheet of the regulator IC.

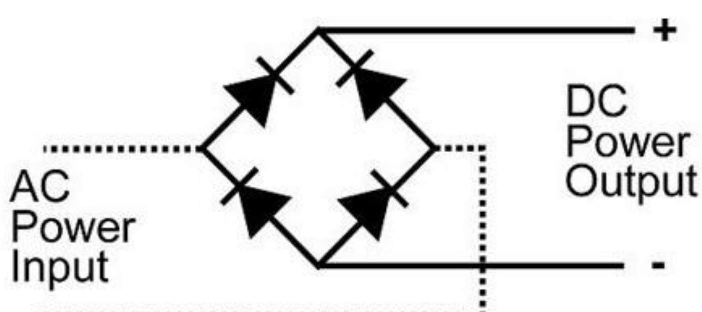
The datasheet of 7805 also prescribes to use a 0.1µF capacitor at the output side to avoid transient changes in the voltages due to changes in load. And a 0.1µF at the input side of the regulator to avoid ripples if the filtering is far away from the regulator.

Step 2: The selection of transformer

We got to know, the minimum input to our selected regulator IC is 7V .So, we need a transformer to step down the main AC to at least this value.But, between the regulator and secondary side of the transformer, there is a diode bridge rectifier too. The rectifier has its own voltage drop across it i.e. 1.4V.

Step 3: The selection of diodes for bridge

You see in the circuit diagram, the rectifier circuit is made by arranging diodes in some pattern. To make rectifier we need to select proper diodes for it. When selecting a diode for the bridge circuit. Keep in mind the output load current, and maximum peak secondary voltage of the transformer i-e 9V in our case.



We selected IN4001 diode because it has the current rating of 1A more than our desire rating, and peak reverse voltage of 50V. Peak reverse voltage is the voltage a diode can sustain when it is reverse biased.

Step 4: The Selection of capacitor and calculations

Things that are supposed to be considered while selecting a proper capacitor filter are, its voltage, power rating, and capacitance value. The voltage rating is calculated from the secondary voltage of a transformer.

Rule of thumb is, the capacitor voltage rating must be at least 20% more than the secondary voltage. So, if the secondary voltage is 13 V (Peak value for 9V), then your capacitor voltage rating must be at least 50V.

To find the proper value of capacitance,

$$C = Io/2\pi fV$$

Where,

Io = Load current i.e. 1A in our design, Vo = Output voltage i.e. in our case 5V, *f = Frequency i.e. 50Hz.*

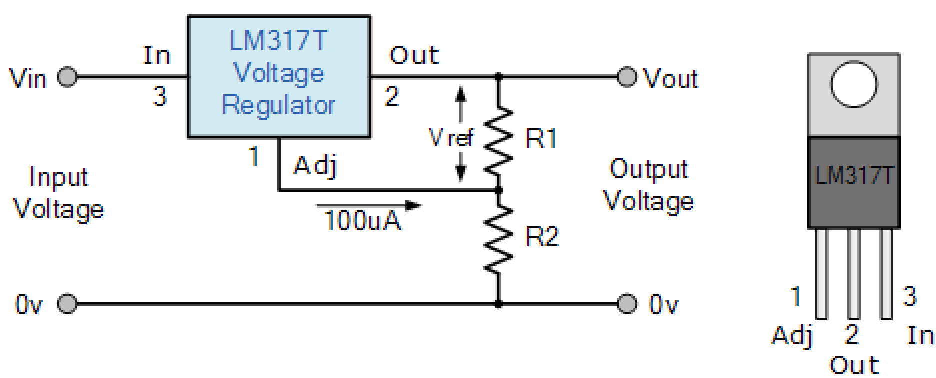
In our case

$C=\frac{1}{2\pi*50*5}$

=6.366X10^-4

The same procedure is followed for -5V and 3V.

Step5: Design of resistors for LM317



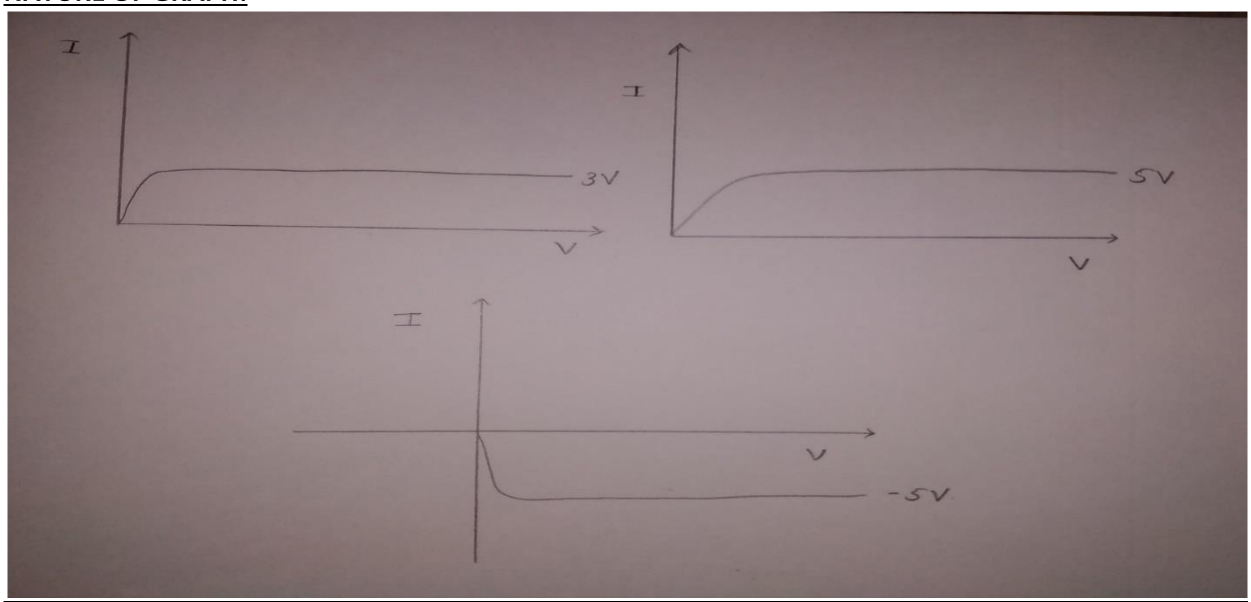
The voltage across the feedback resistor R1 is a constant 1.25V reference voltage, V_{ref} produced between the “output” and “adjustment” terminal. The adjustment terminal current is a constant current of 100uA. Since the reference voltage across resistor R1 is constant, a constant current i will flow through the other resistor R2, resulting in an output voltage of:

$$V_{OUT} = 1.25\left(1+\frac{R_2}{R_1}\right)$$

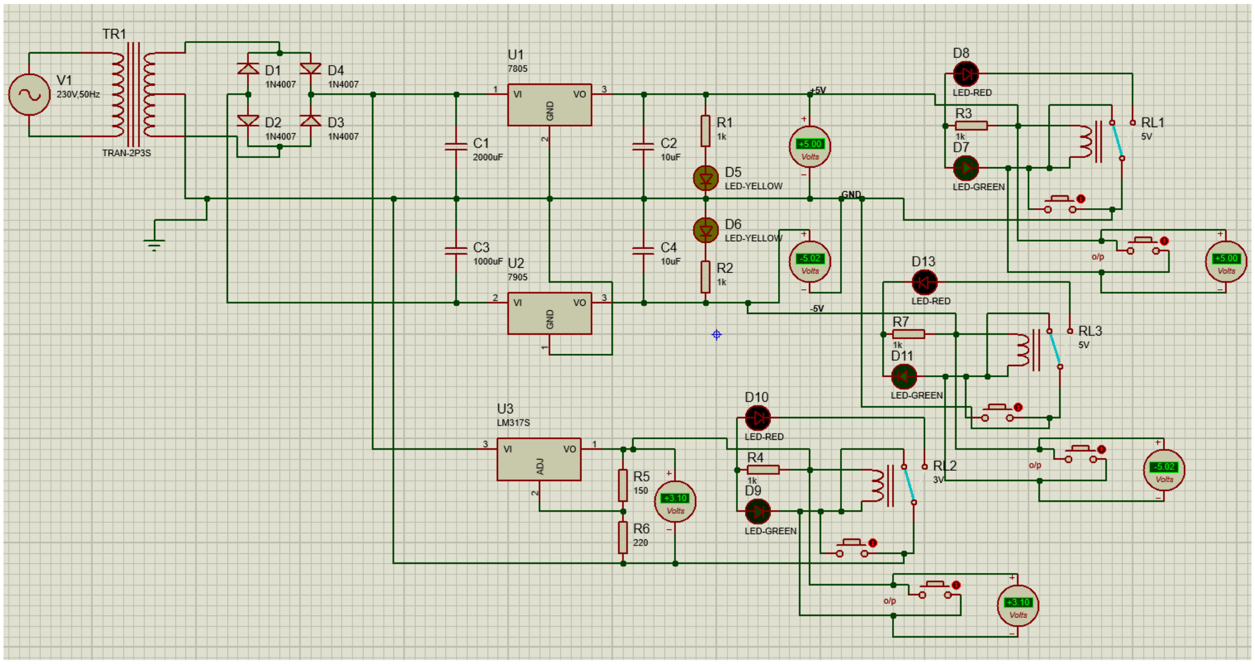
Then whatever current flows through resistor R1 also flows through resistor R2 (ignoring the very small adjustment terminal current), with the sum of the voltage drops across R1 and R2 being equal to the output voltage, Vout. Obviously the input voltage, VIN must be at least 2.5 volts greater than the required output voltage to power the regulator.

Also, the LM317T has very good load regulation providing that the minimum load current is greater than 10mA. So to maintain a constant reference voltage of 1.25V, the minimum value of feedback resistor R1 needs to be 1.25V/10mA = 120 Ohm and this value can range anywhere from 120 ohms to 1,000 ohms with typical values of R1 being about 220Ω's to 240Ω's for good stability.

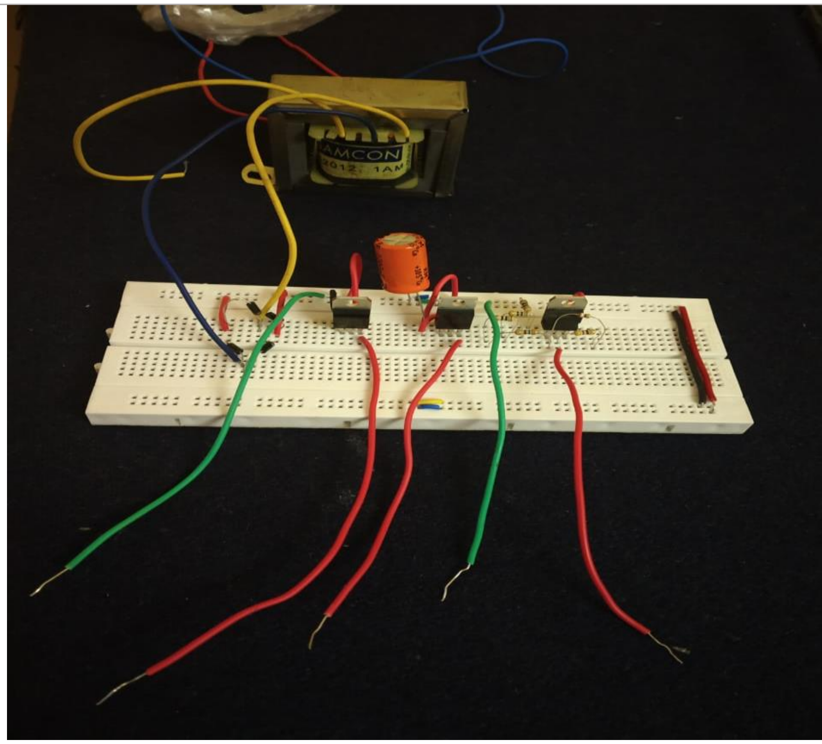
NATURE OF GRAPH:

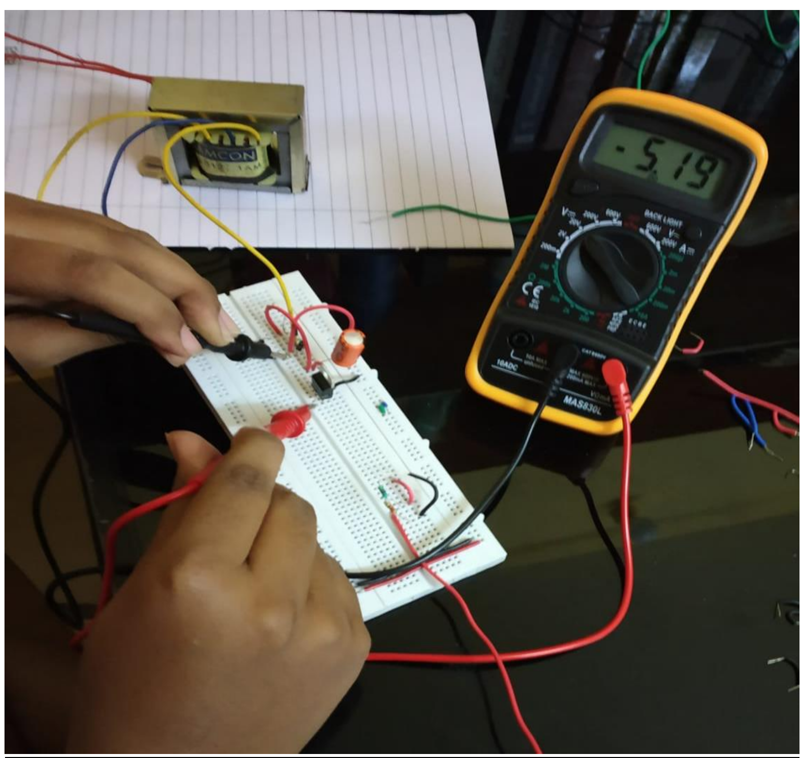


SIMULATION PICTURE:



BREADBOARD PICTURE:

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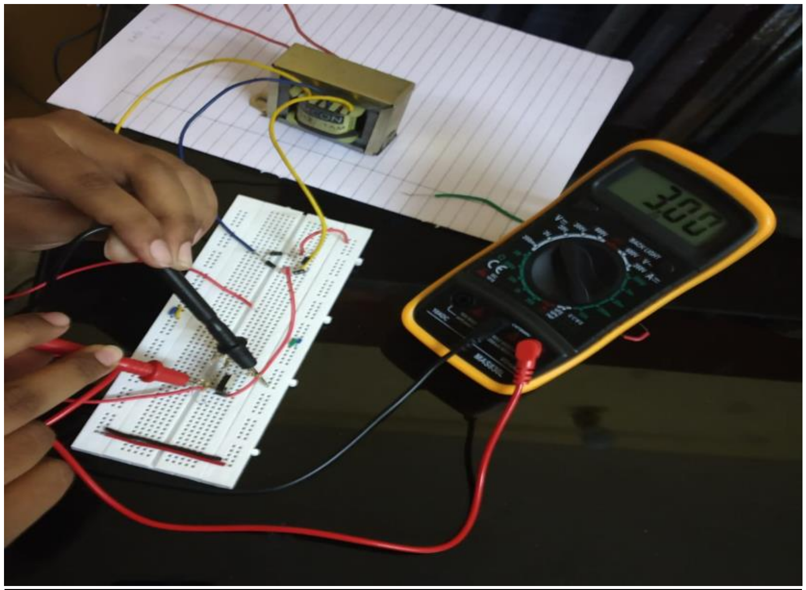
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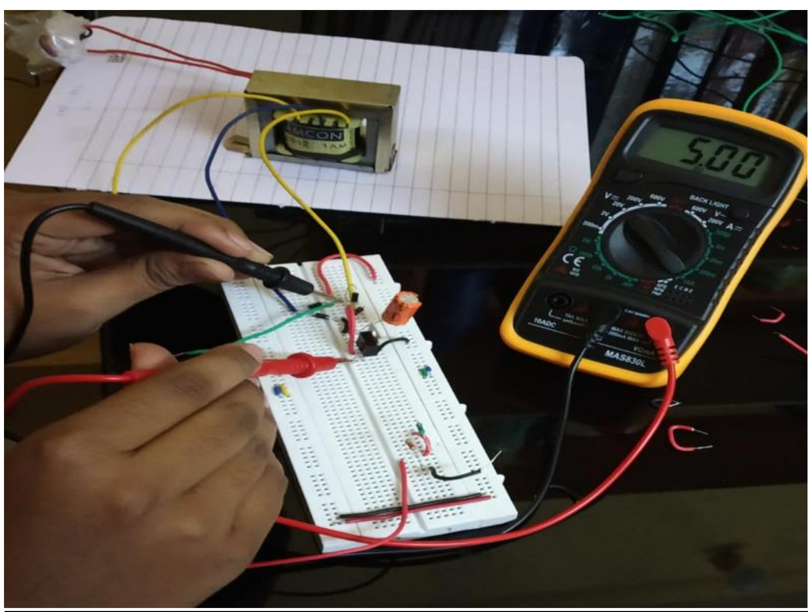
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CONCLUSION:

The experimental setup for fixed DC voltage adaptor is configured and verified for voltages 5V, -5V,3V with current of 1A.

PCB: